B.Sc. Engg. (EE), 2nd Sem. ui 55 Date: August 14, 2018 (Morning)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid Semester Examination
Course No.: EEE 4203
Course Title: Electronics I

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

There are **4 (four)** questions. Answer **any 3 (three)** questions. Assume reasonable value for any missing data. Programmable calculators are not allowed. Figures in the margin indicate marks of the part questions. Do not write on this question paper.

1.(a) (i) For the circuit shown in Fig. 1(a) (i), sketch and label the waveform of battery current i_B and find its average value. 12

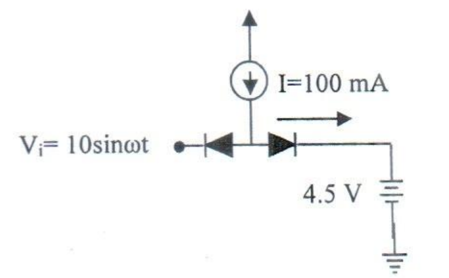


Fig.1(a) (i)

(ii) Find voltage V and current I of the following circuit. Assume the diode is ideal.

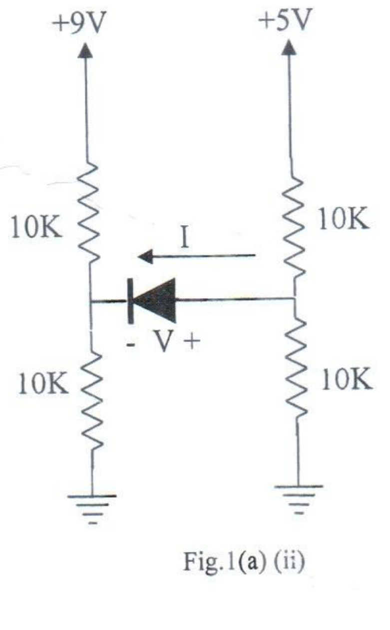


Fig.1(a) (ii)

(b) Design the circuit of Fig. 1 b(i) to provide an output voltage of $V_o = 3.2$ V. The i-v characteristics of the diode is shown in Fig. 1 b(ii) 06

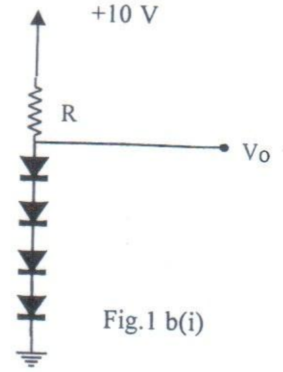


Fig.1 b(i)

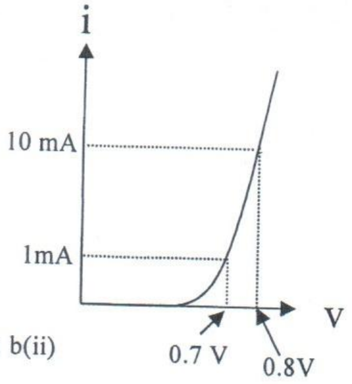


Fig.1 b(ii)

(c) A particular design of a voltage regulator is shown in Fig 1.(c). Each diode D_1 and D_2 has voltage drop of 0.7 V at a current of 10 mA. Each has n = 1. (i) What is the regulated voltage with the 150 Ω load connected? (ii) Find V_o with no load. 07

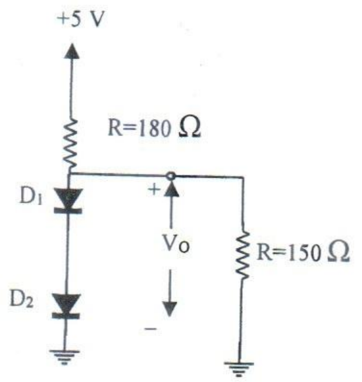
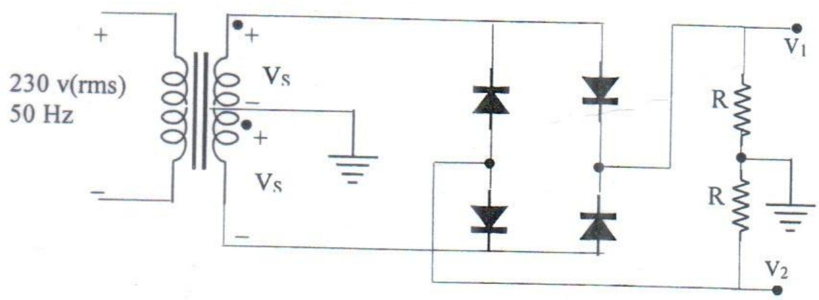


Fig. 1(c)

2.(a) Using the fact that a silicon diode has $I_S = 10^{-14}$ A at 25°C and I_S increases by 15% per degree Celsius rise in temperature. Find the value I_S at 125°C. 04

(b) Sketch and label the waveforms of v_1 and v_2. Assume a 0.7-V drop across each conducting diode. If the magnitude of the average of each output is to be 15 V, find the required amplitude of the sine wave across the entire secondary winding. What is the PIV of each diode? 10



(c) Determine the range V_i that will maintain the zener diode of the circuit shown in Fig. 2c(i) in the "on" state. 11

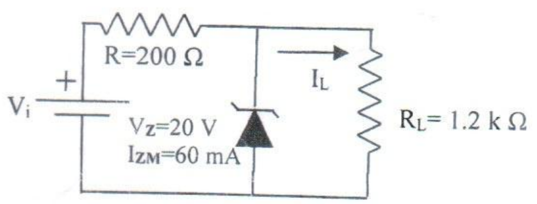
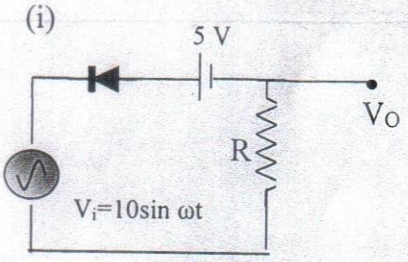


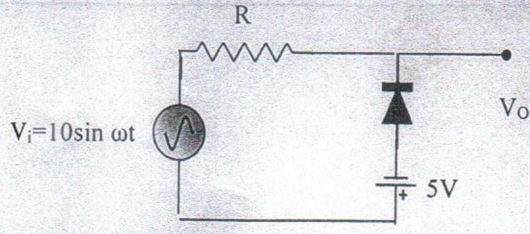
Fig. 2c(i)

3.(a) Find the output waveshapes for the following clippers: 12

(i)

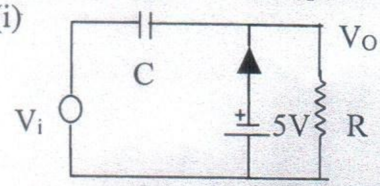


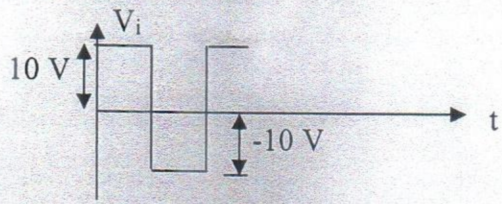
(ii)



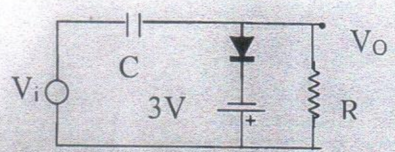
(b) Find the output waveshapes for the following clampers: 13

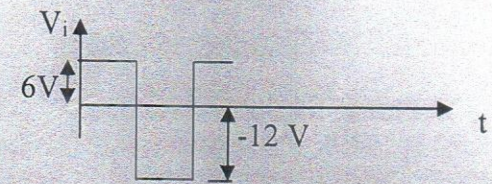
(i)





(ii)

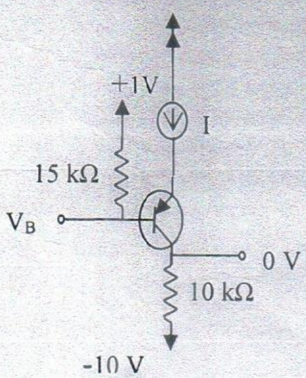




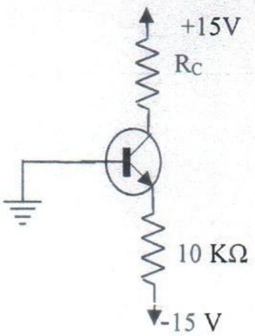
4.(a) Briefly describe how the different currents are generated in any type of BJT with the help of a simplified structure for the active mode of operation. 08

(b) Derive the relationship between α and β of a BJT. Why is the collector current very much close to the emitter current in the active mode of operation? 04

(c) For following circuit, assume that the transistor has α=1. Find V_B and I. 05



(d) The transistor in the following circuit has β=150 and exhibits a v_{BE} of 0.7 V at I_C= 1 mA. Design the circuit so that a current of 2 mA flows through the collector and a voltage of +5 V appears at the collector. 08



58

B. Sc. Engg.(EE), 2nd Sem. Date: August 06, 2018 (Morning)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid-Semester Examination — Summer Semester A. Y. 2017-2018
Course No.: Phy 4221 — Time: 90 Minutes
Course Title: Engineering Physics II — 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) Mention the classification of solids from crystallographic point of view. Crystallographically, which class is favourable and why? 6

   (b) Write down the lattice parameters for monoclinic and hexagonal crystal systems. Draw their 3D Bravais lattices. Calculate number of atoms per unit cell for these systems. 10

   (c) What is the crystalline nature of gold (Au) crystal? Draw a typical unit cell of this crystal. How many unit cells are in a gold foil of length *5.0 cm*, breadth *2.5 cm* and thickness 25 μm? How many gold atoms are in that foil? 9

2. (a) Define packing factor for a crystal system. What is interatomic space? 4

   (b) Calculate packing factors and interatomic spaces for various space lattices in cubic crystal system. 14

   (c) Draw a typical unit cell for NaCl crystal and explain its structure. Write expressions for lattice constant and packing factor in terms of atomic radii of Na and Cl. 7

3. (a) What are Miller indices? How Miller indices are determined? 6

   (b) Sketch separately the following crystal planes and directions in a cubic crystal system: (122), (112), [122] and [112]. 9

   (c) Copper crystal is face centered cubic. The diameter of copper atom is *0.2556 nm*. Calculate interplaner spacing for the (100), (110) and (111) crystal planes. 10

4. (a) What do you mean by defects in crystal? Explain various types of point defects. 12

   (b) Derive Bragg`s law of X-ray diffraction. Distinguish between X-ray diffraction pattern for single crystal and a polycrystalline materials. 13

59

B. Sc. Engg.(EE), 2nd Sem.
B. Sc. TE(2-Yr.), 2nd Sem.

Date: August 09, 2018 (Morning)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid-Semester Examination
Course No. Math 4221/Math 4629
Course Title: Mathematics III

Summer Semester A.Y. 2017-2018
Time: 90 Minutes
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) Prove that in scalar triple product dot and cross can be interchanged. 8

   b) Prove that the volume of the parallelepiped whose edges are the vectors **axb, bxc, cxa** is square of the volume whose edges are **a, b, c**. 8

   c) If the volume of the tetrahedron with edges **a**=2i-j-k, **b**=3i+2j+2k and **c**= 5i-λj+3λk is 4 find the value of λ. 9

2. a) Prove that, $\nabla \times (\phi \mathbf{A}) = \phi(\nabla \times \mathbf{A}) + \nabla\phi \times \mathbf{A}$ and hence find $\nabla \times (r\mathbf{r})$. 12

   b) Determine the constant a, b, c so that the following vector is irrotational: 13

   v=(-4x-3y+az)i+(bx+3y+5z)+(4x+cy+3z).

   Find a scalar function ϕ so that **v**=$\nabla\phi$.

3. a) Find the directional derivative of $\phi = x^2yz + 4xz^2$ at P(1,-2,1) in the direction of the vector a=2i-j-k. Also find the maximum rate of change of ϕ. 12

   b) Evaluate $\int_C \mathbf{F}.d\mathbf{r}$ where F=yi+xj and C is, 13

   i. the arc of $y=x^2-16$ from (4,0) to (6,20) in the xy plane.
   ii. the portion of the x-axis from x=4 to x=6 and then the line x=6 from y=0 to y=20.

