B.Sc. Engg. (EE), 2nd Sem. Date: October 24, 2019 (Morning)

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

Semester Final Examination
Course No.: EEE 4201
Course Title: Electrical Circuit II

Summer Semester, A.Y. 2018-2019
Time: 3 Hours
Full Marks: 150

There are **8 (eight)** questions. Answer **any 6 (six)** questions. All questions carry equal marks. Marks in the margin indicate full marks. Programmable calculators are not allowed. Do not write on this question paper. Assume suitable values for any **missing data**.

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1. a) What is the reflected impedance? Derive the expression for the reflected impedance looking into the primary terminals of an air-core transformer. 05

b) The switch for the circuit in Fig. 1(b) is closed at $t = 0$. Find $i(t)$ and $v(t)$ for all time. 15

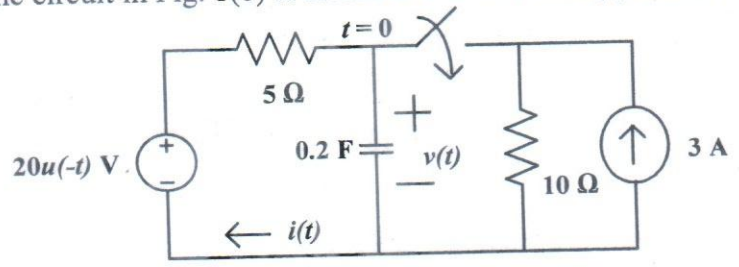

Fig. 1(b)

c) For a balanced Y-connected source, $V_{AB} = 240\angle -20^0$. The source is *abc* sequenced and it is connected to a balanced Δ-connected load of $20\angle 40^0$. Find the line and phase currents. 05

2. a) Determine the π-equivalent circuit for the linear transformer depicted in Fig. 2(a). 05

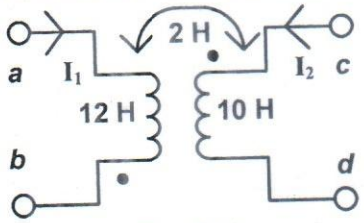

Fig. 2(a)

b) For the circuit in Fig. 2(b), sketch the waveshape for $v(t)$. 15

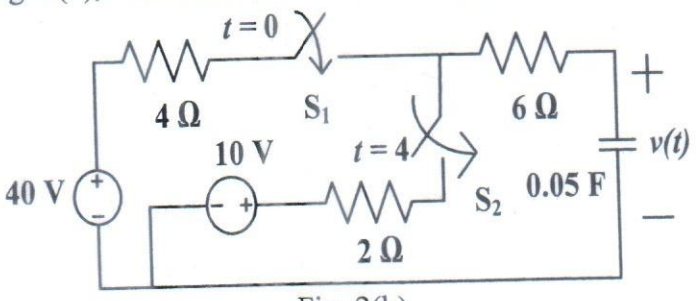

Fig. 2(b)

c) What is a singularity function? Sketch the equivalent circuit diagram for the voltage source $V_s u(t)$ and current source $I_s u(t)$. 05

3. a) Define the quality factor and bandwidth of a resonant circuit. Explain their codependence with appropriate diagrams and expressions. 05

b) For the circuit in Fig. 3(b), calculate: $i(0^+)$, $v(0^+)$, $v_R(0^+)$, $i(\infty)$, $v(\infty)$, $v_R(\infty)$, $\frac{di(0^+)}{dt}$, $\frac{dv(0^+)}{dt}$ and $\frac{dv_R(0^+)}{dt}$. 15

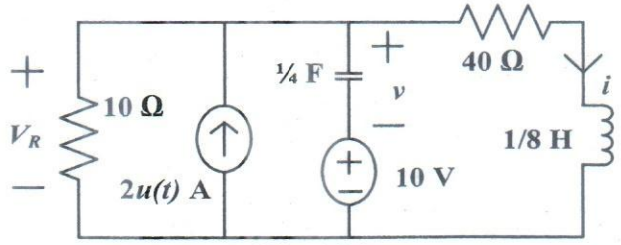

Fig. 3(b)

c) For the circuit in Fig. 3(c), calculate the gain $V_o(w)/V_s(w)$ and its poles and zeros. 05

