B.Sc. Engg. (EE), 1st Semester Date : February 24, 2020 (Morning)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid-Semester Examination
Course No.: EEE 4101
Course Title: Electrical Circuit I

Winter Semester, A.Y. 2019-2020
Time: 90 Minutes
Full Marks: 75

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

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1. a) The current through and the voltage across an element is shown in Figure 1(a). 10+3
   a) Sketch the power delivered to the element for $t > 0$.
   b) Find the total energy absorbed by the element for the period of $0 < t < 4$s.

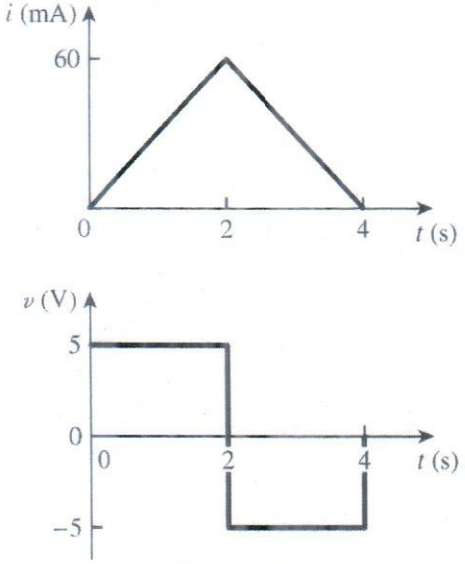

Figure 1(a)

   b) What is a linear circuit element? With examples discuss the properties a linear circuit element must possess. 2+10

2. a) Find the power absorbed by the dependent voltage source in the circuit of Figure 2(a). 13

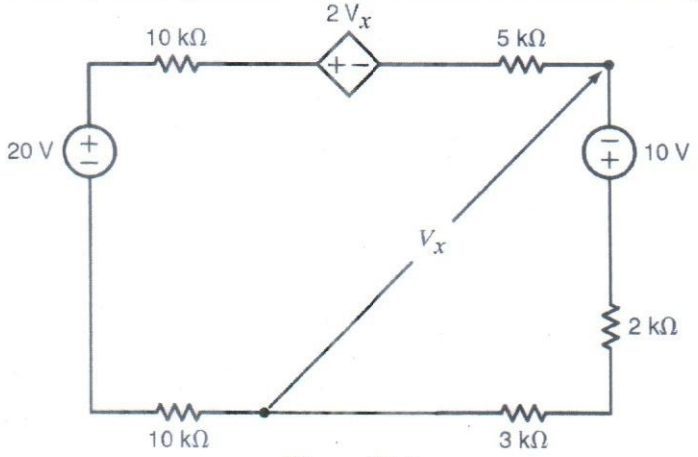

Figure 2(a)

b) Given $V_o = 12$ V, find the value of I_A in the circuit shown in Figure 2(b). 12

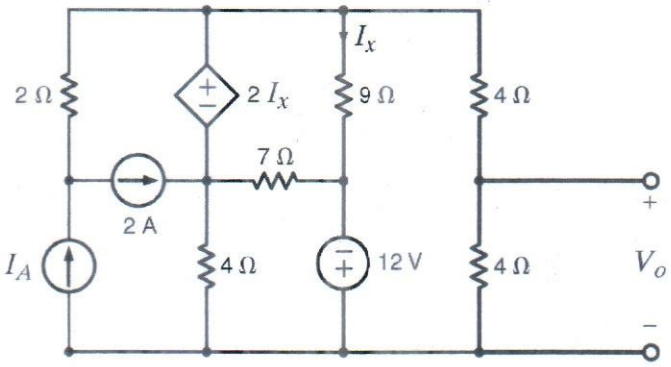

Figure 2(b)

3. a) Use node voltage analysis to write all the equations necessary to find the node voltages V_1, V_2, V_3, V_4 and V_5 shown in Figure 3(a). Find out those node voltages. 10+3

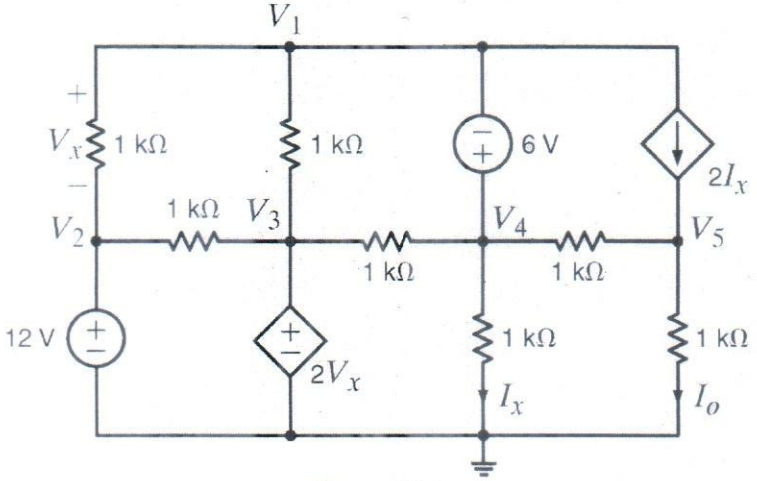

Figure 3(a)

b) Solve for the mesh currents defined in the circuit of Figure 3(b) using mesh current analysis technique. 12

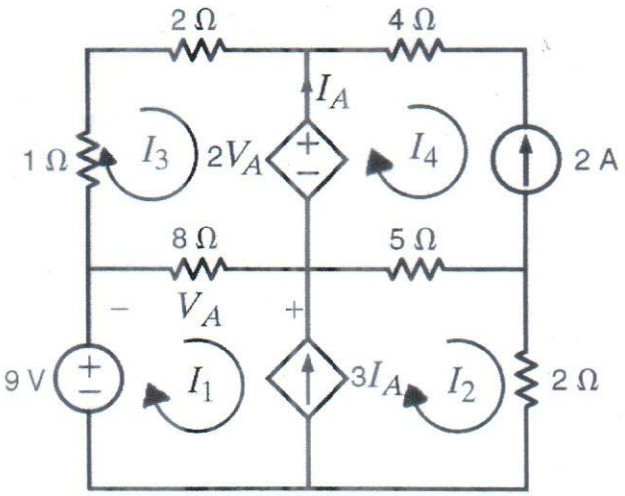

Figure 3(b)

4. a) Find I_o in the circuit of Figure 4(a) using superposition. 13

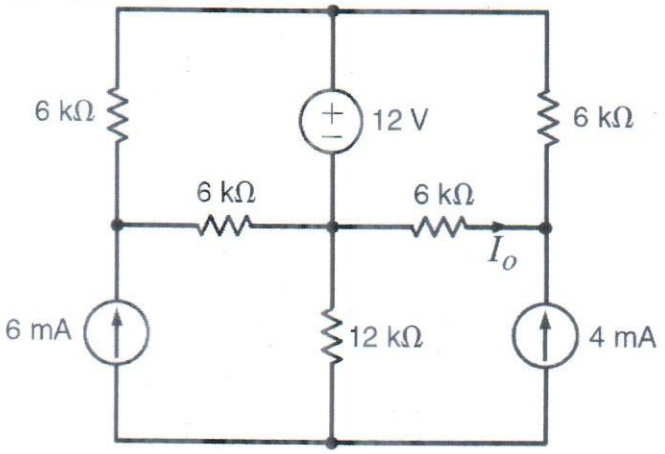

Figure 4(a)

b) Find voltage across the load, V_o in the circuit of Figure 4(b) using Thévenin's theorem. 12

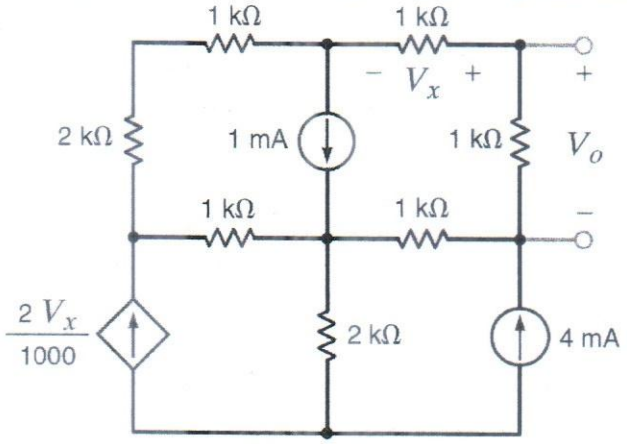

Figure 4(b)

B.Sc. Engg.(EE), 1st Sem. Date: February 27, 2020 (Morning)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid-Semester Examination — Winter Semester, A.Y. 2019-2020
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) Find the value of k for which $6x^2 - 5xy - 6y^2 + 14x + 5y + k = 0$ represents a pair of straight lines. Find the separate equation of straight lines. 13

   b) Remove xy term from the equation $17x^2 + 18xy - 7y^2 = 1$ by using the invariants of transformation. 12

2. a) If $y = e^{ax} \sin bx$ find y_n. 13

   b) If $\ln y = \tan^{-1} x$ then show that 12
   $(1+x^2)y_{n+2} + (2nx + 2x - 1)y_{n+1} + n(n+1)y_n = 0$

3. a) (i) State and prove L' Hospital's theorem. 13
   (ii) Evaluate $\underset{x \to \frac{1}{2}\pi}{Lt} \sec x \left(x \sin x - \frac{1}{2}\pi \right)$.

   b) If $u = ax^2 + by^2 + cz^2 + 2fyz + 2gzx + 2hxy$ and $\frac{\delta^2 u}{\delta x^2} + \frac{\delta^2 u}{\delta y^2} + \frac{\delta^2 u}{\delta z^2} = 2$ then find the value of $a + b + c$. 12

4. a) If $lx + my = 1$ touches the curve $(ax)^n + (by)^n = 1$ then show that $(l/a)^{\frac{n}{n-1}} + (m/b)^{\frac{n}{n-1}} = 1$. 13

   b) If (α, β) are the coordinates of the centre of curvature of the parabola $\sqrt{x} + \sqrt{y} = \sqrt{a}$ at (x,y) then show that $\alpha + \beta = 3(x + y)$. 12

B. Sc. Engg. (EE), 1st Sem. February 28, 2020 (Morning)

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

Mid-Semester Examination — Winter Semester, A. Y. 2019-2020
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 discuss various atomic models. 8
   b) What are the postulates of Bohr atomic model? Derive expressions for radii and energies of orbiting electron in an atom using Bohr model. 13
   c) Find the wavelength of the photon emitted when a hydrogen atom goes from the n=10 state to ground state. 4

2. a) Briefly explain various types of bonds in solids. 8
   b) Draw a typical unit cell of sodium chloride crystal. What is cohesive energy? Derive an expression for cohesive energy of sodium chloride crystal. 13
   c) The ionization energy of the potassium is $4.34\ eV$ and the electron affinity of Chlorine is $3.61\ eV$. The Madelung constant for the KCl structure is 1.748 and the distance between ions of opposite sign is $0.314\ nm$. If $n=9$ calculate cohesive energy for KCl crystal. 4

3. a) What is interference of light? Write down the conditions for constructive and destructive interference of light. 6
   b) Draw schematically the arrangement of Newton's rings experiment. Explain how the wavelength of light can be determined with the help of this experiment. 12
   c) A Newton's rings apparatus is used to determine the radius of curvature of a lens. The radii of the n^{th} and $(n+20)^{th}$ bright rings are measured and found to be 0.162 cm and 0.368 cm, respectively, in light of wavelength 546 nm. Calculate the radius of curvature of the lower surface of the lens. 7

4. a) What do you mean by diffraction of light? Distinguish between Fresnel and Fraunhofer classes of diffraction. 8
   b) What is diffraction grating? Write down grating equation by mentioning each term. 7
   c) Show that the smallest object that can be resolved in an optical microscope is about the same size as the wavelength of light being used. 10

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

Mid-Semester Examination — Winter Semester, A.Y. 2019-2020
Course No.: Math 4123 — Time: 90 Minutes
Course Title: Matrix and Differential Equation — 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) Show that every square matrix can be expressed in one and only one way as he sum of a symmetric and skew-symmetric. 5

   b) Verify that $(AB)^T=B^TA^T$, where 10

$$A=\begin{bmatrix} 1 & 0 & 2 \\ -1 & 1 & 3 \\ 2 & 0 & 1 \end{bmatrix} \text{ and } B=\begin{bmatrix} 2 & -1 & 0 \\ 0 & 2 & 1 \\ 1 & 2 & 1 \end{bmatrix}.$$

   c) Find the adjoint of the matrix, $A=\begin{bmatrix} 1 & 0 & 2 & 1 \\ 0 & 1 & 1 & 0 \\ 2 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$. 10

2. a) Find the differential equation of the family of following curves, where A and B are arbitrary constants. 8

$$y = e^x(A\cos x + B\sin x).$$

   b) Solve: $\cos x\,dx + (1+\frac{2}{y}\sin x)\,dy = 0.$ 8

   c) Solve: $\frac{dP}{dt} + 2tP = P + 4t - 2.$ 9

3. a) Solve the initial value problem: $(x+1)y' + y = \ln x$, $y(1) = 10.$ 8

   b) Solve: $(x - y^3 + y^2 \sin x)\,dx = (3xy^2 + 2y\cos x)\,dy$. 8

   c) Solve: $y\,dx + x(\ln x - \ln y - 1)\,dy = 0$, $y(1) = e.$ 9

4. a) Solve: $y' - y\sec x = y^2 \sin x \cos x.$ 8

   b) A body at a temperature of 50° F is placed outdoors where the temperature is 100° F. If after 5 minutes, the temperature of the body is 60° F. Derive the differential equation and find (i) how long it will take the body to reach a temperature of 75° F and (ii) the temperature of the body after 20 minutes. 8

   c) A 12-volt battery is connected to a series circuit in which the inductance is 0.5 henry and the resistance is 15 ohms. Derive the differential equation of the circuit and determine the current i if the initial current is zero. 9

B.Sc. Engg.(BTM), 1st Sem. Date: 02 March, 2020 (Morning)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid-Semester Examination — Winter Semester, A. Y. 2019-2020
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. All symbols bear their usual meanings.

