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B.Sc. Engg.(EE), 1st Sem. Date: March 19, 2018 (Morning)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid-Semester Examination — Winter Semester, A. Y. 2017-2018
Course No.: EEE 4101 — Time: 90 Minutes
Course Title: Electrical Circuit -I — Full Marks: 75

There are **4 (four)** questions. Answer **any 3 (three)** questions. All questions carry equal marks. Figures in the margin indicate full marks. Programmable calculators are not allowed. Do not write on this question paper.

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1. a) Why are the relationship among charge(Q) and current(I), power(P) and energy(W) for DC are not adequate for time varying electricity? Derive their relationship for the later case. What is the difference between the independent and dependent electrical sources? Name the dependent electrical sources with their control variable. 5

b) The current flowing through an electrical element is depicted in Fig. 1(b) below. Sketch the corresponding charge and verify. 10

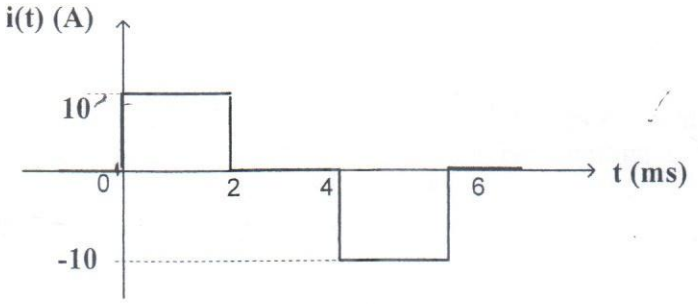

Fig. 1(b).

c) Find the power associated with each element in Fig. 1(c) and verify Tellegen's theorem. 10

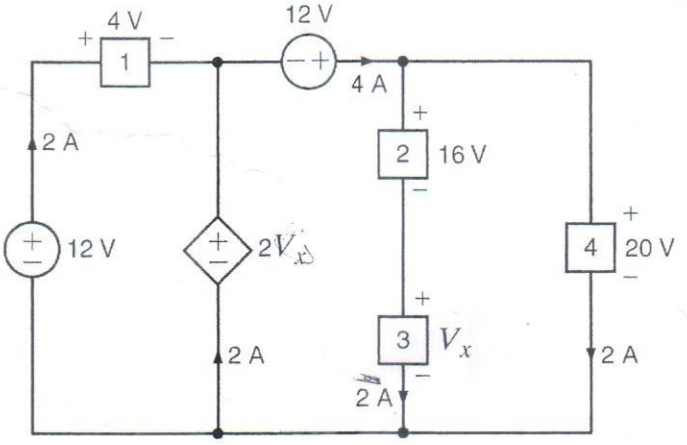

Fig. 1(c).

2. a) Name some practical applications of current divide rule and potential divide rule? Apply the rules in the electrical circuit shown in Fig. 2(a) to find V_x and I_x. 10

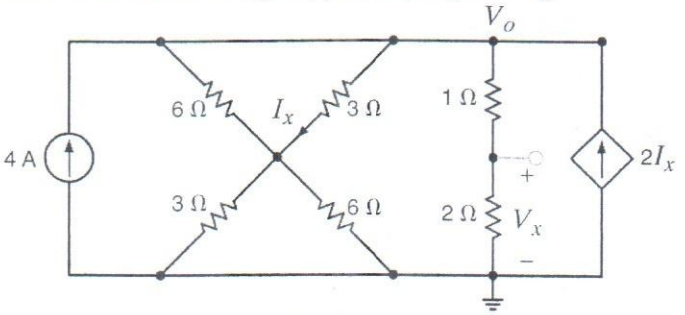

Fig. 2(a).

b) A simplified equivalent circuit of a typical transistor amplifier can be drawn as shown in Fig. 2(b). Find the current, voltage and power associated with 20 kΩ resistor. 10

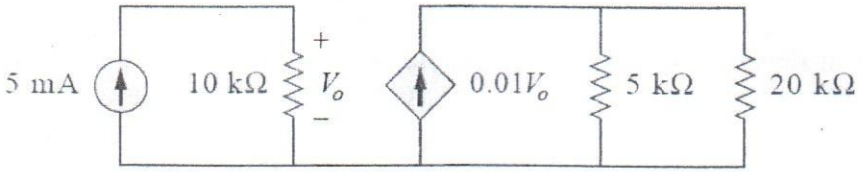

Fig. 2(b).

c) A conceptual model of an automobile head light and ignition system is shown in Fig. 2(c) below. When the ignition switch is OFF the head lights take about 2.0 A to give full illumination. What happens when both headlight and ignition switches are ON. The ignition system typically draws around 100 A. The typical value of battery resistant is $R_{batt} = 25\,\text{m}\Omega$. 5

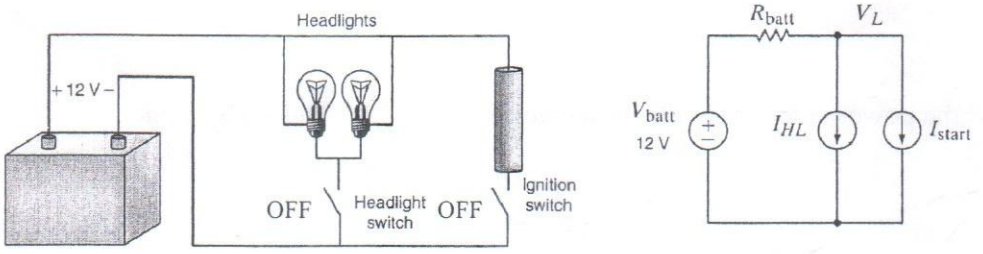

Fig. 2(c).

3. a) Using Δ-Y transformation technique, find the voltage V_o, I and power supplied by the source. 10

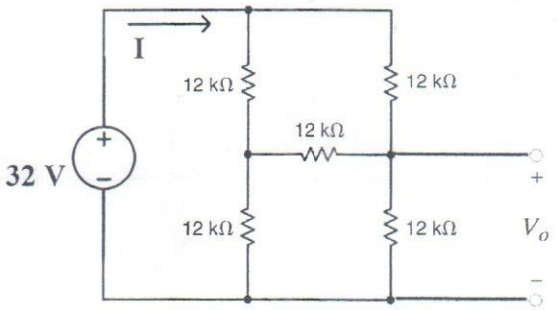

Fig. 3(a)

b) Show by a simple example that if an electrical circuit has N numbers of essential nodes then N-1 lineraly independent nodal equations can be derived using Kirchoff"s Current Law(KCL). 5

c) Find V_o and I_A in Fig. 3(c) using nodal analysis. 10

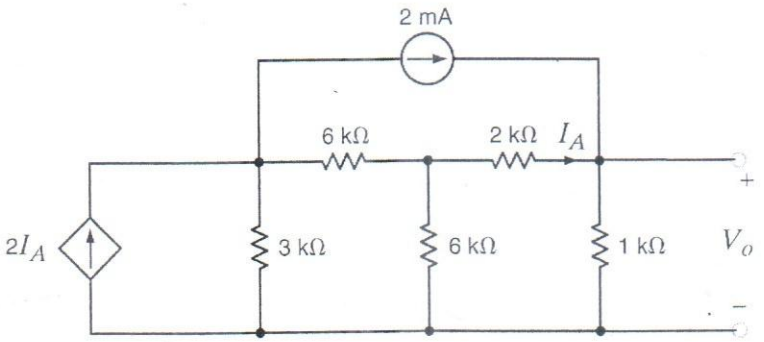

Fig. 3(c)

4. a) Describe the technique of (i) finding node voltages of an electrical network that contains a voltage source between two non-reference nodes; and(ii) finding loop currents when a current source is shared by two adjacent loops. 5

b) Using the concept of supernode find V_x and V_o in the circuit in Fig. 4(b). All resistances are of equal value 1.0 kΩ. 10

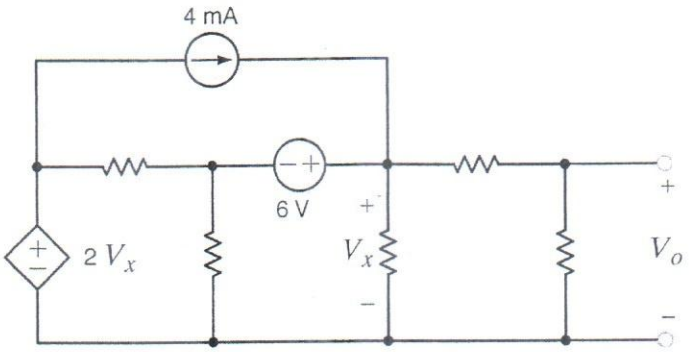

Fig. 4(b).

c) Find V_o in the circuit shown in Fig. 4(c) using loop analysis. 10

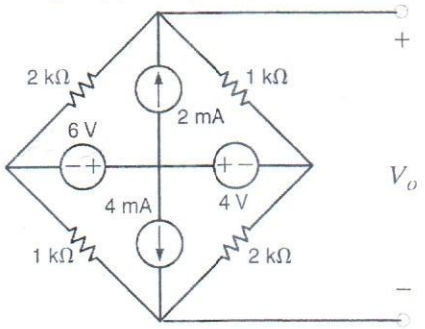

Fig. 4(c).

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid-Semester Examination — Winter Semester, A. Y. 2017-2018
Course No.: EEE 4161 — Time: 90 Minutes
Course Title: Electrical and Electronic Technology I — Full Marks: 75

There are **4 (four)** questions. Answer **any 3 (three)** questions. All questions carry equal marks. Marks in the margin indicate full marks. Programmable calculators are not allowed. Do not write on this question paper.

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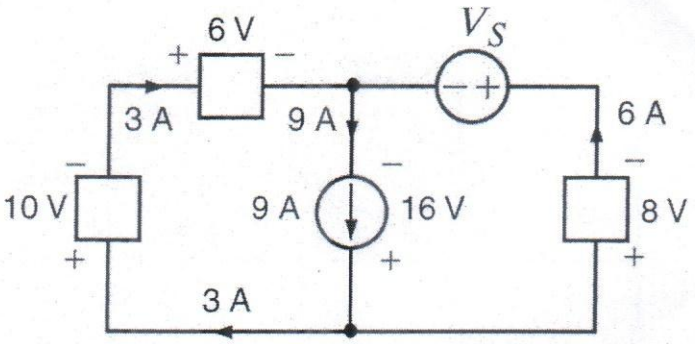
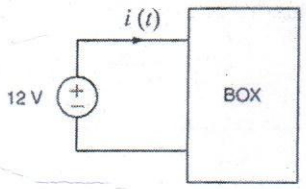
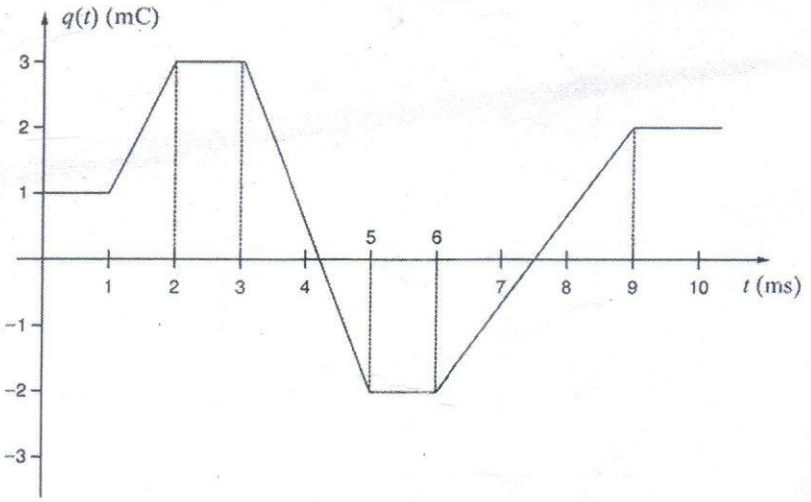
1. a) What are the dependent sources? Explain different types of dependent sources with circuits/symbols. 06

   b) Is the source in the network in the following figure absorbing or supplying power, and how much? 09

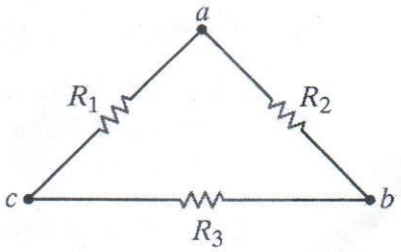


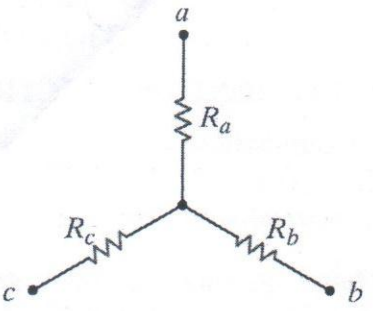
   c) The charge that enters the BOX is shown in the following figure. Calculate and sketch the current flowing into and the power absorbed by the BOX between 0 and 10 milliseconds. 10





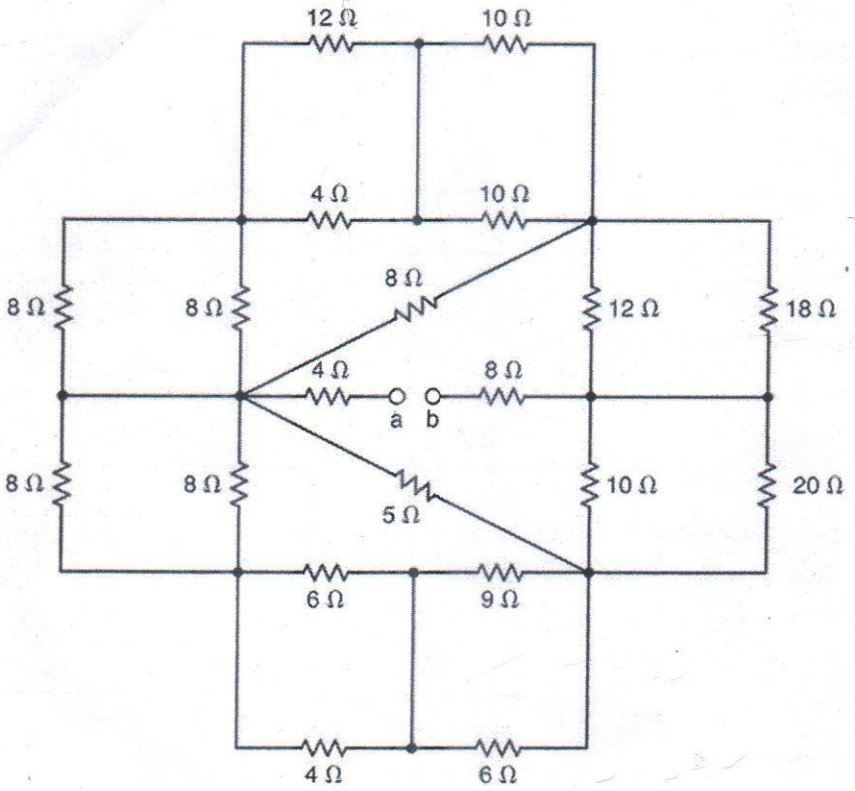
2. a) What is Wye to Delta and Delta to Wye transformation? Derive the equations for R_1, R_2 and R_3 in terms of R_a, R_b and R_c and vice versa from the following figure. 10



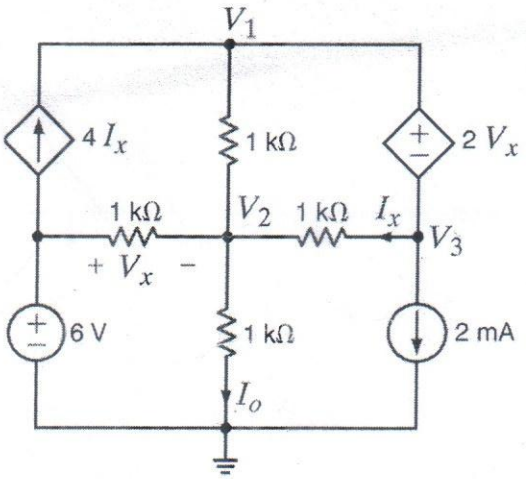


b) State and explain Ohm's law, KCL and KVL. 06

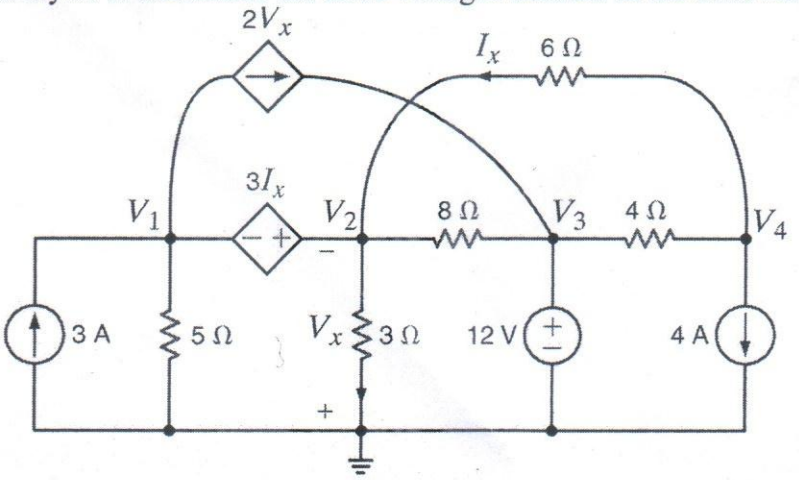
c) Find the equivalent resistance looking in at terminals a-b in the following figure 09



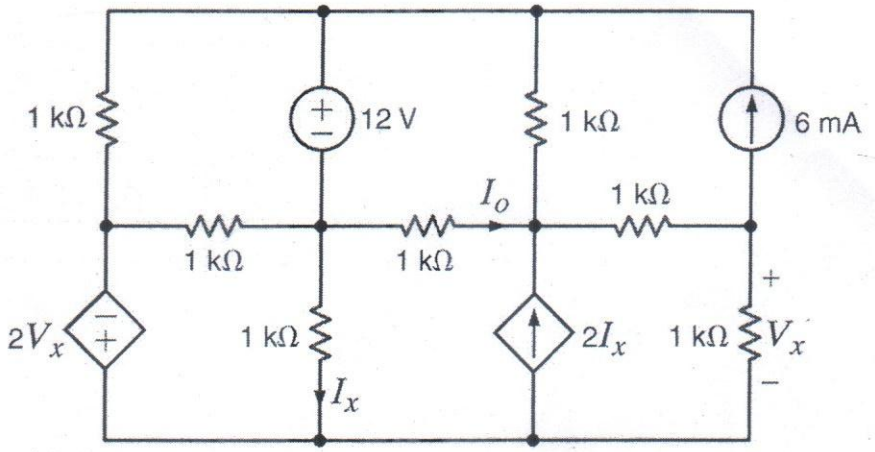
3. a) Use nodal analysis to find I_0 in the following figure. 12



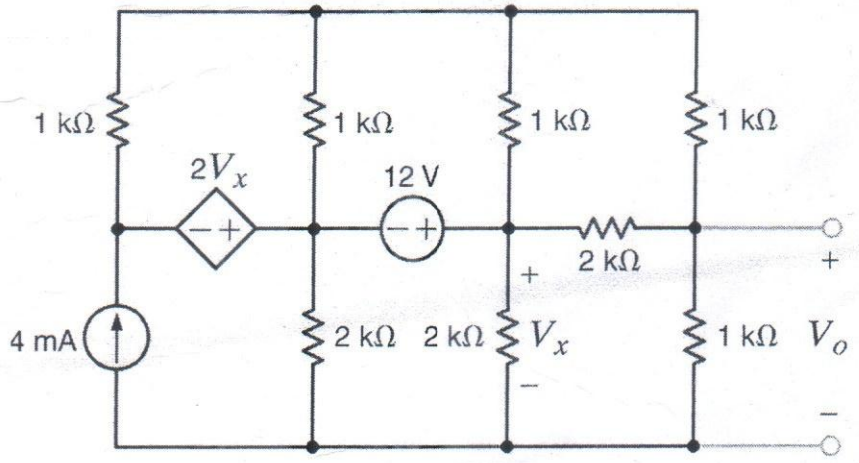
b) Use nodal analysis to determine the node voltages defined in the following figure. 13



4. a) Using loop analysis, find I_0 in the figure below. 12



b) Use both nodal and loop analyses to find Vo in the figure below. 13



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B. Sc. Engg. (EE), 1st Sem. Date: March 20, 2018 (Morning)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid-Semester Examination | Winter Semester, A. Y. 2017-2018
Course No.: Phy 4121 | Time: 90 Minutes
Course Title: Engineering Physics I | Full Marks: 75

There are **4 (four)** questions. Answer **any 3 (three)** questions. All questions carry equal marks. Marks in the margin indicate full marks. Programmable calculators are not allowed. Do not write on this question paper.