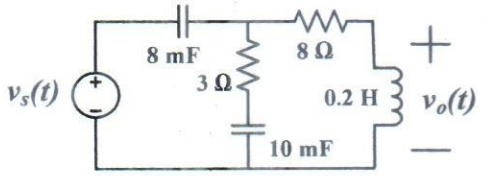

Fig. 3(c)

4. a) Construct the dual of the circuit in Fig. 3(c). 05

b) Calculate $v_o(t)$ for all time for the circuit depicted in Fig. 4(b). 15

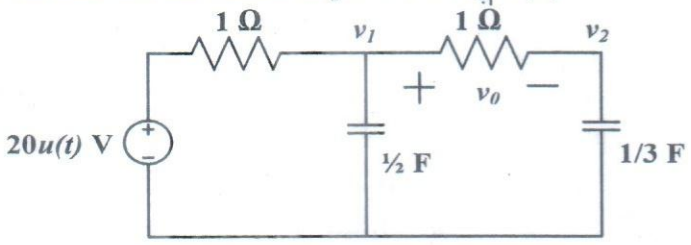

Fig. 4(b)

c) Prove that the average power in a balanced 3-φ system is always constant. 05

5. a) Derive and sketch the step response of an RL circuit. 05

b) Determine the type of filter shown in the circuit of Fig. 5(b). Calculate the cutoff frequency/frequencies, poles, and zeros for the filter response. 15

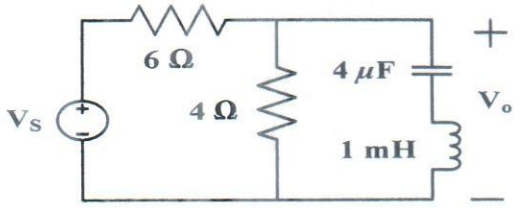

Fig. 5(b)

c) Formulate the voltage-current relationship for an inductor and a capacitor in case of a sinusoidal input. 05

6. a) Sketch the general equivalent circuit diagram for the transmission parameters and inverse transmission parameters of a two-port network. 05

b) Find the hybrid parameters for the network in Fig. 6(b). 15

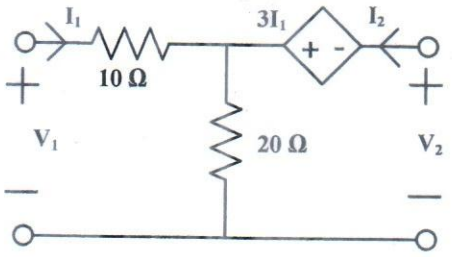

Fig. 6(b)

c) Explain the properties of different z parameters of a two-port network, which is both symmetrical and reciprocal. Which are the conditions to be fulfilled to construct such a two-port network? 05

7. a) Determine the rms value of $i(t)$ depicted in Fig. 7(a). 05

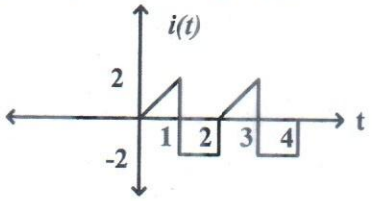

Fig. 7(a)

b) What do you understand by power factor correction? With appropriate circuit diagrams, explain the process of power factor correction for a leading load by using: 15

i) phasor diagram and
ii) power triangle.

c) Analyze the step response of an RL circuit in terms of its natural and forced response. 05