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1. a) For the circuit shown in Fig. 1(a), find V_0 / V_s in terms of α, R_1, R_2, R_3, and R_4. If $R_1 = R_2 = R_3 = R_4$, what value of α will produce $|V_0 / V_s| = 15$? 08

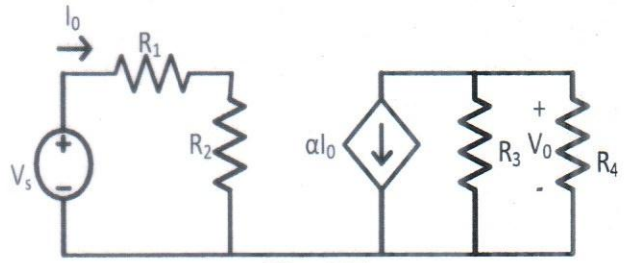

Fig. 1(a)

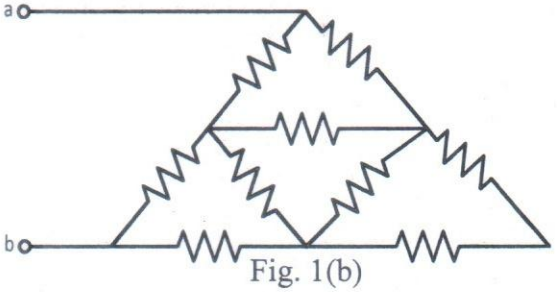

Fig. 1(b)

b) Obtain the equivalent resistance, R_{ab} in the circuit of Fig. 1(b). All the resistors have a value of 40 Ω. 15

c) Define supermesh and supernode. 02

2. a) Find the node voltages in the circuit of Fig. 2(a). 20

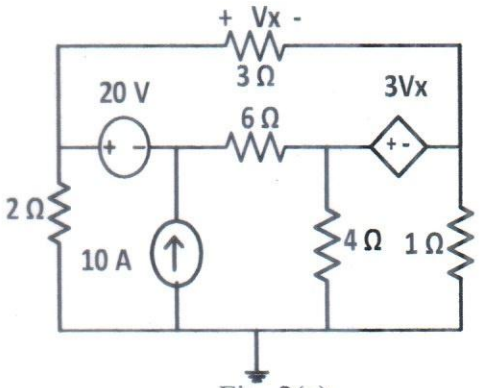

Fig. 2(a)

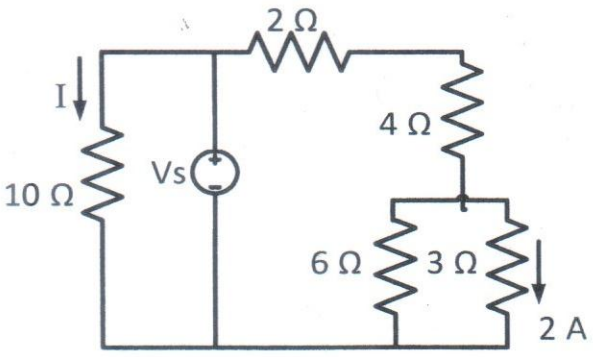

Fig. 2(b)

b) Find I and V_s in the circuit of Fig. 2(b) if the current through the 3Ω resistor is 2 A. 5

3. a) Calculate V and I in the circuit of Fig. 3(a). 15

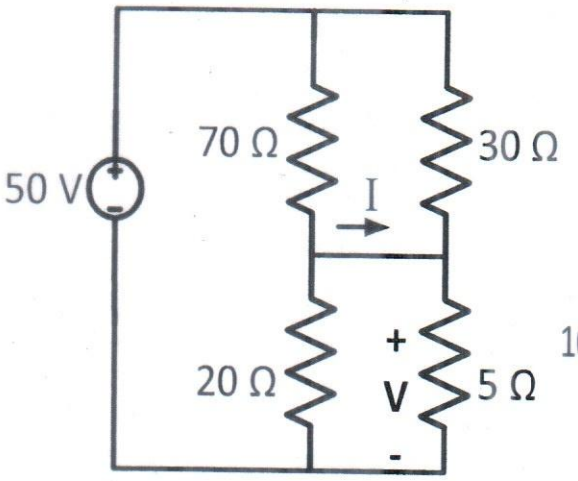

Fig. 3(a)

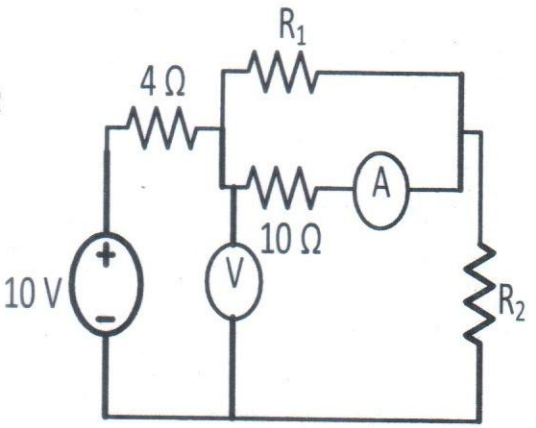

Fig. 3(b)

b) Find the values of R_1 and R_2 in the circuit of Fig. 3(b) if the voltmeter and ammeter read 6 V and 0.6 A, respectively. 10

4. a) In the circuit shown in Fig. 4(a), find the voltage, V_x using superposition theorem. 12

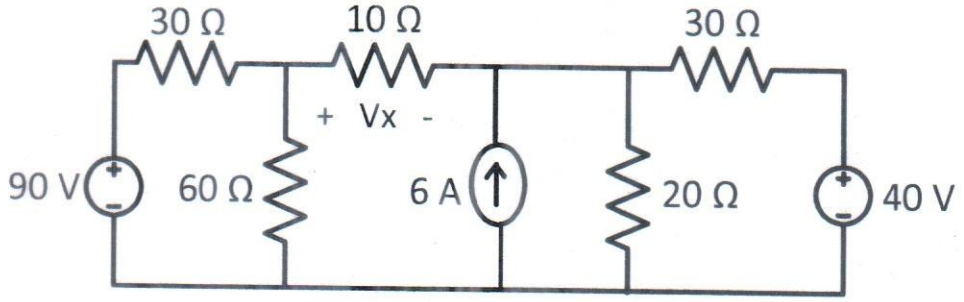

Fig. 4(a)

b) The variable resistor in the circuit shown in Fig. 4(b) is adjusted for maximum power transfer to R_L. Find the value of R_L. Also find the maximum power that can be delivered to R_L. 13

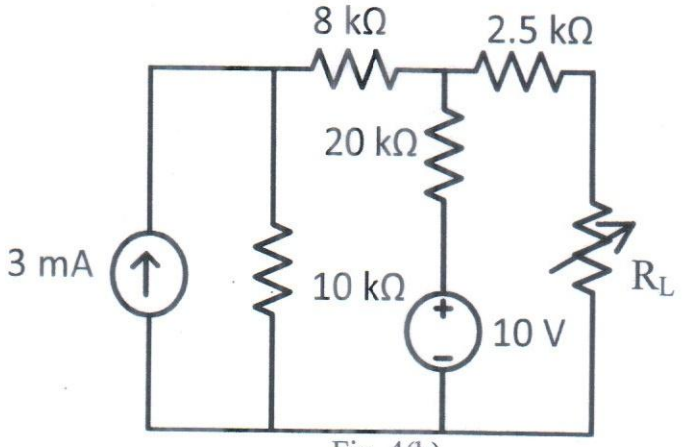

Fig. 4(b)

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

Date: March 02, 2020 (Afternoon)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid Semester Examination
Course No.: EEE 4301/EEE 4395
Course Title: Power System I

Winter Semester, A.Y. 2019-2020
Time: 90 Minutes
Full Marks: 75

There are **4 (four)** questions. Answer **any 3 (three)** questions. All questions carry equal marks. Marks in the right 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) Calculate the GMR of four symmetrically spaced subconductors configuration. Assume that spacing between conductors = 18 in. and diameter of the conductor = 1.424 in. 07

   b) Find the inductance per meter of the 3 phase line with twin bundle arrangement shown in Figure 1(b). The conductors are aluminium ($\mu_r = 1$), with radius r = 0.5 in. 09

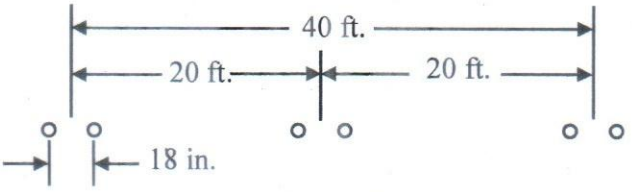

Figure 1(b)

   c) Determine phase-neutral capacitance, susceptance and capacitive reactance per mile for a three phase line with Dm = 35.3 ft, conductor diameter 1.25 in. 09

2. a) A single phase distributor AB has a total impedance of (0.1 + j0.2) ohm. At the far end B, a current of 80 A at 0.8 p.f. lagging and at mid-point C, a current of 100 A at 0.6 p.f. lagging are tapped. If the voltage of the far end is maintained at 200 V, determine:
   (i) Supply end voltage V_A; (ii) Phase angle between V_A and V_B
   The load power factors are w.r.t. the voltage at the far end. 12

   b) A 3-phase, 4-wire system supplies power at 400 V and lighting at 230 V. If the lamps require 70, 84 and 33 amperes in each of the three lines, what should be the current in the neutral wire?
   If a 3-phase motor is now started, taking 200 A from the lines at a p.f. of 0.2 lagging, what should be the total current in each line and the neutral wire? Find also the total power supplied to the lamps and the motor. 13

3. a) A single phase ring distributor ABC is fed at A. The loads at B and C are 20 A at 0.8 p.f. lagging and 15 A at 0.6 p.f. lagging respectively; both expressed with reference to the voltage at A. The total impedance of the three sections AB, BC and CA are (1 + j1), (1+ j2) and (1 + j3) ohms respectively. Find the total current fed at A and the current in each section. Use Thevenin's theorem to obtain the results. 15

   b) Murray loop test is performed to locate an earth fault on one core of a 2-core cable 100 m long. The other core is healthy and used to form the loop. At balance, the resistance connected to the faulty core was 4 Ω. The other resistance arm has a value of 16 Ω. Calculate the distance of the fault from the test end. 10

4. a) What is the percentage saving in copper feeder if the line voltage in a 2-wire d.c. system is raised from 220 V to 500 V for the same power transmitted over the same distance and having the same power loss? 09

b) A 50 km long transmission line supplies a load of 5 MVA at 0.8 p.f. lagging at 33 kV. The efficiency of transmission is 90%. Calculate the volume of aluminium conductor required for the line when 16

(i) single phase, 2-wire system is used

(ii) 3-phase, 3-wire system is used.

The specific resistance of aluminium is 2.85×10^{-8} Ω-m.

B.Sc. Engg.(EE), 3rd Sem. Date: February 25, 2020 (Afternoon)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

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

Winter Semester, A.Y. 2019-2020
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) Draw the simplified voltage transfer characteristic of an op-amp. What are the main characteristics of an ideal op amp? 05

   b) Derive the equation of output voltage, v_0 of the instrumentation amplifier shown in Fig. 1(b). 10

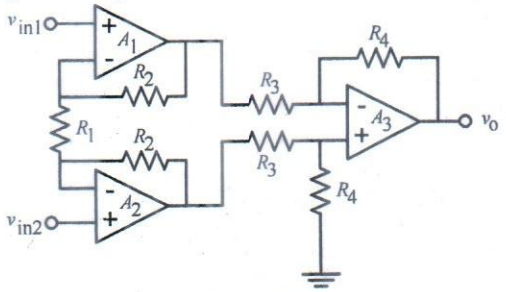

Fig. 1(b)

   c) For the instrumentation amplifier in Fig. 1(b), $R_4 = 90\ k\Omega$, $R_3 = 30\ k\Omega$ and $R_2 = 50\ k\Omega$. Resistance R_1 is a series combination of a fixed 2 kΩ resistor and a 100 kΩ potentiometer. (i) Determine the range of the differential voltage gain. (ii) Determine the maximum current through R_1 for input voltages in the range from -25 mV to +25 mV. 10

2. a) What are the advantages and disadvantages of active and passive filters? 05

   b) What are the types of active filter? Draw the generalized second order Sallen-Key filter structure and derive the transfer function. 10

   c) Consider the circuit shown in Fig. 2(c). (i) The output current of the op-amp is 1.2 mA and the transistor current gain is $\beta = 75$. Determine the resistance R. (ii) Using the results of part (i), determine the op-amp output current if the input voltage is 6 V. 10

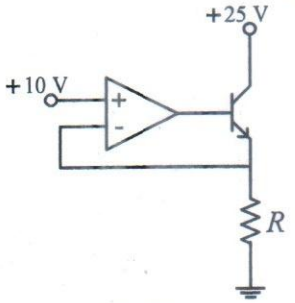

Fig. 2(c)

3. a) Consider the case of a voltage source with a 100 kΩ output impedance driving a 1 kΩ load impedance. If a voltage follower is inserted between the source and the load, then show that it will prevent loading effect. 05

b) Draw the Bode plots (magnitude & phase) for the transfer function, $H(\omega) = \frac{5(j\omega+2)}{j\omega(j\omega+10)}$. 10

c) Given the Bode plot in Fig. 3(c), obtain the transfer function $H(\omega)$. 10

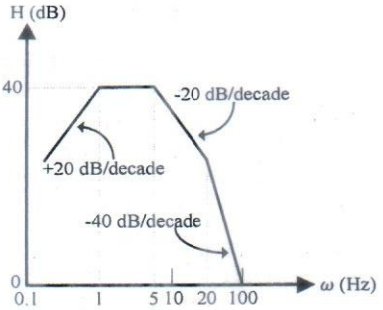

Fig. 3(c)

4. a) Briefly explain an exponential amplifier using an op-amp and a diode. 05

b) Explain the bandwidth extension and show that the gain-bandwidth product of a feedback amplifier is a constant. 10

c) Determine the bandwidth of a feedback amplifier. Consider a feedback amplifier with an open-loop low-frequency gain of $A_o = 10^4$, an open-loop bandwidth of $\omega_H = (2\pi)(100)$ rad/s, and a closed-loop low-frequency gain of $A_f(0) = 50$. 10

B.Sc. Engg. (EE), 3rd Sem. Date: February 27, 2020 (Afternoon)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

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

Winter Semester, A. Y. 2019-2020
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) Convert the following numbers from the given base to the other three bases listed in the table below: 6

Decimal	Binary	Octal	Hexadecimal
369.3125	?	?	?
?	10111101.101	?	?
?	?	326.5	?
?	?	?	F3C7.A

b) Determine the value of radix r if, 9

$((34)_r + (24)_r) \times (21)_r = (2142)_r$

c) Give the next three numbers in each of the following HEX sequences: 5

(a) 4A5, 4A6, 4A7, 4A8, . . . ;

(b) B998, B999, . . .

d) Use (r-1)'s complement to perform the following subtraction operation, 5

(a) $(433451)_6 - (54321)_6$

(b) $(203)_6 - (1883)_6$

2. a) Prove the identity of each of the following Boolean equations, using *algebraic* manipulation: 10

(a) $AB\bar{C} + B\bar{C}\bar{D} + BC + \bar{C}D = B + \bar{C}D$

(b) $WY + \bar{W}Y\bar{Z} + WXZ + \bar{W}X\bar{Y} = WY + \bar{W}X\bar{Z} + \bar{X}Y\bar{Z} + X\bar{Y}Z$

b) Simplify the following Boolean function together with Don't Care condition, d in (i) POS and (ii) SOP form. 8

$F(A, B, C, D, E) = \pi(1, 3, 7, 9, 16, 17, 19, 20, 24, 25, 27, 28, 29, 31)$

$d(A, B, C, D, E) = \pi(0, 4, 8, 10, 12, 14, 18, 21, 22, 23)$

c) Design an 8-input NAND gate using 2-input NAND gates and NOT gates. 7

3. a) Design an 8 × 1 multiplexer. 8

b) Implement the following function with a multiplexer: 8
$F(w, x, y, z) = \sum(0, 1, 3, 4, 8, 9, 15)$

c) Design a combinational circuit that receives a 4-bit number and generates its approximate square root as a 3-bit binary number output. For example, if the square root is 3.5 or larger, it gives a result of 4. If the square root is < 3.5 and ≥ 2.5, it gives a result of 3. 9

4. Design a home security system that has a master switch that is used to enable an alarm, lights, video cameras, and a call to local police in the event of one or more of six sets of sensors detecting an intrusion. In addition, there are separate swithes to enable and disable the alarm, lights, and the call to local police. The inputs, outputs, and operation of the enabling logic are specified as follows: 25

Inputs
Si, i = 0, 1, 2, 3, 4, 5: signals from six sensor sets (0 = no intrusion detected, 1 = intrusion detected)
M: master switch (0 = security system disabled, 1 = security system enabled)
A: alarm switch (0 = alarm disabled, 1 = alarm enabled)
L: light switch (0 = lights disabled, 1 = lights enabled)
P: police switch (0 = police call disabled, 1 = police call enabled)

Outputs
A_o: alarm (0 = alarm off, 1 = alarm on)
L_o: light switch (0 = lights off, 1 = lights on)
P_o: police call (0 = police call off, 1 = police call on)
V: video cameras (0 = cameras off, 1 = cameras on)

Operation
i. If only one sensor detect an intrusion and the security system (M) as well as L are enabled, then L_o and V will be on and all other outputs will be off.
ii. If any two sensors detect intrusion and the security system (M) as well as A, L are enabled, then A_o, L_o and V will be on but P_o will be off.
iii. If three or more sensors detect intrusion and the security system (M) as well as A, L, P are enabled, then all the outputs will be on.