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1. (a) Briefly explain various atomic models. 10

   (b) According to Bohr atom model show that the expressions for radii and energies of orbiting electrons in an atom are $r_n = \frac{n^2 h^2 \varepsilon_0}{\pi m e^2}$ and $E_n = -\frac{me^4}{8\varepsilon_0^{\,2} h^2}\frac{1}{n^2}$, respectively, where the symbols have their usual meaning. 15

2. (a) Explain following terms:
   (i) Polarization of light, (ii) Polarizing angle, and (iii) Double refraction. 10

   (b) State Brewster's law and Malu's law. Prove that the angle between the reflected and refracted rays for complete polarization of reflected ray is 90°. 10

   (c) How will you orient the polarizer and the analyzer, so that a beam at natural light is reduced to (i) 0.125, (ii) 0.25, (iii) 0.5, and (iv) 0.75 of its original intensity? 5

3. (a) What is interference of light? Discuss interference of light analytically and obtain the conditions of maximum and minimum intensities. 10

   (b) A thin transparent plate of thickness t and refractive index μ is introduced into the path of one of the interfering beams. Derive an expression for measuring thickness of the plate using interference pattern obtained on a screen at a distance D from two coherent sources. Assume distance between the coherent sources is d. 10

(c) Two straight and narrow parallel slits 1.0 mm apart are illuminated by monochromatic light. Fringes formed on the screen held at a distance of 100 cm from the slits are 0.50 mm apart. What is the wavelength of light? 5

4. (a) What is diffraction of light? Discus different classes of diffraction? 5

(b) What is slit? Derive an expression for intensity of light due to Fraunhofer diffraction through single slit. 15

(c) Monochromatic light of wavelength 441 nm is incident on a narrow slit. On a screen 2.00 m away, the distance between the second diffraction minimum and the central maximum is 1.50 cm. (i) Calculate the angle of diffraction θ of the second minimum. 5

(ii) Find the width of the slit.

B.Sc. Engg.(EE),1st Sem. Date: March 13, 2018 (Morning)

ISLAMIC UNIVERSITY OF TECHNOLOGY(IUT)
ORGANISATION OF ISLAMIC COOPERATION(OIC)

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid-Semester Examination — Winter Semester A.Y. 2017-2018
Course No.: Math 4121 — Time: 90 Minutes
Course Title: Mathematics I — Full Marks: 75

There are **4 (four)** questions. Answer **any 3 (three)** questions. Marks in the margin indicate full marks. Programmable calculators are not allowed. Do not write on this question paper.

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1. a) If by the rotation of axes about the origin, the expression $ax^2 + 2hxy + by^2$ changes to $a'x'^2 + 2h'x'y' + b'y'^2$ then find the invariants of transformation. (12)

   b) Identify the curve $17x^2 + 18xy - 7y^2 - 16x - 32y - 18 = 0$. Reduce it to standard form. (13)

2. a) If $y = e^{ax} \sin bx$ find y_n. (12)

   b) Differentiate $(1-x^2)y_2 + (2x-1)y_1 = 0$ n times to find the relation connecting y_{n+2}, y_{n+1} and y_n. (13)

3. a) State and prove L' Hospital's theorem.
   Evaluate $Lt_{x\to 0} \dfrac{\tan nx - n\tan x}{n\sin x - \sin nx}$ (12)

   b) If $u = \sin^{-1} \dfrac{x^{10} + y^{10}}{\sqrt[4]{x} + \sqrt[4]{y}}$ then find $x\dfrac{\partial u}{\partial x} + y\dfrac{\partial u}{\partial y}$ using Euler's theorem on homogeneous functions. (13)

4. a) Find the value of n so that the subnormal at any point on the curve $xy^n = a^{n+1}$ may be constant. (12)

   b) A gardener having 120 ft. of fencing wishes to enclose a rectangular plot of land and to erect a fence across the land parallel to two of the sides. What is the maximum area he can enclose? (13)

B.Sc. Engg.(EE)/1st Sem. Date: 15 March, 2018 (Morning)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid-Semester Examination
Course No.: Math 4123
Course Title: Matrix and Differential Equation

Winter Semester, A.Y. 2017-2018
Time: 90 Minutes
Full Marks: 75

There are **4 (Four)** questions. Answer **any 3 (Three)** questions. Programmable calculators are not allowed. Do not write on this question paper. The figures in the right margin indicate full marks. The Symbols have their usual meaning.

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1. (a) Define symmetric and skew-symmetric matrix. Prove that every square matrix can be expressed in one and only one way as the sum of a symmetric matrix and a skew-symmetric matrix. (8)

(b) Find adjA of the matrix $A=\begin{bmatrix}1 & 0 & 2\\ 1 & 1 & 0\\ 1 & 2 & 3\end{bmatrix}$ and hence find A(adjA) (12)

(c) If $A=\begin{bmatrix}2 & 1\\ 1 & 1\end{bmatrix}$ and $B=\begin{bmatrix}3 & 5\\ 1 & 2\end{bmatrix}$, find $B^{-1}A^{-1}$ (5)

2. (a) Using only elementary row transformation, to reduce A to I, find the inverse of

$$A=\begin{bmatrix}1 & 2 & -2 & -1\\ -1 & -4 & 4 & 0\\ 2 & -7 & 4 & -7\\ 1 & 6 & -5 & 1\end{bmatrix}$$ (13)

(b) Solve the following system of linear equations

$$\begin{aligned} x_1 - x_2 + 2x_3 &= 3\\ x_1 + 2x_2 + 3x_3 &= 5\\ 3x_1 - 4x_2 - 5x_3 &= -13 \end{aligned}$$ (12)

3. (a) Solve the following differential equations:

(*i*) $(x^3+y^3)dx - 3xy^2dy = 0$ (8)

(*ii*) $(2xy^4e^y+2xy^3+y)dx+(x^2y^4e^y-x^2y^2-3x)dy = 0$ (9)

(b) An inductance of 4 henries and a resistance of 40 ohms are connected in a series with an e.f.m E volts . If the current is zero when t = 0 , find the current at end of .01 sec if E = 200 volts. (8)

4. Solve the following differential equations:

(i) $x\frac{dy}{dx}+y=(xy)^{\frac{3}{2}}$ (8)

(ii) $(D^2-4D+3)y=x+x^2$ (9)

(iii) $(D^2-D-6)y=2e^x+e^{3x}$ (8)

B.Sc. SWE, 1st Sem. 71 Date: March 15, 2018 (Afternoon)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid-Semester Examination
Course No.: Phy 4143
Course Title: Physics II

Winter Semester, A.Y. 2017-2018
Time: 90 Minutes
Full Marks: 75

There are **4 (four)** questions. Answer **any 3 (three)** questions. All questions carry equal marks. Marks in the margin indicate full marks. Programmable calculators are not allowed. Do not write on this question paper. Symbols carry their usual meanings.

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1. a) For the circuit shown in Fig. 1(a), find out the values of V_0 and I_0. 8

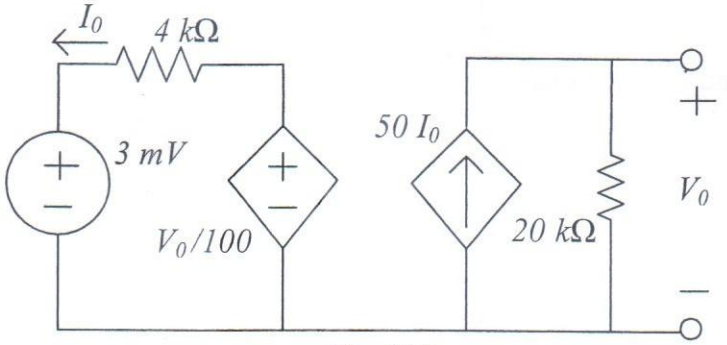

Fig. 1(a)

b) Use source transformation to calculate i_0 in the circuit of Fig. 1(b). 7

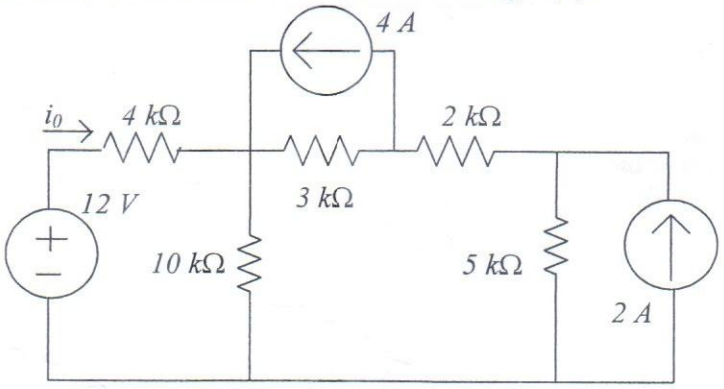

Fig. 1(b)

c) Calculate the value of current, I from the circuit shown in Fig. 1(c). 10

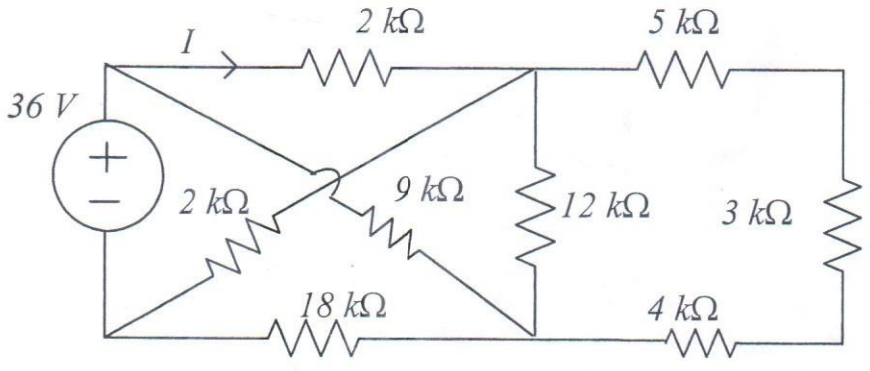

Fig. 1(c)

2. a) For the bridge network in Fig. 2(a), where $E = 20$ V, $R_S = 3\ \Omega$, $R_1 = 4\ \Omega$, $R_2 = 2\ \Omega$, $R_3 = 2\ \Omega$, $R_4 = 1\ \Omega$ and $R_5 = 5\ \Omega$: 12

i. Write the mesh equations using any approach.
ii. Determine the current through R_5.
iii. Write the nodal equations using any approach.
iv. Determine the voltage across R_5.

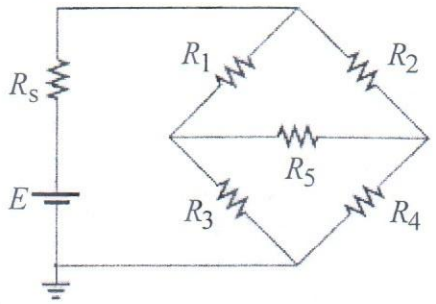

Fig. 2(a)

b) Find current, i_o for the following circuit shown in figure 2(b). Use superposition theorem. 13

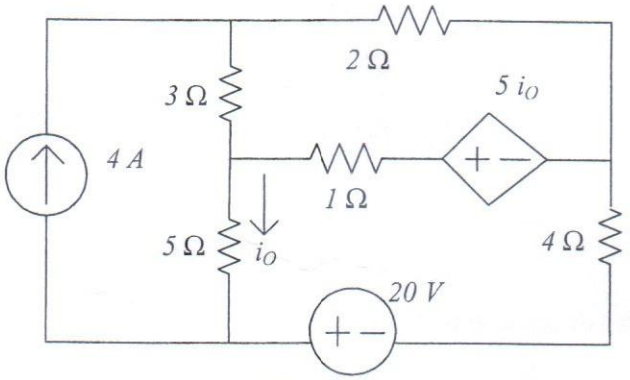

Fig. 2(b)

3. a) The voltage across a 2 F capacitor is shown in Fig. 3(a). Find and draw the current wave shape through the capacitor. 8

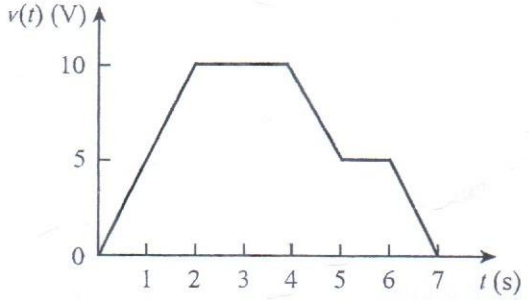

Fig. 3(a)

b) Find the voltage across R_2 for the network in Fig. 3(b), where $E = 24$ V, $R_1 = 6\ \Omega$, $R_2 = 12\ \Omega$ and $I = 1$ A. 8

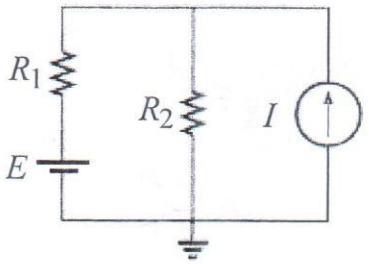

Fig. 3(b)

c) Find the Norton equivalent network for the following circuit given in Fig. 3(c). 9

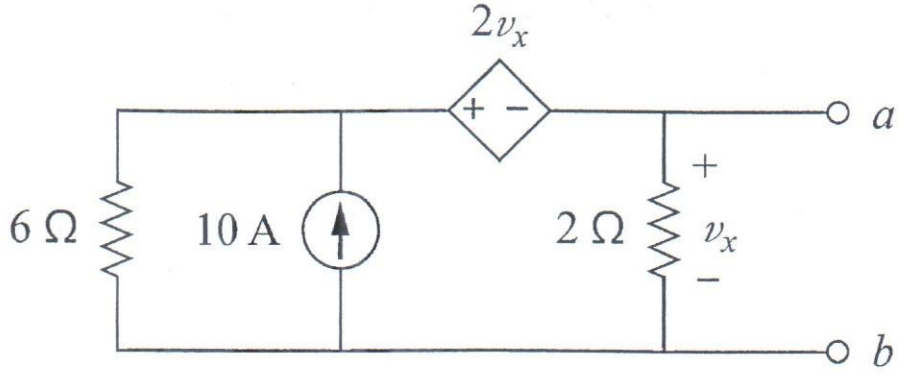

Fig. 3(c)

4. a) For the network shown in Fig. 4(a), where E = 6 V, R_1 = 3 Ω, R_2 = 4 Ω, R_3 = 2 Ω, R_4 = 1 Ω, R_5 = 8 Ω : 15

i. Write down the mesh equations and express them in matrix form.

ii. Solve the mesh equations to determine mesh currents.

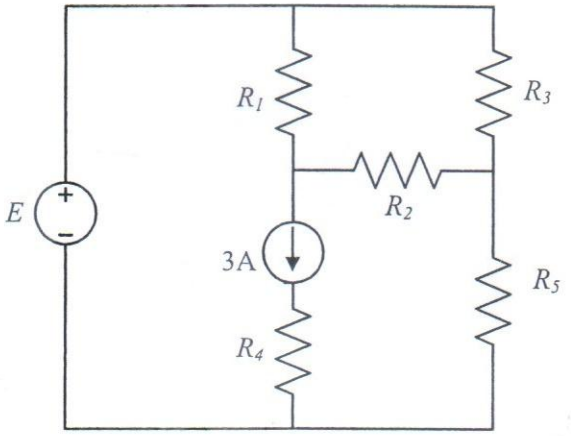

Fig. 4(a)

b) Find the equivalent resistance with respect to terminals A and B in the following circuit shown in Fig. 4(b). Assume all the resistance values are equal to 1 kΩ. 10

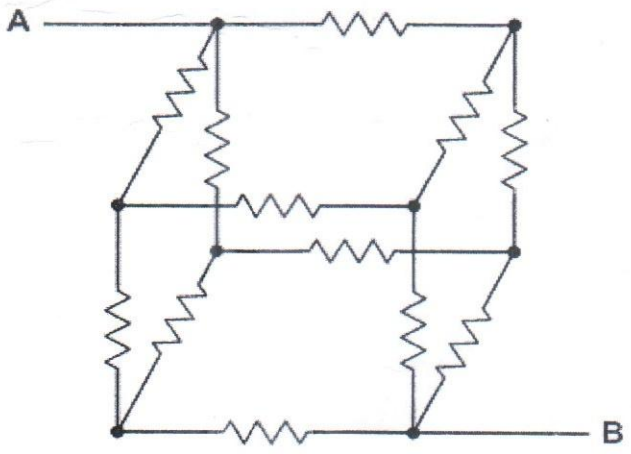

Fig. 4(b)

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B.Sc. Engg. (EE) / HDEE, 3rd Sem. Date: March 19, 2018 (Afternoon)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid Semester Examination — Winter Semester, A.Y. 2017-2018
Course No.: EEE 4301 — Time: 90 Minutes
Course Title: Power System I — Full Marks: 75

There are **4 (four)** questions. Answer **any 3 (three)** questions. All questions carry equal marks. Marks in the margin indicate full marks. Programmable calculators are not allowed. Do not write on this question paper. Symbol(s) preserve their usual meanings. Assume reasonable value if necessary.