8. a) Comment on the values of different voltages, currents and impedances of the passive components of a parallel RLC circuit during resonance. 05

b) Calculate $i_0(t)$ for the circuit in Fig. 8(b). 15

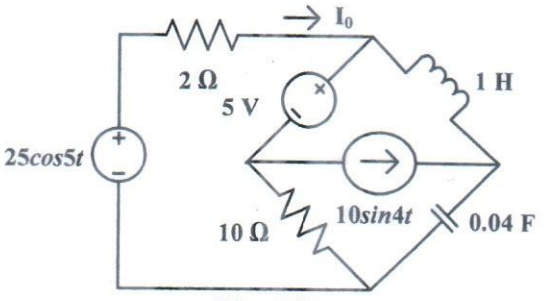

Fig. 8(b)

c) What do you understand by damping? Sketch the responses for different types of damping for the step response of a series RLC circuit. 05

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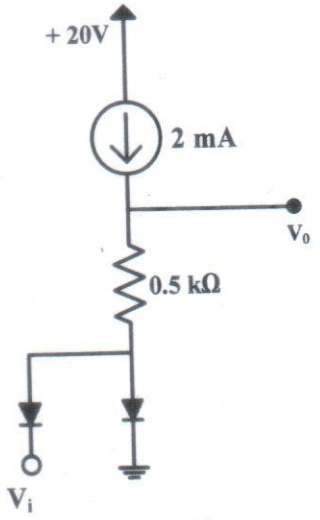


Fig. 1(a)

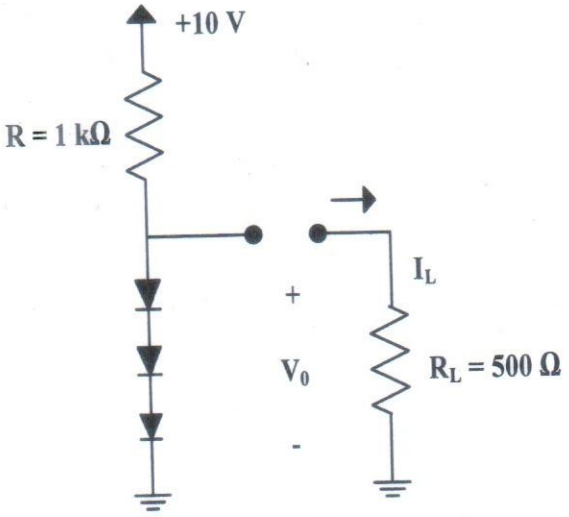


Fig. 1(b)

b) For the above circuit in Fig. 1(b), a string of three diodes are used to provide a constant voltage of about 2.1 volt. Calculate percentage of change in this regulated voltage caused by 8
(i) ±10% change in power supply.
(ii) Connection of load resistance, R_L. Assume, n = 2.

c) Determine the range of values of R_L and I_L for the figure shown in Fig. 1(c). 10

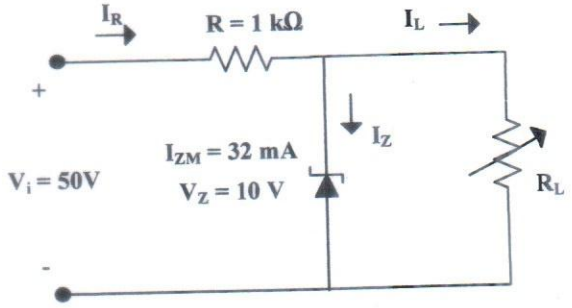


Fig. 1(c)