4. a) Evaluate $\iint_S \phi\, \mathbf{n} dS$ where $\phi = xyz$ and S is the surface of the cylinder $x^2+y^2=25$ included in the first octant between z=0 and z=7. 12

   b) Evaluate $\iiint_V \phi\, dV$ where, $\phi = x^2y$ and V is the region bounded by the planes x+y+z=8, x=0, y=0, z=0. 13

60

BBA (TM), 2nd Sem. Date: August 06, 2018 (Morning)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid-Semester Examination
Course No.: EEE 4261
Course Title: Electrical and Electronic Technology II

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

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

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1. a) What is majority carrier and minority carrier? Describe the difference between *n*-type and *p*-type semiconductor materials. 6

b) What are the equivalent models available for p-n junction diode? Draw the equivalent circuit and sketch the forward characteristics for each model. 7

c) For the zener diode network of Fig. 1(c), (i) determine V_L, V_R, I_Z and P_Z considering $V_Z = 10$ V and $P_{ZM} = 30$ mW. (ii) Repeat part (i) with $R_L = 3$ kΩ. 12

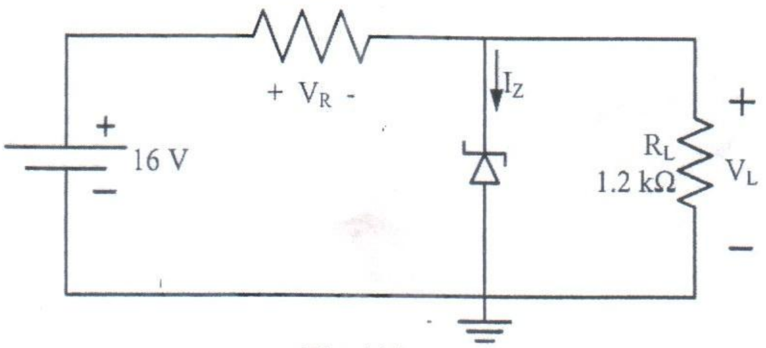

Fig. 1(c)

2. a) A full wave bridge rectifier with a 120 V_{peak} sinusoidal input has a load resistor of 1 kΩ. 15
   i. Draw the circuit diagram.
   ii. Sketch the input and output wave shapes.
   iii. Determine the dc voltage at the output considering ideal diodes.
   iv. Repeat part (ii) with a filter capacitor connected at the output.

b) What is the major difference between a bipolar and unipolar device? Mention which kind of device a BJT is with proper justification. 5

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

3. a) What are the modes of operation of a transistor? Write down the biasing condition of the two junctions for each mode. How should the two junctions be biased for proper transistor amplifier operation? Describe the transistor amplifying action with example. 15

b) Determine the dc bias voltage V_{CE} and collector current I_C for the configuration of Fig. 3(b). Consider $\beta = 140$. 10

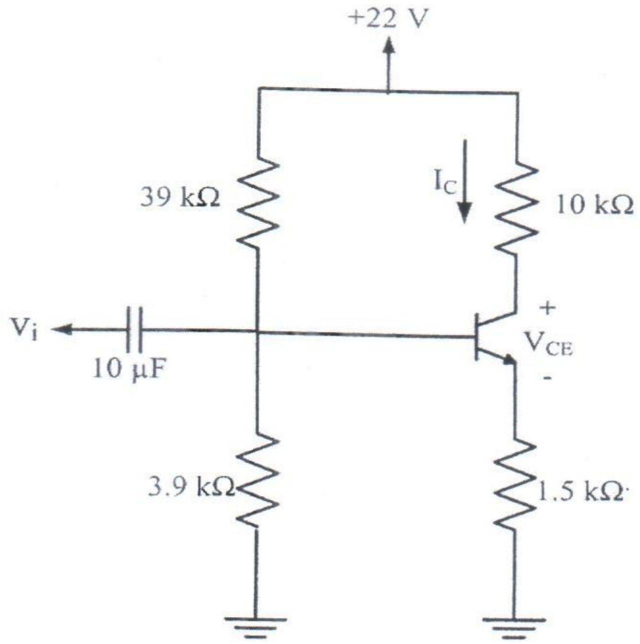

Fig. 3(b)

4. a) What is an op-amp? What are the characteristics of an ideal op-amp? 5

b) Implement the following equation using op-amps: 10

$$2x_1 - 4x_2 - 11\frac{d^2x_3}{dt^2} + \int 8\,x_4\,dt - 3y = 0,$$

where x_1, x_2, x_3 and x_4 are the inputs and y is the output.

c) Determine the dc bias voltage V_{CE} and collector current I_C for the configuration of Fig. 4(c). Consider $\beta = 75$. 10

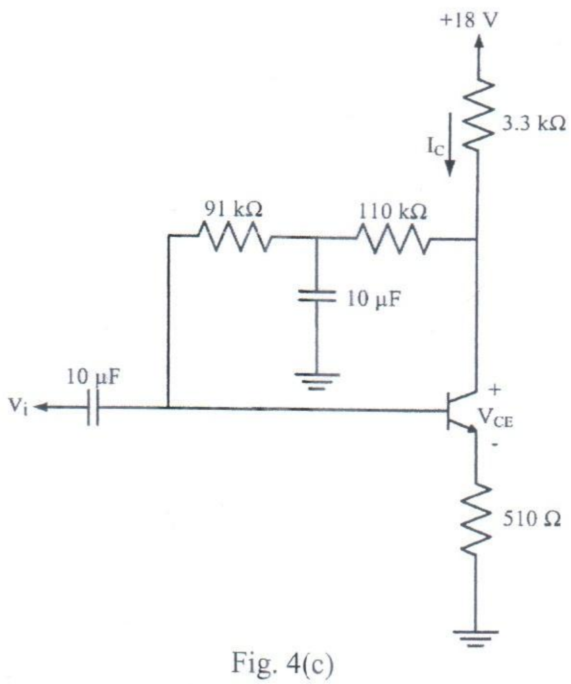

Fig. 4(c)

B.Sc. Engg.(MCE), 2nd Sem. 62 Date: August 13, 2018 (Afternoon)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid-Semester Examination
Course No.: EEE 4281
Course Title: Basic Electrical Engineering

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

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

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1. a) For the circuit shown in Fig. 1(a), find out the values of V_0 and I_0. 10

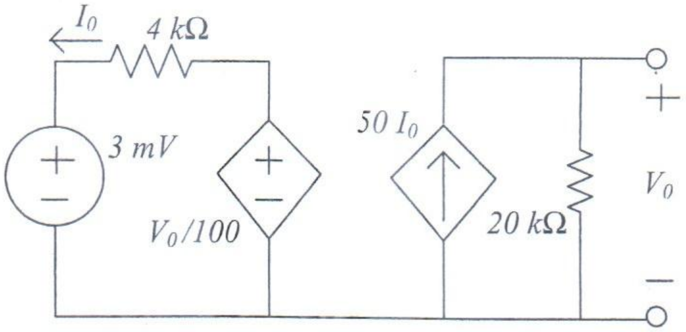

Fig. 1(a)

b) For the bridge network shown in Fig. 1 (b), where $E = 20$ V, $R_S = 3\ \Omega$, $R_1 = 4\ \Omega$, $R_2 = 2\ \Omega$, $R_3 = 2\ \Omega$, $R_4 = 1\ \Omega$ and $R_5 = 5\ \Omega$: 15

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

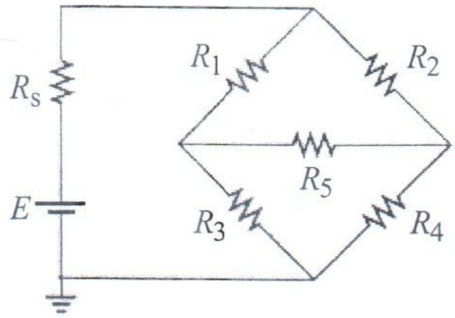

Fig. 1 (b)

2. a) Use source transformation to calculate i_0 in the circuit of Fig. 2 (a). 10

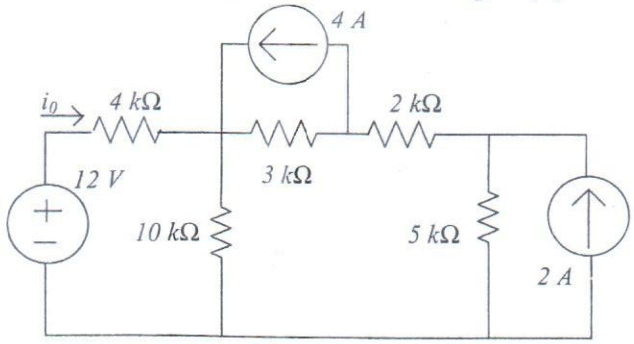

Fig. 2 (a)

b) Find current, i_o for the following circuit shown in figure 2(b). Use superposition theorem. 15

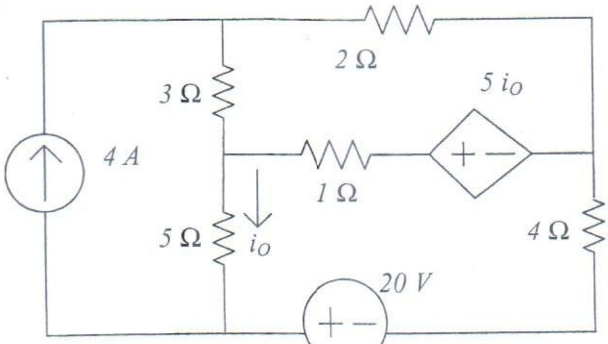

Fig. 2(b)

3. a) The charge flowing through an electric tube is shown in Fig. 3(a). Find and draw the current wave shape through the tube. 8

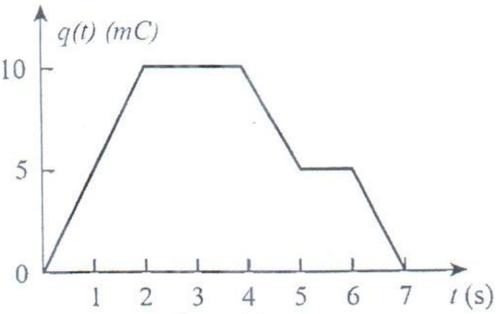

Fig. 3(a)

b) Find current, I in the following circuit of Fig. 3 (b). Assume, all resistors are of equal valued (assume any value) and E = 20V. 8

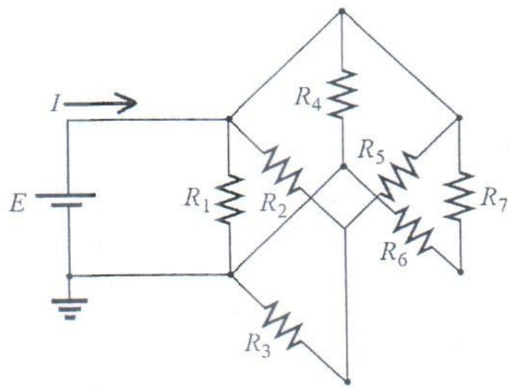

Fig. 3(b)

c) Find out i_1, i_2 and i_3 from the following circuit given in Fig. 3(c). 9

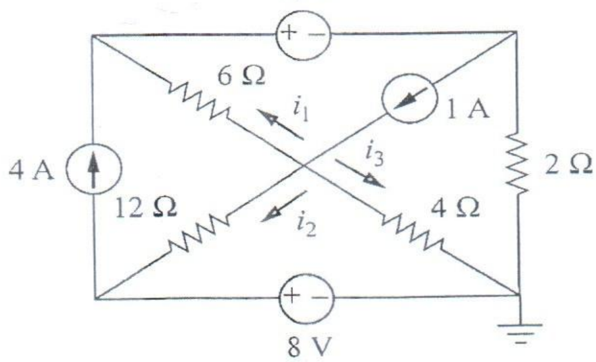

Fig. 3(c)

4\. a) Find current, I through R_2 for the following circuit shown in Fig. 4 (a). Assume, $R_1 = 10\ \Omega$, $R_2 = 4\ \Omega$ and $R_3 = 5\ \Omega$. 5

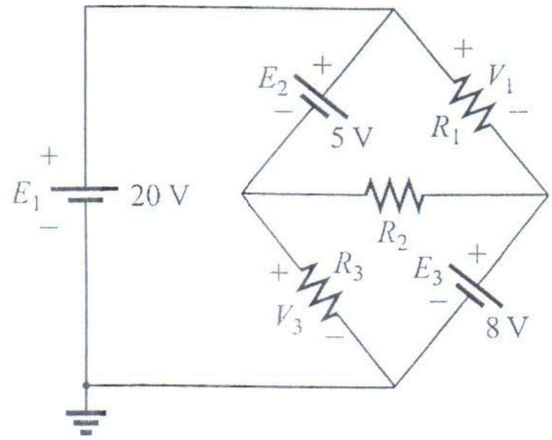

Fig. 4 (a)

b) Find I_5, I_S and V_7 from the following circuit shown in Fig. 4 (b), where $E = 10$ V, $R_1 = 4$ kΩ, $R_2 = 8$ kΩ, $R_3 = 12$ kΩ, $R_4 = 24$ kΩ, $R_5 = 12$ kΩ, $R_6 = 10$ kΩ, $R_7 = 10$ kΩ, $R_8 = 5$ kΩ and $R_9 = 5$ kΩ. 10

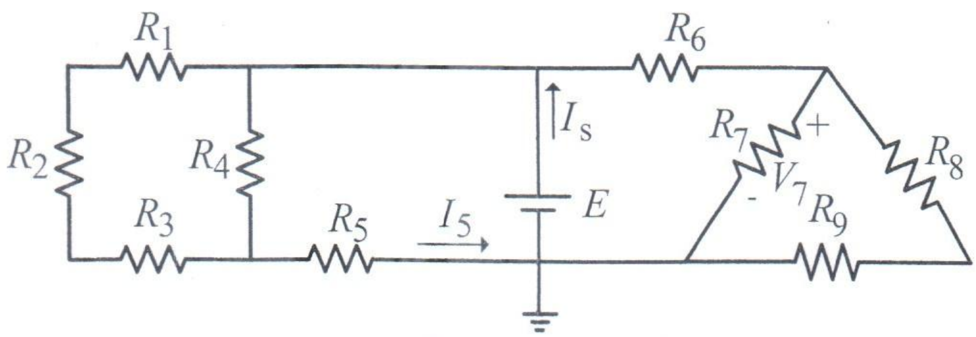

Fig. 4 (b)

c) Find the equivalent resistance with respect to terminals A and B in the following circuit shown in Fig. 4 (c). Assume all the resistance values are equal to 2 kΩ. 10

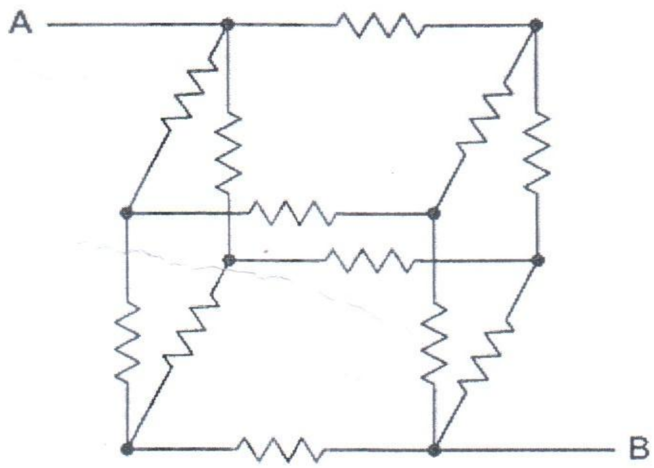

Fig. 4 (c)

65

B.Sc. Engg. (EE) / HDEE, 4th Sem. Date: August 13, 2018 (Afternoon)