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1. a) A single phase a.c. system supplies a load of 300 kW and if this system is converted to a 3-phase, 3-wire a.c. system by running a third similar conductor, calculate the 3-phase load that can now be supplied if the voltage between the conductors is the same. Assume the power factor and transmission efficiency to be the same in the two cases. 12

   b) A transmission line has a span of 150 m between the level supports. The conductor has a cross-sectional area of 2 cm^2. The ultimate strength of the conductor material is 5000 kg/cm^2. The specific gravity of the material is 8·9 gm/cm^3. If the wind pressure is 1·5 kg/m length of conductor, determine the sag at the centre of the conductor if factor of safety is 5. 13

2. a) Two towers of height 40 m and 30 m, respectively support a transmission line conductor at water crossing. The horizontal distance between the towers is 300 m. If the tension in the conductor is 1590 kg, find the clearance of the conductor at a point mid-way between the supports. Weight of conductor is 0·8 kg/m. Bases of the towers can be considered to be at the water level. 15

   b) Explain the key diagram of a typical 11 kV/400 V indoor sub-station with necessary illustration. 10

3. a) 2-wire d.c. distributor AB 500 metres long is fed from point A and is loaded as follows : 7

Distance from feeding point A (in metres) :	100	300	400	500
Load (amperes) :	20	40	40	50

   If the specific resistance of copper is $1·7 \times 10^{-8}$ Ωm, what must be the cross-section of each wire in order that the voltage drop in the distributor shall not exceed 10 volts ?

   b) A 2-wire d.c. distributor AB is 300 metres long. The end A is fed at 205 V and end B at 200 V. The distributor is uniformly loaded at 0·15 A/metre length and has concentrated loads of 50 A, 60 A and 40 A at points distant 75, 175, 225 m respectively from the end A. The resistance of each conductor is 0·15 Ω per kilometre. Calculate : 10

   (i) the point of minimum potential and
   (ii) currents fed at ends A and B.

   c) Discuss the relative merits and demerits of underground and overhead systems. 8

4. a) A d.c. ring main ABCDA is fed from point A from a 250 V supply and the resistances (including both lead and return) of various sections are as follows : AB = 0·02 Ω ; BC = 0·018 Ω ; CD = 0·025 Ω and DA = 0·02 Ω. The main supplies loads of 150 A at B ; 300 A at C and 250 A at D. Determine the voltage at each load point. 11

b) A 3-phase ring distributor ABCD fed at A at 11 kV supplies balanced loads of 40 A at 0·8 p.f. lagging at B, 50 A at 0·707 p.f. lagging at C and 30 A at 0·8 p.f. lagging at D, the load currents being referred to the supply voltage at A. 8+6

The impedances per phase of the various sections are :

Section AB = (1 + j 2) Ω ; Section BC = (2 + j 3) Ω

Section CD = (1 + j 1) Ω ; Section DA = (3 + j 4) Ω

Calculate the currents in various sections and station bus-bar voltages at B, C and D.

B.Sc. Engg.(EE)/HDEE, 3rd Sem. 76 Date: March16, 2018 (Afternoon)

DTE 1st Sem.

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid-Semester Examination
Course No.: EEE 4303/EEE 4381
Course Title: Electronics II

Winter Semester, A.Y. 2017-2018
Time: 90 Minutes
Full Marks: 75

There are **4 (four)** questions. Answer **any 3 (three)**questions. All questions carry equal marks. Marks in the margin indicate full marks. Programmable calculators are not allowed. Do not write on this question paper. Symbols carry their usual meanings.

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1. a) What is meant by negative feedback? What are the advantages and disadvantages of the negative feedback? 8

   b) Derive the ideal form of the general feedback transfer function and define the loop gain factor. 7

   c) Three voltage amplifiers are in cascade as shown in Fig. 1(c) with various amplification factors. The 180 degree phase shift for negative feedback actually occurs in the basic amplifier itself. (i) Determine the value of β such that the closed-loop voltage gain is $A_f = v_o/v_s = -120$. (ii) Using the results of part (i), determine the percent change in A_f if each individual amplifier gain decreases by 10 percent. 10

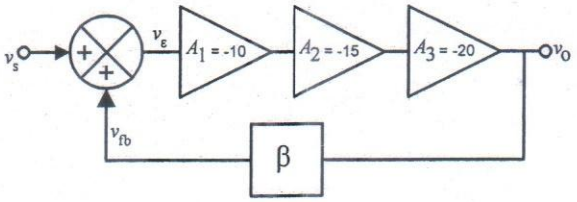

Fig. 1(c)

2. a) Define filter, frequency response and bode plot. 5

   b) What are the major limitations of passive filter? What are the types of active filter? Draw their corresponding circuit diagrams and transfer functions. 12

   c) Design a first order active low pass filter for a 3 dB cut-off frequency of 3000π (radians/second), a dc gain of 2 and an input impedance of at least 100 kΩ. 8

3. a) Draw the simplified voltage transfer characteristic of an op-amp. What are the main characteristics of an ideal op amp? 5

   b) Design an amplifier system with three inverting op-amps circuits in cascade such that the overall closed-loop voltage gain is $A_v = \frac{v_0}{v_i} = -300$. The maximum resistance is limited to 200 kΩ and the minimum resistance is limited to 20 kΩ. In addition, the maximum current in any resistor is to be limited to 60 μA when $v_0 = 6$ V. 10

c) Determine the closed-loop voltage gain $A_v = \frac{v_o}{v_i}$ for the ideal op-amp circuit in Fig. 3(c). Let $R = 30$ kΩ, determine the current in the resistor R in the T-network for $v_i = -0.15$ V. 10

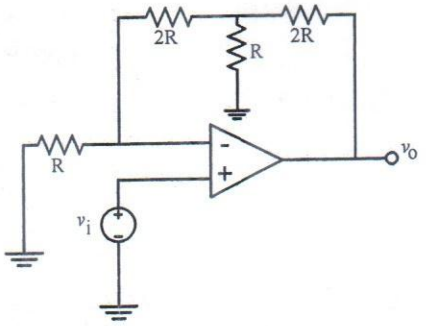

Fig. 3(c)

4. a) Consider the case of a voltage source with a 100 kΩ output impedance driving a 1 kΩ load impedance. If a voltage follower inserted between the source and the load then show that it will prevent loading effect. 7

b) What is the input resistance of an ideal current-to-voltage converter? The Fig. 4(b) shows the inverting amplifier which is used as a voltage-to-current converter. Show that the load current i_L is proportional to the input voltage v_i and is independent of the load impedance Z_L. 10

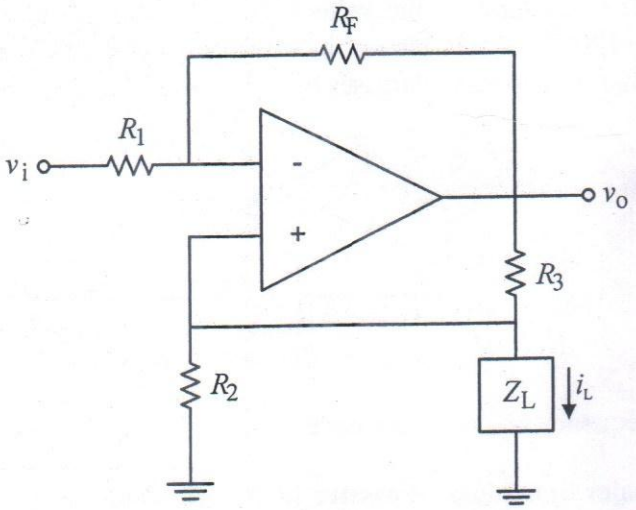

Fig. 4(b)

c) Consider the voltage-to-current converter shown in Fig. 3(b). The load impedance is $Z_L = 200$ Ω and the input voltage is $v_i = -3$ V. Determine the load current i_L and the output voltage v_o if $R_1 = 10$ kΩ, $R_2 = 1.5$ kΩ, $R_3 = 3$ kΩ and $R_F = 20$ kΩ. 8

B.Sc. Engg. (EE)/HDEE, 3rd Sem.
DTE. 1st Sem.

Date: March 13, 2018 (Afternoon)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid-Semester Examination
Course No.: EEE 4307 / EEE 4397
Course Title: Digital Electronics

Winter Semester, A. Y. 2017-2018
Time: 90 Minutes
Full Marks: 75

There are **4 (four)** questions. Answer **any 3 (three)** questions. All questions carry equal marks. Marks in the margin indicate full marks. Programmable calculators are not allowed. Do not write on this question paper.

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1. Assume an aribirtary number system 'Base 32' having 32 bases. The symbols of 'Base 32' number system and their equivalent decimal values are shown in Table I.

Base 32	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
Decimal	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Base 32	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
Decimal	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31

Table I

a) Find the value of X. 12
(i) $(\text{MNOP} \,.\, 9\text{A})_{32} = (\text{X})_{10}$
(ii) $(667154271276727 \,.\, 45735)_8 = (\text{X})_{32}$
(iii) $(16\text{QP32} \,.\, \text{DE})_{32} = (\text{X})_{16}$

b) (i) Determine the value of base x if $(225525)_x = (\text{IUT})_{32}$. 10
(ii) Use 31's complement to perform the following subtraction operation.
$(\text{IVDK24M5})_{32} - (\text{G1NDKV})_{32}$

c) (i) Find the decimal number of the 4221 BCD code: 11000100. 3
(ii) Find the Gray code for the binary number: 10010.

2. a) Simplify the following Boolean function using Karnaugh-Map in (i) POS and (ii) SOP form. 14

$$F = (B + C + D).(A + B + \overline{C} + D).(\overline{A} + B + C + \overline{D}).(A + \overline{B} + C + D).(\overline{A} + \overline{B} + C + D)$$

b) Given that $A \,.\, B = 0$ and $A + B = 1$, use algebraic manipulation to prove that 11

$$(A + C).(\overline{A} + B).(B + C) = B.C$$

3. a) Design a full-adder. Show the truth table and construct Boolean expression for all possible inputs. Draw the logic diagram. 6

b) Construct a 5 × 32 decoder with four 3 × 8 decoders with enable and one 2 × 4 decoder. Show the internal diagram for 3 × 8 decoder only. 9
(*Hint: No need to show the internal diagram of the decoders.*)

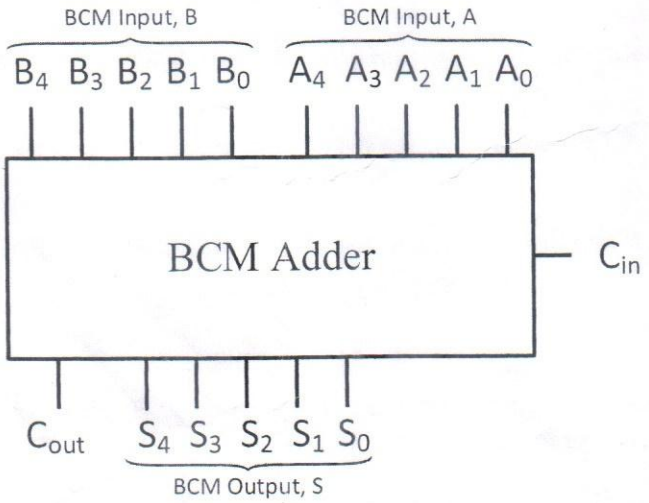
c) Design an 8 bit magnitude comparator that will compare two binary numbers $A=A_7A_6A_5A_4A_3A_2A_1A_0$ and $B=B_7B_6B_5B_4B_3B_2B_1B_0$. The three outputs X_1, X_2 and X_3 will be activated for $A > B$, $A = B$ and $A < B$, resepectively. 10

4. The Maya number system is a vigesimal (base-twenty) positional numeral system used by the pre-Columbian Maya civilization. Binary Coded Maya (BCM) is a way to express each of the Maya digits with 5-bit binary code. The numerals of Maya number system and BCM are shown in Table II. 25

Maya Number Symbols	Decimal Values	Binary Coded Maya (BCM)	Maya Number Symbols	Decimal Values	Binary Coded Maya (BCM)
	0	00000		10	01010
	1	00001		11	01011
	2	00010		12	01100
	3	00011		13	01101
	4	00100		14	01110
	5	00101		15	01111
	6	00110		16	10000
	7	00111		17	10001
	8	01000		18	10010
	9	01001		19	10011

Table II

Design a BCM adder that adds two BCM numbers and gives the output in BCM as shown in the following figure.



B.Sc. Engg.(ME)/ HDME, 3rd Sem. Date: March 15, 2018(Morning)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid-Semester Examination
Course No.: Phy 4313
Course Title: Basic Electronics and Semiconductor Physics

Winter Semester, A.Y. 2017-2018
Time: 90 Minutes
Full Marks: 75

There are **4 (four)** questions. Answer **any 3 (three)** questions. All questions carry equal marks. Marks in the margin indicate full marks. Programmable calculators are not allowed. Do not write on this question paper.

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1. a) Draw the labeled diagram of diode characteristics for both Si and Ge diodes on the same figure. 5

   b) Assuming that the diodes in the circuits of Fig.1(a), Fig. 1(b) and Fig. 1(c) as silicon diodes with $V_T = 0.7$ V, find the values of labeled voltages and currents. 10

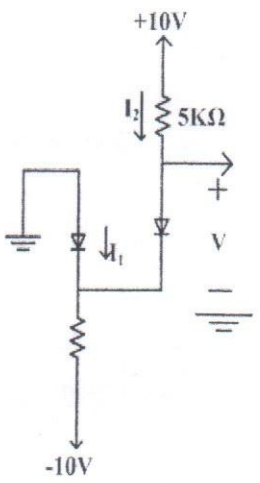

Fig. 1(a)

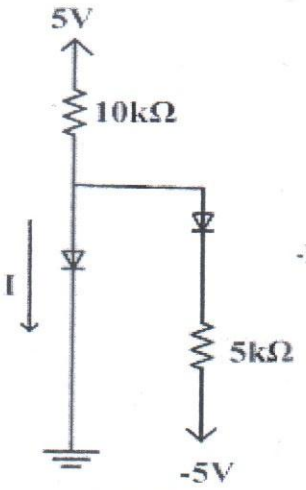

Fig. 1(b)

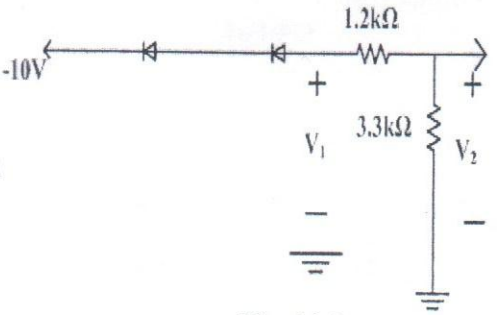

Fig. 1(c)

   c) i) Determine V_L, I_L, I_Z and I_R for the network in Fig. 1(d) if $R_L = 180\ \Omega$, $V_Z = 10$ V and $P_{Zmax} = 400$ mW. 10
   ii) Repeat part (i) if $R_L = 470\ \Omega$.

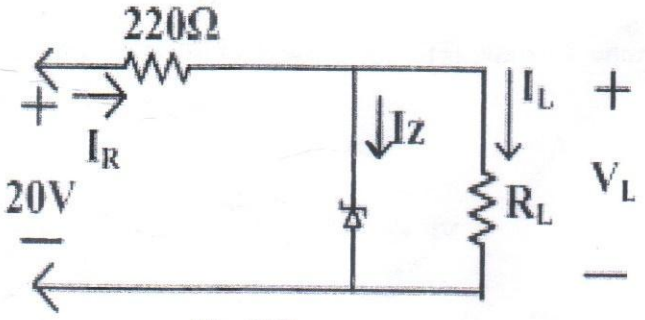

Fig. 1(d)

2. a) Determine V_o for the network in Fig. 2(b) using a silicon diode with $V_T = 0.7$ V 6

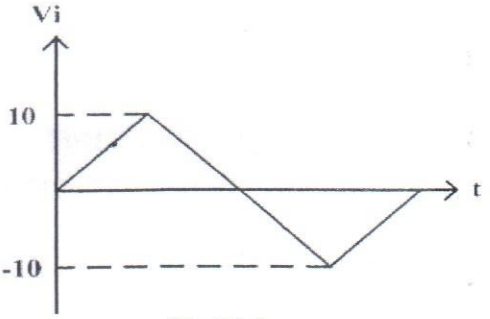

Fig.2(a)

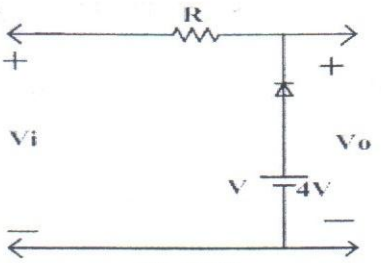

Fig.2(b)

b) Sketch V_o for the circuits in Fig. 2(c) and Fig. 2(d). Consider Vin = 10 Vp-p and V = 3 V. 9

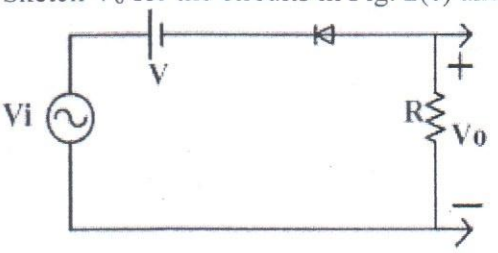

Fig. 2(c)

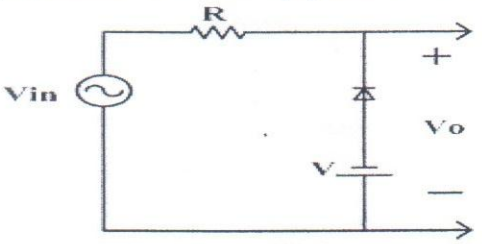

Fig. 2(d)

c) Determine V_o for the network of Fig. 2(e) for the input indicated in Fig. 2(f) using silicon diode with $V_T = 0.75$ V. 10

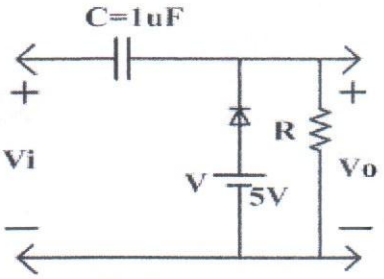

Fig. 2(e)

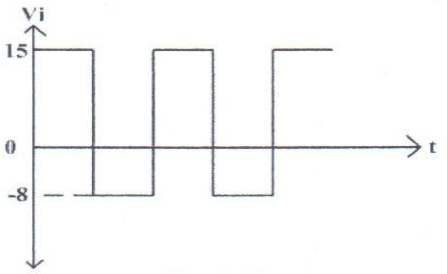

Fig. 2(f)

3. a) What are the modes of operation of a transistor? Write down the biasing condition of two junctions for each mode. How must the two junctions be biased for proper transistor amplifier operation? Describe the transistor amplifying action with example. 13

b) Determine V_{CEQ} and I_E for the network of Fig. 3(b). Assume $\beta = 90$. 12

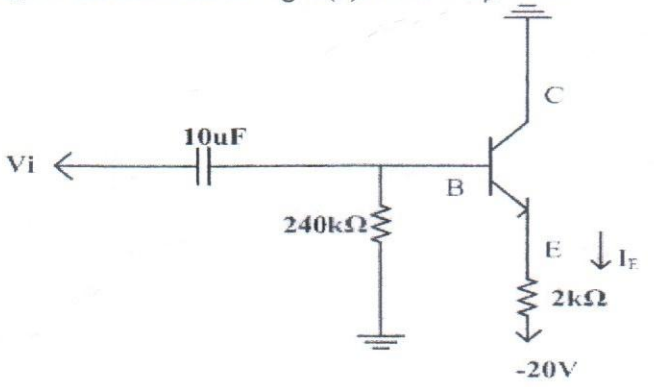

Fig. 3(b)

4. a) Sketch the common-base BJT configuration (for both npn and pnp) and indicate the polarity of the applied bias and resulting current directions. 5

b) For the network of Fig. 4(b), determine I_B, I_C , V_{CE}, V_C, V_E, V_B and V_{BC} . Assume $\beta = 50$. 10

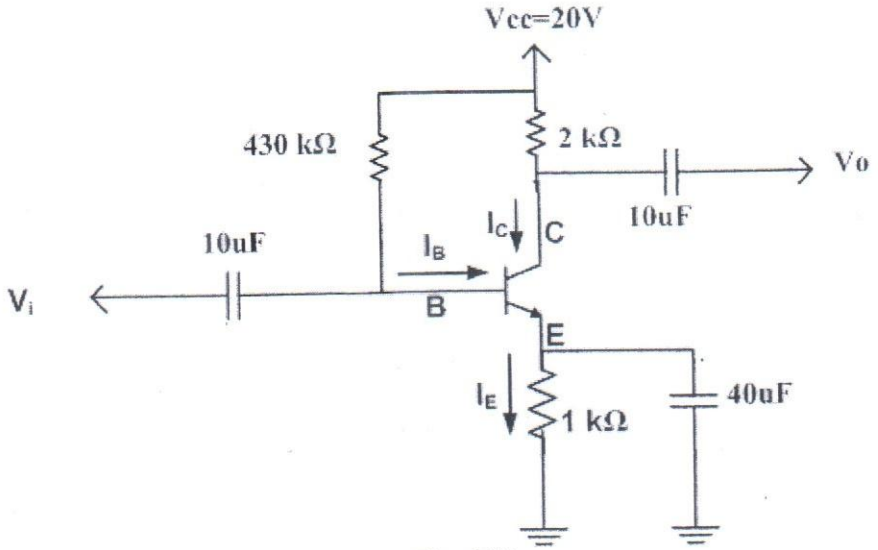

Fig. 4(b)

c) For the network in Fig. 4(c), Determine I_{CQ}, V_{CEQ}, V_B, V_C, V_E and V_{BC}. Assume $\beta = 120$. 10

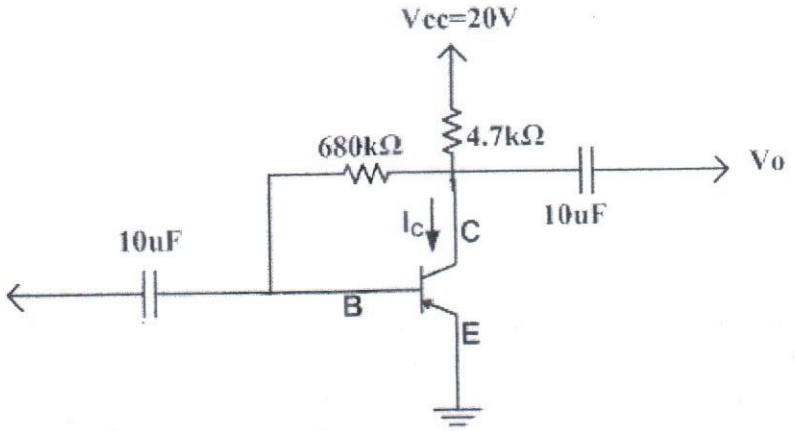

Fig. 4(c)

B.Sc.Engg./HDEE, 3rd Sem.
B.Sc.TE (2-Yr) 1st Sem.