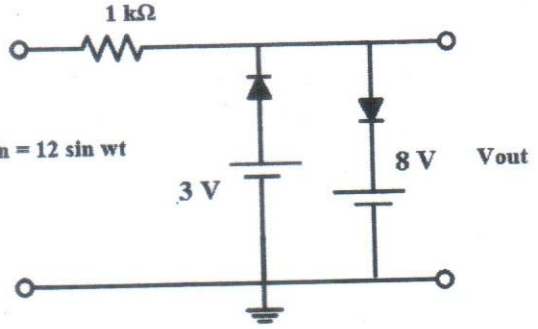
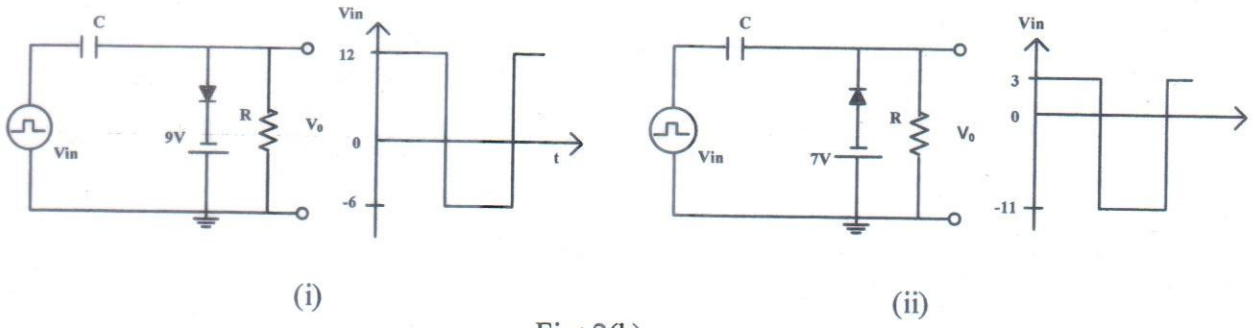


Fig. 2(a)

2. a) Find the output waveshape for the clipper shown in Fig. 2(a). Assume, all diodes are ideal 10

b) Find the output voltage waveshapes for the following clampers (with Si diodes) shown in Fig. 2(b). 15



(i) (ii)

Fig. 2(b)

3. a) What is an Early effect of a BJT? Derive the expression of output resistance considering the Early effect. 8

b) For the circuit in Fig. 3(b), determine the value of the voltage V_{BB} that results in the transistor operating (i) in the active mode with V_{CE} = 5 V, (ii) at the edge of saturation and (iii) deep in saturation with β_{forced} = 10. Assume, V_{BE} = 0.7 V and β = 50. 10

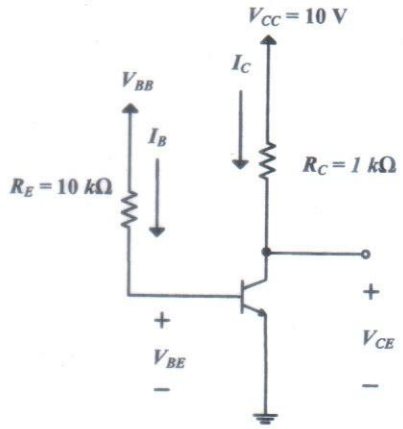


Fig. 3(b)

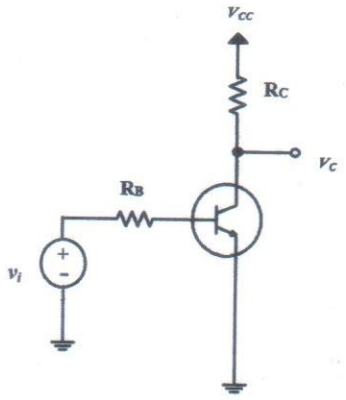


Fig. 3(c)

c) For the circuit shown in Fig. 3(c), calculate the base current, collector current and the collector voltage where V_{CC} = +5 V, V_i = +5 V, R_B = R_C = 1 kΩ and β = 100. If he transistor is saturated, find β_{forced}. What value should R_B be raised to bring the transistor to the edge of saturation? 7