B.Sc. Engg.(ME), 3rd Sem. Date: February 25, 2020 (Morning)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid-Semester Examination — Winter Semester, A.Y. 2019-2020
Course No.: Phy 4313 — Time: 90 Minutes
Course Title: Basic Electronics and Semiconductor Physics — 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) Describe the conditions established by forward and reverse bias conditions on a p-n junction diode and how the resulting current is affected. 7

   b) Determine the diode current at 20 °C for a silicon diode with I_s = 500 pA and an applied forward bias of 0.5 V. ($k = 1.38\times10^{-23}$ J/K) 7

   c) Assuming an ideal diode sketch the input voltage, output voltage, diode voltage and diode current of a half wave rectifier circuit. The input is a sinusoidal waveform with a frequency of 50 Hz. Repeat the problem with a silicon diode. 11

2. a) Determine V_1 and V_2 from the circuits in Fig. 2(a). 6

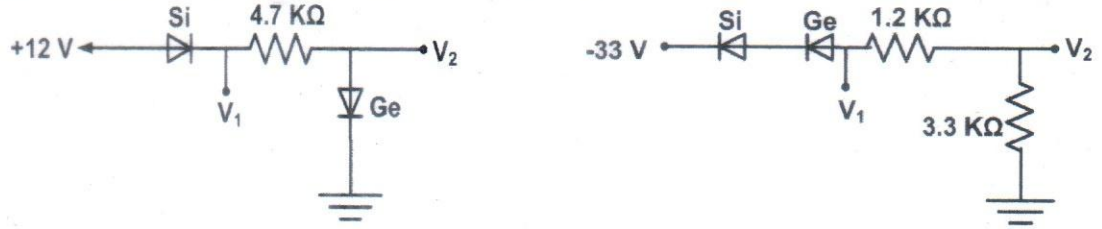

Fig. 2(a)

   b) Sketch V_o for the circuits in Fig. 2(b)(i) and Fig. 2(b)(ii). Consider V_{in} = 10 $V_{p\text{-}p}$ and V = 3 V. 10

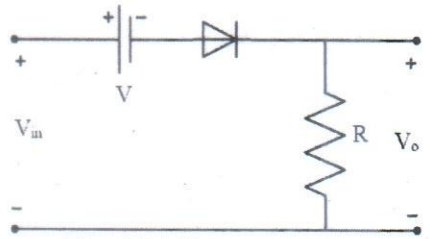

Fig. 2(b)(i)

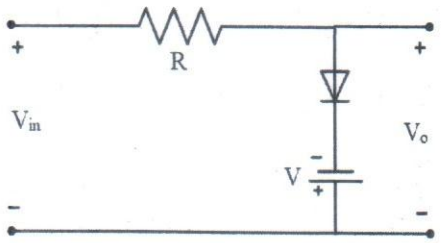

Fig. 2(b)(ii)

   c) Determine the output voltage V_o for the network of Fig. 2(c). Consider silicon diode with threshold voltage, V_T = 0.75 V. Input V_i has an amplitude of 10 V. Consider V = 5 V, C = 1 μF and R = 1000 Ω. 9

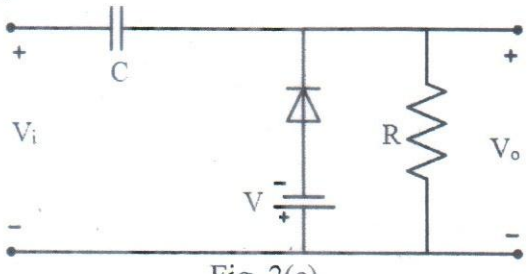

Fig. 2(c)

3. a) What are the modes of operation of a transistor? Write down the biasing condition of two junctions for each mode. Sketch the common base BJT configuration (for both npn and pnp) and indicate the polarity of the applied bias and resulting current directions. 13

b) A full wave bridge rectifier with a 120 V_{peak} sinusoidal input has a load resistor of 1 kΩ. 12

i. Draw the circuit diagram,
ii. Sketch the input and output wave shapes considering silicon diodes,
iii. Determine the dc voltage at the output considering ideal diodes,
iv. Repeat part (ii) with a filter capacitor connected at the output.

4. a) Determine the dc bias voltage V_{CE}, collector current I_C, base voltage V_B and output voltage V_o for the configuration of Fig. 4(a). Consider $\beta = 45$. 10

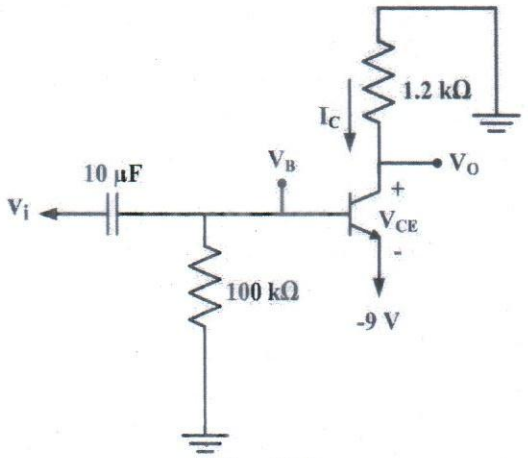

Fig. 4(a)

b) For the network of Fig. 4(b), determine I_C and V_{CE} using both exact and approximate analysis and compare the results. Assume $\beta = 50$. 15

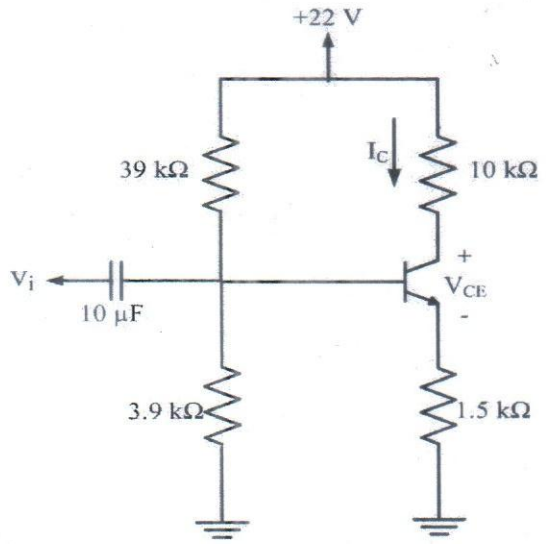

Fig. 4(b)

B.Sc. Engg. (CSE), 3rd Sem. Date: 28 February, 2020 (Afternoon)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid-Semester Examination
Course No.: EEE 4383
Course Title: Electronic Devices and Circuits

Winter Semester, A.Y. 2019-2020
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. Assume suitable value for any missing data.

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1. a) 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) Write down a comparative analysis on the characteristics of BJT and FET. 07

   c) Determine I_D and V_D for the circuit in Fig. 1(c) with V_{DD} = 5 V and R = 1.1 kΩ using the iterative analysis method. Assume the diode current is 1.5 mA at a voltage of 0.7 V. 07

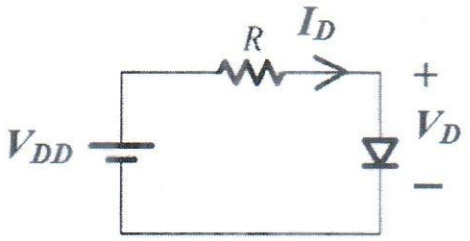

Fig. 1(c)

   d) What is the purpose of DC biasing in BJT? 04

2. a) Design a full wave rectifier and draw the input and output waveshapes for this circuit. 05

   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. 07

   c) Draw the V_{CB}-I_C characteristics of an npn transistor fed with a constant emitter current I_E. Explain the conditions for reaching the saturation for this transistor. What happens to I_C in saturation? 07

   d) What is Q-point? Describe the significance of biasing in case of fixing a Q-point and its effect on amplification in a common-emitter connection for small signals. 06

3. a) What is Shockley's equation? Draw the transfer characteristics of an n-channel JFET. 06

   b) Define the static and dynamic resistance of a diode. 05

   c) What is a virtual ground? What are the characteristics of an ideal op-amp? 06

d) For the circuit in Fig. 3(d), I_{DSS} = 6 mA and V_P = -3 V, calculate the values of I_{DQ}, V_{GSQ}, V_D and V_S. Also draw the graph for Q-point. 08

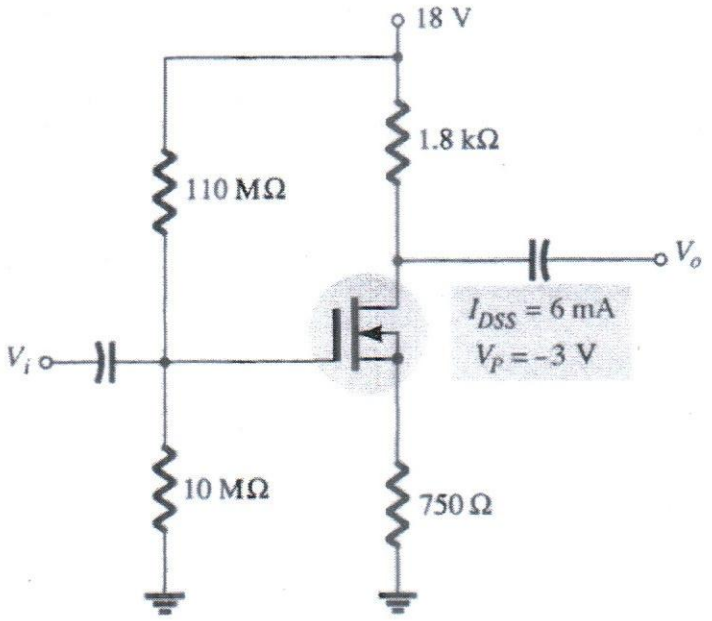

Fig. 3(d)

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. 08

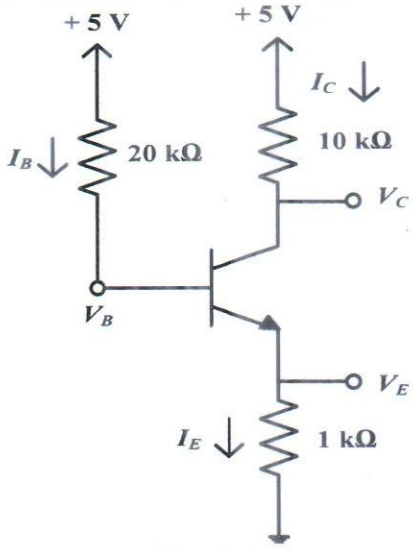

Fig. 4(a)

b) Implement the expression $Vo = -5u + 1.5v + 3.3x + 7y - 11z$ using op-amps. 06

c) Explain the mode of operation of a PN junction diode under the forward and reverse bias conditions. 06

d) What are α and β for a BJT. Derive the expression by which α and β are related to each other. 05

B.Sc. Engg.(EE)/HDEE, 5th Sem. Date: March 2, 2020 (Morning)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid-Semester Examination — Winter Semester, A. Y. 2019-2020
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. Figures in the right margin indicate full marks. Programmable calculators are not allowed. Do not write on this question paper. Symbols bear their usual meaning.