Date: March 14, 2018 (Afternoon)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid-Semester Examination — Winter Semester, A.Y.2017-2018
Course No.: Math 4321/Math 4529 — Time: 90 Minutes
Course Title: Transform Technique and Linear Algebra — Full Marks: 75

There are **4 (four)** questions.Answer **any 3 (three)**questions. All questions carry equal marks. Marks in the margin indicate full marks. Programmable calculators are not allowed. Do not write on this question paper.

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1. a) Define Fourier series of a function f(x) in the interval [-T, T] with period 2T. Also derive the alternative Fourier series with amplitude and phase angle. Write the applications of Fourier series in various science and engineering fields. 15

   b) Find the Fourier Series of the function having period 2π in the interval $-\pi \le x \le \pi$ such that $f(x) = \begin{cases} -\pi, & -\pi \le x < 0 \\ x, & 0 \le x \le \pi \end{cases}$ and the sketch the graph for values of x from -5π to 5π. 10

2. a) Define half range Fourier sine and cosine series. Express $f(x) = x$ as a half range cosine series in the interval [0,2] 15

   b) Find the Fourier Integrals of the function $f(x) = \begin{cases} 1, & |x| < 1 \\ 0, & |x| > 1 \end{cases}$ 10

3. Define Finite Fourier sine and cosine transforms of a function. Solve the following heat equation by using Fourier transform: 25
   $\frac{\partial H}{\partial t} = \frac{\partial^2 H}{\partial^2 x}$, $H(0,t) = 0$, $H(\pi,t) = 0$, and $H(x,0) = 2x$, where $0 \le x \le \pi$, $t > 0$.

4. a) Define Laplace transform of a function f(x). Find the Laplace transforms for the following functions: i) $f(x) = \cosh(ax)$, ii) $f(x) = x^n e^{ax}$. 15

   b) Find the Laplace transform of $F(x)$, where $F(x) = \begin{cases} 5 + x, & 0 \le x \le 2 \\ 3, & x > 2 \end{cases}$. 10

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B.Sc. Engg. (CSE)/ HDCSE, 3rd Sem. Date: 19 March, 2018 (Morning)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid-Semester Examination — Winter Semester, A.Y. 2017-2018
Course No.: EEE 4383 — Time: 90 Minutes
Course Title: Electronic Devices and Circuits — Full Marks: 75

There are 4 **(four)** questions. Answer **any 3 (three)** questions. All questions carry equal marks. Marks in the margin indicate full marks. Programmable calculators are not allowed. Do not write on this question paper. Assume suitable value for any missing data.

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1. a) Define intrinsic and extrinsic semiconductors. Draw the detailed transfer characteristics of a pn junction diode composed of Ge, Si and GaAs in the same graph and indicate different regions in the diagram. 07

   b) What is transconductance? For a small ac signal as the input, derive the expression for transconductance for a common emitter configuration with circuit diagrams. 06

   c) Determine I and V for the circuit in Fig. 1(c) assuming the diodes D_1 and D_2 are ideal. 06

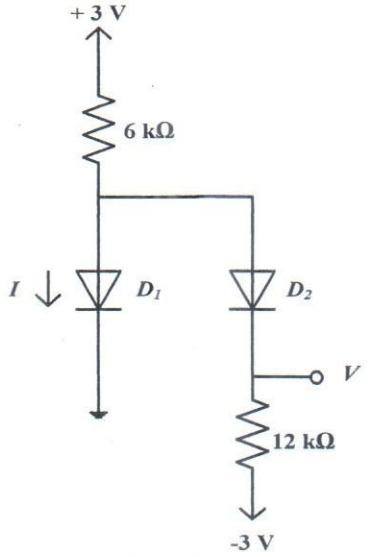

Fig. 1(c)

   d) What is the pinch-off voltage for an n-channel JFET? Explain the pinch-off phenomenon with detailed diagram. 06

2. a) Design a full wave rectifier and draw the input and output waveshapes for this circuit. Calculate the Vdc and PIV for this circuit (assume all the diodes are real diodes). 07

   b) Draw the majority and minority carrier concentrations profile of an npn transistor in the forward active mode. Explain the different currents generated due to the flow of these carriers and their relations. 06

   c) Explain the avalanche and zener breakdown of a pn junction diode with detailed diagram. What is the difference between them? 06

d) Derive the expressions for the amplifier gain of an npn transistor in active mode for a common emitter configuration. What will be condition for obtaining maximum gain? 06

3. a) In the circuit of Fig. 3(a), If $\beta = 50$, find I_E, I_B, V_E, I_C and V_C. 07

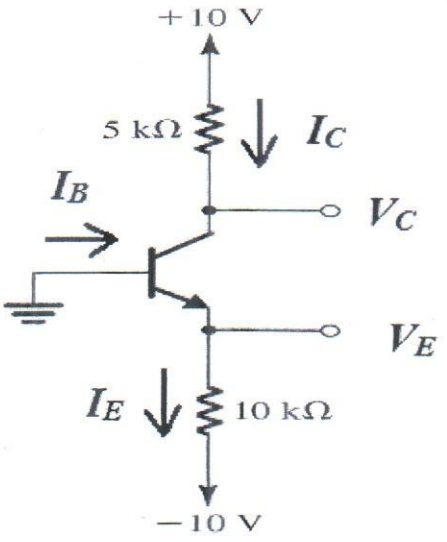

Fig. 3(a)

b) Draw the hybrid pie and T equivalent circuit diagrams for a pnp transistor for a small input signal. 06

c) Define the static and dynamic resistance of a diode. Design a DC battery charger circuit and draw the input and output waveshapes for V_{dc} = 12 V and the supply is a 24 V (peak) sinusoid. 06

d) What is a Darlington pair? With detailed diagram, explain the advantages and disadvantages of this arrangement over an npn transistor. 06

4. a) For the circuit in Fig. 4(a), calculate the values of I_E, I_B, V_E, V_B, I_C and V_C. 07

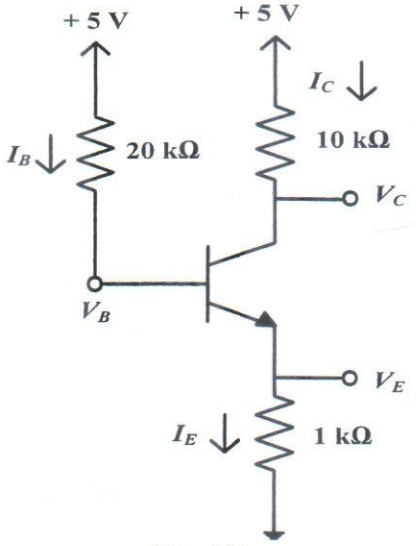

Fig. 4(a)

b) Explain the overdrive factor in the light of the transfer characteristics in Fig. 4(b). Design a simplified equivalent circuit for an npn transistor acting in the saturation mode. 06

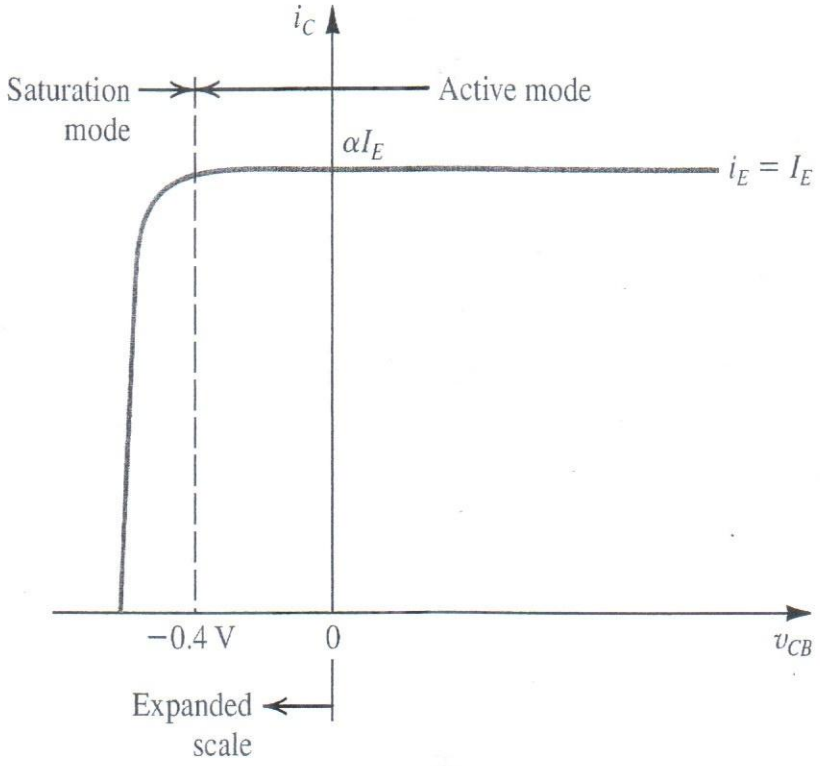

Fig. 4(b)

c) Explain the process of amplification of a small sinusoidal signal for an npn transistor in the active region for a common emitter configuration with appropriate diagrams. 06

d) Using the short hand method, sketch the transfer curve defined by I_{DSS} = 12 mA and V_P = -6 V for a JFET. What type of JFET is this? 06

B.Sc. Engg.(CEE), 3rd Sem. 87 Date: March 19, 2018 (Morning)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid-Semester Examination — Winter Semester, A.Y. 2017-2018
Course No.: EEE 4385 — Time: 90 Minutes
Course Title: Electrical and Electronic Technology — Full Marks: 75

There are **4 (four)** questions. Answer any **3 (three)** questions. All questions carry equal marks. Marks in the margin indicate full marks. Programmable calculators are not allowed. Do not write on this question paper. Symbols carry their usual meanings.

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1. a) Define current and voltage. A 600-W TV receiver is turned on for 4 hours with nobody watching it. If electricity costs Tk. 5/kWh, how much money is wasted? 5

   b) What do you mean by load? Give at least one practical example from each category. A walker's cassette tape player uses four AA batteries in series to provide 6 V to the player circuit. The four alkaline battery cells store a total of 200 watt-seconds of energy. If the cassette player is drawing a constant 10 mA from the battery pack, how long will the cassette operate at normal power? 8

   c) A phonograph pickup, stereo amplifier, and speaker are shown in Fig. 1(c.1) and redrawn as a circuit model as shown in Fig. 1(c.2). Determine the resistance R so that the voltage, V across the speaker is 16 V. Determine the power delivered to the speaker. 12

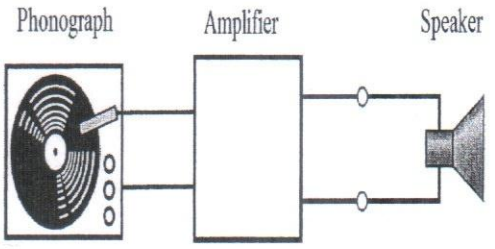

Fig. 1(c.1)

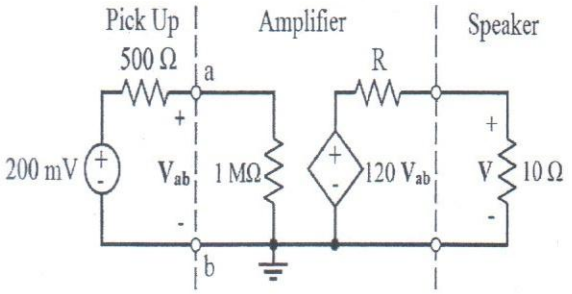

Fig. 1(c.2)

2. a) A wiring circuit for a special lamp in a home is shown in Fig. 2(a). The lamp has a resistance of 2 Ω. The lamp will light when $I \geq 50$ mA, but will burn out when $I > 75$ mA. Determine the range of R, so that the lamp will provide light without any hazard. 5

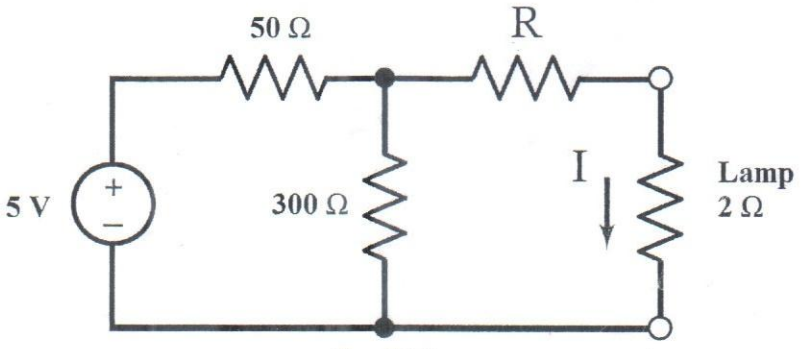

Fig. 2(a)

b) An electric current is applied to bone fractures that have not healed in the normal period of time. The process seeks to imitate natural electrical forces within the body. It takes only a small amount of electric stimulation to accelerate bone recovery. The direct current method uses an electrode that is implanted at the bone. This method has a success rate approaching 80 percent. 8

The implant is shown in Fig. 2(b.1), and the circuit model is shown in Fig. 2(b.2). Find the energy delivered to the cathode during a 24-hour period. The cathode is represented by the dependent voltage source and the 100 kΩ resistor.

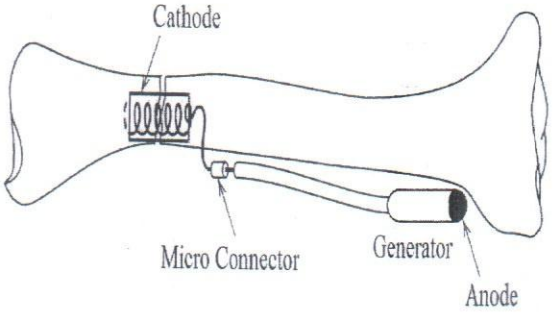

Fig. 2(b.1)

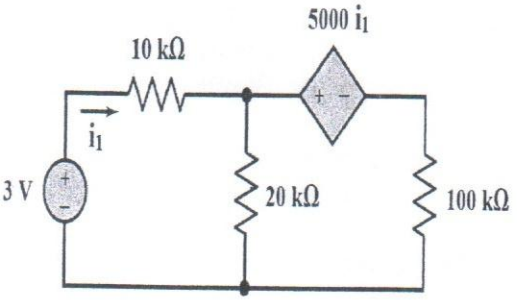

Fig. 2(b.2)

c) Find R_{Th} ,V_{Th} at the *a-b* terminal. 12

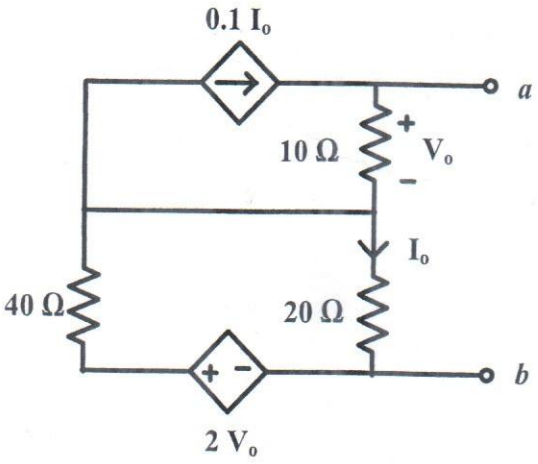

Fig. 2(c)

3. a) Obtain the equivalent resistance R_{ab} for the circuit shown in Fig. 3(a) where, E = 120 V, R_1 = 12.5 Ω, R_2 = 5 Ω, R_3 = 10 Ω, R_4 = 15 Ω, R_5 = 20 Ω and R_6 = 30 Ω and use it to determine the current *i*. 10

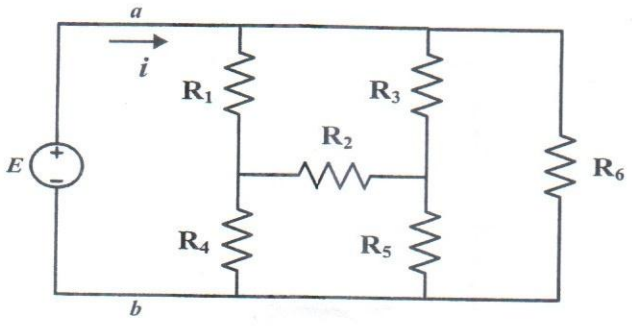

Fig. 3(a)

b) The idea of using an induction coil in a lamp isn't new, but applying it in a commercially available product is. An induction coil in a bulb induces a high-frequency energy flow in mercury vapor to produce light. The lamp uses about the same amount of energy as a fluorescent bulb but lasts six times longer, with 60 times the life of a conventional incandescent bulb. The circuit model of the bulb and its associated circuit are shown in Fig. 3(b). Determine the voltage v(t) across the 2 Ω resistor when C = 40 μF, L = 40 μH, $V_s = 10\cos(\omega_0 t + 30^0)$ V and $\omega_0 = 10^5 rad/s$. 15

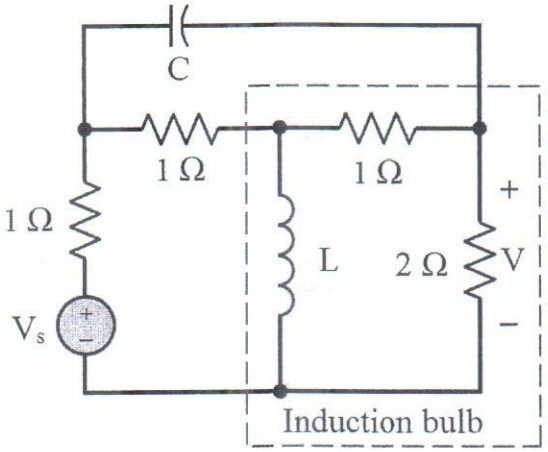

Fig. 3(b)

4. a) Define instantaneous and average power. Prove that, for an AC circuit the maximum average power will be, $P_{max} = \frac{|V_{Th}|^2}{8R_{Th}}$. 7

b) What is the power factor? In a TV transmitter, a series circuit has an impedance of 3 kΩ and a total current of 50 mA. If the voltage across the resistor is 80 V, what is the power factor of the circuit? 8

c) A new electronic lamp (e-lamp) has been developed that uses a radio-frequency sinusoidal oscillator and a coil to transmit energy to a surrounding cloud of mercury gas as shown in Fig. 4(c.1). The mercury gas emits ultraviolet light that is transmitted to the phosphor coating, which, in turn, emits visible light. A circuit model of the e-lamp is shown in Fig. 4(c.2). The capacitance C and the resistance R are dependent on the lamp's spacing design and the type of phosphor. Select R and C so that maximum power is delivered to R, which relates to the phosphor coating. The circuit operates at $\omega_0 = 10^{-7}$ rad/s. 10

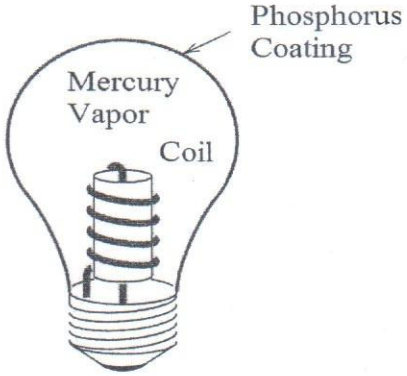

Fig. 4(c.1)

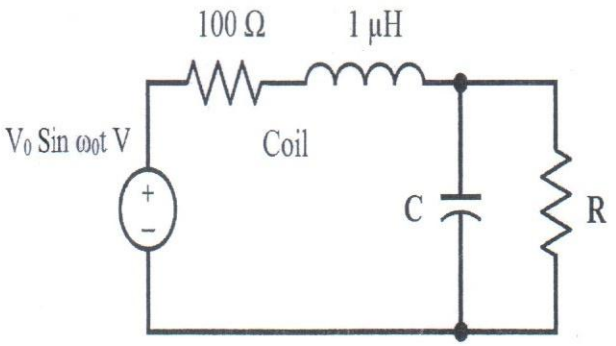

Fig. 4(c.2)

B.Sc. Engg.(EE)/HDEE, 5th Sem. 90 Date: March 15, 2018 (Morning)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid-Semester Examination — Winter Semester, A. Y. 2017-2018
Course No.: EEE 4501 — Time: 90 Minutes
Course Title: Electromagnetic Fields and Waves — Full Marks: 75

There are **4 (four)** questions. Answer **any 3 (three)** questions. All questions carry equal marks. Marks in the margin indicate full marks. Programmable calculators are not allowed. Do not write on this question paper. Symbols preserve their usual meaning.