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

Mid Semester Examination — Summer Semester, A.Y. 2017-2018
Course No.: EEE 4401 — Time: 90 Minutes
Course Title: Power System II — 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) A balanced three-phase load connected in star consists of (6+8) Ω impedance in each phase. It is connected to a three phase supply of 400 V, 50 Hz. Find : 15
   - (i) Phase current,
   - (ii) Line current,
   - (iii) Per phase power and
   - (iv) Total power.

   b) A single phase 9.6 kVA, 500 V / 1.5 kV transformer has an impedance of 1.302 Ω with respect to primary side. Find its per-unit impedance with respect to primary and secondary sides. 10

2. a) Obtain the symmetrical components for the set of unbalanced three phase voltages $V_a = 300\angle{-120^\circ}$, $V_b = 200\angle{90^\circ}$ and $V_c = 100\angle{-30^\circ}$. 09

   b) The reactance diagram, with reactances specified in per unit, is shown in Fig. 2 (b). A generator with emf equal to $1.25\angle{0^\circ}$ per unit is connected through a transformer to high-voltage node (3), while a motor with internal voltage equal to $0.85\angle{-45^\circ}$ is similarly connected to node (4)· Develop the admittance matrix, Y_{bus} for each of the network branches. 16

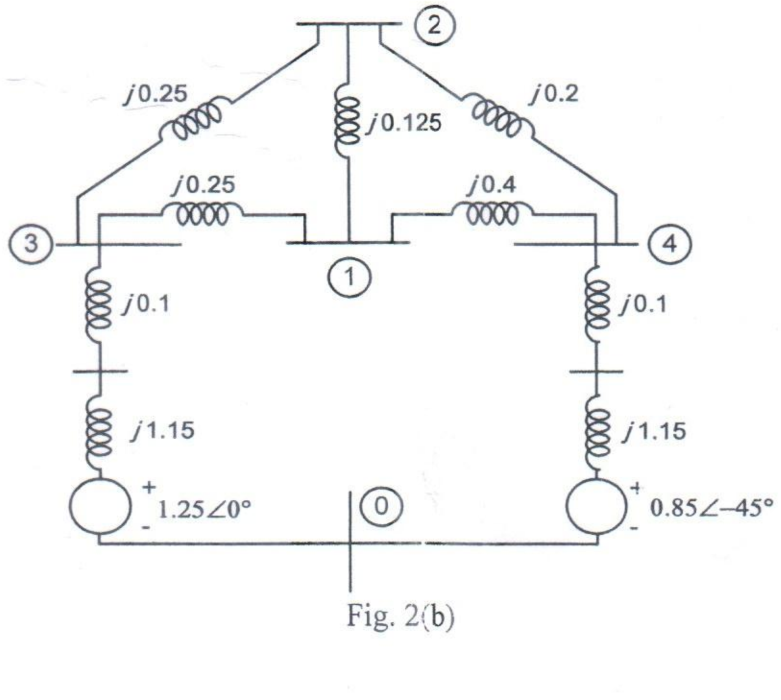

Fig. 2(b)

ee

3\. a) A three phase circuit has a 60 Hz voltage of 208 V line to line and a wye connected load of 28 Ω ∠ 60° per phase. If the phase rotation is ABC and phase A is at zero degrees then draw the phasor diagram mentioning the line currents. 12

b) The three phase power and line-line ratings of the electric power system shown in Fig. 3(b) are given below. 13

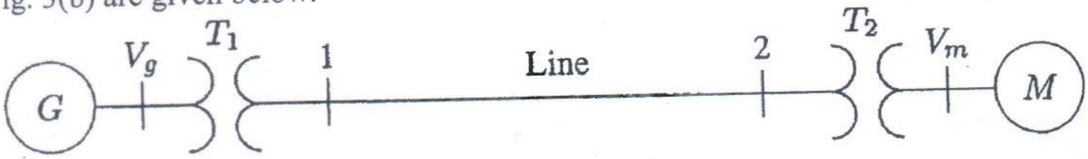

Fig. 3(b)

G_1 :	60 MVA	20 kV	$X = 9\%$
T_1 :	50 MVA	20/200 kV	$X = 10\%$
T_2 :	50 MVA	200/20 kV	$X = 10\%$
M :	43.2 MVA	18 kV	$X = 8\%$
Line:		200 kV	$Z = 120 + j200\ \Omega$

Draw an impedance diagram showing all impedances in per unit on a 100 MVA base. Choose 20 kV as the voltage base for generator.

4\. a) Find a root of the following equation using the Gauss- Seidel method with an acceleration factor of α = 1.25. Perform ***five iterations*** and start with an initial estimate of $x^{(0)} = 2$. 13

$$f(x) = x^3 - 6x^2 + 9x - 4 = 0$$

b) Use Newton-Raphson method to find the solution of the following nonlinear equations: 12

$$x_1^2 - 2x_1 - x_2 = 3$$
$$x_1^2 + x_2^2 = 41$$

Start with the initial estimates of $x_1^{(0)} = 2$, $x_2^{(0)} = 3$. Perform ***three iterations*** for partial derivatives as Jacobian matrix of the above equations.

67

B.Sc. Engg. (EE) / HDEE, 4th Sem. Date: August 14, 2018 (Afternoon)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid-Semester Examination — Summer Semester, A. Y. 2017-2018
Course No.: Math 4421 — Time: 90 Minutes
Course Title: Random Signals and Processes — 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) Suppose Bappi wants to eat a sandwich but needs to go on a diet. So, Bappi decides to let the flip of a coin determine whether he eats. Using an unbiased coin, Bappi will postpone the diet (and go directly to the refrigerator) if either (I) he flips heads on his first flip or (II) he flips tails on the first flip but then proceeds to get two heads out of the next three flips. Note that the first flip is not counted in the attempt to win two of three and that Bappi never performs any unnecessary flips. Let H_i be the event that Bappi flips heads on try i. Let T_i be the event that tails occurs on flip i. 08
   i) Sketch the tree for this experiment. Label the probabilities of all outcomes carefully.
   ii) What are $P[H_3]$ and $P[T_3]$?

   b) Computer programs are classified by the length of the source code and by the execution time. Programs with more than 150 lines in the source code are big (B). Programs with less than or equal to 150 lines are little (L). Fast programs (F) run in less than 0.1 seconds. Slow programs (W) require at least 0.1 seconds. Monitor a program executed by a computer. Observe the length of the source code and the run time. The probability model for this experiment contains the following information: $P[LF] = 0.5$, $P[BF] = 0.2$, and $P[BW] = 0.2$. What is the sample space of the experiment? Calculate the following probabilities. 07
   i) $P[W]$,
   ii) $P[B]$,
   iii) $P[W \cup B]$.

   c) In an experiment, *A, B, C,* and *D* are events with probabilities $P[A \cup B] = 5/8$, $P[A] = 3/8$, $P[C \cap D] = 1/3$, and $P[C] = 1/2$. Furthermore, *A* and *B* are disjoint, while *C* and *D* are independent. 10
   i) Find $P[A \cap B]$, $P[B]$, $P[A \cap B^C]$, and $P[A \cup B^C]$.
   ii) Are *A* and *B* independent?
   iii) Find $P[D]$, $P[C \cap D^C]$, $P[C^C \cap D^C]$, and $P[C|D]$.
   iv) Find $P[C \cup D]$ and $P[C \cup D^C]$.

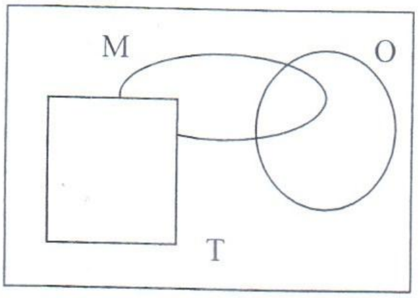
2. a) Explain the terms difference, mutually exclusive and collectively exhaustive. 7.5

   b) Monitor three consecutive phone calls going through a telephone switching office. Classify each one as a voice call (v) if someone is speaking, or a data call (d) if the call is carrying a modem or fax signal. Your observation is a sequence of three letters (each one is either v or d). For example, three voice calls corresponds to vvv. The outcomes vvv and ddd have probability 0.2 whereas each of the other outcomes vvd, vdv, vdd, dvv, dvd, and ddv has probability 0.1. Count the number of voice calls N_v in the three calls you have 10 observed. Consider the four events $N_v = 0$, $N_v = 1$, $N_v = 2$, and $N_v = 3$. Describe in words and also calculate the following probabilities.

i) $P[N_v = 2]$.
ii) $P[N_v \geq 1]$.
iii) $P[\{vvd\}|N_v = 2]$.
iv) $P[\{ddv\}|N_v = 2]$.
v) $P[N_v = 2|N_v \geq 1]$.
vi) $P[N_v \geq 1|N_v = 2]$.

c) A pizza at Pizza Hut is either Regular (R) or Tuscan (T). In addition, each slice may have mushrooms (M) or onions (O) as described by the Venn diagram shown below. For the sets specified below, shade the corresponding region of the Venn diagram. 7.5

(i) R
(ii) $M \cup O$
(iii) $M \cap O$
(iv) $R \cup M$
(v) $R \cap M$
(vi) $T^C - M$



3. a) Explain the families of a discrete random variable X. Include PMF of X, E[X] and Var[X] in your answer. 10

b) Suppose that a cellular phone costs $20 per month with 30 minutes of use included and that each additional minute of use costs $0.50. If the number of minutes you use in a month is a geometric random variable M with expected value of $E[M] = 1/p = 30$ minutes, what is the PMF of C, the cost of the phone for one month? Express C as a function of M, the number of minutes used. What is the expected monthly cost E [C]? 15

4. a) Determine the expected values of Poisson and Geometric random variables. 13

b) Suppose each day (starting on day 1) you buy one lottery ticket with probability *1/2*; otherwise, you buy no tickets. A ticket is a winner with probability p independent of the outcome of all other tickets. Let N_i be the event that on day i you do not buy a ticket. Let W_i be the event that on day i, you buy a winning ticket. Let L_i be the event that on day i you buy a losing ticket. 12

(i) What are P[W33], P[L87], and P[N_{99}]?
(ii) Let K be the number of the day on which you buy your first lottery ticket. Find the PMF $P_K(k)$.
(iii) Find the PMF of R, the number of losing lottery tickets you have purchased in m days.
(iv) Let D be the number of the day on which you buy your jth losing ticket. What is $P_D(d)$?

B.Sc. Engg.(EE) / HDEE, 4th Sem. Date: August 10, 2018 (Afternoon)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid-Semester Examination
Course No.: EEE 4403
Course Title: Communication Engineering I

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

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

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1. a) How do you define yourself as Electrical Communication Engineer? What does make you different than other engineers? Explain your answer with suitable example. 5

b) Why communication is important in our daily life? What is electrical communication system? How electron is used as carrier of messages? What are the advantages of electrical communication? How did people in old days communicate to send message in distant places? How does modern communication technique improve the telecommunication method? Give suitable example of some modern communication techniques. 10

c) "Any signal outside of the devices is continuous analog signal", explain with suitable example. What are Analog communication system and Digital communication system? Explain with suitable example. How do electrical communication technologies improve productivity and energy conversion? Explain with suitable example. 10

2. a) In the commutation system, "The transmitter modifies the baseband signal for efficient transmission in the channel". Explain with suitable example, how does transmitter modify the baseband signal. 4

b) As an IUT communication expert you want to transmit your voice from South hall to your friend at North hall. During your design, you have found that communication system requires pair of devices and well synchronization among them. Explain this requirement with suitable diagram. 11

Using the following block diagrams as much as possible, draw basic communication diagram depending upon your desired model (you may not use all diagrams). Explain your design model and each block that you have chosen. If you want to create a digital communication system, how many devices do you need and where do you need to put them in the communication system? Explain your method with the help of the following block diagram.

c) An IUT communication expert observes that double side band (DSB) amplitude modulation simply shifts the spectrum of baseband signal to the carrier frequency. Explain the characteristics of DSB amplitude modulation technique with suitable illustrations and define the upper sideband and lower sideband. Why is this technique called double-sideband suppressed carrier (DSB-SC)? 10

70

3. a) For your sustainable communication products, why are distortion and noise important? Explain distortion and noise with suitable example. "Proper care can reduce the effect of noise but can never eliminate it", - explain with suitable example. 4

b) What is desired signal and what is unwanted signal? Why do you prefer the signal to noise ratio (SNR) greater than 1? Why is SNR usually measured in decibels (dB)? In the communication system, how SNR improves better communication technology? 5

c) As an engineer, to build a real world practical product, you need to follow four steps. 11
Step1: Finding problem and define expected solution and hypothesis,
Step2: Create Mathematical Model,
Step3: Create Simulation Model,
Step4: Create Practical Product.
Briefly explain each step with suitable example (use any communication engineering problem as a case study, as for example, designing a Modulator).

d) Sometimes engineers require to think out of the box and break the circle of theoretical boundaries. Explain this method mentioning the choice of the value of incoming signal strength *Vs* and the noise level *Vn* while calculating SNR. 5

4. a) What are baseband communication and Carrier communication? What is modulation technique? How does the modulation technique solve the antenna sizing problem for wireless communication? 5

b) To build a mathematical model of a modulator, frequency shifting (FS) property of Fourier Transform (FT) gives a suitable guideline, explain the FS property. 5

In practical device, imaginary term $e^{j\omega_c t}$ used in Fourier Transform cannot be used. How do you solve this problem to build your desire real life product?

c) What do you mean by the time domain and frequency domain representation? Explain with suitable diagram. 7

With necessary illustration, explain the graphical representation of frequency domain terms $G(\omega), G(\omega-\omega_c)$, and $G(\omega+\omega_c)$ for the time domain signal $g(t)$.

d) You want to transmit a DSB-SC modulated signal $m(t)\cos\omega_c t$ to your friend. At the receiving end, you have asked your friend to create a demodulator/detector, which is almost identical to the modulator you have used except one element. Write down the name of that element. Draw and explain the demodulator/detector circuit. Why are DSB-SC demodulators called synchronous or coherent or homodyne demodulators? 8

7L

B.Sc. Engg. (EE) / HDEE, 4th Sem.
DTE. 2nd Sem.