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1. a) Define electric field ($\vec{E}$) and electric flux density ($\vec{D}$). Is $\vec{D}$ charge density? Justify your answer. 5

   b) 72π μC charge is uniformly distributed over the circumference of a circle described by $x^2 + y^2 = 9$ on the $z = 0$ plane. Find the force exerted on a 4 mC point charge at $(0, 0, 4m)$ and the corresponding $\vec{E}$. 10

   c) Show that $\vec{E}$ at a point above an infinite sheet charge with uniform charge density ρ_s C/m^2 is independent of the distance from the point to the sheet. Using this result show that the electric field outside a parallel plate capacitor is zero. 10

2. a) State Gauss's law. How is it useful in finding $\vec{D}$ or $\vec{E}$ due to a charge system? Derive Maxwell's first equation from Gauss's law. 5

   b) Given that $\vec{D} = 2x(1+z^2)\hat{a}_x + 2x^2 z\hat{a}_z$ nC/m^2. Find (i) volume charge density and (ii) flux crossing the rectangular region defined by $z = 1, 0 < x < 2, 0 < y < 3$. 10

   c) Figure 2(c) represents a portion of a coaxial system of length L. The inner and outer cylinders contain a uniform volume charge density of ρ_v C/m^3. Using Gauss's law find $\vec{E}$ in all regions. 10

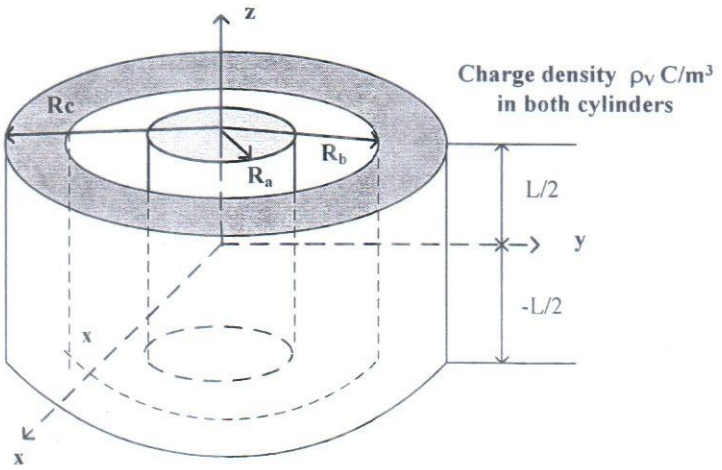

Fig. 2(c)

3. a) An annular disk of inner radius R_a and outer radius R_b is placed on the xy plane as shown in Fig. 3(a). If the disk carries a uniform charge density ρ_s C/m^2, find the potential V at P and corresponding $\vec{E}$ using V. 13

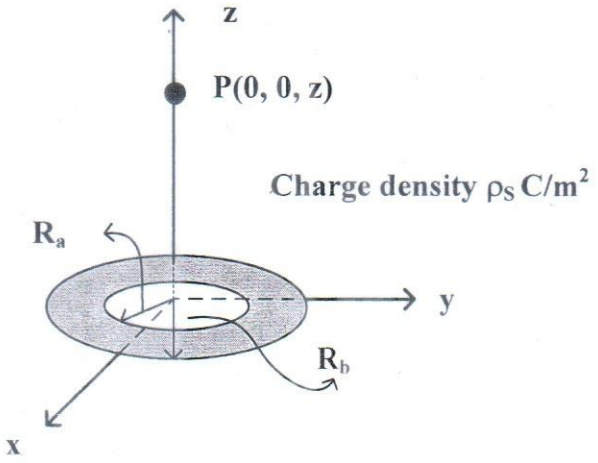

Fig. 3(a)

b) Electric flux density in free space is given by $\vec{D} = 2xyz\hat{a}_x + x^2z\hat{a}_y + x^2y\hat{a}_z$ V/m. Caulculate the amount of work necessary to move a 2μC charge form (2, 1, -1) to (5, 1, 2). All distance coordinates are in meters. 12

4. a) If the potential distribution in a region is $V = x - y + xy + 2z$ V, find $\vec{E}$ at (1,2,3) and the elctrostatic energy stored in a cube of side 4 m centered at the origin. 10

b) How is the resistance of a conductor with nonuniform cross section calculated? 5

c) In a dielectric material $E_x = 10$ kV/m and polarization $\vec{P} = \frac{1}{10\pi}(3\vec{a}_x - \vec{a}_y + 4\vec{a}_z)$ nC/m^2. Calculate (i) χ_e (ii) $\vec{E}$ and (iii) $\vec{D}$. 10

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

Date: 27 February, 2020 (Morning)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF THE 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. 2019-2020
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. Assume reasonable value for any missing data and assume that the power devices are ideal.

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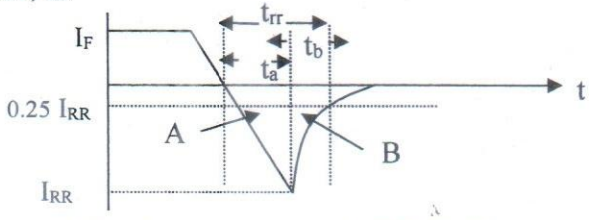
1. a) With the help of a block diagram, explain how a power electronic system meets the demand of the users. Can a power electronic system be replaced by a linear electronic system to convert high power conversion? Give explanation of your answer. 10

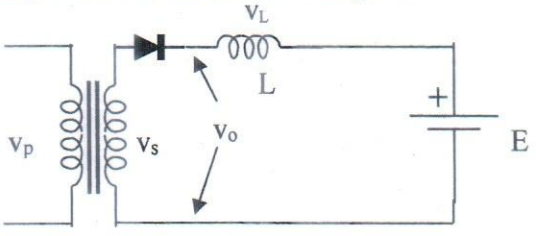
   b) Name at least one device each of which has the following switching characteristics: 07
   (i) Uncontrolled turn on and uncontrolled turn off
   (ii) Controlled turn on and controlled turn off
   (iii) Controlled turn on and uncontrolled turn off

   c) Why is the reverse recovery characteristic of a semiconductor device considered so important? Following is a reverse recovery characteristic of a semiconductor device whose data are as follows: Area, A= 120 amp-μs, area B= 100 amp-μs, di/dt=30A/μs. Find (i) I_{RR} and (ii) the reverse recovery time, t_{rr}. 08



2. a) An RLC circuit with a diode is supplied by a dc source of 220 V. The value of inductance L=5 mH, capacitance C=10 μF and the resistance R=22 Ω. The initial voltage of the capacitor is V_{c0}= 50 V. If the circuit is switched on at t=0, determine (i) the expression of current and (ii) the conduction time of the diode. 09

   b) Following is a diode circuit whose input voltage is v_s = 381sin314t, and the battery voltage is E = 100 V. The current stops conducting at β=215°. (i) Draw the wave-shape of the v_o and also (ii) calculate the average value of the output voltage v_o. 08



   c) 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? 08

3. An inverting (buck-boost) converter operating at 50 kHz has a +50 V DC and has a output of -50 V into a resistive load of 25 Ω. The inductor has a peak-peak current of 8A (the converter is in the continuous-discontinuous boundary condition). The output voltage ripple is negligible. 25

(i) Draw a circuit diagram and label important voltage and currents. Explain briefly how the circuit works. (ii)Sketch the inductor voltage and current waveforms. What is the value of the inductor? (iii) Determine the RMS value of the diode and transistor current (iv) Find out the power loss in the diode and the transistor [Assume forward voltage drop is 0.6 V and the on resistance of the transistor is 1 mΩ]. (v) Calculate the efficiency of the system.

4. What is dead time as referred to voltage source inverter? Explain the impacts of dead time in voltage source inverters (VSI). (i) Draw a three phase VSI and explain with necessary gating waveforms how 3-phase output can be obtained using 180° conduction schedule. Consider a 3-phase star connected balanced load. (ii) A three phase VSI running in square wave mode with 180° conduction needs to output a line to line fundamental output voltage of 400 V (RMS). Determine the inverter dc supply voltage (Vs) 25

B.Sc. Engg. (EE)/ HDEE, 5th Sem. Date: February 24, 2020 (Morning)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid-Semester Examination
Course No.: Math 4521
Course Title: Numerical Methods

Winter Semester, A.Y. 2019-2020
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. Consider appropriate approximation for any missing data.

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1. a) With the help of Taylor series expansions determine the coefficient of the x^5 term in the Maclaurin polynomial for $sin(2x)$. 5

   b) Derive the expression for true error in calculating the derivative of $sin(2x)$ at $x = \frac{\pi}{4}$ by using the approximate expression $f'(x) \approx \frac{f(x+h) - f(x)}{h}$. 5

   c) A hypothetical computer stores floating point numbers in 14-bit words. The first bit is used for the sign of the number, the second bit for the sign of the exponent, the next four bits for the magnitude of the exponent, and the next eight bits for the magnitude of the mantissa. In every second, the error between 0.1 and its binary representation in the 14-bit word is accumulated. Calculate the accumulated error after one day. [Hints: Consider up to five decimal places.] 6

   d) In mathematics, functions can often be represented by infinite series. For example, the exponential function can be computed using 9

   $$e^x = 1 + x + \frac{x^2}{2!} + \frac{x^3}{3!} + \frac{x^4}{4!} + \cdots$$

   Thus, as more terms are added in sequence, the approximation becomes a better and better estimate of the true value of e^x. Now, calculate the approximate error starting from the first term to seventh term to prove above assertion.

2. a) The second-order linear ordinary differential equation for a typical R-L-C circuit can be expressed as $L\frac{d^2q}{dt^2} + R\frac{dq}{dt} + \frac{1}{c}q = 0$. The solution of this equation is given by: 12

   $$q(t) = q_0 e^{-2Rt/(2L)} cos\left[\sqrt{\frac{1}{LC} - \left(\frac{R}{2L}\right)^2} \times t\right]$$

   A typical electrical engineering design problem might involve determining the proper resistor to dissipate energy at a specified rate, with known values for L and C. For this problem, assume the charge must be dissipated to 1% of its original value $\left(\frac{q}{q_0} = 0.01\right)$ in $t = 0.05s$, with $L = 5H$ and $C = 10^{-4}F$. Now, use the false position method of finding roots of equations to find the value of R. Conduct three iterations to estimate the root of the above equation with initial guesses of $x_l = 300$ and $x_u = 350$. Find the absolute relative approximate error at the end of each iteration.

   b) The resistivity ρ of doped silicon is based on the charge q on an electron, the electron density n, and the electron mobility, μ. The electron density is given in terms of the doping density, N and the intrinsic carrier density, n_i. The electron mobility is 13

described by the temperature, T, the reference temperature, T_0, and the reference mobility, μ_0. The equation required to compute the resistivity is:

$$\rho = \frac{1}{qn\mu} .$$

where, $n = \frac{1}{2}(N + \sqrt{N^2 + 4n_i^2})$ and $\mu = \mu_0(\frac{T}{T_0})^{-2.42}$.

Determine N using modified secant method with initial guess 1 and 0.001 for small perturbation δ. Given that, $T_0 = 300$ K, $T = 1000$ K, $\mu_0 = 1350$ cm2 $(Vs)^{-1}$, $q = 1.7 \times 10^{-19}$ C, $n_i = 6.21 \times 10^9$ cm^{-3}, and a desired $\rho = 6.5 \times 10^6$ Vscm/C. Conduct three iterations and find the absolute relative approximate error at the end of each iteration.

3. In control systems analysis, transfer functions are developed that mathematically relate the dynamics of a system's input to its output. A transfer function for a robotic positioning system is given by 25

$$G(s) = \frac{C(s)}{N(s)} = \frac{s^3 - 13x - 12}{s^4 - 2s^3 + 6s^2 - 2s + 5} .$$

Where, $G(s)$ = system gain, $C(s)$ = system output, $N(s)$ = system input, and s = Laplace transform complex frequency.

Now, use Müller's method to determine the roots of the numerator and denominator and factor these into the form

$$G(s) = \frac{(s+a_1)(s+a_2)(s+a_3)}{(s+b_1)(s+b_2)(s+b_3)(s+b_4)} .$$

Where, a_i and b_i are equal to the roots of the numerator and denominator, respectively. [Hints: To perform the evaluation of complex roots, Müller's method uses parabolic equation in form of $a(x - x_2)^2 + b(x - x_2) + c$. Take appropriate initial guesses for determining the roots of both numerator and denominator, and perform up to three iterations.]

4. a) The inverse of a matrix can be computed in a column-by-column fashion by generating solutions with unit vectors as the right-hand-side constants. The best way to implement such a calculation is with the LU decomposition algorithm. Now, employ LU decomposition to determine the matrix inverse for the system matrix A. 15

$$A = \begin{bmatrix} 3 & -0.1 & -0.2 \\ 0.1 & 7 & -0.3 \\ 0.3 & -0.2 & 10 \end{bmatrix}$$

b) A liquid-liquid extraction process conducted in the Electrochemical Materials Laboratory involved the extraction of nickel from the aqueous phase into an organic phase. A typical set of experimental data from the laboratory is given below in table II. 10

Table: II

Ni aqueous phase, a (g/l)	2	2.5	3
Ni organic phase, g (g/l)	8.57	10	12

Assuming g is the amount of Ni in the organic phase and a is the amount of Ni in the aqueous phase, the quadratic interpolant that estimates g is given by

$$g = x_1 a^2 + x_2 a + x_3, \; 2 \le a \le 3 .$$

Find the values of x_1, x_2, and x_3 using naïve Gauss elimination with partial pivoting. Estimate the amount of nickel in the organic phase when 2.3 g/l is in the aqueous phase using quadratic interpolation.

B.Sc. Engg.(EE)/ HDEE, 5th Sem.
B.Sc.TE (2-Yr), 1st Sem. Date: February 25, 2020(Morning)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid-Semester Examination — Winter Semester, A. Y. 2019-2020
Course No.: EEE 4521 / EEE 4595 — Time: 90 Minutes
Course Title: Power System Protection — 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 by 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) What types of error occur in an instrumentation transformer? Explain them with proper derivation. 9

   c) Differentiate between Current Transformer (C.T.) and Potential Transformer (P.T.). Why secondary of C.T. should not be kept open circuited? 7

2. a) Explain the operation of relay with make type contact and relay with break type contact. Give proper circuit representation for each of the cases. 16

   b) For induction type relays show: 9

$$F \propto \varphi_{1m}\varphi_{2m} \sin\alpha$$

   where F, φ_{1m}, φ_{2m} and α have their usual meaning.

3. a) Show a detail comparison between reactance relay and admittance relay including their schematic arrangement, torque equation and operating characteristic. Derive all the necessary equations. 13

   b) On a R-X diagram show a line having an impedance of (2.8 + j5) Ω. On the same diagram show the operating characteristics of 12

      i. Impedance Relay,
      ii. Reactance Relay,
      iii. Mho Relay.

   Assume that these relays are adjusted to just operate for a zero impedance short circuit at the end of the line section. An arcing short circuit fault having an arc impedance of (1.5 + j0) Ω occurs anywhere on the line. For each type of distance relay, find the maximum portion of line that can be protected.