4. a) For the network of Fig. 4(a), Find I_C, I_B, I_E, V_C and V_E 10

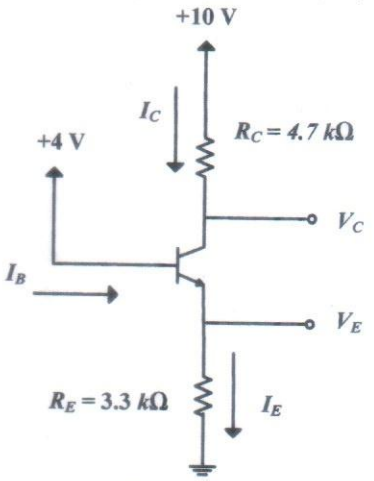


Fig. 4(a)

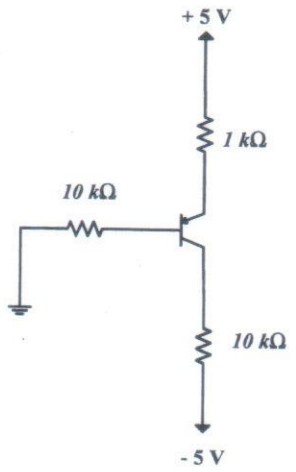


Fig. 4(b)

b) Analyze the circuit of Fig. 4(b) and find all the node voltages and branch currents. The minimum value of β is specified to be 30. 15

5. a) For the circuit of Fig. 5(a), determine the voltages at all nodes and currents through all branches. Assume, $\beta = 100$. 12

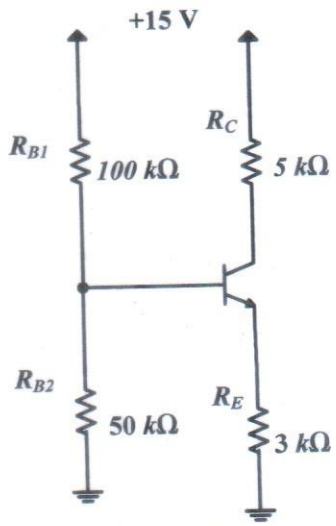


Fig. 5(a)

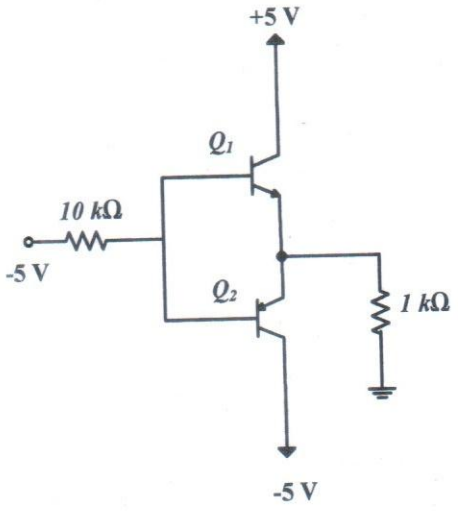


Fig. 5(b)

b) Evaluate the voltages at all nodes and the currents through all branches in the circuit of Fig. 5(b). Assume, β = 100. 13

6. a) Derive the expression of g_m , r_π and r_e for the small signal model of a BJT. 7

b) Analyze the transistor amplifier shown in Fig. 6(b) to determine its voltage gain v_0/v_i Assume, $\beta = 100$ and neglect the early effect. 8

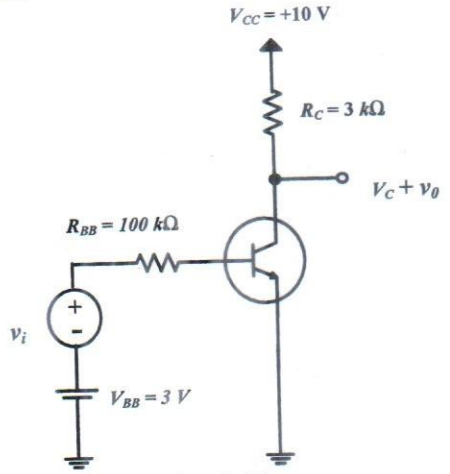
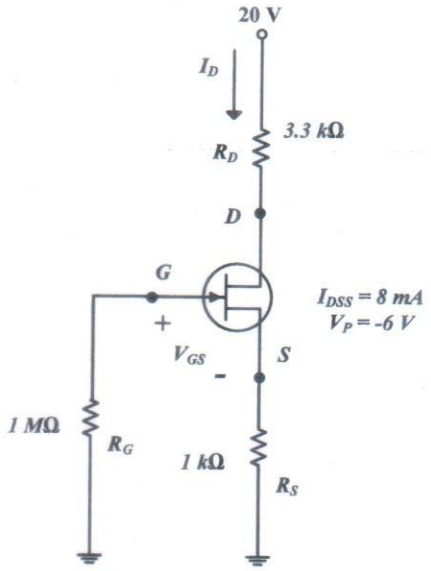