Date: August 9, 2018 (Afternoon)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid-Semester Examination
Course No.: EEE 4405/EEE 4491
Course Title: Energy Conversion II

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

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

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1. a) Answer the following questions in brief:
   - (i) Explain, with suitable diagrams, how a uniformly rotating magnetic field of equal magnitude is produced from 3-phase supply currents which are 120° apart. 4
   - (ii) Define 'Slip (s)'. Sketch the rotor speed (N_r) vs. slip (s) curve showing three different regions: brake region, motor region and generator region. Show the range of values of 's' at different regions. 3
   - (iii) In which region, mentioned in (ii), the rotor current will be the highest? What will be the state of the stator currents under the same cases? 3
   - (iv) What will be the behavior of a 3-phase induction motor if the slip-ring connection of wound rotor is kept open and a 3-phase supply is given to the stator? Explain the behavior for both standstill and running conditions. 3
   - (v) If you increase the supply voltage of a three phase induction motor, what will be the change in synchronous speed and the rotor speed? 2

   b) A 480-V, 60-Hz, 50-hp, three-phase induction motor is drawing 60 A at 0.85 pf lagging. The stator copper losses are 2 kW, and the rotor copper losses are 700 W. The friction and windage losses are 600 W, the core losses are 1800 W, and the stray losses are negligible. Find the following quantities: 4×2.5 = 10
   - (i) The air-gap power P_{AG}.
   - (ii) The power converted P_{conv}.
   - (iii) The output power P_{out}.
   - (iv) The efficiency of the motor.

2. a) Torque of an induction motor (T_r) can be written as, 5×3.5 =17.5

$$T_r = \frac{3}{2\pi N_S} \frac{sE_2^2 R_2}{R_2^2 + (sX_2)^2}.$$

   - (i) Sketch the shape of a typical three phase induction motor torque speed characteristic curve. Show the stable and unstable regions.
   - (ii) Using above equation, derive the condition of maximum torque under running condition.
   - (iii) Suppose a three phase induction motor is having a total rotor resistance of R_2 and standstill rotor reactance, X_2 where $R_2 > X_2$. Show the effect of increasing rotor resistance on torque speed characteristic curve.
   - (iv) Is it possible to change the value of maximum running torque of a three phase induction motor by changing rotor resistance (R_2)? Explain with torque speed characteristic curve for different values of R_2.
   - (v) Show the effect of changing rotor resistance (R_2) on the rotor current (I_2) for both standstill condition and running condition.

b) A three phase induction motor having a star-connected rotor has an induced e.m.f. of 80 volts between slip-rings at stand still on open-circuit. The rotor has a resistance and reactance per phase of 1 Ω and 4 Ω respectively. Calculate current / phase and power factor when (i) slip rings are short-circuited (ii) slip-rings are connected to a star-connected rheostat of 3 Ω per phase. 7.5

3. a) Why is a single-phase induction motor unable to start itself without special auxiliary windings? Explain using double revolving-field theory. 7

b) A 3-phase induction motor having a 6 pole, star-connected stator winding runs on 240 V, 50 Hz supply. The rotor resistance and standstill reactance are 0.12 Ω and 0.85 Ω per phase respectively. The effective ratio of stator to rotor turns is 1.8. Full load slip is 4%. 18

(i) Calculate the developed torque at full load.
(ii) Calculate the maximum torque.
(iii) Calculate the speed at maximum torque.
(iv) Calculate the starting torque of the motor.

If the motor is stopped, will the motor start with the full load? If the motor starts, what will be the starting torque? If the motor does not start, what can be done to start the motor with this amount of load? Show necessary calculations.

4. a) Describe the operating principle of a capacitor start-induction-run single phase motor. Show the circuit diagram, torque-speed characteristics and vector diagram. 7

b) How can you reverse the direction of rotation of a capacitor start-induction-run motor? 3

c) If you increase the supply frequency of a capacitor start-induction-run motor, what change will occur in the speed of the rotor? Describe with torque-speed characteristic curve. 3

d) How is starting torque produced in a shaded-pole motor? 5

e) In which direction a shaded-pole motor run? How can you reverse the direction of a shaded-pole motor? 2

f) What are the methods of speed-control for a single phase induction motor? 5

73

B.Sc. Engg. (EE) / HDEE, 4th Sem. Date: August 06, 2018 (Afternoon)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid-Semester Examination
Course No.: Phy 4421
Course Title: Semiconductor Devices

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

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

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1. a) What do you mean by uncertainty principle? Show that, for the particle in the infinite potential well the wave function can be written as $\psi(x) = \sqrt{\frac{2}{a}} \sin Kx$. 7

   b) What is tunneling? For an electron with an energy of 2 eV impinging on a potential barrier with $V_0 = 20$ eV and a width of 3 Å, calculate the probability of the electron tunneling through a potential barrier. 7

   c) What is carrier generation and recombination? Define excess minority carrier lifetime. 7

   d) Excess electrons have been generated in a semiconductor to a concentration of $\delta n(0) = 10^{15}\ \text{cm}^{-3}$ .The excess carrier lifetime is $\tau_{n0} = 10^{-6}$ s. The forcing function generating the excess carrier turns off at $t = 0$ so the semiconductor is allowed to return to an equilibrium condition for $t > 0$. Calculate the excess electron concentration for $t = 0$ and $t = 6\ \mu s$. 4

2. a) What are metals, insulators and semiconductors? Explain them with their respective energy band diagrams. From k-space diagram draw the E versus k curve for the free electron. 8

   b) Derived the general expression for the density of allowed electron quantum states using the model of a free electron with mass m bounded in a three-dimensional infinite potential well. 12

   c) The Fermi energy for copper at $T = 1000$ K is 7.0 eV. The electrons in copper follow the Fermi-Dirac distribution function. Find the probability of an energy level at 7.15 eV being occupied by an electron. 5

3. a) What is thermal equilibrium? Determine the electron and hole concentration using the quadratic formula at thermal-equilibrium. 8

   b) Calculate the intrinsic carrier concentration in GaAs at $T = 300$ K and $T = 450$ K. Where the values of N_c and N_v at $T = 300$ K for GaAs are $4.7 \times 10^{17}\ \text{cm}^{-3}$ and $7 \times 10^{18}\ \text{cm}^{-3}$ respectively. Both N_c and N_v vary as $T^{3/2}$. Assume the bandgap energy of GaAs is 1.42 eV and does not vary with temperature over this range. 9

c) For an n-type silicon doped with arsenic at a concentration of $N_d = 10^{16}$ cm^{-3}, determine the temperature at which 95% of donor atoms are ionized. Where the values of $N_c = 1.04 \times 10^{19}$ at $T = 300$ K and assume the degeneracy factor, $g = 4$. The impurity ionization energy in silicon for arsenic is 0.05 eV. 8

4. a) Define mobility effect and conductivity. The hole concentration is given by $p = 10^{16} \exp(-x/L_p)$ cm^{-3} for $x \geq 0$ and the electron concentration is given by $n = 5 \times 10^{14} \exp(+x/L_n)$ cm^{-3} for $x \leq 0$. The values of L_p and L_n are 5×10^{-4}cm and 10^{-3}cm respectively. The hole and electron diffusion coefficients are 10 cm^2/s and 25 cm^2/s respectively. The total current density is defined as the sum of the hole diffusion current density at $x = 0$ and the electron diffusion current density at $x = 0$. Calculate the total current density. 12

b) What is Hall effect? What is the significance of negative Hall voltage? Draw the geometry for measuring the Hall effect. 7

c) Determine the majority-carrier concentration and mobility, where $L = 10^{-1}$ cm, $W = 10^{-2}$ cm, and $d = 10^{-3}$ cm. Also assume that $I_x = 1.5$ mA, $V_x = 12.5$ V, $B = 500$ gauss $= 5 \times 10^{-2}$ tesla, and $V_H = 8.25$ mV. 6

75

B.Sc. Engg. (CSE)/HDCSE, 4th Sem. Date: August 09, 2018 (Morning)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid-Semester Examination
Course No.: EEE 4483
Course Title: Digital Electronics and Pulse Techniques

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

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

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1. a) Mentioning differential and common inputs applied to an op-amp, derive the following equation, where A_d and A_c have their usual meanings. Draw relevant diagrams that is helpful to explain the steps of derivation. 10

$$\text{CMRR (log)} = 20 \log_{10} \frac{A_d}{A_c}$$

b) If a reference voltage of 10 V is applied to a 3-bit Flash ADC, draw the complete circuit diagram and truth table showing the voltage ranges, output from the comparators and output from the priority encoder. 8

c) Explain the operation of a sample and hold (S/H) circuit. Draw the generic block diagram of S/H circuit. Assuming sinusoidal signal as input, draw the output from the switching gate, sampled output and final version of the signal from the S/H circuit. 7

2. a) Show the capacitor charging and discharging path drawing the internal block diagram of a 555 Timer. 5

b) Derive the design equations from the circuit schematics from 2(a). From the derived design equations find the period, frequency and duty cycle. Draw the timing diagram of capacitor voltage, comparator outputs (set and reset), output from the flip-flop and transistor voltage. 8+3

c) Draw the circuit diagram of a bistable multivibrator which includes a 555 timer. Show the output in wave shapes with arbitrary trigger and reset input. 4+2

d) Natural human voice occupies the range of 80 to 3,400 Hz. Human ear can tolerate signal-to-noise ratio (SNR) of 40 dB. Assume we want to transmit human voice in digitized form. What bit rate (bps) should be supported by the channel to enable such transmission? What is possible number of levels with the bit rate? 2+1

3. a) What are the different layers of abstraction in digital system design? Draw the Gajski and Kuhn's Y-chart showing different design domains. 2+5

b) Briefly explain the vector types in VHDL. 3

c) With examples show ways to concatenate multiple signals in VHDL. 3

d) Write a complete VHDL code of a 4-bit ALU which can perform addition, 12 subtraction, AND-operation, OR-operation, NOT-operation and XOR-operation.

4. a) Calculate V_o in the circuit of Fig. 4(a). 5

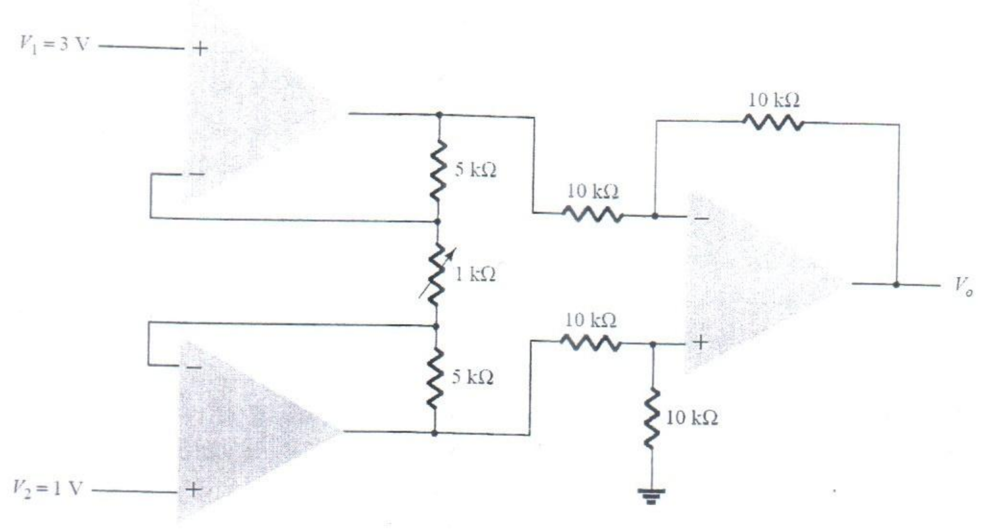

Fig. 4(a)

b) What are the disadvantages of binary-weighted input digital-to-analog converter (DAC)? How to overcome the disadvantages by using R-2R ladder DAC? 5

c) Design a voltage level detector with noise immunity that indicates when an input signal crosses the nominal threshold of -2.5 V. The output is to switch from high to low when the signal crosses the threshold in the positive direction, and vice versa. Expected noise level is 0.2 $V_{P\text{-}P}$, maximum. Assume the output levels are $V_H = 10$ V and $V_L = 0$ V. 15

B.Sc. Engg.(EE)/HDEE, 6th Sem. Date: August 09, 2018 (Morning)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid-Semester Examination
Course No.: EEE 4601
Course Title: Signals and Systems

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

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

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1. a) What are meant by signals and systems from electrical engineering point of view? Give examples. How are discrete time (DT) signals prepared from continuous time (CT) signals? Are all DT signals digital? Justify your answer.

   b) How are the even and odd parts of a signal separated? Sketch the even and odd parts of the following signals; 10

   (i) $x(t) = (1+t^3)\cos^3(10t)$

   (ii) $x[n] = \begin{cases} n, & 0 \le n \le 5 \\ 0, & \text{otherwise} \end{cases}$.

   c) A rectangular pulse $p(t)$ is defined by 10

   $$p(t) = \begin{cases} A, & 0 \le t \le T \\ 0, & \text{otherwise} \end{cases}.$$

   The pulse is applied to an integrator defined by,

   $$y(t) = \int_0^t p(\tau)d\tau .$$

   Find the total energy of the output $y(t)$.

2. a) A signal $x(t)$ is applied to a system S as shown in Fig. 2(a). The system is performing time scaling and time shifting operation on $x(t)$. What is the precedence rule for the operations performed by S? What is the consequence of not maintaining the precedence rule. Discuss with an example.