4. a) Explain frame leakage protection and circulating current protection of bus-bar with proper diagram. 13

b) A typical power system is represented in Fig. 4b (1). Time grading margin between relay 1 and relay 2 is 0.6 sec for discrimination. If any fault occurs at point 'X' then calculate actual time of operation for both the relays and time setting multiplier for relay 2. Time setting multiplier of relay 1 is 0.3. A time current characteristics curve is given in Fig. 4b (2). 12

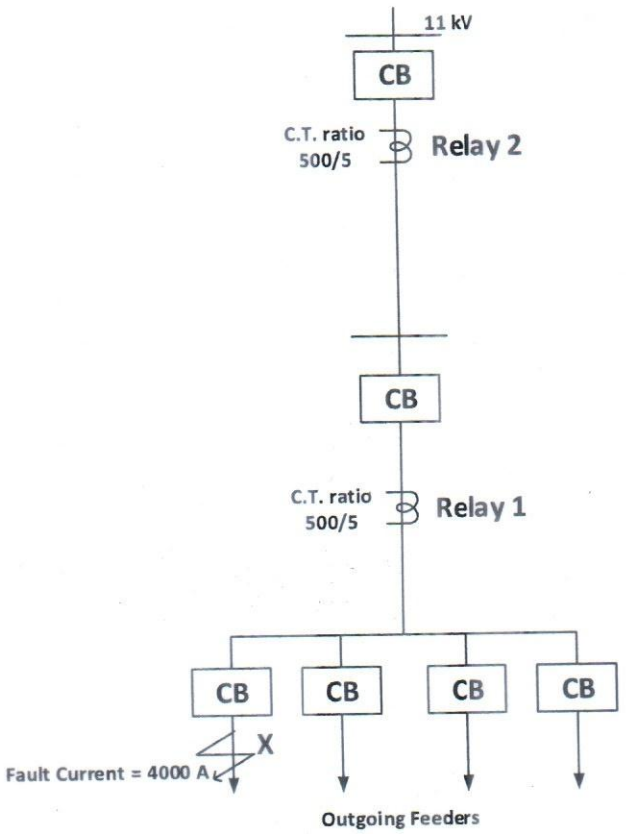

Fig. 4b (1)

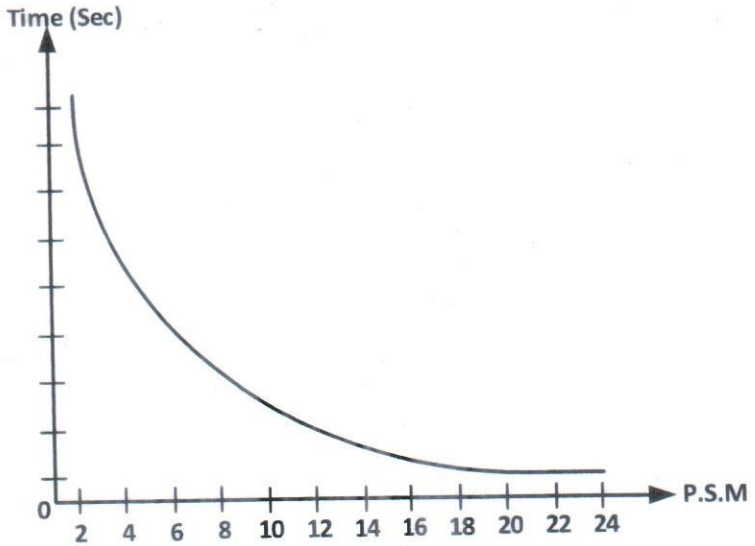

Fig. 4b (2)

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

Mid-Semester Examination — Winter Semester, A. Y. 2019-2020
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) Compare Cat5e and Cat6 in terms of data rate, maximum length, delay, and price. Compare WiGig with WiFi 6. What is the difference between fast ethernet and gigabit ethernet? For larger bandwidth, mention whether thinner or thicker coaxial cable should be chosen. 12

   b) For very long distance communication at high frequencies, an antenna is used for both transmission and reception. Suggest mediums for connection between the antenna and the circuit for both transmission and reception. Give reasons for your choice. 5

   c) Mention whether uplink or downlink communication uses lower frequency band for satellite communication and write down its reason. Mention whether the antenna size typically decreases or increases if the HPBW increases. What is the difference between the shaped reflector and the combined system? 8

2. a) Derive an expression for received power in the case of two-ray model for a large distance between the transmitter and the receiver. 13

   b) A transmitter is transmitting with EIRP 50 dBm and it is at height 30 m from the ground. The receiver antenna has gain 0 dB and it is at height 10 m from the ground. The transmitter and the receiver are 10 km away from each other. The frequency of the signal is 1.5 GHz. Calculate the magnetic field strength of EM wave in the air at the location of the receiver. Use two-ray model. 12

3. a) In the case of non-LOS communication, if the receiver increases his velocity, how may the errors in the received bits be affected? Give reasons. 5

   b) Which frequencies are going to be used most popularly for 5G cellular communication? Mention which 3GPP and 3GPP2 technologies can support only data services with the maximum data rate. What are the existing TDD cellular technologies? Which series of 3GPP specifications is dedicated for LTE? Write down the names of the companies which play major roles in the development of 3GPP specifications. 10

c) There is free space communication between a transmitter and a receiver and the distance between them is 5 km. The height of the transmitter and the receiver are 40 m and 20 m, respectively. The free space received power is –62 dBm. The frequency of the signal is 6 GHz. When an object with knife-edge is placed at a point 3 km away from the transmitter and 2 km away from the receiver, the received power increases to –60.2 dBm. Determine the height of the object. The profile for diffraction gain vs. Fresnel-Kirchoff diffraction parameter is shown in Figure 1. 10

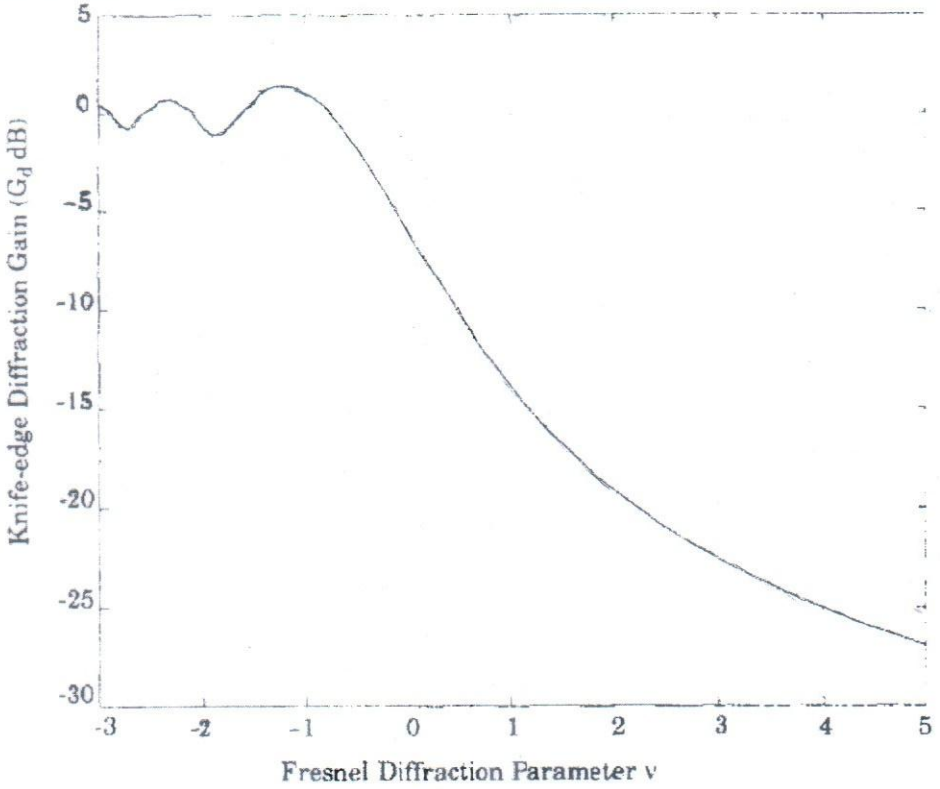

Figure 1

4. a) Compare the building penetration loss (BPL) between old and new building types. Give reasons for their differences. 5

b) What was a common use of sky wave in the past? What is the typical distance for long distance terrestrial LOS links, used to connect districts in Bangladesh? How many radio bearers (RBs) or data flow pipes can be established in LTE? Why is Circuit Switched FallBack (CSFB) used in LTE? 10

c) Calculate the minimum symbol period of data transmission for the multipath profile shown in Figure 2, which can offer flat fading. Also, determine if this multipath profile would offer flat fading or frequency selective fading for LTE (LTE uses a bandwidth of 15 kHz). 10

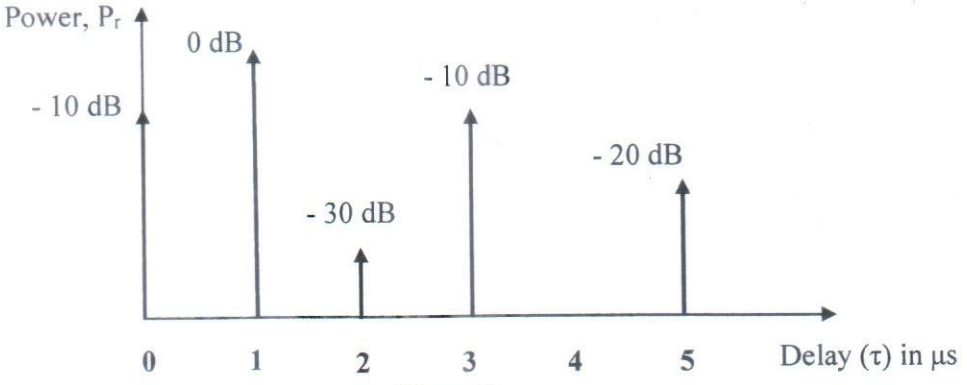

Figure 2

B.Sc. Engg.(EE) / HDEE, 5th Sem. Date: 28 February 2020 (Morning)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid-Semester Examination — Winter Semester, A. Y. 2019-2020
Course No.: EEE 4551 — Time: 90 Minutes
Course Title: Data Communication and Networking 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) How is the electron considered as the basic medium for electronic data communication? Discuss the low-level mechanisms and technologies used to send information across the physical communication medium. Use suitable illustrations. 10

   b) Discuss the importance of computer networks that has produced a demand in all industries to plan, acquire, install, operate and manage the hardware and software systems for networks. 5

   c) As a network designer, you are asked to develop an intra network with basic network components in IUT halls of resident. Briefly define each of the components and their working principles using suitable illustrations. 10

2. a) What is network application (software)? Briefly explain with examples the followings: email, file transfer, web browsing, voice telephone calls (VoIP), distributed databases, audio/video teleconferencing and social networking. 10

   b) You want to send 100 data from a source to a destination. Using suitable illustrations, explain how data communicates through following switching methods: i) Circuit switching and ii) Packet switching. 10
   Explain which technique is better: i) with respect to guaranteed service and ii) with respect to faster delivery time.

   c) "In data communication, all network applications communicate over a single and shared network". Justify your answer and briefly explain the challenges with suitable illustrations. 5

3. a) Explain ring topology, start topology and bus topology. Discuss the advantages and disadvantages of these three topologies. For the Internet connectivity which topology is suitable. Justify your answer. What is ethernet? 13

   b) Network can be classified into two categories by their component roles i.e., P2P and Client-Server. Write down the role of P2P network and Client-Server network. Write down the examples of different servers. 12

4. a) Why do we need queue in the packet switching? How does queue create data loss in the network? Mention four sources of packet delay. Briefly explain each of them using suitable illustrations. 10

   b) What is routing table? How does routing table work? Explain using suitable illustration. 5

   c) What is throughput in networking? Why is it important for data transfer? How does bottle neck occur if throughput is not considered perfectly? 10

B.Sc. Engg.(EE), 7th Sem. Date: 02 March, 2020 (Afternoon)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid-Semester Examination
Course No.: EEE 4701
Course Title: Digital Signal Processing I

Winter Semester, A.Y. 2019-2020
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) Consider an analog signal $x(t)$ which contains the frequency component up to 300 Hz. $x(t)$ is sampled and converted to a discrete signal, $x(n)$. Plot the approximate magnitude response of $X(\omega)$ with proper normalized frequency scaling for the following sampling frequencies: 10
   i) $f_s = 200$ Hz.
   ii) $f_s = 700$ Hz.

   b) For the above example what would be the band of the final signal after passing through the DAC, when the sampling frequency is taken as 100 Hz. 15

2. a) What is the fundamental difference between convolution sum and correlation process? Explain it with proper example and diagram. 10

   b) Let the impulse response of a system is a delta function. Consider a sinusoidal discrete signal as an input to that system. What would be the output of that system? From frequency domain aspects justify the result. 15

3. a) Find the total response of the system described by the difference equation: 17
   $y(n) - 1.5y(n-1) + 0.5y(n-2) = x(n), \quad where\ y(-1) = 1, \quad y(-2) = 0.$

   b) Draw the direct form II structure of the following system: 08

$$y(n) = -\sum_{k=1}^{2}(a_k y(n-k)) + \sum_{k=0}^{3}(b_k x(n-k)).$$

4. a) Usually why do we use a low pass filter before sampling an analog signal? Explain it with an example. 05

   b) i) Determine the DTFT of the following signal: 20

$$x(n) = \delta(n) - \alpha^n u(n).$$

   ii) Draw the magnitude spectrum for the above signal, when $\alpha = 0.7$.

B.Sc. Engg. (EE), 7th Sem. Date: February 27, 2020 (Afternoon)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid-Semester Examination | Winter Semester, A.Y.2019-2020
Course No.: EEE 4731 | Time: 90 Minutes
Course Title: Power System 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.All symbols carry their usual meanings.

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1. a) Discuss the necessity of analyzing power system stability with its classification. 10

   b) Figure 1 represents the cross-sectional view of a two-pole synchronous machine under loaded condition at some arbitrary instant. Consider that at time $t = 0$, the d-axis was aligned with the stator A-axis. 15
      i) Draw the rotor mmf phasor for the given field current direction at $t = 0$.
      ii) What will be the relation between the electrical and mechanical representation of the rotor angular position?
      iii) Show the effects of stator magnetic field on the rotor magnetic field (de-magnetizing and cross-magnetizing components).
      iv) Draw the corresponding phasor diagram considering zero armature resistance.

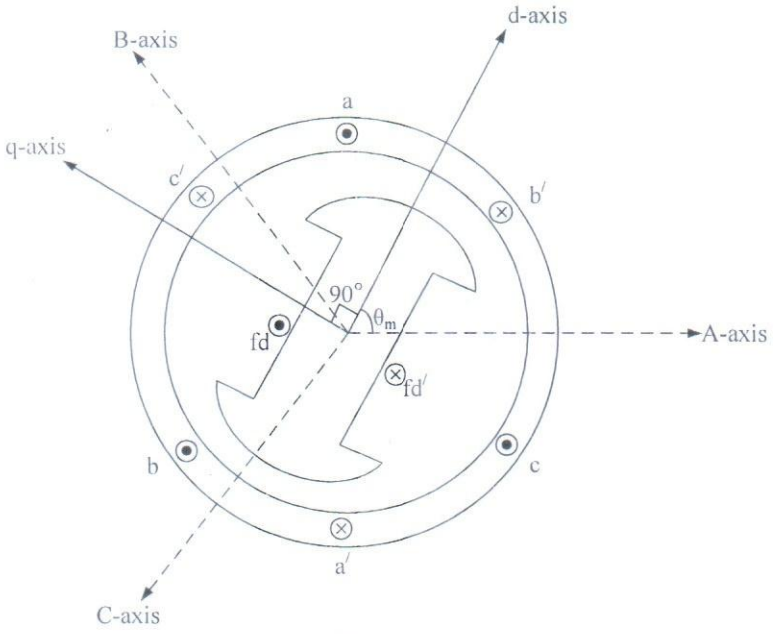

Figure 1

2. a) Why are the reactances along d-axis (X_d) and q-axis (X_q) of a salient pole synchronous machine different? Explain with neat diagram. 05

   b) Which type of power system stability problem is analyzed using the second order swing equation? What is meant by steady state stability limit? Discuss with neat diagram. 06

c) Consider a salient-pole synchronous machine characterized by the following parameters: $X_d = 1.0$, $X_q = 0.7$, $X_d' = 0.55$, $R_a = 0$ per unit. 14
The machine is connected to an infinite bus of voltage 1.05 per unit through a transmission line having negligible reactance. The amount of real power delivered by the machine is 1.0 per unit at 0.85 power factor lagging.
Calculate:

i) the initial rotor angle δ_0,
ii) the steady state excitation voltage $|E|$, and
iii) the q-axis transient voltage E_q'. Also, find out the expression of reluctance power of the machine.