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1. a) What is electromagnetics? As an engineer, what is your main motivation to study electromagnetic fields and waves. Explain your answer by mentioning some important engineering applications of electromagnetics. 5

b) Starting from coulomb's law, define and derive electric field intensity, $\vec{E}$. 6

Assume that two point charges *-500* mC and *-800* mC are located at *(6,4,-2)* and *(-1,-1,4)*, respectively.

Calculate the electric force, $\vec{F}$, on a *300* nC charge located at *(0,6,2)* and the electric field intensity, $\vec{E}$, at that point [$\varepsilon_o = 8.85 \times 10^{-12}$ C/Vm].

c) What is del (∇) operator? Define divergence, laplacian, curl and gradient and by using del operator, provide mathematical expression for cartesian coordinates. 10

State divergence theorem and for a vector electric field, $\vec{A}$,

prove that $\int_v \nabla \bullet \vec{A} dv = \oint_s \vec{A} \bullet d\vec{S}$.

d) In Fig. 1(d), find the force, $\vec{F}$, on a *300*μC charge at *(0,0,3)* m, if four like chages of *35*μC are located on the *x* and *y* axes at ± *4* m. [$\varepsilon_o = 8.85 \times 10^{-12}$ C/Vm]. 4

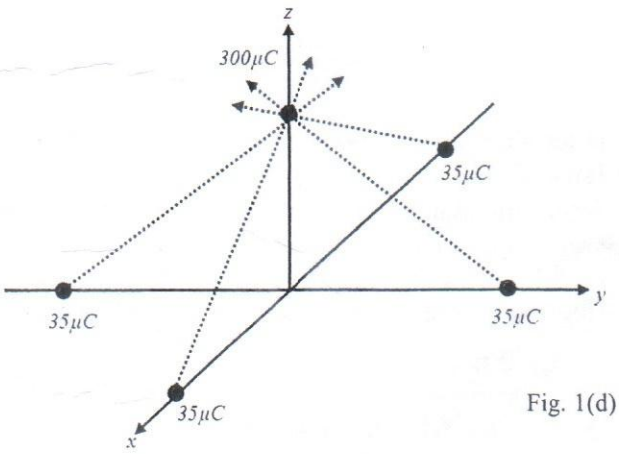


Fig. 1(d)

2. a) In Fig. 2(a), assume that the infinite line charge is aligned along the Z axis symmetrically with respect to the origin. The charge associated with each element length dz is $dQ = \rho_L dz$ and can be treated as point charge. By defining all other terms show that electrice flux density, $\vec{D}$ at point P becomes $\vec{D} = \frac{\rho_L}{2\pi_0 \rho}\hat{a}_\rho$. 10

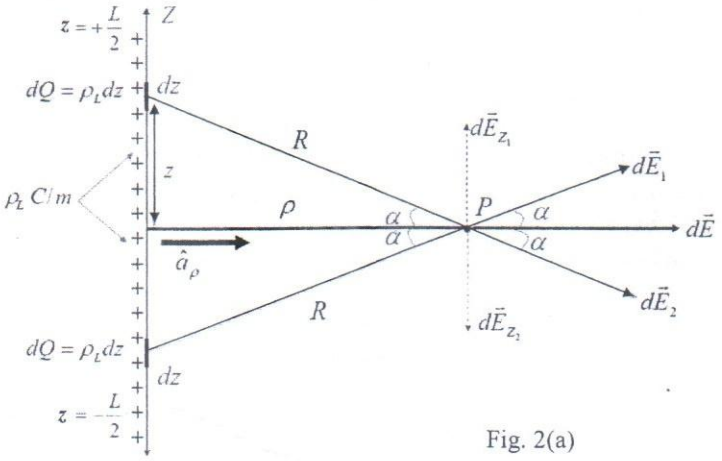


Fig. 2(a)

b) Refer to Fig. 2(b), assume that the infinite sheet charge located in the x-z plan is composed of line charge distributions with charge density $\rho_L = \rho_s dz$. 15
By defining all other terms and making use of equation of electric field intensity of an infinite line charge is $\vec{E} = \frac{\rho_L}{2\pi\varepsilon_0\rho}\hat{a}_\rho$, Show that electric field intensity, $\vec{E}$ at point P becomes $\vec{E} = \frac{\rho_s}{2\varepsilon_0}\hat{a}_y$.

And hence find the electric field intensity, $\vec{E}$ and electrice flux density, $\vec{D}$ between two plates in a parallel plate capacitor.

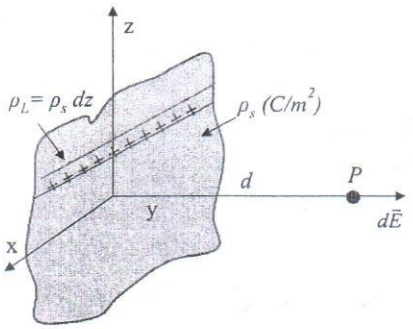


Fig. 2(b)

3. a) Gauss's law is an alternative statement of Coulomb's law which constitutes one of the fundamental laws of electromagnetism. State Gauss's law. 10
How do you determine that a continuous charge distribution has rectangular symmetry or cylindrical symmetry or spherical symmetry?

b) A charge distribution in free space has $\rho_v = 2r$ nC/m^3 for $0 \le r \le 10$ m and zero otherwise. 7
Determine $\vec{E}$ at $r = 2$ m and $r = 12$ m.

c) The finite sheet $0 \le x \le 1$, $0 \le y \le 1$ on the $z = 0$ plane has a charge density $\rho_s = xy(x^2 + y^2 + 25)^{3/2}$. Find 8

i) The total charge on the sheet.
ii) The electric field at (0,0,5).
iii) The force experienced by a -1 mC charge located at (0,0,5).

4. a) How do you obtain differential form of Gauss's law from integral form of Gauss's law? Derive first Maxwell's equation in differential form from differential form of Gauss's law. 8

b) Given that $\vec{D} = z\rho\cos^2\phi\vec{a}_z$ C/m^2, calculate the charge density at (1, π/4, 3) and the total charge enclosed by the cylinder of radius 1 m with $-2 \le z \le 2$ m. 8

c) If $\vec{D} = (2y^2 + z)\vec{a}_x + 4xy\vec{a}_y + x\vec{a}_z$ C/m^2, find 9

i) The volume charge density at (-1, 0 3).

ii) The flux through the cube defined by $0 \le x \le 1$, $0 \le y \le 1$, and $0 \le z \le 1$.

iii) The total charge enclosed by the cube.

B.Sc. Engg. (EE) / HDEE (5th Sem.)
B.Sc. TE (2-Yr) (1st Sem.)

Date: March 20, 2018 (Morning)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid-Semester Examination
Course No.: EEE 4503/EEE 4591
Course Title: Power Electronics

Winter Semester, A. Y. 2017-2018
Time: 90 Minutes
Full Marks: 75

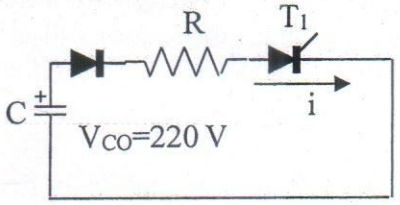
There are **4 (four)** questions. Answer **any 3 (three)** questions. All questions carry equal marks. Marks in the margin indicate full marks. Do not write on this question paper. Assume reasonable value for any missing data and assume that the power devices are ideal.

1.(a) "Power electronic circuits operate more efficiently than linear electronic circuits in converting high electrical power"-Justify the statement. 08

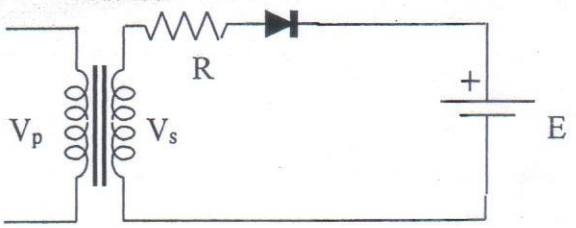
(b) Draw the basic components of a power electronic system and clearly identify the role of the power processor in that system. 08

(c) Draw the reverse recovery characteristic of a semiconductor diode. Find the expression of reverse recovery time t_{rr} and peak of reverse recovery current I_{rr}. If the reverse recovery charge Q_{RR} is given as 135 μC and rate of fall current di/dt is given as 40A/ μs, calculate t_{rr} and I_{rr}. 09

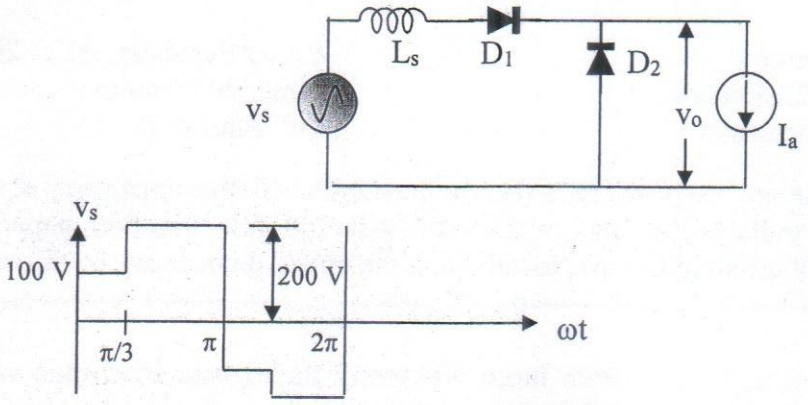
2.(a) In the diode circuit as shown below with R = 220 Ω and C = 100 μF, the thyristor T_1 is fired at t = 0, derive the expression for the voltage across the capacitor and energy lost in the circuit. 07



(b) A battery voltage in the following figure is E = 12 V and its capacity is 100 Wh. The average charging current should be I_{dc} = 5A. The primary input voltage is V_p = 120 V, 50 Hz, and the transformer has a turn ratio of n = 2:1. Calculate (i) the conduction angle of the diode (ii) the current limiting resistance R (iii) the power rating P_R of the resistor R (iv) the charging time h_O in hours (v) the PIV of the diode. 12



(c) Draw (i) the output voltage wave-shape and calculate (ii) the commutation angle (iii) the average output voltage of the following circuit. Following data are given: frequency = 50 Hz, L_s = 5mH, I_a = 10A. 06

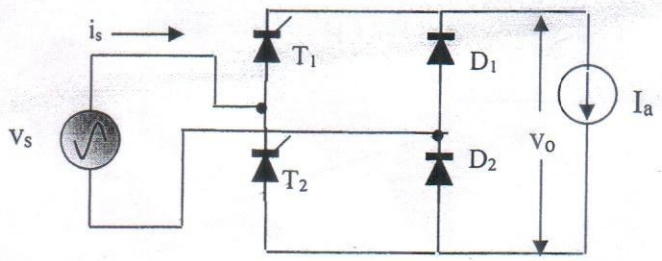


3.(a) Draw a half-wave rectifier circuit with R-L load. Draw the wave-shapes of (i) load current, i_o (ii) output voltage, v_o (iii) voltage across the inductor, v_L and (iv) voltage across the resistor v_R. Also (v) derive the expression of the average value of the output voltage. (vi) if a free-wheeling diode is connected across the load, will there be any change in the wave-shapes of the output voltage and the source current? 15

(b) Draw the circuit diagram of full bridge rectifier with a source inductance of 10 mH. If the rectifier is supplying a load of a highly inductive that carries 10 A current when a sinusoidal voltage of rms value = 230V and frequency 50Hz is applied, (i) draw the wave-shapes of input current, output voltage. and (ii) find the value of commutation angle and output dc voltage. 10

4.(a) Draw the circuit diagram of a three-phase full bridge rectifier with a resistive load. 15
(i) Find the expression of dc output voltage and rms value of diode current.
(ii) Find the rectifier efficiency, Form Factor (FF), Transformer Utilization Factor (TUF)

(b) For the following converter circuit T_1 is fired at $\omega t = \alpha$ and T_2 is fired at $\omega t = \pi+\alpha$, respectively. Identify the devices operating at different regions of one cycle of the input voltage. Also draw the output voltage and input current wave-shapes and find the expression of the average output voltage. 10



B.Sc. Engg.(EE)/ HDEE, 5th Sem 95 Date: March 16, 2018 (Morning)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid-Semester Examination
Course No.: Hum 4521
Course Title: Engineering Management

Winter Semester, A.Y. 2017-2018
Time: 90 Minutes
Full Marks: 75

There are **4 (four)** questions. Answer **any 3 (three)** questions. All questions carry equal marks. Marks in the margin indicate full marks. Programmable calculators are not allowed. Do not write on this question paper.

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1. a) What is management? Explain different levels of management with their functions. (07)

   b) Discuss the role of knowledge leadership and change handler of a manager in an organization. (08)

   c) What are the functions of management? Explain briefly. (10)

2. a) What is organization? Briefly describe four building blocks of an Organization. (10)

   b) What is matrix organizational structure? Dicuss advantages and disadvatages of matrix organization. (09)

   c) Describe Lewin's model of organization development. (06)

3. a) Explain the "Three Circles" technique to develop strategic planning. (06)

   b) What is forecasting? Discuss different types of forecasts by time horizon. (06)

   c) The demand (in MW) for electrical power in a city over the years 2006 - 2012 is given below. Find the Trend Line Equation. Also find the demand at 2013 and 2014. (13)

Year	:	2006	2007	2008	2009	2010	2011	2012
Demand	:	74	79	80	90	105	142	162

4. a) What is staffing? Briefly discuss the staffing process in an organization. (08)

   b) What is job sequencing? Discuss the four steps of Johnson's Rule for sequencing n-jobs in 2 machines. (05)

c) A company is faced with seven tasks that have to be processed through two work centers. (12)
Assume work center I works continuously and that they are using Johnson's rule. Data appear below in hours. Once job is done in work center I it moves to work center II.

Task	Work center I	Work center II
A	2.58	3.47
B	1.66	5.84
C	2.71	2.41
D	5.52	1.99
E	3.38	7.62
F	5.22	1.73
G	2.89	1.11

(i) What is the sequence of tasks ?
(ii) What is the time in hours to complete all the tasks in both work centers ?
(iii) What is the total idle time in hours for work center I ?
(iv) What is the total idle time in hours for work center II ?

B.Sc. Engg. (EE) /HDEE, 5th Sem. Date: March 19, 2018 (Morning)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid-Semester Examination | Winter Semester, A.Y. 2017-2018
Course No.: Math 4521 | Time: 90 Minutes
Course Title: Numerical Methods | Full Marks: 75

There are **4 (four)** questions. Answer **any 3 (three)** questions. All questions carry equal marks. Marks in the margin indicate full marks. Programmable calculators are not allowed. Do not write on this question paper. Consider appropriate approximation for any missing data.

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1. a) Derive general expressions for Runga-Kutta second-order method from Taylor series expansion about a point. 13

   b) From general expressions of Runga-Kutta second-order method, derive (i) Heun's Method, (ii) Ralston's Method, and (iii) Mid-point Method. 3×4=12

2. a) The free-fall portion of a bungee jump system consists of following ordinary differential equations, which are accounted for solving velocity and position for a bungee jumper. 20

$$\frac{dx}{dt} = v$$

$$\frac{dv}{dt} = g - \frac{c_d}{m}v^2$$

   Where, x is the position, v is the velocity, and m is mass of the bungee jumper. Moreover, g is acceleration due to gravity and c_d is drag co-efficient. Now, if at $t = 0$, $x = v = 0$ and $m = 68.1\,kg$, $g = 9.81\,m/s^2$, $c_d = 0.25\,kg/m$, integrate to $t = 6s$ for step size of $3s$ using 4th order Kutta method.

   b) If the analytical solution for position and velocity of bungee jump system of question 2(a) are $x(t) = \frac{m}{c_d}\ln[cosh\left(\sqrt{\frac{gc_d}{m}}\,t\right)]$ and $v(t) = \sqrt{\frac{gm}{c_d}}\,tanh\left(\sqrt{\frac{gc_d}{m}}\,t\right)$, calculate the percentage of relative error for each step of Kutta method for question 2(a). 5

3. Solve the following problem over the interval from x = 0 to 1 using a step size of 0.5 where $y(0) = 1$. Display all your results on the same graph. 5×5=25

$$\frac{dy}{dx} = (1 + 2x)\sqrt{y}\ .$$

   (i) Analytically,
   (ii) Euler Method,
   (iii) Using Ralston's method,
   (iv) Using Heun's Method,
   (v) Using Midpoint Method.