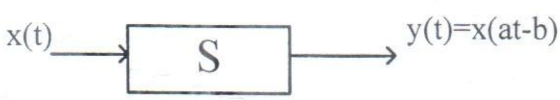

Fig.2(a)

   b) A CT signal $x(t)$ is depicted in Fig. 2(b). Sketch $y(t) = x(3t) + x(3t+2)$. 10

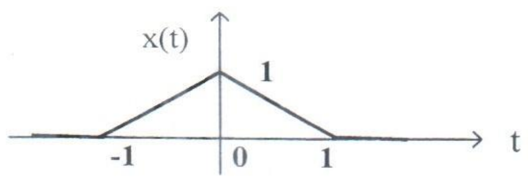

Fig. 2(b)

c) Consider an LTI system whose response to the signal $x_1(t)$ is $y_1(t)$ as shown in Fig. 2(c). Sketch the output of the system for the input $x_2(t)$. 10

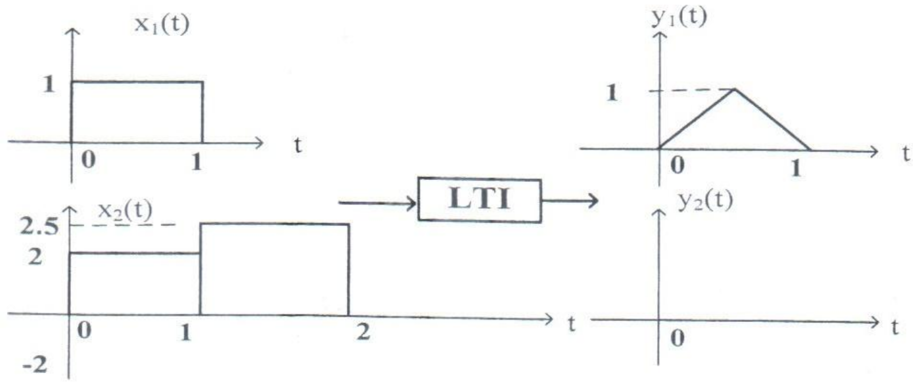

Fig. 2(c)

3. a) Show that the zero state response (ZSR) of an LTI system can be determined as 5

$$y[n] = x[n] * h[n].$$

Where, $x[n]$ and $h[n]$, are respectively the input and impulse response of the system and '*' stands for convolution operation.

b) What is meant by impulse response of a system? A simple DT model of a multipath communication system is given by the following I/O relation: 10

$$y[n] = x[n] + 0.5x[n-1] + 0.25x[n-2].$$

Find the impulse response $h[n]$ of the system and the output of the system for the following input:

$$x[n] = \begin{cases} 2, & n = 0 \\ 4, & n = 1 \\ 0, & elsewhere \end{cases}.$$

c) The impulse response of a first order CT system is given as, $h(t) = e^{-t}u(t)$. Find the ZSR $y(t)$ of the system if the input is $x(t) = u(t)$. 10

4. a) Define Laplace transform and verify the initial and final value theorems for $f(t) = 1 + e^{-t}(\sin t + \cos t)$. 10

b) Considering the RC circuit shown in Fig. 4(b), find the relationship between the input x(t) and the output y(t) if, i) x(t) = $v_s(t)$ and y(t) = $v_c(t)$ and ii) x(t) = $v_s(t)$ and y(t) = i(t). Using Laplace technique, find the system function H(s) and the impulse response h(t) of the RC circuit. 15

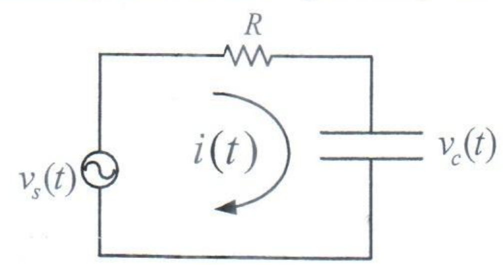

Fig. 4(b)

79

B.Sc. Engg.(EE)/ HDEE, 6th Sem.
BScTE (2-Yr), 2nd Sem
DTE, 2nd Sem

Date: August 14, 2018 (Morning)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid-Semester Examination
Course No.: EEE 4603/93/4493
Course Title: Measurement and Instrumentation

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

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

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1. a) Briefly describe the different types of errors in measurement system. 05

   b) What are the problems of measuring low resistances by using a Wheatstone Bridge? How these problems can be overcome by using Kelvin Double Bridge? Derive operating equation for Kelvin Double Bridge. 12

   c) Explain, with neat sketches, the working principle of a PMT (Photo Multiplier Tube). 08

2. a) Define active and passive transducers. Derive an expression for the gauge factor of a strain gauge. 13

   b) Fig. (1) shows two strain gauges R_{g1} and R_{g2} mounted on a cantilever. The bridge arrangement for the two gauges is shown in Fig. (2) where $R_3 = R_4 = 100\ \Omega$ and both the strain gauges have unstrained resistance of $120\ \Omega$. The galvanometer has resistance of $50\ \Omega$ and current sensitivity of 4 mm/μA. For both the gauges Poisson's ratio is 0.5. The battery voltage is 4 V. 12

      (i) Calculate the output voltage and galvanometer current when a strain of 400 microstrain is applied.

      (ii) Suppose, the previous galvanometer is replaced by a galvanometer with resistance of $100\ \Omega$ and current sensitivity of 5 mm/μA. Which galvanometer will be more sensitive to a small unbalance due to the applied strain?

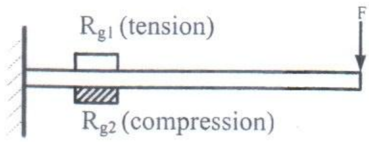

Fig. (1)

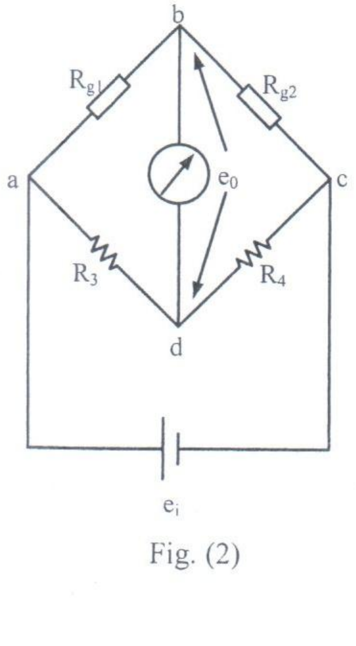

Fig. (2)

3. a) With neat diagrams, explain how linear motion is converted to electrical signal using LVDT (Linear Variable Differential Transformer). Also, explain how LVDT can be incorporated for electro-mechanical pressure measurement. 15

b) A parallel plate capacitive transducer uses plates of area 500 mm^2 which are separated by a distance of 0.2 mm. Calculate the value of capacitance when the dielectric is air having a permittivity of 8.85×10^{-12} F/m. 10

(i) Calculate the change in capacitance if a linear displacement reduces the distance between the plates to 0.18 mm. Also, calculate the ratio of per unit change of capacitance to per unit change of displacement.

(ii) Suppose a mica sheet of 0.01 mm thickness is inserted in the gap. Calculate the value of original capacitance and change in capacitance for the same displacement. Also, calculate the ratio of per unit change in 'capacitance to per unit change in displacement. The dielectric constant of mica is 8.

4. a) Briefly discuss the working principle of a PMMC (Permanent Magnet Moving Coil) galvanometer. Also, write the steady state torque equation and discuss the dynamic behavior of the deflection of a PMMC. 13

b) The voltmeter in Fig. (3) uses a 1 mA meter movement with an internal resistance of 200 Ω. The shunt resistance R_{sh} across the movement is 400 Ω. Diodes D_1 and D_2 each has a forward resistance of 100 Ω, zero cut-in voltage and infinite reverse resistance. 12

(i) Explain the function of resistance R_{sh}.

(ii) Explain the function of diode D_2.

(iii) Calculate the values of series resistors R_1, R_2 and R_3, if the required meter ranges are 50 V, 100 V and 200V.

(iv) Determine the sensitivity of the AC voltmeter.

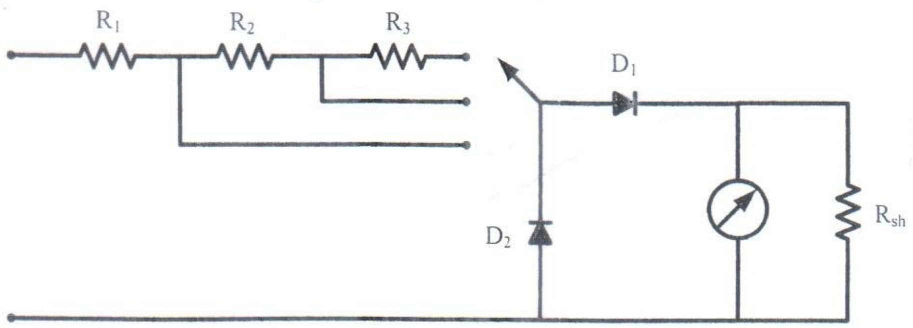

Fig. (3)

81

B.Sc. Engg. (EE) /HDEE, 6^{th} Sem.
B.Sc.TE (2Yr.) 2nd Sem.

Date: August 06, 2018 (Morning)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid-Semester Examination
Course No.: EEE 4605/ EEE 4689
Course Title: Microcontroller Based System Design

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

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

1.a) Why and in which applications microcontrollers are preferred over microprocessors? (03)

b) What is addressing mode? How many addressing modes 8051 microcontroller has? (05)

c) Draw the block diagram of the internal architecture of 8051 microcontroller showing the most common features. (03)

d) A byte of information is needed to be sent serially to a peripheral connected to P3.5 of 8051 microcontroller. The device is reasonable slower than the microcontroller. What measures can be taken to resolve the speed-mismatch issue? The status of the peripheral may be obtained through P3.4 (Busy = 1). Write the corresponding code. (07)

e) Write a program to design a switched binary counter using a switch connected to P2.0 and eight LEDs connected to P1. (07)

2.a) What is the information provided by the name *AT89C52-24PC?* (02)

b) Two bytes of information is saved into memory location 90-91H. Write a program to find the number of 1's in those bytes and store the result to the memory location 80H. (08)

c) Write a program to find the lowest number present in RAM memory locations 40-49H. Save the number into register R5. (15)

3.a) What is lookup table? Write a program to receive decimal values 0-6 from Port 1 of 8051 and send the cubed values to the Port 2 using lookup table. (07)

b) Write a program for the following actions: (10)
 i. To receive an 8-bit binary number through the Port 3 of 8051 microcontroller.
 ii. Convert the number into decimal number.
 iii. Find the ASCII values of the converted number.

c) Explain how PWM signal can be used to control the speed of a DC motor? Generate a 10% duty cycle PWM signal of frequency 1kHz at pin 0 of port 1 using 12 MHz crystal connected to 8051. (08)

8051 Instruction Set Summary

Rn Register R7-R0 of the currently selected Register Bank.

Data 8-bit internal data location's address. This could be an internal Data RAM location (0-127) or a SFR [i.e. I/O port, control register, status register, etc. (128-255)].

@Ri 8-bit Internal Data RAM location (0-255) addressed indirectly through register R1 or R0.

#data 8-bit constant included in instruction.

#data16 16-bit constant included in instruction.

addr16 16-bit destination address. Used by LCALL and LJMP. A branch can be anywhere within the 64k byte Program Memory address space.

addr11 11-bit destination address. Used by ACALL and AJMP. The branch will be within the same 2k byte page of Program Memory as the first byte of the following instruction.

rel Signed (two's component) 8-bit offset byte. Used by SJMP and all conditional jumps. Range is –128 to +127 bytes relative to first byte of the following instruction.

bit Direct Addressed bit in Internal Data RAM or Special Function Register.

Instruction	Flag C	Flag OV	Flag AC	Instruction	Flag C	Flag OV	Flag AC
ADD	X	X	X	CLR C	O		
ADDC	X	X	X	CPL C	X		
SUBB	X	X	X	ANL C,bit	X		
MUL	O	X		ANL C,/bit	X		
DIV	O	X		ORL C,bit	X		
DA	X			ORL C,/bit	X		
RRC	X			MOV C,bit	X		
RLC	X			CJNE	X		
SETB C	1						

Note that operations on SFR byte address 206 or bit addresses 209-215 (i.e. the PSW or bits in the PSW) will also affect flag settings.