3. a) What are meant by *synchronizing power coefficient (P_s) and damping coefficient (D)*? How do they affect the steady state stability of a power system? Explain with the help of relevant equations. 10

b) A 50-Hz synchronous generator having inertia constant H = 6 MJ/MVA and a transient reactance $X_d' = 0.35$ per unit is connected to an infinite bus through a purely reactive circuit as shown in Figure 3. Reactances are marked on the diagram on a common system base. The generator is delivering real power of 0.9 per unit, 0.8 power factor lagging to the infinite bus at a voltage of V = 1.0 per unit. Assume the per unit damping power coefficient is D = 0.18. Consider a small disturbance of $\Delta\delta = 15^0$. Obtain equations describing the motion of the rotor angle and the generator frequency. 15

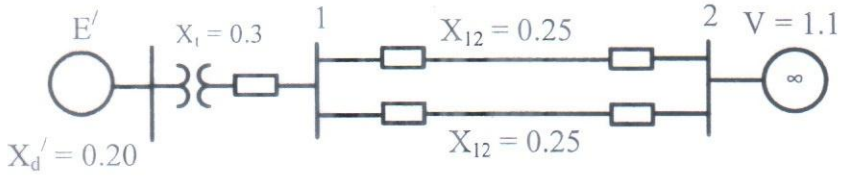

Figure 3

4. a) Discuss with example the constraints that are to be incorporated in the analysis of economic load dispatch problem. 05

b) The fuel-cost functions for three thermal plants in Tk./h are given by 20

$$C_1 = 600 + 5.3\,P_1 + 0.003\,P_1^2$$
$$C_2 = 500 + 5.9\,P_2 + 0.005\,P_2^2$$
$$C_3 = 400 + 5.1\,P_3 + 0.007\,P_3^2$$

where P_1, P_2 and P_3 are in kW. The total load P_D is 700 kW. Neglecting line losses and generator limits, find the optimal dispatch and the total cost in Tk./h by iterative technique using the gradient method. Consider initial value of $\lambda = 7.1$ Tk./kWh.

B.Sc. Engg. (EEE), 7th Sem. Date: February 25, 2020 (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: Optical Communication

Winter Semester, A. Y. 2019-2020
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. All symbols bear their usual meaning. Assume reasonable values for missing data.

---

1. a) What was the wavelength of operation and material used for first generation of lightwave system? Why was 1.3 μm wavelength chosen for second generation lightwave system? Why could not conventional InGaAsP lasers be used for third generation system? 2+3+2

   b) Compare between RZ and NRZ modulation formats of the resulting optical bit-stream. Explain SONET, SDH and STM with their respective bit rates. Name the SONET equivalent of STM-64 and mention its channel number along with bit rate. 5+9+4

2. a) Draw cross-section and refractive index profile for step-index and graded-index fiber. Why is graded-index plastic fiber popular only for short distance application? 4+3

   b) Explain 'numerical aperture' and express it in terms of fractional index change, Δ. Using geometrical optics, show that parabolic index fiber doesn't exhibit intermodal dispersion. 5+5

   c) Calculate an estimation of bit-rate distance product for a cladded graded-index fiber with $n_1 = 1.5$, $n_2 = 1.497$. Find out the index profile α for minimum dispersion in this case. Compare this α value with that of parabolic index profile. 8

3. a) A typical fiber has $n_1 = 1.45$, $\lambda = 1.2$ μm, $\Delta = 5\times10^{-3}$. What will be the maximum value of core radius for the fiber to behave as a single mode fiber? What is required to continue with the single mode operation if the core radius is changed to 4 μm? 7

   b) Clarify the concept of mode in optical fiber. Explain when a mode reaches cutoff using p and q parameters from Helmholtz equation in cylindrical coordinates. 3+5

   c) A typical multimode fiber with 25 μm core radius, $\Delta = 5\times10^{-3}$ and $\lambda = 1.3$ μm roughly supports 162 modes. Find out its core refractive index. Define TEM, TE, TM and hybrid modes. 5+5

4. a) What is spot size? Define effective core area and mention how it is related with non-linear effect. From the expression of normalized spot size find out 'confinement factor' for $V = 2$. 1+3+5

   b) Find an estimate of BL product for a standard silica based single more fiber working near 1.3 μm wavelength having dispersion 1 ps/(km-nm) and spectral width of 4 nm. 5

   c) Define zero dispersion wavelength. Explain fiber birefringence covering degree of modal birefringence, beat length, fast and slow axis. 3+8

B.Sc. Engg. (EEE), 7th Sem. Date: February 25, 2019 (Afternoon)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid-Semester Examination
Course No.: EEE 4765
Course Title: Embedded System Design

Winter Semester, A. Y. 2019-2020
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. All symbols bear their usual meanings.

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1. a) Write VHDL source code for odd parity generator. 10

   b) What are the ways of delayed signal assignment in VHDL? 2

   c) How basic logic element (BLE) forms a CLB? Draw block diagram of a BLE. 8

   d) Mention six (6) shift operators used in VHDL. Illustrate with example. 5

2. a) If channel width is 10, draw the internal and external connections, while Fs = 4 and Fc = 0.6. 5

   b) Draw the reachability tree and reachability graph for the Fig. 2(b). 10

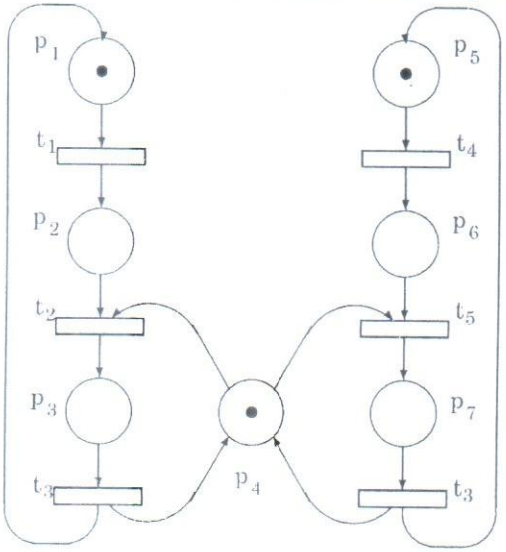

Fig: 2(b)

   c) Find the incidence matrix for the Fig. 2(b). 4

   d) How 'Technology Mapping' is related to FPGA? 3

   e) What are the general user expectations of FPGA? 3

3. a) What are the steps in modern digital design flow? Write the description of tasks at each step. 3

   b) Show switch box connection of bidirectional and unidirectional mesh-based FPGA routing architecture. 6

c) What are some major programmable logic architectures available today? Draw simplified structure of PLA and PAL. 5

d) What is 'hardware-in-a-loop'? What are the main characteristics of an embedded system? 4

e) Design a testbench skeleton for the diagram in Fig. 3(e). Consider a clock and reset is also included in the digital circuit. 7

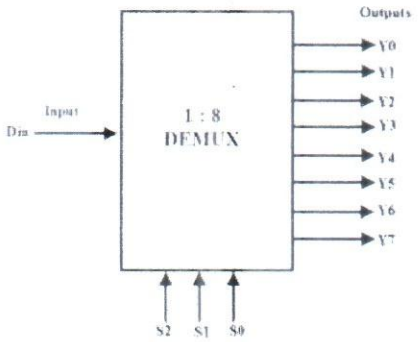

Fig: 3(e)

4. a) Mention 6 (six) directory names and their functions of an Embedded Linux system. 5

b) What are the major FPGA structural classifications? Illustrate with diagrams. 6

c) Draw the Y-Chart illustrating top-down design approach. 7

d) Draw the generic block diagram of Mutual Exclusion PN (Petri Net) structure. Also illustrate with a real-world example. 7

B.Sc. Engg.(EE), 7th Sem. Date: February 27, 2020 (Afternoon)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid-Semester Examination
Course No.: EEE 4773
Course Title: Artificial Neural Networks and Fuzzy Logic

Winter Semester, A.Y. 2019-2020
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. Make necessary assumptions (if any).

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1. a) An Inverted Pendulum is depicted in Figure 1(a), the pendulum has its center of mass above its pivot point. It is unstable and without additional help will fall over. It can be suspended stably in this inverted position by using a control system to monitor the angle of the pole *(d)*, angular velocity of the pendulum *(w)* and move the pivot point horizontally back under the center of mass when it starts to fall over, keeping it balanced. For the monitoring purpose two sensors have been deployed in the inverted pendulum to measure the angular velocity, *w (rad/sec)* and the angular displacement, *d (rad)*. The membership functions of these two sensors in terms of linguistic variables have been provided in Figure 1(b). The pivot point balance is done using a cart, where a pair of DC motors have been used. A fuzzy control system allows to supply current, *I (μA)* in the DC motors which can be described again by linguistic variable shown in Figure 1(c). The fuzzy inference rule is described as follows 25

   A. When *w* is medium and *d* is medium then *I* is medium
   B. When *w* is high and *d* is medium then *I* is high

   Now find out the current in μA; when,

   I. $w = 1.5$ *rad/s*, $d = \pi/4$
   II. $w = 0.5$ *rad/s*, $d = -\pi/6$

   Use Centroid method for de-fuzzification

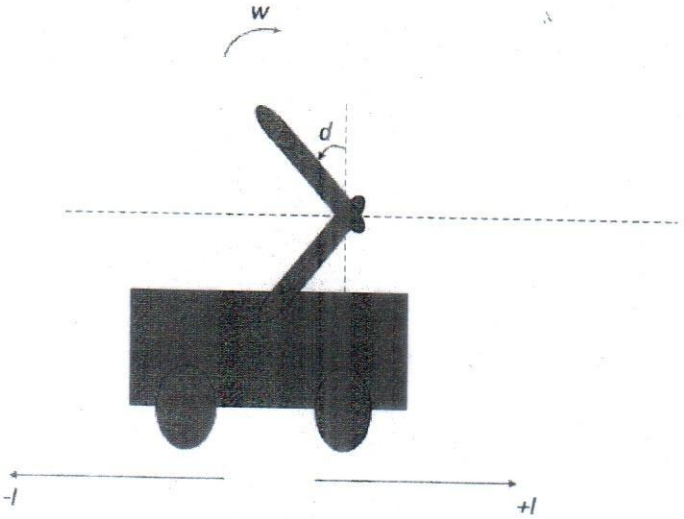

Figure 1(a)

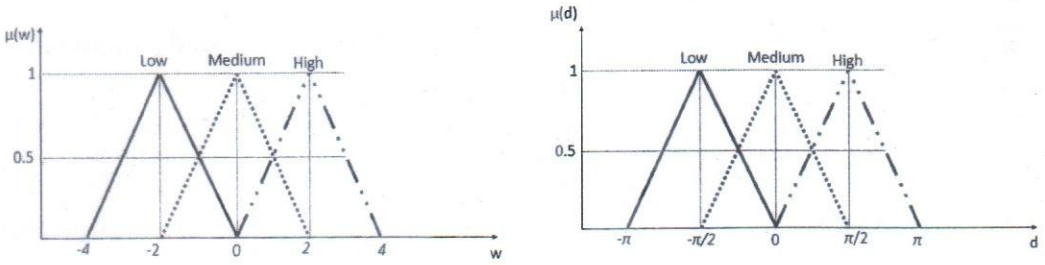

Figure 1(b)

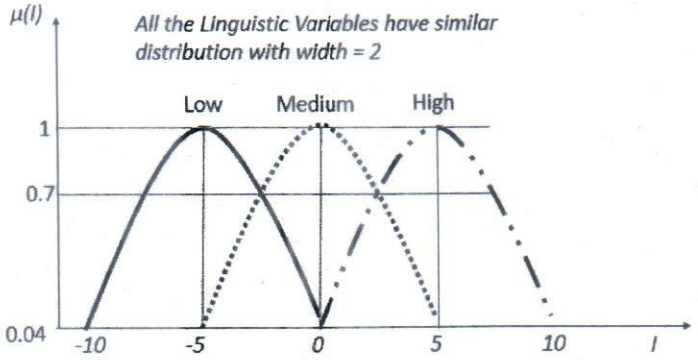

Figure 1(c)

2. a) Briefly discuss about the fuzzy membership functions with mathematical representations. 10

   b) Describe Different fuzzy Inference Mechanism with proper illustrations. 15

3. a) A ball is placed on a beam, see Figure 3(a)-(b) below, where it is allowed to roll with 1 degree of freedom along the length of the beam. A lever arm is attached to the beam at one end and a servo gear at the other. As the servo gear turns, the position of the beam is changing either up or down. When the ball is moved from the center, a sonar (S) and a proximity sensor (P) will measure the deviation from the horizontal position of the beam in cm and a fuzzy controller will process these two inputs to send control signals (C) to the servo motor. The servo will adjust the beams position to set the ball at the center and gravity causes the ball to roll along the beam. A fuzzy controller will be designed for this system so that the ball's position can be manipulated. The input and output in terms of linguistic variables have been given in Figure 3(c) and Figure 3(d). 15

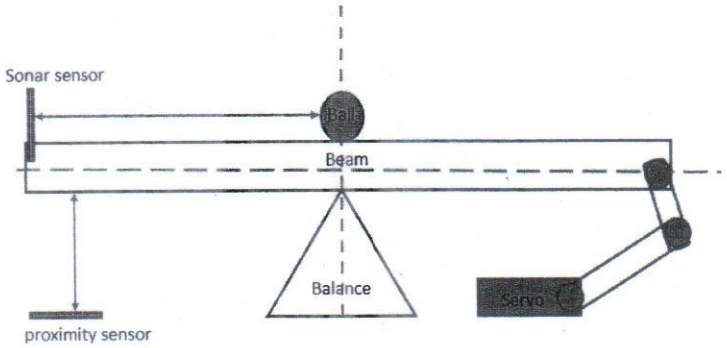

Figure 3(a)

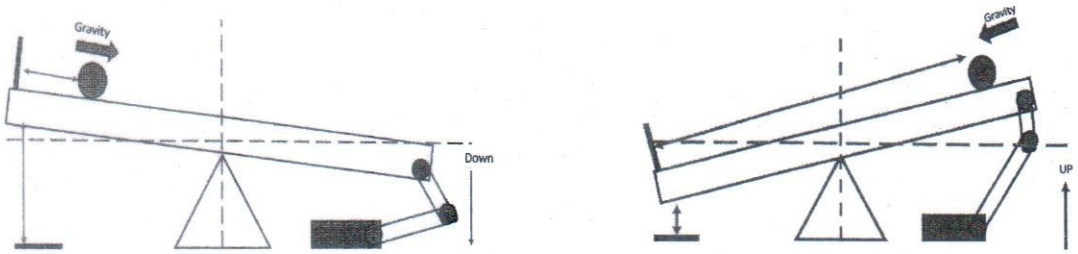

Figure 3(b)

The fuzzy inference rule is described as follows:

A. When P is medium and S is medium then C is medium
B. When P is low and S is medium then C is low

Now find out the De fuzzified output, when

$P = 4.5\ cm,\ S = 4.5\ cm.$

Use Centroid method for de-fuzzification.