4. a) The growth of populations of organisms has many engineering and scientific applications. One of the simplest models assumes that the rate of change of the population p is proportional to the existing population at any time t: 5

$$\frac{dp}{dt} = k_g p$$

Where, k_g= growth rate. The world population in millions from 1950 through 2000 was :

t	1950	1955	1960	1965	1970	1975
p	2555	2780	3040	3346	3708	4087
t	1980	1985	1990	1995	2000	
p	4454	4850	5276	5686	6079	

Assume the above mentioned equation holds, use the data from 1950 through 1970 to estimate k_g.

b) With the help of RK4 method along with the results of question 4(a), calculate world population from 2000 to 2020 with a step size of 5 years. 20

B.Sc.TE (2-Yr), 1st Sem.
B.Sc. Engg.(EE)/ HDEE, 5th Sem. Date: March 13, 2018(Morning)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid-Semester Examination — Winter Semester, A. Y. 2017-2018
Course No.: EEE 4523 / EEE 4595 — Time: 90 Minutes
Course Title: Switchgear and Protection Equipment -I — Full Marks: 75

There are **4 (four)** questions. Answer **any 3 (three)** questions. All questions carry equal marks. Marks in the margin indicate full marks. Programmable calculators are not allowed. Do not write on this question paper. Symbols preserve their usual meanings.

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1. a) What do you mean protective zones and dead zones? Draw the figure of a typical power system mentioning protective zones for each component. Can dead zone be practically available in a typical power system? Justify your answer. 9

   b) Mention and explain the essential qualities of Protective Relaying. 8

   c) Differentiate between Current Transformer (C.T.) and Potential Transformer (P.T.). Why should not secondary of C.T. be kept open circuited? 8

2. a) Derive the current equation for sudden short circuit in R-L series circuit. Explain the conditions for D.C. component to become maximum and minimum respectively. 16

   b) In a 132 kV transmission system, the phase to ground capacitance is 0.01 μF and inductance is 6 H. Calculate interrupted magnetizing current for voltage of 245 kV appearing across the pole of a circuit breaker. Find the value of resistance to be used across contact space to eliminate the striking voltage transient. 9

3. a) What do you mean by rate of rise of TRV? What are the significant characteristics of TRV? Derive the following equation: 11

$$\text{R. R. R. } V_{max} = 2\pi E_m f_n$$

   where E_m and f_n have their usual meanings.

   b) A 50 Hz sinusoidal voltage of amplitude 400 V is applied to a series circuit of resistance 10 Ω and inductance 0.1 H. Find an expression for the value of current at any instant after the voltage is applied, assuming voltage is zero at the instant of application. Calculate the value of transient current at 0.02 seconds after switching on. 10

   c) Explain rated short circuit making current and rated short circuit breaking current of circuit breakers. 4

4 a) What do you mean by an arc extinction? Explain the high resistance arc interruption methods. 8

   b) Explain Slepian's theory of arc interruption. What were the drawbacks of this theory? State the assumptions of Cassie's theory and explain how it described arc interruption successfully. 9

   c) Explain the construction and working principle of Air-Break Circuit Breaker. 8

100

B.Sc. Engg.(EE)/ HDEE, 5th Sem — Date: March 14, 2018 (Morning)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid-Semester Examination — Winter Semester, A.Y. 2017-2018
Course No.: EEE 4531 — Time: 90 Minutes
Course Title: Energy Conversion III — Full Marks: 75

There are **4 (four)** questions. Answer **any 3 (three)** questions. All questions carry equal marks. Marks in the margin indicate full marks. Programmable calculators are not allowed. Do not write on this question paper. Symbols preserve their usual meanings.

1. a) What is energy? How many energy conversion processes are there? Explain with examples. Briefly discuss four non-conventional energy sources. 13

   b) Describe Faraday's law of electromagnetic induction. With proper circuit diagram, find out the dynamic equation of singly excited electromechanical system. 12

2. a) Draw the e-q curve of a simple charged capacitor and point out energy and co-energy and write the corresponding integral equations. Show that $W_{fld} = W'_{fld} = \frac{1}{2}Ce^2$ for energy in electrostatic field. 15

   b) What is a back emf ? The armature winding of a 200 V, 4-pole, series motor is lap-connected. There are 280 slots and each slot has 4 conductors. The current is 45 A and the flux per pole is 18 mWb. The field and armature resistances are $0.3\,\Omega$ and $0.5\,\Omega$ respectively. The iron and friction loss is 800 W. The pulley diameter is 0.41 m. Find the pull in newton at the rim of pulley. 10

3. a) Define self and mutual inductance. Show that the expression of energy in a doubly excited magnetic system is $W_{fld} = \frac{1}{2}L_{11}i_1^2 + \frac{1}{2}L_{22}i_2^2 + L_{12}i_1i_2$. 15

   b) What is speed regulation? A 200 V DC shunt motor takes 4 A at no-load when running at 700 r.p.m. The field resistance is 100 Ω.The resistance of armature at standstill gives a drop of 6 volts across armature terminals when 10 A was passed through it. Calculate (a) Speed on load (b) torque in N-m (c) efficiency. The normal input of the motor is 8 kW. 10

4. a) What is a solar cell? Draw the structure of a solar cell and briefly describe all the parts of it. How much power will be generated if the solar cell is 16% efficient, the size is 12cm×12cm and solar radiation is 1000 W/m^2. 10

   b) Draw solar cell, module and array and differentiate among them. What is EVA film? Why is it used in solar cell? Discuss all the properties of EVA film. 15

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid-Semester Examination — Winter Semester, A. Y. 2017-2018
Course No.: EEE 4541 — Time: 90 Minutes
Course Title: Wireless Communication — Full Marks: 75

There are **4 (four)** questions. Answer **any 3 (three)** questions. All questions carry equal marks. Marks in the margin indicate full marks. Programmable calculators are not allowed. Do not write on this question paper.

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1. a) Why is modulation performed in wireless communication? What is the bandwidth of FM radio broadcast? 5

   b) Mention which technologies are known as 3.75G for 3GPP and 3GPP2. Which technology did first support very high data rate in uplink in 3GPP2? 4

   c) Define elliptical polarization. Explain how the polarization alignment is managed for mobile phones. 4

   d) Compare circuit switching (CS) and packet switching (PS) in terms of advantages and disadvantages? Which one is getting obsolete and why? 6

   e) Show that for plane wave, the wave number, $k = 2\pi/\lambda$ where λ is wavelength. 6

2. a) State the theorem of Shannon's capacity. Explain how the practical data rate is related to this theorem. Then comment on what may be the possible ways to improve the practical data rate. 6

   b) Explain how a large IP packet is sent over Ethernet. How does IP address help in routing packets? 6

   c) How long is the IP address in IPv6 and why is it needed to be so long? Justify this statement, 'for x bits long IP address, all 2^x number of IP addresses cannot be used'. 6

   d) An electromagnetic wave with frequency 6 GHz has the magnetic field intensity at the receiving antenna, 0.1 Amp/meter in air. The gain of the receiving antenna is 100. Determine the power received by the receiving antenna. 7

3. a) How does a GEO satellites maintain its same location in the sky? How many satellites are used in GPS system? Mention how many satellites are required to be visible for the GPS receiver to work and give reasons for this number. Also, mention the minimum and maximum number of GPS satellites that should be visible at any moment. 8

   b) Reshaping an antenna, its gain has been increased. Mention whether each of these parameters will increase or decrease: physical size of the antenna, directivity, HPBW, effective aperture. 4

   c) Among different types of wireless and wired communication options, which one is usually preferable as the last mile solution? Mention an agreement that Tier 1 ISPs use among themselves. 4

d) Mention which one between International Terrestrial Cable (ITC) and submarine cable has a larger share of internet traffic in Bangladesh. Give reasons. 4

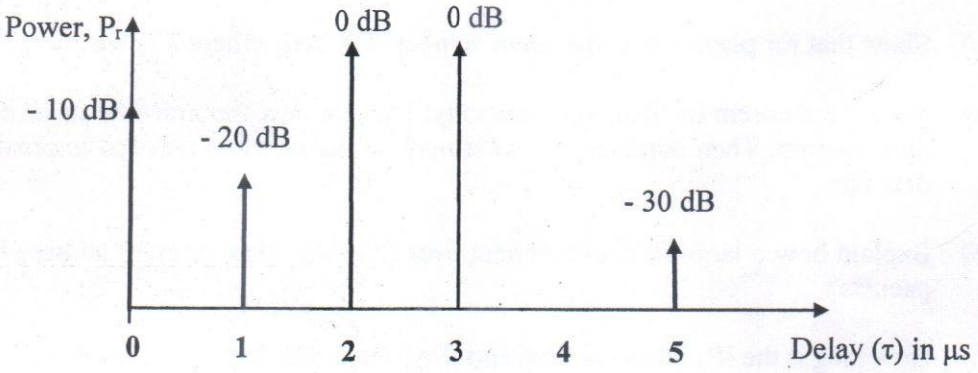
e) What is spectral efficiency? The experience of delay in speech during international voice calls is now less than what it was two decades ago. Explain how the delay has improved recently. 5

4. a) What is backhaul in cellular network? Write down the names of the basic properties of electromagnetic wave that make non-LOS communication possible. Mention whether uplink or downlink communication uses lower frequency band for satellite communication and write down its reason. What will be the maximum frequency supported by 5G cellular communication? 10

b) There are a lot of trees in an area. Write down if the coherence time will increase or decrease if the airflow increases. 3

c) How does a rake receiver improve SNR? Calculate the minimum symbol period of data transmission for the following multipath profile, which can offer flat fading. Also, determine whether this multipath profile would offer flat fading or frequency selective fading for the following technologies. 12

i. GSM (200 kHz channels)
ii. UMTS (5 MHz channels)
iii. LTE (15 kHz channels)
iv. CDMA 2000 (1.25 MHz channels)



B.Sc. TE. (2-Yr), 1st Sem. Date: March 19, 2018 (Morning)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid Semester Examination — Winter Semester, A. Y. 2017-2018
Course No.: EEE 4597 — Time: 90 Minutes
Course Title: Telecommunication Principles — Full Marks: 75

There are **4 (four)** questions. Answer **any 3 (three)** questions. All questions carry equal marks. Marks in the margin indicate full marks. Programmable calculators are not allowed. Do not write on this question paper. All symbols bear their usual meanings. Assume reasonable values for missing data.

---

1. a) What is the difference between SNR and dynamic range? What happens if $V_s = V_n$, $V_s >> V_n$ and $V_s < V_n$ in the equation $SNR = 20 \log_{10}(V_s/V_n)$? 4+6

   b) Show that multiplication of a signal g(t) by a sinusoid of frequency ω_c shifts the spectrum $G(\omega)$ by $\pm\omega_c$. 9

   c) Explain energy and power spectral density. 3+3

2. a) Mention the properties of auto-correlation of a periodic signal. 5

   b) Describe different ways of expressing bandwidth of digital data? Mention the bandwidth dilemma of digital communication system. 8+4

   c) A scheme for coherent demodulation is shown in Fig. 2(c). Show that this scheme can demodulate the AM signal $[A+ m(t)]\cos \omega_c t$ regardless of the value of A,where m(t) is the message signal. 8

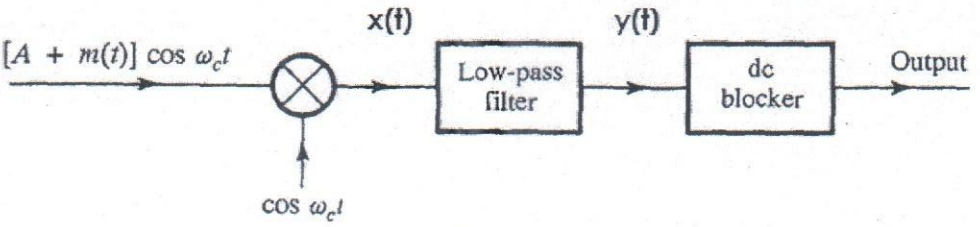


Fig. 2(c)

3. a) What is double sideband supressped carrier (DSB-SC) modulation? How can we recover the baseband signal from the modulated signal in this case? Why is this process also known as coherence detection? 4+13

   b) Explain the process of frequency mixing. Define up and down conversions. 8

4. a) Define and explain nonlinear modulation in detail. Why is it also called a single balanced modulator? 7+3

   b) Why are the single sideband (SSB) modulated outputs known as suppressed carrier signals? How can you improve the spectral efficiency of amplitude modulation? 7

   c) Explain the phase shift method of generation of SSB signal 8

B.Sc. Engg. (EE) 7th Sem/
B.Sc.TE (2Yr) 3rd Sem/ B.Sc.TE (1 Yr) 1st Sem.

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March 13, 2018 (Afternoon)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid-Semester Examination — Winter Semester, A. Y. 2017-2018
Course No.: EEE 4705/ EEE 4791 — Time: 90 Minutes
Course Title: Control System Engineering — Full Marks: 75

There are **4 (four)** questions. Answer **any 3 (three)** questions. All questions carry equal marks. Marks in the margin indicate full marks. Programmable calculators are not allowed. Do not write on this question paper. Assume suitable value for missing data.

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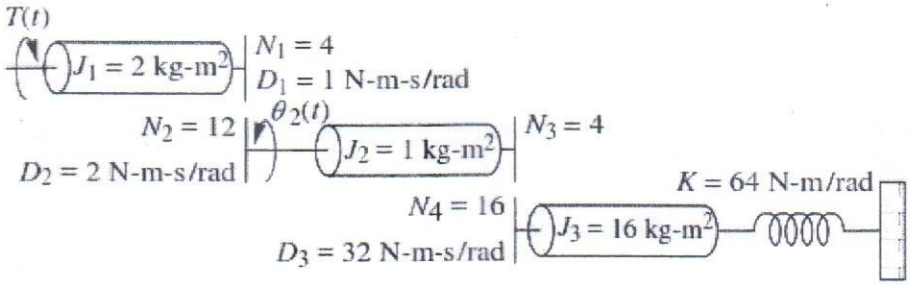
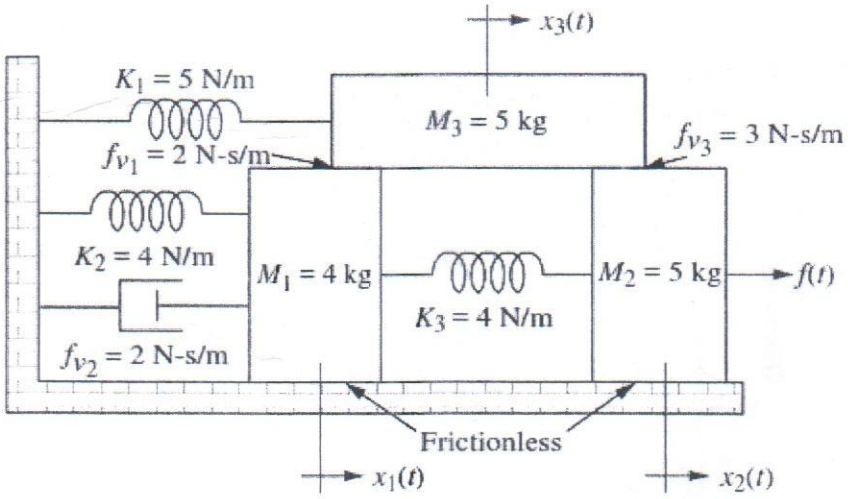
1. a) Define control system. Mention the advantages of a control system. [1+2]

   b) Mention different test waveforms used in control systems. Why Laplace and inverse Laplace transformation is preferred in control system? [4+1]

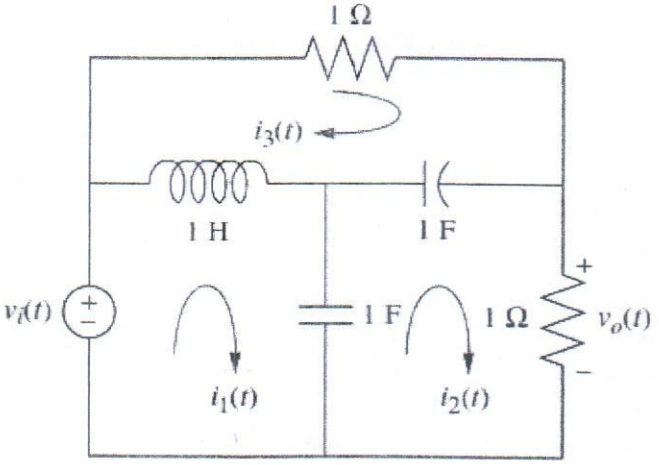
   c) For the rotational system shown in the following figure, find the transfer function, $G(s) = \theta_2(s)/T(s)$. [12]



   d) Write the equations of motion for the translational mechanical system in the following diagram. (Solution is not necessary) [5]



2. a) Find the state-space representation of the network shown in the following figure if the output is $v_o(t)$. [10]

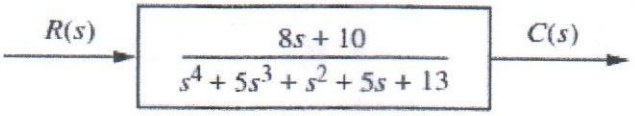


b) Find the transfer function $G(s) = Y(s)/R(s)$ for the following system represented in state space: [9]

$$\dot{X} = \begin{bmatrix} 3 & -5 & 2 \\ 1 & -8 & 7 \\ -3 & -6 & 2 \end{bmatrix} X + \begin{bmatrix} 0 \\ -3 \\ 0 \end{bmatrix} r$$

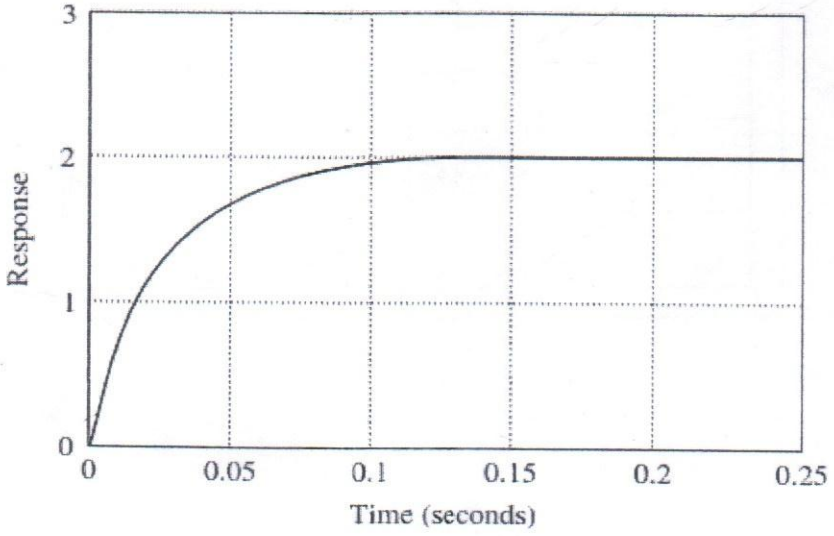
$$y = \begin{bmatrix} 0 & -4 & 0 \end{bmatrix} X$$

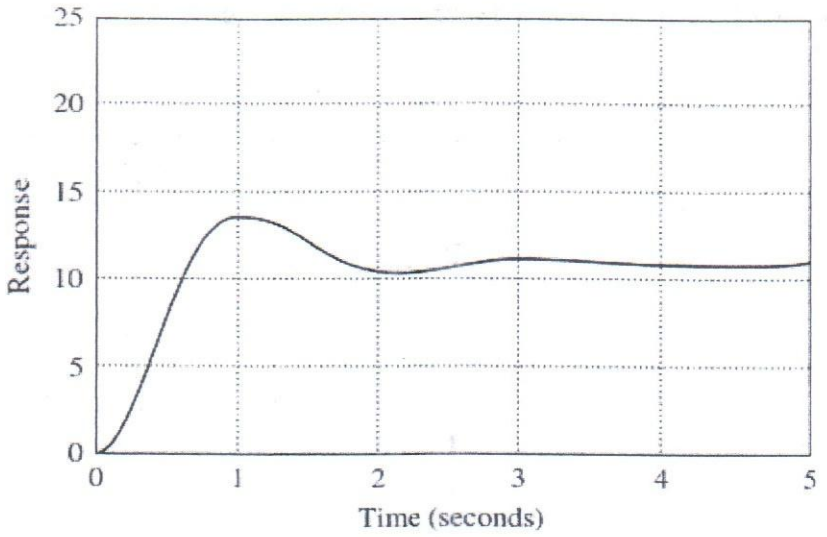
c) For the system shown in the following figure, write the state equations and the output equation for the phase-variable representation. [6]