Mnemonic	Description	Byte	Cycle
Arithmetic operations			
ADD A,Rn	Add register to accumulator	1	1
ADD A,direct	Add direct byte to accumulator	2	1
ADD A,@Ri	Add indirect RAM to accumulator	1	1
ADD A,#data	Add immediate data to accumulator	2	1
ADDC A,Rn	Add register to accumulator with carry flag	1	1
ADDC A,direct	Add direct byte to A with carry flag	2	1
ADDC A,@Ri	Add indirect RAM to A with carry flag	1	1
ADDC A,#data	Add immediate data to A with carry flag	2	1
SUBB A,Rn	Subtract register to accumulator with borrow	1	1
SUBB A,direct	Subtract direct byte to A with carry borrow	2	1
SUBB A,@Ri	Subtract indirect RAM to A with carry borrow	1	1
SUBB A,#data	Subtract immediate data to A with carry borrow	2	1
INC A	Increment accumulator	1	1
INC Rn	Increment register	1	1
INC direct	Increment direct byte	2	1
INC @Ri	Increment indirect RAM	1	1
DEC A	Decrement accumulator	1	1
DEC Rn	Decrement register	1	1
DEC direct	Decrement direct byte	2	1
DEC @Ri	Decrement indirect RAM	1	1
INC DPTR	Increment data pointer	1	2
MUL AB	Multiply A and B -> [B hi]:[A lo]	1	4
DIV AB	Divide A by B -> A=result, B=remainder	1	4
DA A	Decimal adjust accumulator	1	1
CLR A	Clear accumulator	1	1
CPL A	Complement accumulator	1	1
RL A	Rotate accumulator left	1	1
RLC A	Rotate accumulator left through carry	1	1
RR A	Rotate accumulator right	1	1
RRC A	Rotate accumulator right through carry	1	1
SWAP A	Swap nibbles within the accumulator	1	1
Logic operations			
ANL A,Rn	AND register to accumulator	1	1
ANL A,direct	AND direct byte to accumulator	2	1
ANL A,@Ri	AND indirect RAM to accumulator	1	1
ANL A,#data	AND immediate data to accumulator	2	1
ANL direct,A	AND accumulator to direct byte	2	1
ANL direct,#data	AND immediate data to direct byte	3	2
ORL A,Rn	OR register to accumulator	1	1
ORL A,direct	OR direct byte to accumulator	2	1
ORL A,@Ri	OR indirect RAM to accumulator	1	1
ORL A,#data	OR immediate data to accumulator	2	1
ORL direct,A	OR accumulator to direct byte	2	1
ORL direct,#data	OR immediate data to direct byte	3	2
XRL A,Rn	Exclusive OR register to accumulator	1	1
XRL A,direct	Exclusive OR direct byte to accumulator	2	1
XRL A,@Ri	Exclusive OR indirect RAM to accumulator	1	1
XRL A,#data	Exclusive OR immediate data to accumulator	2	1
XRL direct,A	Exclusive OR accumulator to direct byte	2	1
XRL direct,#data	Exclusive OR immediate data to direct byte	3	2
Boolean variable manipulation			
CLR C	Clear carry flag	1	1
CLR bit	Clear direct bit	2	1
SETB C	Set carry flag	1	1
SETB bit	Set direct bit	2	1
CPL C	Complement carry flag	1	1
CPL bit	Complement direct bit	2	1
ANL C,bit	AND direct bit to carry flag	2	2
ANL C,/bit	AND complement of direct bit to carry	2	2
ORL C,bit	OR direct bit to carry flag	2	2
ORL C,/bit	OR complement of direct bit to carry	2	2
MOV C,bit	Move direct bit to carry flag	2	1
MOV bit,C	Move carry flag to direct bit	2	2
Program and machine control			
ACALL addr11	Absolute subroutine call	2	2
LCALL addr16	Long subroutine call	3	2
RET	Return from subroutine	1	2
RETI	Return from interrupt	1	2
AJMP addr11	Absolute jump	2	2
LJMP addr16	Long jump	3	2
SJMP rel	Short jump (relative address)	2	2
JMP @A+DPTR	Jump indirect relative to the DPTR	1	2
JZ rel	Jump if accumulator is zero	2	2
JNZ rel	Jump if accumulator is not zero	2	2
JC rel	Jump if carry flag is set	2	2
JNC rel	Jump if carry flag is not set	2	2
JB bit,rel	Jump if bit is set	3	2
JNB bit,rel	Jump if bit is not set	3	2
JBC bit,rel	Jump if direct bit is set and clear bit	3	2
CJNE A,direct,rel	Compare direct byte to A and jump if not equal	3	2
CJNE A,#data,rel	Compare immediate to A and jump if not equal	3	2
CJNE Rn,#data,rel	Compare immed. to reg. and jump if not equal	3	2
CJNE @Rn,#data,rel	Compare immed. to ind. and jump if not equal	3	2
DJNZ Rn,rel	Decrement register and jump in not zero	2	2
DJNZ direct,rel	Decrement direct byte and jump in not zero	3	2
NOP	No operation	1	1
Data transfer			
MOV A,Rn	Move register to accumulator	1	1
MOV A,direct*)	Move direct byte to accumulator	2	1
MOV A,@Ri	Move indirect RAM to accumulator	1	1
MOV A,#data	Move immediate data to accumulator	2	1
MOV Rn,A	Move accumulator to register	1	1
MOV Rn,direct	Move direct byte to register	2	2
MOV Rn,#data	Move immediate data to register	2	1
MOV direct,A	Move accumulator to direct byte	2	1
MOV direct,Rn	Move register to direct byte	2	2
MOV direct,direct	Move direct byte to direct byte	3	2
MOV direct,@Ri	Move indirect RAM to direct byte	2	2
MOV direct,#data	Move immediate data to direct byte	3	2
MOV @Ri,A	Move accumulator to indirect RAM	1	1
MOV @Ri,direct	Move direct byte to indirect RAM	2	2
MOV @Ri,#data	Move immediate data to indirect RAM	2	1
MOV DPTR,#data16	Load data pointer with a 16-bit constant	3	2
MOVC A,@A+DPTR	Move code byte relative to DPTR to accumulator	1	2
MOVC A,@A+PC	Move code byte relative to PC to accumulator	1	2
MOVX A,@Ri	Move external RAM (8-bit addr.) to A	1	2
MOVX A,@DPTR	Move external RAM (16-bit addr.) to A	1	2
MOVX @Ri,A	Move A to external RAM (8-bit addr.)	1	2
MOVX @DPTR,A	Move A to external RAM (16-bit addr.)	1	2
PUSH direct	Push direct byte onto stack	2	2
POP direct	Pop direct byte from stack	2	2
XCH A,Rn	Exchange register to accumulator	1	1
XCH A,direct	Exchange direct byte to accumulator	2	1
XCH A,@Ri	Exchange indirect RAM to accumulator	1	1
XCHD A,@Ri	Exchange low-order nibble indir. RAM with A	1	1

*) MOV A,ACC is not a valid instruction

jne A,#data,@ *(jump if A ! = data)*		cjne	A,#data,@			
je A, #data,@ *(jump if A == data)*		add jz	A,#low(–data) @	*or* ne:	cjne jmp ...	A,#(data),ne @
ja, jnbe A,#data,@ *(jump if A > data)*		add jc	A,#low(–data–1) @	*or* ne:	cjne jnc	A,#(data+1),ne @
jae, jnb A,#data,@ *(jump if A >= data)*		add jc	A,#low(–data) @	*or* ne:	cjne jnc	A,#(data),ne @
jb, jnae A,#data,@ *(jump if A < data)*		add jnc	A,#low,(–data) @	*or* ne:	cjne jc	A,#(data),ne @
jbe, jna A,#data,@ *(jump if A <= data)*		add jnc	A,#low(–data–1) @	*or* ne:	cjne jc	A,#(data+1),ne @
switch A <,==,> #data *(no A modification)*	 ne:	cjne ... jc jnc	A,#data,ne is_below is_above	; execute code if A==data ; jump if A<data ; jump if A>data or exec. code		

84

B. Sc. Engg.(EE), 2nd Sem. Date: August 09, 2018 (Morning)
B. Sc. TE(2-Yr.), 2nd Sem.

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid-Semester Examination Summer Semester A.Y. 2017-2018
Course No. Math 4221/Math 4629 Time: 90 Minutes
Course Title: Mathematics III 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) Prove that in scalar triple product dot and cross can be interchanged. 8

   b) Prove that the volume of the parallelepiped whose edges are the vectors **axb, bxc, cxa** is square of the volume whose edges are **a, b, c**. 8

   c) If the volume of the tetrahedron with edges **a**=2i-j-k, **b**=3i+2j+2k and **c**= 5i-λj+3λk is 4 find the value of λ. 9

2. a) Prove that, ∇x(ϕ**A**) = ϕ(∇x**A**) + $\nabla\phi$x**A** and hence find ∇x(**r**r). 12

   b) Determine the constant a, b, c so that the following vector is irrotational: 13

   v=(-4x-3y+az)i+(bx+3y+5z)+(4x+cy+3z).

   Find a scalar function ϕ so that **v**=$\nabla\phi$.

3. a) Find the directional derivative of $\phi=x^2yz+4xz^2$ at P(1,-2,1) in the direction of the vector a=2i-j-k. Also find the maximum rate of change of ϕ. 12

   b) Evaluate $\int_C$ **F.dr** where F=yi+xj and C is, 13

   i. the arc of $y=x^2-16$ from (4,0) to (6,20) in the xy plane.
   ii. the portion of the x-axis from x=4 to x=6 and then the line x=6 from y=0 to y=20.

4. a) Evaluate $\iint_S \phi$ ndS where $\phi=xyz$ and S is the surface of the cylinder $x^2+y^2=25$ included in the first octant between z=0 and z=7. 12

   b) Evaluate $\iiint_V \phi\, dV$ where, $\phi = x^2y$ and V is the region bounded by the planes x+y+z=8, x=0, y=0, z=0. 13

965

B.Sc. Engg.(EE)/ HDEE, 6th Sem. Date: August 13, 2018 (Morning)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid-Semester Examination
Course No.: EEE 4625
Course Title: Utilization of Electrical Energy

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

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

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1. a) Define diversity factor, demand factor and load factor. Explain the disadvantages of poor load factor and diversity factor. 07

   b) What are meant by standing costs and running costs? Which one of them is dependent on energy usage? Draw the approximate daily load curve of IUT gymnasium and academic building for summer season. 08

   c) The annual load duration curve of a certain power station can be considered as straight line from 20 MW to 4 MW. To meet this load, three turbine generator units, two rated at 10 MW each and one rated at 5 MW are installed. Determine (i) installed capacity, (ii) plant factor, (iii) units generated per annum, (iv) load factor and (v) utilization factor. 10

2. a) What are the different types of tariffs? Explain each of them in detail. 12

   b) State Kelvin's economy law related to the selection of most economic conductor size. Prove that this size is obtained whenever the variable part of annual charge equals the cost of energy losses in the year. 05

   c) A consumer has an average demand of 400 kW at a p.f of 0.8 lagging and annual load factor of 50%. The tariff is Tk. 50 per kVA of maximum demand per annum plus 5 paisa per kWh. If the power factor is improved to 0.95 lagging by installing phase advancing equipment then calculate (i) the capacity of phase advancing equipment and (ii) the annual saving effected. 08
   The phase advancing equipment costs Tk 100 per kVAR and the annual interest and depreciation together amount to 10%.

3. a) Define steady state stability of a motor-drive system. Derive the expression for change in the speed of a motor-drive system following a small disturbance either in the motor side or in the load side. 12

   b) What is the difference between steady state and transient stability of electric drive system? In which case the linearized analysis is valid and why? 05

   c) A motor-driven pulley system is carrying a cage of 5 kg at one end of a rope and the other end is counter balanced by a weight of 10 kg. Determine the operating mode of the motor-driven pulley if the cage is loaded with 3 kg and it is desired to move the cage (i) up and (ii) down by the motor. Draw the figure and show the direction of movement (speed) of the motor, the torque directions and the quadrant of operation in these two cases. 08

4. a) What are the different types of motor ratings used in industries? Define heating time constant of a motor. Prove that the temperature rise of a motor can be expressed by $\theta = \theta_f(1 - e^{-\frac{t}{T}})$. 15

b) The following temperature variations are observed in the temperature rise test of a DC motor. 10
After 1 hour : 15° C
After 3 hours : 25° C
Find out (i) the final steady temperature rise and rise time constant of the motor and (ii) the steady temperature rise after 1 hour at 50% overload, from cold. Assume that the final temperature rise on 50% overload is 90° C.

B.Sc. Engg.(EE)/ HDEE, 6th Sem. Date: August 07, 2018 (Morning)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid-Semester Examination
Course No.: EEE 4631
Course Title: Renewable Energy

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

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

---

1. a) What is the basic criterion for distinguishing between renewable and non-renewable energy sources? Based on that, categorize the following energy sources: i) solar, ii) wind, iii) natural gas, iv) hydro, v) biogas, vi) nuclear, and vii) coal. 08

   b) What are the major problems being created by the continuous usage of fossil fuel based energy sources? How could you contribute towards the minimization of those problems? 05

   c) What is a blackbody? Consider the earth to be a blackbody with an average surface temperature of 12° C and an area equal to 5.1×10^{14} m^2. i) Find the rate at which the energy is radiated by the earth and the wavelength at which maximum power is radiated? ii) Compare this peak wavelength with that for a 5800 K blackbody (the sun)? iii) Draw the complete emissive power spectrum for the earth. iv) Calculate the solar emissive power available from the visible range of spectrum. 12

2. a) How do you identify whether an energy source is renewable or sustainable? Can an energy source be categorized as renewable as well as sustainable? Explain in short with proper example. 05

   b) Mention the difference between extraterrestrial solar flux and terrestrial solar flux. What is meant by zero air-mass ratio (AM0)? Where do we use this? 05

   c) Find the optimum tilt angle for a south-facing photovoltaic module in Dhaka (latitude 23.81° N) and San'aa (latitude 15.36° N) at solar noon on March 1. What would be the facing and optimum tilt angle of the module for the places having latitudes 23.81° S and 15.36° S, respectively? 15

3. a) What is solar declination angle? How does it vary throughout the day (24-hour period) for a particular location on the earth? Justify your answer with required mathematical equation(s). 05

   b) Explain the flow of diffusion and drift currents in a PV junction diode under no biasing? How would that change with the introduction of biasing? Provide necessary diagrams. 10

   c) Find the direct beam solar radiation normal to the sun's rays at solar noon on a clear day in Abuja, Nigeria (latitude 9.072° N) on April 15. 10

4. a) What are the different components of solar radiation available on the earth surface? Which one of them could be neglected? Explain the reason. 05

b) Explain the formation of forward bias in a PV cell under solar radiation with neat diagram. Which component of current of become dominant under this condition? Does the flow of the remaining component of current completely stop under forward bias? Justify your answer. 10

c) What is meant by dark saturation current? Why is it named so? Consider an 80 cm^2 PV cell with reverse saturation current $I_0 = 10^{-10}$ A/cm2. In full sun, it produces a short-circuit current of 20 mA/cm^2 at 25° C. Find the open-circuit voltage at full sun (100% sunlight) and for 30% sunlight. Plot the results. 10

Formula:

$$E_\lambda = \frac{3.74\times10^8}{\lambda^5\left[\exp\left(\frac{14400}{\lambda T}\right)-1\right]};\qquad E = A\sigma T^4;\qquad \lambda_{max}(\mu\text{m}) = \frac{2898}{T(\text{K})};$$

$$\delta = 23.45\sin\left[\frac{360}{365}(\text{n}-81)\right];\qquad \beta_N = 90^\circ - L + \delta;\qquad A = 1160 + 75\sin\left[\frac{360}{365}(\text{n}-275)\right];$$

$$k = 0.174 + 0.035\sin\left[\frac{360}{365}(\text{n}-100)\right];\qquad m = \frac{1}{\sin\beta};\qquad I_B = Ae^{-km};$$

$$I = I_{SC} - I_0(\text{e}^{\text{qV/kT}}-1).$$

93

B.Sc. Engg.(EE), 8th Sem.