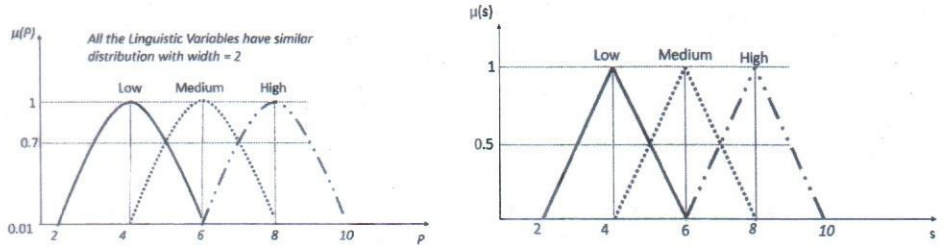

Figure 3(c)

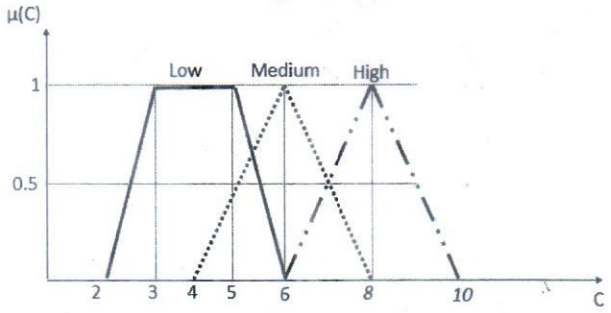

Figure 3(d)

b) The Beam-Ball-Balance problem mentioned in Figure 3(a), the output can be defined by the following equations instead of linguistic variables. 10

I. $Z_1 = 3P + 2S + 1,$
II. $Z_2 = P + 2S + 3,$
III. $Z_3 = P + 5S - 1,$
IV. $Z_4 = 2S + 1.$

The truth table is as follows:

P	S		
	Low	Medium	High
Low	Z_1	Z_3	Z_2
Medium	Z_2	Z_4	Z_1
High	Z_1	Z_3	Z_4

Now find out the De fuzzified output, when

$P = 3.5\ cm,\ S = 3.5\ cm.$

4 a) Briefly describe the concept of Linguistic Variables and how to represent them. Describe Linguistic Hedges and their mathematical representation. 10

b) Deduce a relation between two fuzzy sets with proper illustration. 5

c) two fuzzy sets A and B have been described as follows: 10

$$A(x) = \begin{cases} 0 & \text{if } 0 < x < 1 \\ x-1 & \text{if } 1 \leq x < 2 \\ 1 & \text{if } 2 \leq x < 3 \\ 4-x & \text{if } 3 \leq x < 4 \\ 0 & \text{if } 4 \leq x \end{cases}$$

$$B(x) = \begin{cases} e^{x-3} & \text{if } 0 \leq x < 3 \\ 1 & \text{if } 3 \leq x < 5 \\ 1 - \frac{x-5}{2} & \text{if } 5 \leq x < 10 \\ 0 & \text{if } 10 \leq x \end{cases}$$

Find out $A \wedge B$ and $A \vee B$.

BSc TE (1-yr), 1st Semester
BSc TE (2-yr), 3rd Semester

Date: March 02, 2020 (Afternoon)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid-Semester Examination
Course No.: EEE 4793
Course Title: Advanced Electronics

Winter Semester, A.Y. 2019-2020
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) Define contact potential. Derive the equation for contact potential (in terms of donor and acceptor ions) when a p-type and n-type materials are brought close together to form a junction. (10)

   b) Derive the equations for the instantaneous concentrations of excess carriers $\delta n(t)$ and $\delta p(t)$ after a short flash of light is applied at $t = 0$. Write the expression for carrier life time. (7)

   c) A 0.46 μm-thick sample of GaAs is illuminated with monochromatic light of $h\nu = 2$ eV. The absorption coefficient α is 5×10^4 cm^{-1}. The power incident on the sample is 10 mW. Find the total energy absorbed by the sample per second (J/s). (8)

2. a) What is luminescence? Mention its important types according to the excitation mechanism. Discuss the mechanisms involved in excitation and recombination of carriers in photoluminescence when a trapping level for electrons is present. (8)

   b) Derive the expressions for concentration of electrons and holes in a semiconductor at equilibrium. (9)

   c) Show schematically electrons and holes concentrations at thermal equilibrium by using fermi-dirac distribution function, density of states and band diagram for:
   (i) Intrinsic semiconductors (ii) n-type semiconductors (iii) p-type semiconductors. (8)

3. a) Briefly explain direct and indirect semiconductors. From (E, k) diagram, describe direct and indirect electron transition in semiconductors. (10)

   b) Define fermi-dirac distribution function. What will be the shape of fermi-dirac distribution function at T= 0 K and also at higher temperatures for the following cases:
   (i) $E < E_F$ *(ii)* $E > E_F$ *(iii)* $E = E_F$ (10)

   c) A Si sample is doped with 10^{17} As atoms/cm^3.What is the equilibrium hole concentration P_0 at 300 K? Where is E_F relative to E_i ? ($n_i = 1.5\times10^{10}$). Assuming ($n_0 = N_d$). (5)

4. a) Briefly discuss the process of diffusion. Derive diffusion current density equations for electrons and holes. (7)

b) Discuss the effect of recombination in diffusion process. Derive continuity equation and diffusion equation for holes and electrons. (8)

c) In a very long p-type Si bar with cross-sectional area = 0.5 cm^2 and $N_a = 10^{17}$ cm^{-3}, we inject holes such that the steady state excess hole concentration is 5×10^{16} cm^{-3} at x = 0. What is the steady state separation between F_p and E_c at $x = 1000 \times 10^{-8}$ m? What is the hole current there? How much is the excess stored hole charge? Assume that μ_p = 500 $cm^2/V\text{-}s$ and $\tau_p = 10^{-13}$ S ($n_i = 1.5 \times 10^{10}$ cm^{-3}). (10)

M.Sc. TE. (2 yr), 1st Sem. Date: February 28, 2020 (Afternoon)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid-Semester Examination
Course No.: EEE 6199
Course Title: Solid State Devices

Winter Semester, A.Y. 2019-2020
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 are the majority and minority carriers? Describe the differences between *n*-type and *p*-type semiconductor materials. 07

   b) What are the equivalent models available for *p-n* junction diode? Draw the equivalent circuit and sketch the forward characteristics for each model. 08

   c) Describe the conditions established by zero bias, forward bias and reverse bias modes of a *p-n* junction diode and how the resulting current is affected. (Draw necessary diagrams) 10

2. a) In solid-state device fabrication, what is the purpose of the diffusion and ion implantation process? With neat diagrams describe the ion implantation process. Write the advantages of ion implantation process over diffusion? 15

   b) What do you understand by dry and wet oxidation? For both dry and wet oxidation, show the variation of oxide thickness with respect to oxidation time in case of (100) silicon surface on the same graph. 10

3. a) With neat diagrams describe the steps involved in the fabrication of a *p-n* junction diode. 15

   b) With neat diagrams describe the working principle of *p-n* junction photodiode. Also draw its *I-V* characteristics graph for different photogeneration rate. 10

4. a) How can you categorize semiconductor photodevices? What are the different categories? 05

   b) Sketch the *I-V* characteristics of a *p-n* junction solar cell. Define what is meant by short-circuit current, open circuit voltage and maximum power rectangle of a solar cell with necessary equations. 08

   c) With neat diagrams discuss the working principle of a light emitting diode (LED). Draw the cross-sectional sketch of the standard LED package and briefly discuss the structure of the LED package. 12

M.Sc. Engg./ PhD (EE) Date: February 25, 2020 (Afternoon)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid-Semester Examination — Winter Semester, A.Y.2018-2019
Course No.: EEE 6307 — Time: 90 Minutes
Course Title: Power System Modeling — 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 carry their usual meanings.

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1. a) Consider the rotating part of a synchronous machine, represented by a single mass having moment of inertia J (kg-m^2). An input torque T_m (N-m) is applied at the shaft of the rotating mass to create an angular acceleration α (rad/s^2). Considering that an output electromagnetic torque T_e (N-m) gets induced at the shaft due to this acceleration, 15
   i) Write down the corresponding equation of motion in terms of rotor acceleration.
   ii) Rewrite the equation of motion of part (i) in terms of rotor angular position (mechanical).
   iii) Obtain the equation of motion in terms of electrical angular position.
   iv) Represent the equation of motion of part (iii) in per unit form.

   b) What is the process of locating the direct axis and quadrature axis of a synchronous machine? How are those different from the stator MMF axes (A, B and C axes)? Discuss with neat diagram. 10

2. a) Fig. 2(a) represents the cross-sectional view of a two-pole synchronous machine with damper coils. 20

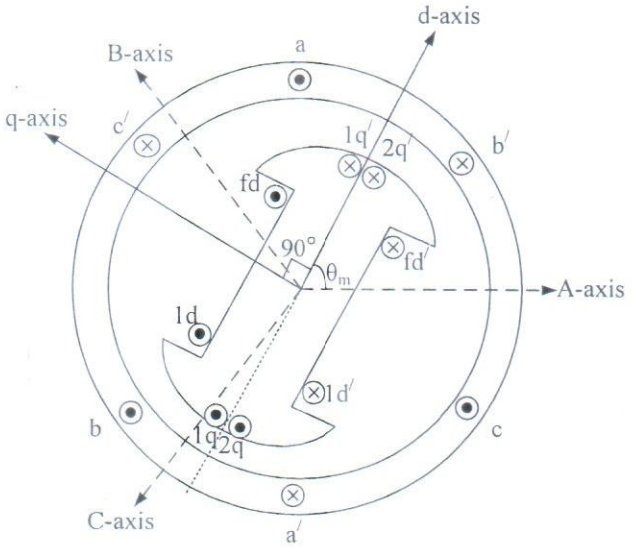

Fig. 2(a)

   i) Show the variation of air-gap permeance as a function of rotor angle (θ_m) and discuss its nature.
   ii) Obtain the expressions for inductance l_{aa} and l_{bc}.

   b) Is it necessary to transform the rotor quantities (flux linkages, currents, voltages, etc.) into d-q reference frame? Justify your answer. 05

3. a) Consider a given abc-dq0 transformation matrix T_{dq0} as follows. 10

$$T_{dq0} = k_1 \begin{bmatrix} \cos(\theta_s) & \cos(\theta_s - 120^\circ) & \cos(\theta_s + 120^\circ) \\ -\sin(\theta_s) & -\sin(\theta_s - 120^\circ) & -\sin(\theta_s + 120^\circ) \\ k_2 & k_2 & k_2 \end{bmatrix}$$

Using $k_1 = \sqrt{\frac{2}{3}}$ and $k_2 = \sqrt{\frac{1}{2}}$ and assuming a three phase balanced set of currents in *abc* reference frame, find out the corresponding expression of current in the *dq0* reference frame.

b) Consider a synchronous generator supplying real power, P_t = 1.0 p.u and reactive power, Q_t = 0.15 p.u with terminal with voltage V_t = 1.0 p.u. The generator is connected to an infinite bus system having voltage V_b through a transmission line having reactance X_L = 0.8 p.u. The machine parameters (in p.u. except otherwise stated) are given as follows: 15

Parameter	Value	Parameter	Value
H	6.0	D	3.0
X_d	1.2	X_q	0.9
X_d'	0.6	T_{do}'	5 sec.
f	50 Hz		

Calculate the initial values of the system variables.

4. a) The third order flux-decay model of a synchronous machine is expressed as: 20

$$\dot{\delta} = \omega_{base}(\omega - 1)$$

$$\dot{\omega} = \frac{1}{2H}(P_m - P_e - P_D)$$

$$\dot{E}_q' = \frac{1}{T_{d0}'}(E_{fd} - E_q)$$

where,

$$P_e = V_{td} I_{td} + V_{tq} I_{tq}; \quad P_D = D(\omega - 1); \; E_q = E_q' + (x_d - x_d')I_{td};$$

$$V_{td} = x_q I_{tq}; \; V_{tq} = E_q' - x_d' I_{td}; \quad I_{td} = \frac{E_q' - V_b \cos\delta}{x_d' + x_L}; \; I_{tq} = \frac{V_b \sin\delta}{x_q + x_L}.$$

Obtain the linearized state space representation of the above model in the form $\dot{X} = AX + BU$.

b) What is damping power, P_D? When does it become activated? Explain in brief. 05

M.Sc.Engg. (EE)/Ph.D. (EE) Date: March 02, 2020 (Afternoon)

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

Mid-Semester Examination
Course No.: EEE 6403
Course Title: Wireless Communication

Summer Semester, A. Y. 2019-2020
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) Show that the theoretical minimum E_b/N_0 is – 1.6 dB for data transfer with negligible error. 10

   b) Compare WiGig with WiFi 6. How does interleaving reduce errors in the received data? 7

   c) The data rate is 100 kbps for signal-to-noise ratio (S/N) = 100. What will be the data rate for S/N = 10000? Assume that S/N >> 1. 8

2. a) Mention which 3GPP and 3GPP2 technologies can support only data services with the maximum data rate. What are the existing TDD cellular technologies? What are the names of the base stations in 2G, 3G, and 4G technologies? 9

   b) Which 3GPP release may first specify 6G cellular communication? Which technology is functioning when H+ appears on the display of the phone? 5

   c) Which one between Voice over LTE (VoLTE) and Circuit Switched FallBack (CSFB) is currently used for voice support in Bangladesh? Give reasons. 5

   d) What is the name of the message that carries the phone number when a voice call is made using 3G or CSFB? Why are different radio bearers (RBs) or data flow pipes required for different types of applications? 6

3. a) Which 3GPP release did first introduce Device-to-Device (D2D) communication? If two phones or UEs do not receive any signal from the base station, do 3GPP standards allow setting up D2D communication between them? 6

   b) What are the advantages of D2D communication? Distinguish between its overlay and underlay modes. 8

   c) Why is discontinuous reception (DRX) used? What does the phone do when it wakes up? 6

   d) Explain the coverage requirement and the capacity requirement considering the deployment of cellular communication. 5

4. a) Explain how radio resources are allocated in downlink and uplink in LTE. 10

   b) What are the three techniques that can be used as in-building solution (IBS)? Write down a short note on distributed antenna system (DAS). 7

   c) What will be the advantage if a fast moving user remains connected to the macrocell as it passes through HetNets? Explain the purpose of cell range extension (CRE). 8

M.Sc. Engg. (EE)/Ph.D
M.Sc.TE, 1st Sem.