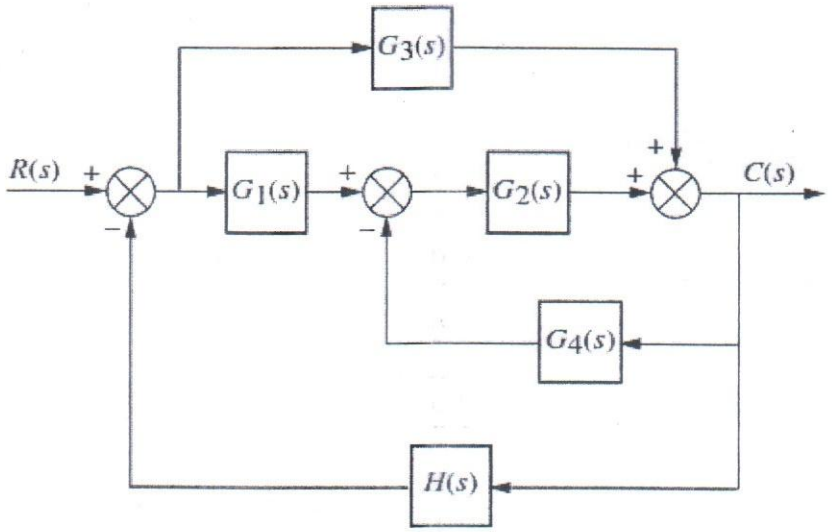
3 a) For a generalized second order equation in underdamped condition, derive the solution and hence find the expressions for peak time, %OS and settling time. [15]

b) For each of the two unit step responses shown in the following figures, find the transfer functions of the systems. [3+7]



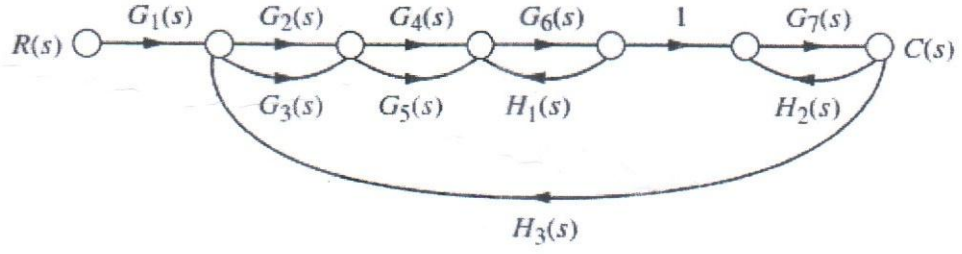


4. a) Reduce the block diagram in the following figure to a single transfer function, $T(s)=C(s)/R(s)$. [8]



b) Convert the block diagram of the figure of question 4.a) into a signal flow diagram. [5]

c) Use Mason's rule to find the transfer function $T(s)=C(s)/R(s)$ for the system represented in the following figure. [12]



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B.Sc. Engg. (EE), 7th Sem. Date: March 15, 2018 (Afternoon)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid-Semester Examination — Winter Semester, A.Y. 2017-2018
Course No.: EEE 4729 — Time: 90 Minutes
Course Title: Discrete Mathematics and Numerical Analysis — Full Marks: 75

There are **4 (four)** questions. Answer **any 3 (three)** questions. All questions carry equal marks. Marks in the margin indicate full marks. Programmable calculators are not allowed. Do not write on this question paper. Make necessary assumptions if any.

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1. a) Figure 1 (a) represents a distributive lattice. Expand the lattice up to Layer 7. 15

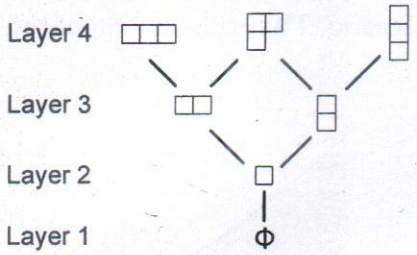


Figure: 1 (a)

b) Find out whether the following figures are lattice or not? Justify your answer. 10
Find out the least, greatest, maximal, minimal elements.

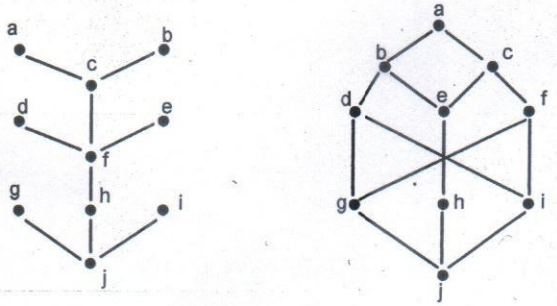


Figure: 1 (b)

2. a) Write a pseudo code of factorial of a number. And find the time function for the algorithm. Consider the machine configuration as defined in Figure: 2 (a) 10

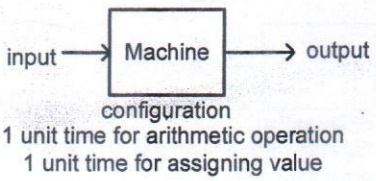


Figure: 2 (a)

b) The addition of the integer numbers from 1 to 100 can be written using the following Matlab codes: 15

I)
```
Sum = 0;
  for i = 1:100
    Sum = Sum + i;
  End
  Sum
```

II) sum(1:100)

sum (A) returns the sum of the elements of A along the first array dimension whose size does not equal 1.

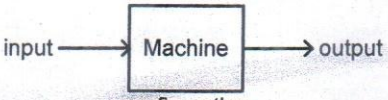
Find the time function for each of the code and compare them time vs. input size graph and obtain the best algorithm based on time consumption. Consider the machine configuration as defined in Figure: 3

3. a) For the MATLAB code given below find out the total time of execution considering the worst case scenario. The configuration of the machine is given on Figure: 3 25

```
for k = 1:100
  for j = 1:100
    x = X(j);
    t = T(k);

    if (j == 1) && (k == 1)
      U(j,k) = (p(t) + f(x))/2;
    elseif ( j==length(X) ) && ( k==1 )
      U(j,k) = ( f(x)+q(t) )/2;
    elseif j == 1
      U(j,k) = p(t);
    elseif j == length(X)
      U(j,k) = q(t);
    elseif k == 1
      U(j,k) = f(x);
    else

      U(j,k) = r*U(j-1,k-1) + (1-2*r)*U(j,k-1) + r*U(j+1,k-1);
    end
  end
end
```



configuration
1 unit time for arithmetic operation
1 unit time for assigning value
Intel® Core™ i5-4570 CPU
@3.20GHZ

Figure: 3

4. a) A small nation issues license plate consists of just one number (selected from the digits 0 through 9, inclusive) and four letters (selected from A-Z), repeats are permitted. However there is one four letter combination that is not allowed to appear on the license plate. How many allowable license plate combinations exist? 12

Our genetic material, DNA, is formed from a 4 letter "alphabet" of bases: A, T, G, C (adenine, thymine, guanine, and cytosine). The order in which the letters are arranged is important, but because a molecule can move, there is no difference between a sequence and the same sequence reversed. For example, the sequence of base 7 (A, A, T, A, G, A, T) is the same as the sequence (T, A, G, A, T, A, A). How many distinct DNA sequences of 6 bases are there? If you could write one sequence in a second how long will it take to write all the sequences of base 6? 13

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B.Sc. Engg.(EE), 7th Sem./
B.Sc.TE. 1st Sem. (1 Yr)/ B.Sc.TE. 3rd Sem. (2 Yr)

Date: March 15, 2018 (Afternoon)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid-Semester Examination
Course No.: EEE 4739/ EEE 4795
Course Title: Microwave Engineering

Winter Semester, A. Y. 2017-2018
Time: 90 Minutes
Full Marks: 75

There are **4 (four)** questions. Answer **any 3 (three)** questions. All questions carry equal marks. Marks in the margin indicate full marks. Programmable calculators are not allowed. Do not write on this question paper.

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1. a) Derive the following expressions for voltage v and current i on an ideal transmission line with characteristic impedance, Z_0 and phase velocity, v_p. 13

$$v(z,t) = f_1\left(t - \frac{z}{v_p}\right) + f_2\left(t + \frac{z}{v_p}\right)$$

$$i(z,t) = \frac{1}{Z_0}\left[f_1\left(t - \frac{z}{v_p}\right) - f_2\left(t + \frac{z}{v_p}\right)\right].$$

b) A transmission line has characteristic impedance 50 Ω. The wavelength becomes 12.5 cm at frequency 2 GHz for the transmission line. Determine the equivalent inductance and capacitance per unit length for the transmission line. 12

2. a) An ideal transmission line with characteristic impedance, $Z_O = \frac{1}{Y_o}$ and phase constant β is connected to the load impedance, $Z_L = \frac{1}{Y_L}$. Show that the input admittance, Y_i at a distance l away from the load is given as follows. 12

$$Y_i = Y_O \frac{Y_L \cos\beta l + j\, Y_o sin\beta l}{Y_o \cos\beta l + j\, Y_L sin\beta l}$$

b) The maximum impedance on the transmission line is 100 Ω and the second maximum impedance point is located 6.5 cm away from the load. The minimum impedance on the line is 25 Ω and the third minimum impedance point is located 8.5 cm away from the load. The incident voltage is $V_+ = 5\angle 0^0$ V at the point of load. Determine both reflected voltage and reflected current at the point, which is 12 cm away from the load. 13

3. a) Show that the propagation constant, $\gamma = \sqrt{(R + j\omega L)(G + j\omega C)} = \alpha + j\beta$, where $V(z) = Ve^{-\gamma z}$ represents the voltage wave equation for lossy transmission line. Mention the significance of the attenuation constant, α. 8

b) A transmission line is connected to the load $Z_L = 40 - j30\ \Omega$. The line has characteristic impedance $Z_0 = 50\ \Omega$. The operating frequency is 6 GHz. The maximum voltage amplitude on the line is 10 V. Determine: 17

i) input impedance at a point 2 cm away from the load,
ii) insertion loss (IL) at the point of the load,
iii) the minimum current amplitude on the line and
iv) the shortest distance from the load in cm for which the impedance is purely resistive.

4. a) What is the usual frequency range that microwave engineers work with? Draw the configuration of a stripline. 4

b) Explain why computer simulations are performed to check the variation of return loss around the design frequency. 4

c) Prove the following relationship for a transmission line. 7

$$\frac{V_{max}}{I_{max}} = \frac{V_{min}}{I_{min}} = Z_0$$

d) The S parameters of a two-port network are $S_{11} = 0.8\angle -90^0$, $S_{21} = 5.1\angle 80^0$, $S_{12} = 0.3\angle 70^0$ and $S_{22} = 0.62\angle -40^0$. The voltage signal entering port 1 is $V^+_1 = 10\angle 0^0$ V and the voltage signal entering port 2 is $V^+_2 = 5\angle 30^0$ V. Determine the voltage signal leaving port 2. 10

Student No.:

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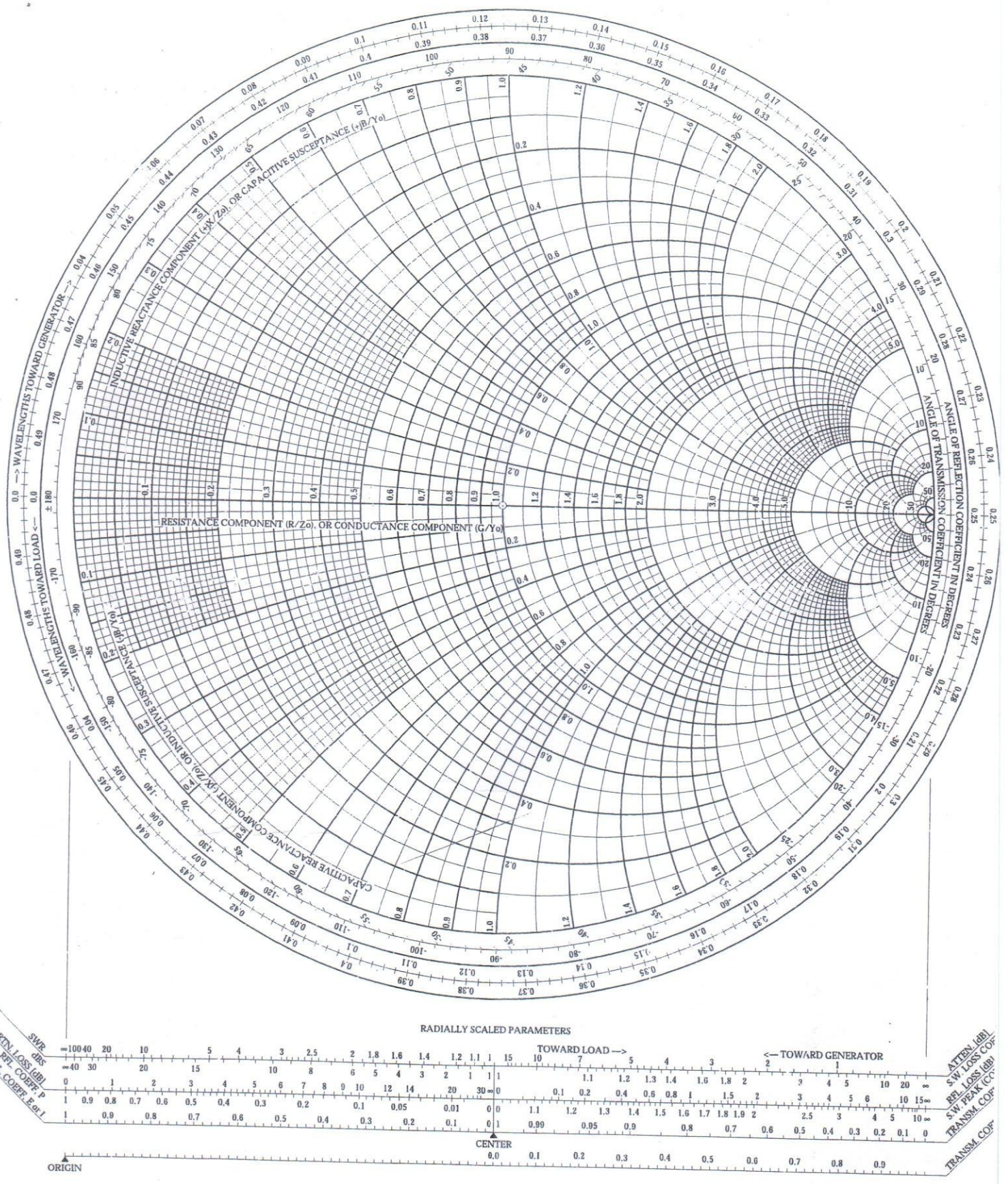

Student No.:

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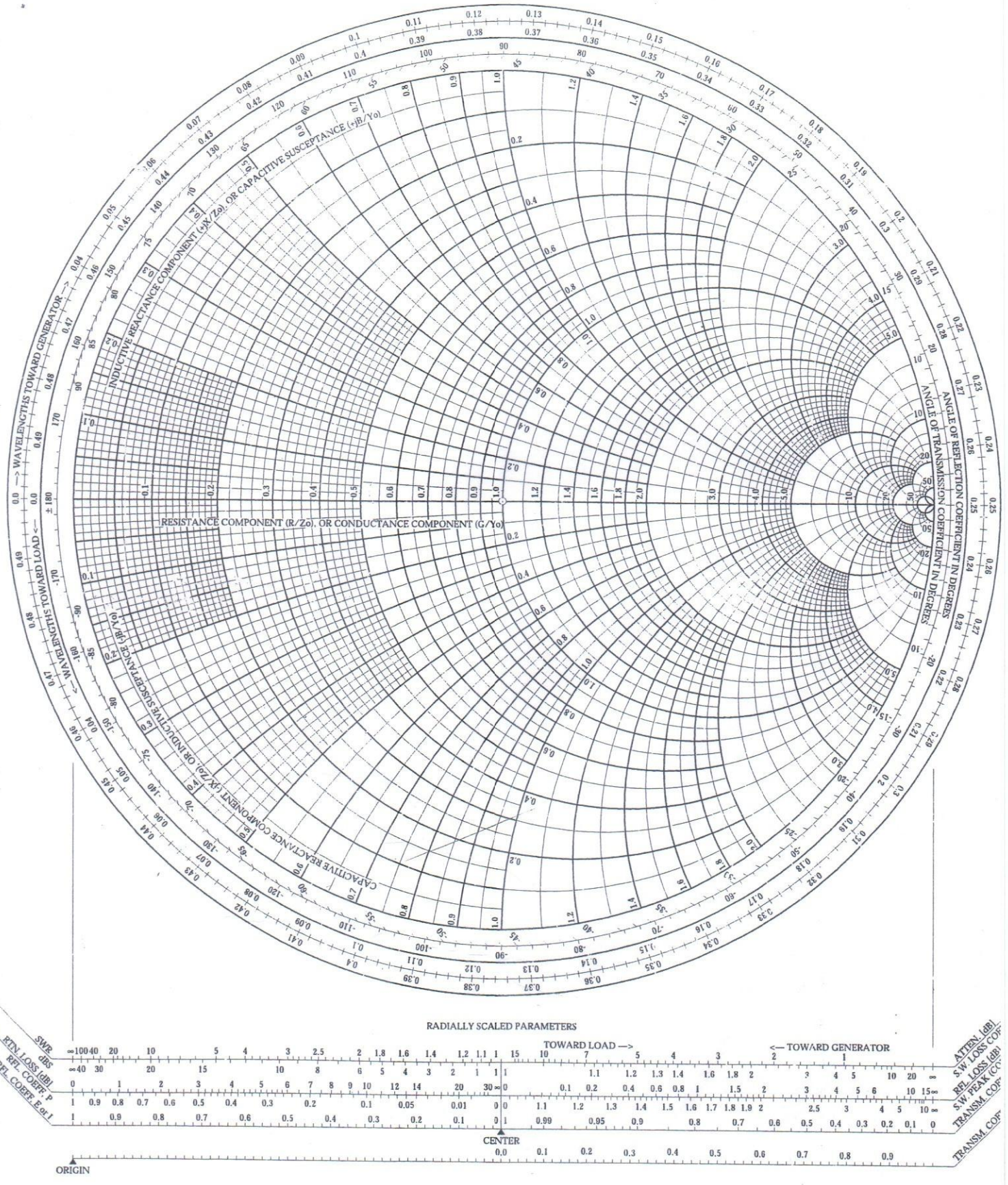

B. Sc. Engg.(EE), 7th Sem. 114 Date: March 19, 2018 (Afternoon)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid-Semester Examination
Course No.: EEE 4741
Course Title: Digital Signal Processing

Winter Semester, A.Y. 2017-2018
Time: 90 Minutes
Full Marks: 75

There are **4 (four)** questions. Answer **any 3 (three)** questions. All questions carry equal marks. Marks in the margin indicate full marks. Programmable calculators are not allowed. Do not write on this question paper. Symbols preserve their usual meaning.