Date: August 10, 2018 (Afternoon)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid-Semester Examination
Course No.: EEE 4805
Course Title: Telecommunication Engineering

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

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

---

1. a) What mathematical dilemma is the cause for having several different definitions of bandwidth? 5

   b) Define an energy signal and power signal. Write the properties of autocorrelation of an energy signal and a power signal. 10

   c) Identify whether the following signals are energy signals and / or power signals. Find the normalized energy and / or normalized power of each 10
      I. $x(t) = A \sin 2\pi f_0 t$ for $-\infty < t < \infty$,
      II. $x(t) = 5 \cos t + \cos 2t$ for $-\infty < t < \infty$.

2. a) Demonstrate duobinary coding and decoding for the following sequence: {xk} = 0 0 1 0 1 1 0 0 1 1 1 0 0 1 0 1 1 1 0 0 0. Consider the first bit of the sequence to be a startup digit, not part of the data. Illustrate this example for differential precoding. 10

   b) The analog signal recovered from the sampled, quantized, and transmitted pulses will contain corruptions from several sources. Explain different corruptions. 15

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

   b) Consider the functions $\psi_1(t) = \exp(-|t|)$ and $\psi_2(t) = 1 - A\exp(-2|t|)$ determine the constant A such that $\psi_1(t)$ and $\psi_2(t)$ are orthogonal over the interval $(-\infty\ \infty)$. 10

4. a) Explain uniform and non-uniform quantization. Which kind of quantization is used for speech communication? Explain in details. 10

   b) Explain the vector view of signals and noise. Derive the waveform energy from that. 8

   c) Describe the basic steps in demodulation or detection of digital signal. Express the normalized energy E_i associated with waveform t over a symbol interval T. 7

94 X

B.Sc. Engg.(EE), 8th Sem., B.Sc.TE(2-Yr), 4th Sem. Date: August 06, 2018 (Afternoon)
B.Sc.TE(1-Yr), 2nd Sem.

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid-Semester Examination
Course No.: EEE 4813/EEE 4881
Course Title: Energy Conversion

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

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

---

1. a) What is energy? Name different types of energy sources and discuss any 4 (four) of them. 15

   b) What is meant by energy conversion? Briefly discuss the operating principle of the electromechanical energy conversion system shown in Fig. 1(b) below. 5

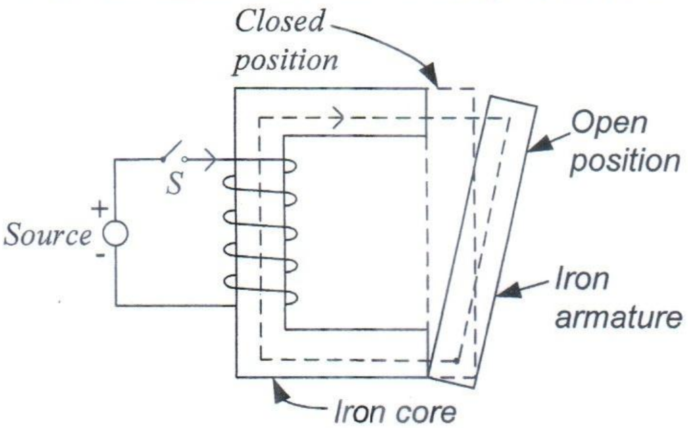

Fig. 1(b)

   c) If the armature of Fig. 1(b) is fixed in its open position then show that, $W_{fld} = \int_0^\lambda i(\lambda)d\lambda = \int_0^\varphi F(\varphi)d\varphi$. 5

2. a) Write four assumptions for an ideal transformer. 5

   b) Define self and mutual inductance and show that, $\begin{bmatrix}\lambda_1\\ \lambda_2\end{bmatrix} = \begin{bmatrix}L_{11} & L_{12}\\ L_{21} & L_{22}\end{bmatrix} \times \begin{bmatrix}i_1\\ i_2\end{bmatrix}$ for two coupled coils. 10

   c) Assume that the functional relationship of mmf F, flux ϕ, and the position coordinate x is given by $F = \phi^2 x^2$. Find the mechanical force f acting in the x direction. Use both the energy and coenergy expressions and show that the results are identical. 10

3. a) For a linear coupled circuit, show that the coefficient of coupling K is the geometric mean of the coupling factors k_1 and k_2. 5

   b) Show that, the expression of energy in a doubly excited magnetic system is $W_{fld} = \frac{1}{2}L_{11}i_1^2 + \frac{1}{2}L_{22}i_2^2 + L_{12}i_1 i_2$. 10

c) The inductances in henrys of a multiply excited electromechanical energy conversion system are given as $L_{11} = (3 + \cos 2\theta) \times 10^{-3}$; $L_{12} = 0.1\cos\theta$; $L_{22} = 30 + 10\cos 2\theta$. Find the torque $T_{fld}(\theta)$ for the current $i_1 = 1$ A; $i_2 = 0.01$ A and plot the torque components. 10

4. a) Drawing an e-q curve for a simple charged capacitor, point out energy and co-energy and write the corresponding integral equation. 5

b) Show that, $W_{fld} = W'_{fld} = \frac{1}{2}Ce^2$ for energy in the electrostatic field. 10

c) If the i-λ plots of Fig. 4(c) pertain to the relay of Fig. 1(b), find the expression for the electrical energy input, increase in field energy and mechanical energy output in terms of λ_1, λ_2 and i_1, i_2. 10

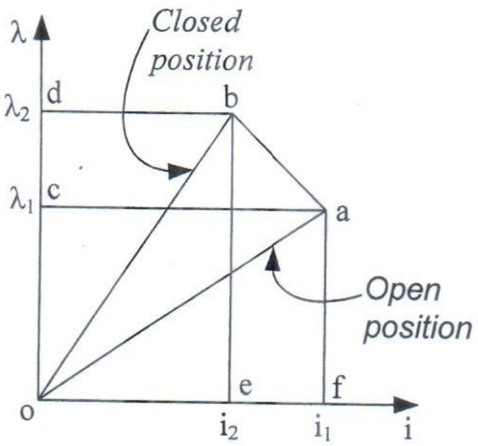

Fig. 4(c)

B.Sc. Engg. (EE), 8th Sem. Date: August 14, 2018 (Afternoon)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid-Semester Examination
Course No.: EEE 4831
Course Title: Semiconductor Devices

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

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

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1. a) Write one and three dimensional Schrödinger wave function, where both space and time dependencies could be explained. Discuss Schrödinger wave function for z-dimension and separate time dependent and independent equations. 5

   b) Write short note on potential well problem and discuss its wave function along with the derivation of amplitude constant, where symbols carry their respective meaning. Also calculate the first three energy levels for an electron in the quantum well of width 10 Å with infinite walls. 15

   c) Discuss the quantum mechanical tunneling of electron through a barrier of finite thickness and height. 5

2. a) Write short note on i) epitaxial growth, ii) lattice matching in epitaxial growth, iii) vapor phase epitaxy and iv) molecular beam epitaxy. 16

   b) Draw the diagram showing the relationship between band gap and lattice constant for alloys in the InGaAsP and AlGaAsSb systems. 4

   c) Write down the postulates of Bohr atomic model along with its limitation. 5

3. a) Discuss the effect when two isolated atoms brought together. 7

   b) With the help of appropriate example discuss the difference between direct and indirect semi-conductor. 8

   c) Prove that electron effective mass in a band depends on the curvature of the energy vs wave-vector diagram. 5

   d) Elaborate the effect of variation of alloy composition on band gap. 5

4. a) Derive current density along z-dimension in terms of electron and hole mobility. Also discuss the dependence of mobility on both lattice and impurity scattering along with pointing the temperature regime at which these scattering becomes significant. 12

b) Show that the concentration of electrons in the conduction band and that of holes in the valence band is given by, 8

$$n_0 = n_i e^{\frac{(E_F - E_i)}{kT}} \quad \text{and}$$

$$p_0 = n_i e^{\frac{(E_i - E_F)}{kT}}.$$

c) Show the energy band discontinuities for a thin layer of GaAs sandwiched between layers of wider band gap AlGaAs. Discuss how the Quantum States are formed (e-h^+ in Quantum Well) in the valance and conduction bands for an extremely thin (few Angstrom) GaAs region. 5

98

B.Sc. Engg.(EE), 8th Sem. Date: August 07, 2018 (Afternoon)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid-Semester Examination
Course No.: EEE 4835
Course Title: Medical Electronics

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

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

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1. a) What are the kinds of synapse? Explain the propagation steps of synaptic potential via the chemical synapse with proper diagram. 12

   b) With proper example, explain the following terms for a medical instrument: 5
      i) Accuracy,
      ii) Precision.

   c) Design a hypothetical blood flow measurement system using maximum two sensors. 8

2. a) What is the effect of input offset voltage for the adder circuit? How to minimize the effect? 12

   b) For the following circuit in Figure: 2(b), find the value of R_3 and R_7 so that the bias current effect is minimum. Let $I_{B+} = I_{B-}$. 13

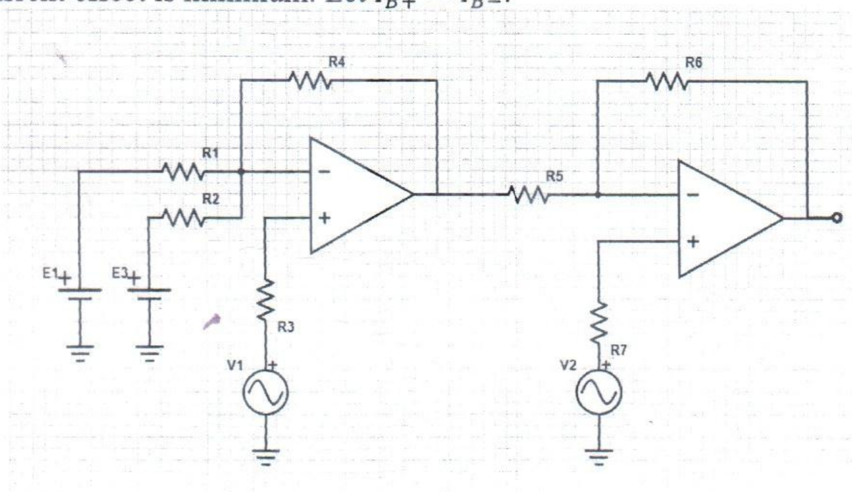

Figure: 2 (b)

3. a) What are the main advantages of a classical blood pressure measurement system? Propose a blood pressure measurement system which can improve the measurement accuracy. 10

   b) What is ground fault? How to overcome ground fault? 05

   c) What is Ground Loop? What is the effect of a Ground Loop on an amplifier? 10

4. a) What are the practical problems of using a strain gauge? How can you overcome those problems? 13

b) Write short note on the following topics: 12
   i) Cardiac system,
   ii) Nervous system.

B.Sc. Engg. (EE), 8th Sem. Li 100 Date : August 09, 2018 (Afternoon)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid-Semester Examination
Course No.: EEE 4849
Course Title: VLSI Circuits

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

There are **4 (four)** questions. Answer **any 3 (three)** questions. All questions carry equal marks. Marks 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) With appropriate figures describe in detail the nMOSFET transistor operation in cut off, linear and saturation regions. Clearly show the depletion regions and the channel (if exists) in the figures. 12

   b) Write down the definition and expression of transconductance, g_m and output conductance, g_{ds} of a MOSFET. Explain how and why threshold voltage of a MOSFET varies with doping in both nMOSFET and pMOSFET. 4+9

2. a) Describe nMOS fabrication process in detail with figures. 12

   b) Draw the qualitative equilibrium energy band diagram for a MOS capacitor fulfilling the following conditions: 10+3
      i) $\Phi_m < \Phi_S$,
      ii) interface charge produce a band bending equal to $q\Phi_i$,
      iii) semiconductor is n-type and
      iv) a negative metal to semiconductor voltage (V_{MS}) has been applied.

      Show the amount of band bendings at the oxide-semiconductor interface.

3. a) With diagram(s), derive the expression of total drain current of an nMOSFET in linear and saturation regions of operation. 9+3

   b) An nMOS inverter with resistive load is operating under following conditions: 13
   supply voltage is V_D = 5V, threshold voltage V_t = 1.2V, required low level output voltage $V_{out} = 0.2V_t$, high level voltage is V_D, $=\frac{\varepsilon\mu_n}{D}$ 30 $\mu A/V^2$. Find out the value of load resistance if smallest transistor (W = L = minimum channel length) is used.