Date: February 27, 2020 (Afternoon)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid-Semester Examination
Course No.: EEE 6705/EEE 6195
Course Title: Digital Control System

Winter Semester, A.Y. 2019-2020
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. Use suitable assumptions for missing information.

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1. a) With suitable diagram classify different types of signals. [5]

   b) Briefly explain different types of sampling operation. [5]

   c) Derive the Z-Transform from the Laplace Transform in three steps. [10]

   d) Compare the region of convergence of s-plane and z-planes. [5]

2. a) Briefly explain the significance of Z transformation in designing digital controller for continuous-time system. [5]

   b) For the control system shown in Figure 2.a, find the z-transform of the output of the system $X(s)$. [10]

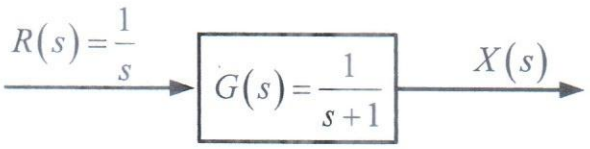

Figure 2.a

   c) Obtain the z transform of k^2 and ka^{k-1}. [10]

3. a) Obtain the inverse z transform of $X(z)$ by using the partial fraction method. [13]

$$X(z)=\frac{z^2+z+2}{(z-1)(z^2-z+1)}.$$

   b) Obtain the inverse z transform of $X(z)$ by using the inverse integral method. [12]

$$X(z)=\frac{z^2}{(z-1)^2(z-e^{-aT})}.$$

4. a) Show that, the Laplace transform of the impulse-sampled signal $x^*(t)$ is same as the z transform of signal $x(t)$ if e^{Ts} is defined as z, or $e^{Ts}=z$. [10]

   b) Derive the transfer function of the first-order hold as follows, [15]

$$G_{h1}(s)=\left(\frac{1-e^{-Ts}}{s}\right)^2\frac{Ts+1}{T}.$$

Table 2-1: Table of z Transform

	$X(s)$	$x(t)$	$x(kT)$ or $x(k)$	$X(z)$
1.	-	-	Kronecker delta $\delta_o(k)$ $1, \quad k=0$ $0, \quad k\neq 0$	1
2.	-	-	$\delta_o(n-k)$ $1, \quad n=k$ $0, \quad n\neq k$	z^{-k}
3.	$\frac{1}{s}$	$1(t)$	$1(k)$	$\frac{1}{1-z^{-1}}$
4.	$\frac{1}{s+a}$	e^{-at}	e^{-akt}	$\frac{1}{1-e^{-aT}z^{-1}}$
5.	$\frac{1}{s^2}$	t	kT	$\frac{Tz^{-1}}{\left(1-z^{-1}\right)^2}$
6.	$\frac{2}{s^3}$	t^2	$(kT)^2$	$\frac{T^2z^{-1}\left(1+z^{-1}\right)}{\left(1-z^{-1}\right)^3}$
7.	$\frac{6}{s^4}$	t^3	$(kT)^3$	$\frac{T^3z^{-1}\left(1+4z^{-1}+z^{-2}\right)}{\left(1-z^{-1}\right)^4}$
8.	$\frac{a}{s(s+a)}$	$1-e^{-at}$	$1-e^{-akt}$	$\frac{\left(1-e^{-aT}\right)z^{-1}}{\left(1-z^{-1}\right)\left(1-e^{-aT}z^{-1}\right)}$
9.	$\frac{b-a}{(s+a)(s+b)}$	$e^{-at}-e^{-bt}$	$e^{-akt}-e^{-bkt}$	$\frac{\left(e^{-aT}-e^{-bT}\right)z^{-1}}{\left(1-e^{-aT}z^{-1}\right)\left(1-e^{-bT}z^{-1}\right)}$
10.	$\frac{1}{(s+a)^2}$	te^{-at}	kTe^{-akt}	$\frac{Te^{-aT}z^{-1}}{\left(1-e^{-aT}z^{-1}\right)^2}$
11.	$\frac{s}{(s+a)^2}$	$(1-at)e^{-at}$	$(1-akt)e^{-akt}$	$\frac{1-(1+aT)e^{-aT}z^{-1}}{\left(1-e^{-aT}z^{-1}\right)^2}$
12.	$\frac{2}{(s+a)^3}$	t^2e^{-at}	$(kT)^2e^{-akt}$	$\frac{T^2e^{-aT}\left(1+e^{-aT}z^{-1}\right)z^{-1}}{\left(1-e^{-aT}z^{-1}\right)^3}$
13.	$\frac{a^2}{s^2(s+a)}$	$at-1+e^{-at}$	$akt-1+e^{-akt}$	$\frac{\left[\left(at-1+e^{-aT}\right)+\left(1-e^{-aT}-aTe^{-aT}\right)z^{-1}\right]z^{-1}}{\left(1-z^{-1}\right)^2\left(1-e^{-aT}z^{-1}\right)}$
14.	$\frac{\omega}{s^2+\omega^2}$	$\sin\omega t$	$\sin\omega kT$	$\frac{z^{-1}\sin\omega T}{1-2z^{-1}\cos\omega T+z^{-2}}$

15.	$\frac{s}{s^2+\omega^2}$	$\cos \omega t$	$\cos \omega kT$	$\frac{1-z^{-1}\cos \omega T}{1-2z^{-1}\cos \omega T+z^{-2}}$
16.	$\frac{\omega}{(s+a)^2+\omega^2}$	$e^{-at}\sin \omega t$	$e^{-akT}\sin \omega kT$	$\frac{e^{-aT}z^{-1}\sin \omega T}{1-2e^{-aT}z^{-1}\cos \omega T+e^{-2aT}z^{-2}}$
17.	$\frac{s}{(s+a)^2+\omega^2}$	$e^{-at}\cos \omega t$	$e^{-akT}\cos \omega kT$	$\frac{1-e^{-aT}z^{-1}\cos \omega T}{1-2e^{-aT}z^{-1}\cos \omega T+e^{-2aT}z^{-2}}$
18.			a^k	$\frac{1}{1-az^{-1}}$
19.			a^{k-1} $k=1,2,3,...$	$\frac{z^{-1}}{1-az^{-1}}$
20.			ka^{k-1}	$\frac{z^{-1}}{(1-az^{-1})^2}$
21.			k^2a^{k-1}	$\frac{z^{-1}(1+az^{-1})}{(1-az^{-1})^3}$
22.			k^3a^{k-1}	$\frac{z^{-1}(1+4az^{-1}+a^2z^{-2})}{(1-az^{-1})^4}$
23.			k^4a^{k-1}	$\frac{z^{-1}(1+11az^{-1}+11a^2z^{-2}+a^3z^{-3})}{(1-az^{-1})^5}$
24.			$a^k\cos k\pi$	$\frac{1}{1+az^{-1}}$
25.			$\frac{k(k-1)}{2!}$	$\frac{z^{-2}}{(1-z^{-1})^3}$
26.		$\frac{k(k-1)...(k-m+2)}{(m-1)!}$		$\frac{z^{-m+1}}{(1-z^{-1})^m}$
27.			$\frac{k(k-1)}{2!}a^{k-2}$	$\frac{z^{-2}}{(1-az^{-1})^3}$
28.		$\frac{k(k-1)...(k-m+2)}{(m-1)!}a^{k-m+1}$		$\frac{z^{-m+1}}{(1-az^{-1})^m}$

Table 2.2: Important Properties and Theorems of the z Transform

	$x(t)$ or $x(k)$	$Z[x(t)]$ or $Z[x(k)]$
1.	$ax(t)$	$aX(z)$
2.	$ax_1(t)+bx_2(t)$	$aX_1(z)+bX_2(z)$
3.	$x(t+T)$ or $x(k+1)$	$zX(z)-zx(0)$
4.	$x(t+2T)$	$z^2X(z)-z^2x(0)-zx(T)$
5.	$x(k+2)$	$z^2X(z)-z^2x(0)-zx(1)$
6.	$x(t+kT)$	$z^kX(z)-z^kx(0)-z^{k-1}x(T)-\ldots-zx(kT-T)$
7.	$x(t-kT)$	$z^{-k}X(z)$
8.	$x(n+k)$	$z^kX(z)-z^kx(0)-z^{k-1}x(T)-\ldots-zx(k-1)$
9.	$x(n-k)$	$z^{-k}X(z)$
10.	$tx(t)$	$-Tz\frac{d}{dz}X(z)$
11.	$kx(k)$	$-z\frac{d}{dz}X(z)$
12.	$e^{-at}x(t)$	$X\left(ze^{aT}\right)$
13.	$e^{-ak}x(k)$	$X\left(ze^{a}\right)$
14.	$a^kx(k)$	$X\left(\frac{z}{a}\right)$
15.	$ka^kx(k)$	$-z\frac{d}{dz}X\left(\frac{z}{a}\right)$
16.	$x(0)$	$\lim_{z\to\infty}X(z)$ if the limit exists
17.	$x(\infty)$	$\lim_{z\to1}\left[\left(1-z^{-1}\right)X(z)\right]$ if $\left(1-z^{-1}\right)X(z)$ is analytic on and outside the unit circle
18.	$\nabla x(k)=x(k)-x(k-1)$	$\left(1-z^{-1}\right)X(z)$
19.	$\Delta x(k)=x(k+1)-x(k)$	$(z-1)X(z)-zx(0)$
20.	$\sum_{k=0}^{n}x(k)$	$\frac{1}{1-z^{-1}}X(z)$
21.	$\frac{\partial}{\partial a}x(t,a)$	$\frac{\partial}{\partial a}x(z,a)$
22.	$k^mx(k)$	$\left(-z\frac{d}{dz}\right)^mX(z)$
23.	$\sum_{k=0}^{n}x(kT)y(nT-kT)$	$X(z)Y(z)$
24.	$\sum_{k=0}^{\infty}x(k)$	$X(1)$

M.Sc. Engg. /Ph.D. (EE) Date: 28 February, 2020 (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. 2019-2020
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.

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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)

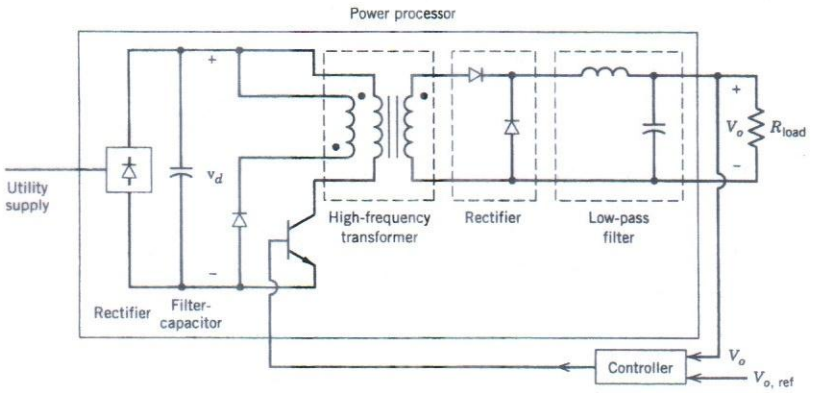

Fig. 1(b)

Figure 1(b) demonstrates the use of power electronic system for SMPS. Clearly identify the advantages of using power electronic over linear electronic systems for the above SMPS.

(c) Consider a switch-mode dc power supply as shown in Fig. 1(c). The input dc voltage v_d = 20 V, duty ratio D = 0.75, switching frequency f_s = 300 kHz and the resistive load draws 240 W. The filter data are L = 1.3μH and C = 50 μF. The attenuation in V_{oi} in decibels can be calculated by the formula, $attenuation = 20\log_{10}\dfrac{V_o(s)}{V_{oi}(s)}$, where $s = j\omega_h = j(2\pi h f_s)$, h is the number of harmonic. Calculate the attenuation in V_{oi} at h = 1, 2 and 3.

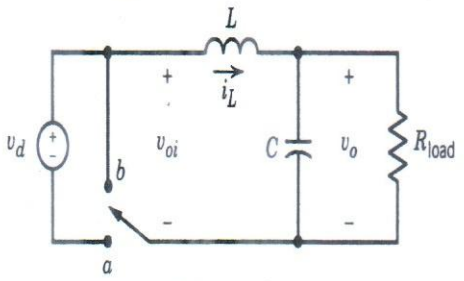

Fig. 1(c)

2. (a) (i) Describe some of the main industrial applications of power electronics.
(ii) Describe desirable characteristics of a controllable switch.

(b) The data sheets of a switching device specify the following switching times corresponding to the linearized switching characteristics for clamped-inductive switching:
t_{ri}=100 ns, t_{fv}=50 ns, t_{rv}=100 ns, t_{fi}=200 ns. Calculate and plot the switching power loss as a function of frequency in a range of 25 to 100 kHz. Assume V_d=400 volt, I_O=6 amp in the following circuit as shown in Fig. 2 (b).

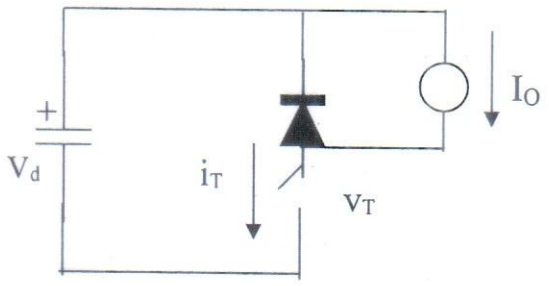

Fig. 2(b)

Comment on the switching power loss of the on-state and off-state of the power electronic switch. If the switching power loss increases with the switching frequency, what trade-off do you think to consider for efficient switching operation?

3.(a) Explain why line current is more distorted in an uncontrolled ac to dc converter without a finite source inductance than that of the converter with finite value of source inductance for a highly inductive load. Calculate the loss of output voltage due to source inductance of an ac to dc converter for a highly inductive load.

(b) An ac to dc uncontrolled 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?

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

(b) A single phase bridge rectifier with a finite source inductance L_S = 5 mH has a constant-current load of 10 amp. It has a frequency of 50 Hz. The input voltage has the following wave-shape as shown in Fig. 4(b).

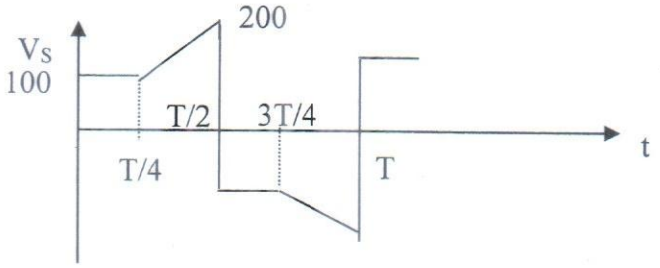

Fig. 4(b)

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