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1. a) If an analog signal contains 90 kHz to 15 kHz frequency components, choose a suitable sampling frequency and present the signal in the relative frequency domain with approximation. Assume, lower frequency components have lower amplitude. 13

   b) If a discrete time signal can be presented by a frequency $\omega = 3\pi/2$, what would be the continues time signal frequency after retrieving back the signal to the analog domain? Assume that the sampling frequency is 2 kHz. 12

2. a) The input sequence of a system is given as: 12

$$x(n) = \{1, \underset{\uparrow}{2}, 1\}.$$

   Determine the impulse response of the system for the following response:

$$y(n) = \{-1, 0, \underset{\uparrow}{2}\}.$$

   b) Determine the output $y(n)$ of a relaxed LTI system with impulse response, 13

$$h(n) = b^n \mathrm{u(n)}, \text{where } |b| < 1,$$

   when the input is a unit step sequence.

3. a) By graphical representation determine the time-varying property (Time-variant or Time-invariant) of the following system: 13

$$y(n) = 0.6\, x(-2n).$$

   b) With a proper example show that a non-recursive system can be converted to a recursive system. What is the main advantage to use a recursive system? 12

4. a) Find the total response of the system described by the difference equation: 18

$$y(n) - 1.5y(n-1) + 0.5y(n-2) = x(n), \quad \textit{where } y(-1) = 1, \quad y(-2) = 0.$$

   b) Using appropriate diagram show that, the period of a discrete signal largely depends on the sampling frequency. 07

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
THE ORGANISATION OF THE ISLAMIC CONFERENCE (OIC)

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid-Semester Examination
Course No.: EEE 6193
Course Title: Electric and Magnetic Properties of Materials

Winter Semester, A.Y. 2017-2018
Time : 90 Minutes
Full Marks : 75

There are **4 (four)** questions. Answer **any 3 (three)**. Marks for each part of the questions are indicated on the right margin. Symbols have their usual meanings. Programmable calculators are not allowed. Do not write on this question paper.

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1. a) Derive the equation of electron energies in Bohr atomic orbits. Using the derived equation calculate the frequency of the emitted electromagnetic wave when an electron makes a transition from second excited state to ground state. Permittivity of free space, $\varepsilon_0 = 8.854 \times 10^{-12}$ farad m^{-1}; Planck's constant, $h = 6.62 \times 10^{-34}$ joule-sec; electron mass, $m = 9.1 \times 10^{-31}$ kg; electronic charge, $e = 1.6 \times 10^{-19}$ Coulomb. 12+5

   b) According to the wave mechanics theory how do the quantum numbers originate? What are the things determined by different quantum numbers? 2+6

2. a) Two lattice planes cut the axes as following : 8
   i) $x = ½$, $y = ⅓$ and $z = 2$,
   ii) $x = ⅞$, parallel to both y and z axes.
   Find out the Miller indices of the planes.

   b) Two atoms are being brought together and the energy of one atom in the field of another is given by $W(r) = -\alpha/r^n + \beta/r^m$ where symbols carry their usual meanings. Derive the expression of the distance between two atoms so that the atoms may form a bond. Use appropriate figure. Also derive the relation between m and n. 6+4

   c) Define monocrystalline, multicrystalline and amorphous materials. What do you understand by space lattice? 6+1

3. a) What is a unit cell of a crystal? Describe different crystal systems with example. 2+14

   b) Describe the Bravais space lattices for cubic crystal system using appropriate figures. 6

   c) What do you understand by de Broglie waves? 3

4. a) What is wave function of a body? What properties a wave function must have to represent a real body? 3+3

   b) Write down the time dependant and steady-state forms of Schrödinger wave equation in three dimensions. 3+3

   c) The wave function of certain particle is $\psi_n = \sqrt{\frac{2}{L}} \sin \frac{n\pi x}{L}$ for $0 \le x \le L$. Find out the probability of finding the particle between $x = 0.45L$ and $x = 0.55L$ for ground state. 6

   d) A particle having energy E is striking an energy barrier of height V where V is finite but V>E. Explain how, according to quantum mechanics, the particle can pass through the barrier. 7

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M.Sc. Engg. (EE) / PhD (EE) Date: March 14, 2018 (Afternoon)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid-Semester Examination
Course No.: EEE 6407
Course Title: Digital Communication

Winter Semester, A. Y. 2017-2018
Time: 90 Minutes
Full Marks: 75

There are **4 (four)** questions. Answer **any 3 (three)** questions. All questions carry equal marks. Marks in the margin indicate full marks. Programmable calculators are not allowed. Do not write on this question paper.

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1. a) Classify the following signals as energy signals or power signals. Find the normalized energy or normalized power of each. 15

i) $x(t) = A\cos 2\pi f_0 t \quad \text{for } -\infty < t < \infty$

ii) $x(t) = \begin{cases} A\cos 2\pi f_0 t & \text{for } -\frac{T_0}{2} \le t \le \frac{T_0}{2}, \text{where } T_0 = 1/f \\ 0 & \text{elsewhere} \end{cases}$

iii) $x(t) = \begin{cases} A\exp(-at) & \text{for } t > 0, a > 0 \\ 0 & \text{elsewhere} \end{cases}$

iv) $x(t) = \cos t + 5\cos 2t \quad \text{for } -\infty < t < \infty$

b) Determine which, if any, of the following functions have the properties of power spectral density functions. Justify your determination. 10

i) $X(f) = \delta(f) + \cos^2 2\pi f$
ii) $X(f) = 10 + \delta(f - 10)$
iii) $X(f) = \exp(-2\pi|f - 10|)$
iv) $X(f) = \exp[-2\pi(f^2 - 10)]$

2. a) Explain uniform and non uniform quantization. Which kind of quantization is used for speech communication? Explain in details. What is Aliasing? Which one is better: pre filtering or post filtering? 13

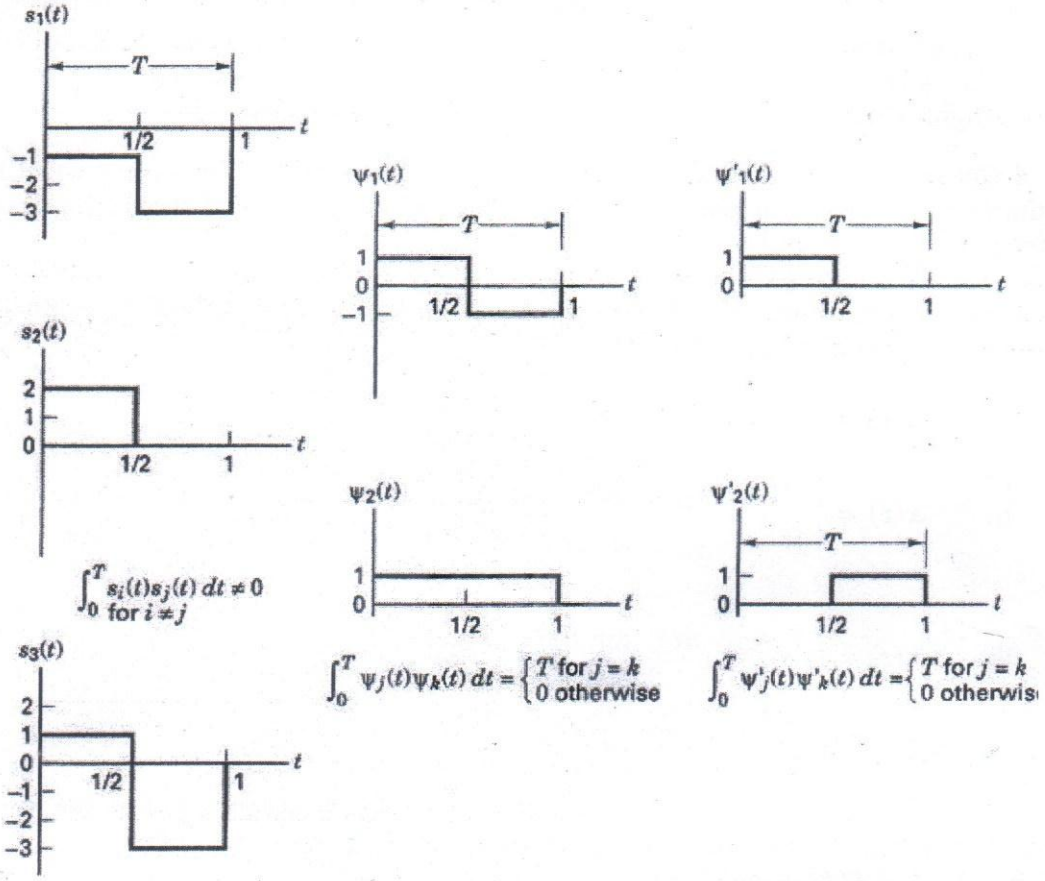
b) In the compact disc (CD) digital audio system, an analog signal is digitized so that the ratio of the peak-signal power to the peak-quantization noise power is at least 96 dB. The sampling rate is 44.1 kilo samples/s. 12

(i) How many quantization levels of the analog signal are needed for $(S/N_q)_{peak} = 96\,dB$?
(ii) How many bits per sample are needed for the number of levels found in part (i)?
(iii) What is the data rate in bits/s?

3. a) What is correlative coding? Explain Duobinary Coding and Decoding with a demonstration. Also explain precoding with an Illustration. 15

3a

b) In the following figure, it shows a set of three waveforms $s_1(t)$, $s_2(t)$ and $s_3(t)$. Demonstrate that these waveforms do not form an orthogonal set. How can these non orthogonal sets be expressed as a linear combination of $\Psi_1(t)$ and $\Psi_2(t)$? Do the same procedure for $\Psi_1'(t)$ and $\Psi_2'(t)$. 10



4. a) Derive the impulse response of a matched filter that produces the maximum output signal to noise ratio. Explain the correlation realization of a matched filter. 15

b) The analog signal recovered from the sampled, quantized, and transmitted pulses will contain corruption from several sources. Explain different corruptions. 10

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M.Sc. Engg.(EE) /PhD(EE) Date: March 19, 2018(Afternoon)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid-Semester Examination
Course No.: EEE 6607
Course Title: Computational Electromagnetics

Winter Semester, A. Y. 2017-2018
Time: 90 Minutes
Full Marks:75

There are **4 (Four)** questions. Answer **any 3 (three)** questions. All questions carry equal marks. Marks in the margin indicate full marks. Programmable calculators are not allowed. Do not write on this question paper.

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1. a) How are electromagnetic (EM) problems classified using the characteristics of their mathematical model? What are the most common analytical methods generally used to solve EM problems? Are the analytical method adequate to solve all types of EM problems? Justify your answer. 5

   b) What are the advantages of using computational methods in EM? List some common computational methods used to solve EM problems. 10

   c) What are meant by accuracy and stability of numerical methods? Give a conceptual analysis on the selection of step sizes to obtain a desirable numerical solution of an EM problem. 10

2. a) Describe the general method of separation of variable technique in solving an elliptic type EM problem in rectangular coordinates. 10

   b) A boundary value elliptic type EM problem with Dirichlet type boundary condition as shown in Fig. 2(b) is described as follows; 15

$$\nabla^2 V = 0: \qquad 0 < x < a, \qquad 0 < y < b$$
$$V(x,0) = 0, \qquad V(x,b) = 0: \qquad 0<x<a$$
$$V(0,y) = 0, \qquad V(a,y) = f(y): \qquad 0<y<b$$

Find the general solution for $V(x,y)$. Considering $f(y) = 10.0\,\text{V}$, find $V(1.0\text{ cm}, 0.5\text{ cm})$. Use the first three non-zero rectangular harmonics.

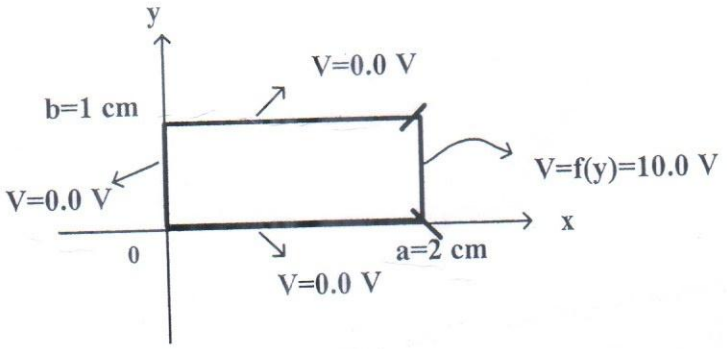

Fig. 2(b).

3. a) Derive the finite difference (FD) scheme for a three dimensional elliptic type EM problem with specified boundary condition. What are the possible numerical methods to solve the resulting FD equations? Mention their relative advantages and disadvantages. 12

b) Using the FD schemes derived in 3(a), find $V(1.0\text{ cm}, 0.5\text{ cm})$ in problem 2(b) and verify the result. 13

4. a) Derive the explicit FD scheme for the one dimensional parabolic type EM problem defined as, 15

$$k\frac{\partial \varphi}{dt} = \frac{\partial^2 \varphi}{\partial x^2}.$$

What is the most serious pitfall of this type of FD scheme. How can it be mitigated by Crank-Nicholson implicit scheme?

b) Using Von-Neumann spectral method find the stability condition of the explicit type FD scheme derived in 4(a). 10

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M.Sc. Engg. /Ph.D. (EE) Date: 16 March, 2018 (Afternoon)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid-Semester Examination
Course No.: EEE 6801
Course Title: Power Electronics

Winter Semester, A. Y. 2017-208
Time: 90 Minutes
Full Marks: 75

There are **4 (four)** questions. Answer **any 3 (three)** questions. All questions carry equal marks. Programmable calculators are not allowed. Do not write on this question paper.

1.(a) "The power electronics revolution is giving the ability to shape and control large amounts of power with ever-increasing efficiency". With reference to this statement, briefly explain how the power crisis in Bangladesh can be improved by proper use of the power electronic systems.

(b)

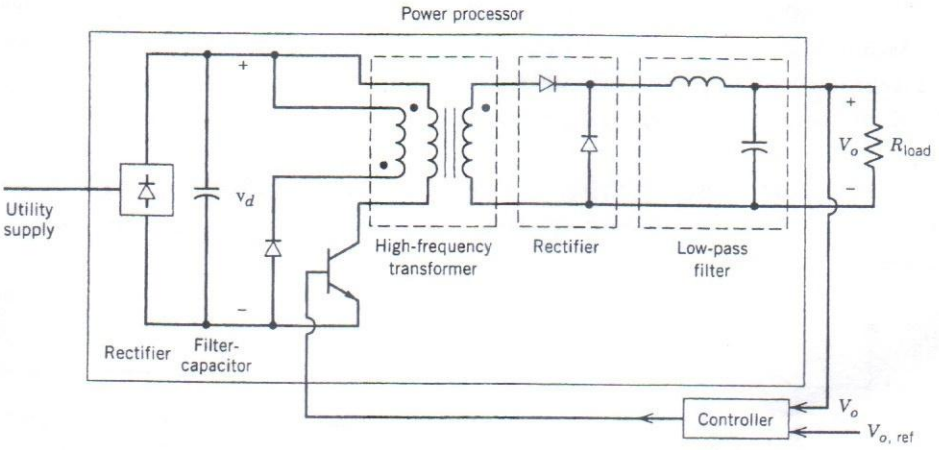


Figure 1(b)

The Figure 1(b) demonstrates the use of power electronic system for SMPS. Clearly identify the advantage of using power electronic rather than linear electronic systems for the above SMPS.

(c) Consider a linear regulated power supply as shown in the Figure 1.(c). The instantaneous input voltage corresponding to the lowest waveform in Figure 1.(c), where $V_{d,\,min} = 20$ V and $V_{d,max} = 30$ V. Approximate this waveform by a triangular wave consisting of two linear segments between the above two values. Let $V_O = 15$ V and assume the output load is constant. Calculate the energy efficiency in this part of the power supply due to losses in the transistor.

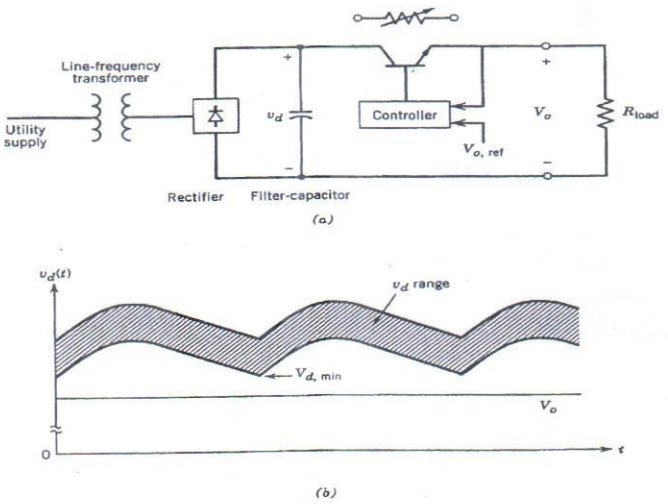
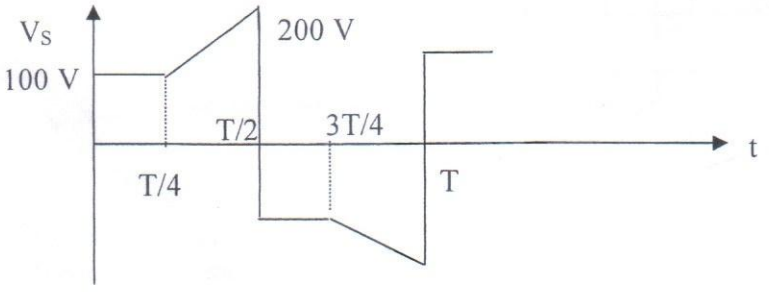


Figure 1(c)

2.(a) Draw the circuit diagram of a single phase full-wave uncontrolled rectifier with a source inductance. Show that the average output power decreases linearly with the increase of source inductance for a sinusoidal input.

(b) An ac to dc converter is used to charge a battery. The converter has a source inductance. Draw the wave-shape of the load current for a discontinuous mode of operation. Also draw the wave-shape of the voltage drop across the source inductance. Mathematically formulate the average value of the load current for the above circuit. How can you determine the final value of conduction angle for this case?

3.(a) A single-phase bridge rectifier with a finite source inductance L_S = 5 mH has a load of constant current of 10 amp. It has a frequency of 50 Hz. The input voltage has the following wave-shape



(i) Draw the wave shapes of source current and output voltage. (ii) Calculate the commutation angle and average value of the output voltage.

(b) Draw the output voltage and input current wave-shapes of a single phase controlled rectifier for highly inductive load and also for resistive load. Compare the wave-shapes of both cases and explain which one adds more noise to the other equipment connected to the system.

4.a) Describe the current commutation process of a three-phase rectifier with finite source inductance and a constant dc current. Derive the expression of the commutation angle.

(b) Draw the circuit diagram of a single-phase line frequency controlled rectifier for a highly inductive load. If the input voltage is sinusoidal, draw the waveshape of input current and output voltage. Find the expression of average voltage in terms of firing angle and input rms voltage. What will be the THD of the input current?

(c) For the converter circuit in Figure 4(c) T_1 is fired at $\omega t = \alpha$ and T_2 is fired at $\omega t = \pi+\alpha$, respectively. Identify the devices operating at different regions of one cycle of the input voltage. Also draw the output voltage and input current wave-shapes and find the expression of the average output voltage.

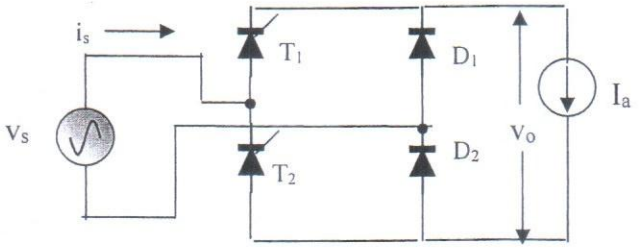


Figure 4(c)