4. a) Write the expression of threshold voltage, V_t of a MOSFET. Explain the origin of each of the terms contributing to V_t. With figure (and without using any equation), explain the body effect in a pMOSFET. 2+8 +2

   b) Consider an nMOS inverter with enhancement load. Supply voltage, V_D = 3.5 V. Threshold voltages of load and driver transistors both are 0.8 V (at zero body bias). $\frac{\varepsilon\mu}{D}$ for load and driver transistors are both 40 $\mu A/V^2$. Body effect parameter is 0.5. Required low level output voltage, $V_{out} \leq 0.2V_t$. Calculate high level output voltage and threshold voltage of the load transistor when output is high. Also, calculate the required minimum inverter ratio, k. Choose suitable values of the aspect ratios of the load and driver transistors. 7+4 +2

B.Sc. Engg. (EE), 8th Sem. Date: 7 August, 2018 (Afternoon)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid-Semester Examination
Course No.: EEE 4851
Course Title: Advanced Communication Techniques

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

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

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1. a) Define the following with respect to a satellite: 9
   i) Eccentricity,
   ii) Ascending node and
   iii) Mean anomaly.

   b) A satellite downlink at 12 GHz operates with a transmit power of 66 W having an antenna diameter of 3 m and efficiency of 0.55. Calculate EIRP. 6

   c) Show that beat linewidth of an optical LO is equal to the sum of the two linewidth of the lasers in a heterodyning scheme. Why the linewidth of the optical LO broadens into a Lorentzian shape? 7+3

2. a) Mention the challenges of a phased array antenna in respect of beamforming network. Compare beamformer with an omnidirectional antenna. 5+7

   b) Explain operation of an optical ring resonator in a beamformer network. 6

   c) For ASTRA satellite operated at 9.75 GHz having 33 MHz bandwith and 37938 km from earth surface, calculate the carrier to noise ratio (C/N) of the received signal. [Assume, clear sky attenuation, receiver directional error and polarisation error of 0.5 dB each, satellite EIRP = 52.0 dBW, Antenna gain = 37 dB, Noise figure of the LNB = 1 dB, Boltzmann's constant = - 228.6 dBW/K/Hz and operating temperature 25^0 C]. 7

3. a) Discuss various categories of spreading sequences. Explain direct sequence spread spectrum (DSSS) using BPSK. 5+5

   b) Using Snell's law for air-core media derive the maximum acceptance angle in optical fiber. What is the fiber numerical aperture when $n_1 = 1.46$ and $n_2 = 1.44$? 5+5

   c) Derive the expression of the ratio of bit energy to noise density (E_b/N_0) for a satellite link-power budget. 5

102

4\. a) Explain various categories of noise. Also, discuss various schemes of optical generation of mm-waves. 5+5

b) Though the linewidth of the individual laser have not becomes pure, the photodetected signal in a side frequency injection locking scheme becomes spectrally pure. Justify the above statement with detail analysis. 10

c) A microwave transmitter with an output of 0.5 W at 2 GHz is used in a transmission system, where both the transmitting and receiving antennas are parabolas, each 1 m in diameter. Suppose the two antennas are directionally aligned and are 10 kms apart. 5

i) What is the effective radiated power of the transmitted signal, in Watt and dB?

ii) What is the available signal power out of the receiving antenna?

103

Ph. D/M.Sc. Engg.(EE) Date: August 06, 2018 (Afternoon)

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

Mid-Semester Examination — Summer Semester, A. Y. 2017-2018
Course No.: EEE 6105 — Time: 90 Minutes
Course Title: Advanced Engineering Analysis — Full Marks: 75

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

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1. (a) Define Green's function of a causal system. Enumerate the properties of Green's function of a second order LTI system. How the response of a system is determined using the Green's function? 10

   b) Find the causal Green's function for the system whose I/O relation can be expressed as: 15

$$\frac{d^2y}{dt^2}+6\frac{dy}{dt}+9y=\sin(100t).$$

2. a) A linear R-L-C circuit shown in Fig. 2(a) is excited by a source i_s (t) at t = 0. Current through the inductor $i_L(t)$ is the desired output. Derive the input-output relation. Find the Green's function of the system and hence the output for $i_s(t)=u(t)$. Consider R = 1 Ω, L = 2 H and C = 2 F. 13

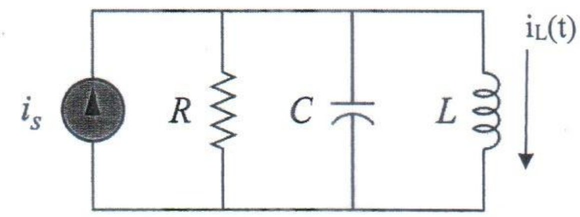

Fig. 2(a)

   b) Define fixed point and phase portrait of a nonlinear system. Interpret $\frac{dy}{dt}=\cos(y)$ as flow in a line. Find all the fixed points of the flow. At which points y does the flow have greatest velocity to flow right? Find the points where the flow has maximum positive acceleration. Draw the trajectory of two particles one starting from $y_0=\pi/4$ and other starting from $y_0=3\pi/4$. 12

3. a) Consider the system $\dot{x}=4x-y,\ \dot{y}=2x+y$. i) Write the system as $\dot{\mathbf{x}}=A\mathbf{x}$. Find the eigenvalues and eigenvector of A. ii) Find the general solution of the system. iii) Identify the fixed point and classify it. iv) Comment on the stability of the system. 12

   b) Find all the fixed points of the system $\dot{x}=-2x,\ \ \dot{y}=-y+y^3$, and use linearization to classify them. Check your conclusions against the phase portrait of the full nonlinear system. 13

4. a) A one-dimensional dynamical system is defined by $\frac{dy}{dt} = y^2 - 9$. Draw the phase portrait of the system and examine the nature of the fixed points. Draw the particle trajectory y(t) for the following initial values $y_0 = -4.0,\ -1.5,$ and 5.0. 12

b) Derive the condition for linear stability for a first order dynamical system. Use linear stability analysis to classify the fixed points of the following systems. If the linear stability analysis fails because of $f'(y^*) = 0$, use graphical argument to decide the stability for the fixed point. 13

(i) $\frac{dy}{dt} = y^2(4 - y)$ and (ii) $\frac{dy}{dt} = y(2 - y)(3 - y)$.

M.Sc.Engg. (EE)/Ph.D. (EE) 105 Date: August 13, 2018 (Afternoon)

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

Mid-Semester Examination | Summer Semester, A. Y. 2017-2018
Course No.: EEE 6403 | 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) Explain how a voice call is routed when the call is between a Grameenphone user and a Robi user in the case of UMTS. 5

   b) Draw the network architecture for UMTS and identify the entities in core network for CS and PS services. 6

   c) Compare the advantages and disadvantages of circuit switching (CS) and packet switching (PS)? Does circuit switching use packetized data bits? Mention why packet switching has higher chances of missing data (i.e. the receiver does not receive data packet)? 8

   d) How long is a slot in millisecond and how many chips are there in the slot? What are the possible values of Transmission Time Interval (TTI)? 6

2. a) Why scrambling codes can be used to different cells whereas OVSF codes must be used to differentiate the users in the same cell in UMTS? How many primary scrambling codes (PSCs) are available and why are so many PSCs required. How many scrambling codes are available for use in uplink and why are so many scrambling codes required in uplink? 8

   b) Write down any four OVSF codes with spreading factor 8. 7

   c) Determine and plot autocorrelation properties of the sequence 1110010 by rotating its whole length. 10

3. a) What does a UE perform after the UE is powered up and before downlink synchronization? Explain the step 1/2/3 search procedure for UMTS. 10

   b) Explain briefly rate matching and interleaving? 5

   c) User A transmits information 1 −1 using OVSF code 1 −1 1 −1. User B transmits information −1 1 using OVSF code 1 −1 −1 1. Show the spreading of signal and the composite signal waveform. Then show how user B can detect the correct information bits. 10

4. a) Assume that the whole OVSF code tree is used for the data transfer and 128 users were using spreading factor 128 in the cell. Then cutting off the service of some users, these new spreading factors have been allocated: 1 user with spreading factor 4, 2 users with spreading factor 16 and 1 user with spreading factor 32. What is the new number of users in the cell? 8

   b) What are the minimum and maximum values of spreading factor in uplink and downlink in UMTS? What is the typical value of spreading factor for voice? Determine the data rate in kbps when the spreading factor is 512. 8

   c) Write down any two OVSF codes with spreading factor 4. Using them, show that a wrong use of code by the receiver does not allow detection of anything. 9

106

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

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

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

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

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

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1. a) Write the properties of autocorrelation of an energy signal and a power signal. Explain the bandwidth of different data in different perspective. 13

   b) Classify the following signals as energy signals or power signals. Find the normalized energy or normalized power of each. 12

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

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

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

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

2. a) The analog signal recovered from the sampled, quantized, and transmitted pulses will contain corruption from several sources. Explain different corruptions. 13

   b) Draw the block diagram of formatting and transmission of baseband signals. Explain message, character and symbol for 8-ary and 32-ary digits. 12

3. a) Human speech is characterized by unique statistical properties. How does it affect quantization of signals? 10

   b) A waveform $x(t) = 10\, cos\,(1000t + \pi/3) + 20\, cos\,(2000t + \pi/6)$ is to be uniformly sampled for digital transmission. 08
   i) What is the maximum allowable time interval between sample values that will ensure perfect signal reproduction?
   ii) If we want to reproduce 1 hour of this waveform, how many sample values need to be stored?

c) Consider an audio signal with spectral components limited to the frequency band 300 to 3300 Hz. Assume that a sampling rate of 8000 samples/s will be used to generate a PCM signal. Assume that the ratio of peak signal power to average quantization noise power at the output needs to be 30 dB. 07

i) What is the minimum number of uniform quantization levels needed, and what is the minimum number of bits per sample needed?

ii) Calculate the system bandwidth (as specified by the main spectral lobe of the signal) required for the detection of such a PCM signal.

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

b) In the compact disc (CD) digital audio system, an analog signal is digitized so that the ratio of the peak-signal power to the peak-quantization noise power is at least 96 dB. The sampling rate is 44.1 kilo samples/s. 10

i) How many quantization levels of the analog signal are needed for $\left(\frac{S}{N_q}\right)_{peak} = 96dB$?

ii) How many bits per sample are needed for the number of levels found in part (i)?

iii) What is the data rate in bits/s?

L08

M.Sc. Engg.(EE) / Ph.D. (EE) Date: August 7, 2018 (Afternoon)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid-Semester Examination
Course No.: EEE 6411
Course Title: Wireless Ad Hoc and Sensor Networks

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

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

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1. a) Why do we need queue in the packet switching? Consider sending a packet from a source host to a destination host over a fixed route. List the delay components in the end-to-end delay. Which of these delays are constant and which are variable? 9

   b) Network can be classified into two categories by their component roles i.e., P2P and Client-Server. Write down the characteristics of P2P network and Client-Server network. 8

   c) Suppose end system A wants to send a large file to end system B. At a very high level, describe how end system A creates packets from the file. When one of these packets arrives at a packet switch, what information in the packet does the switch use to determine the link onto which the packet is forwarded? Why is packet switching in the Internet analogous to driving from one city to another and asking directions along the way? 8

2. a) For personal area networking (PAN), both IR and Bluetooth technologies have their advantages and disadvantages. Justify your choice of technology between IR and Bluetooth technologies by mentioning appropriate applications. 5

   b) You and your friend want to share data between two wireless enable devices with the help of Bluetooth. Write down the basic characteristics and parameters of Bluetooth communication. 8
   What is spread-spectrum frequency hopping of Bluetooth? Briefly explain with examples.

   c) At the beginning of the data transferring, how does the Bluetooth device create connection with another Bluetooth device? 12
   Briefly discuss Bluetooth Piconets.
   How does Bluetooth operate during data transferring? Briefly explain the operation state with suitable flow chart.

3. a) As a network designer, why do you need protocol suite? What does happen among network components if there is no protocol suite? 4

   b) Write the name of layers of OSI model and briefly explain the responsible job done by each layer and how do they contribute to the whole network. What is the basic difference between OSI model and TCP/IP model? Briefly explain by comparing the layers of both models with suitable tabular forms. 13

   c) How long does it take for a packet of length 1,000 bytes to propagate over a link of distance 2,500 km, propagation speed 2.5×10^8 m/s and transmission rate 2 Mbps? More generally, how long does it take for a packet of length L to propagate over a link of distance d, propagation speed s and transmission rate R bps? Does this delay depend on packet length? Does this delay depend on transmission rate? 8

109

4\. a) As an engineer, to build a real world practical product, you need to follow four steps. 11
Step1: Finding problem and define expected solution and hypothesis,
Step2: Create Mathematical Model,
Step3: Create Simulation Model,
Step4: Create Practical Product.
Briefly explain each step with suitable example (use any engineering problem as a case study).

b) For data communication in internet using layering protocols, packet switching is more efficient than circuit switching. Define packet switching and circuit switching. For an effective packet switching, justify your design mechanism for the following issues when multiple data are transferring: 8

c) Define and differentiate PAN, LAN, MAN and WAN. What are the design goals and different design choices for Wireless LAN (WLAN)? 6

110

M.Sc.TE.(2 Yr) 4th Sem. Date: August 10, 2018 (Afternoon)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid-Semester Examination
Course No.: EEE 6499
Course Title: Laser Theory and Optical Communication

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

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

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1. a) What multiplexing technique is used in the fourth generation lightwave system? Why is dry fiber used in the fifth generation of fiber optic communication systems? If the minimum bit rate for analog TV transmission is 66 Mbps with a signal bandwidth of 4 MHz, find out the SNR value. 4+4

   b) Derive the equation that provides the minimum bit-rate required for digital representation of an analog signal of bandwidth Δf in terms of signal to noise ratio (SNR). 8

   c) Explain SONET, SDH and STM with their respective bit rates. 9

2. a) Draw cross-section and refractive index profile for step-index fiber and graded index fiber. Show that parabolic index fiber doesn't exhibit intermodal dispersion. 5+5

   b) Explain 'numerical aperture' and express it in terms of fractional index change, Δ. Draw ray trajectories in a graded-index fiber. 8

   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. 7

3. a) Explain how and when a mode ceases to be guided highlighting the values of p,q parameters from Helmholtz equation. Explain fiber birefringence covering degree of modal birefringence, beat length, fast and slow axis. 5+8

   b) Find out effective core area, normalized propagation constant and confinement factor for a fiber with core radius 3.15 μm and normalized frequency, $V = 2.3$. Also calculate the value of numerical aperture and effective index taking wavelength, $\lambda = 1.2$ μm and fractional index, $\Delta = 3.25 \times 10^{-3}$. 12

4. a) From the expression of normalized spot size find out 'confinement factor' for $V = 1.5$ and calculate the corresponding normalized propagation constant value. 6+3

   b) Derive the extent of pulse broadening in group velocity dispersion for a single mode fiber of length L. Calculate the maximum attainable BL-product for dispersion parameter, $D = 1.05$ ps/(km-nm) and a corresponding spectral width, $\Delta\lambda = 2.9$ nm. 9

   c) Define zero dispersion wavelength. Explain dispersion shifted and dispersion flattened fibers. 7