Fig. 6 (b)

c) A CE amplifier utilizes a BJT with β = 100 is biased at I_C = 1 mA and has a collector resistance R_C = 5 kΩ. Find R_{in}, R_0 and A_{v0}. If amplifier is fed with a signal source having a resistance of 5 kΩ and load resistance R_L = 5 kΩ is connected to the output terminal, find the resulting A_v and G_v. 10

7. a) What is the basic difference between JFET and BJT? Write down the advantages and disadvantages of JFET. 5

b) Determine (i) V_{GS_Q} (ii) I_{D_Q} (iii) V_{DS} (iv) V_S (iv) V_G (v) V_D for the circuit shown in Fig. 7(b). 10



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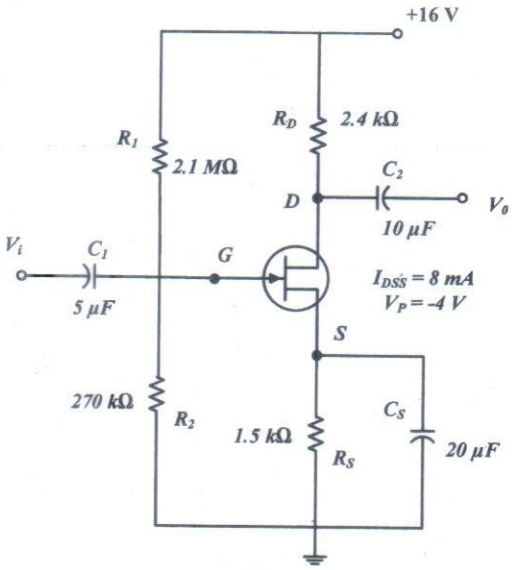
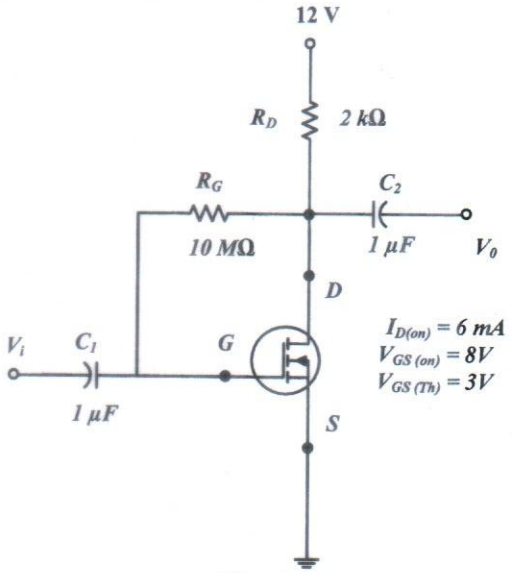


Fig. 7(c)

c) Determine (i) I_{D_Q} and V_{DS_Q} (ii) V_D (iii) V_S (iv) V_{DS} (v) V_{DG} for the network of Fig. 7(c). 10

8. a) What is the difference between depletion type MOSFET and enhancement type MOSFET with respect to transfer characteristics? 7

b) Determine I_{D_Q} and V_{DS_Q} for the enhancement type MOSFET shown in Fig. 8(b). 8



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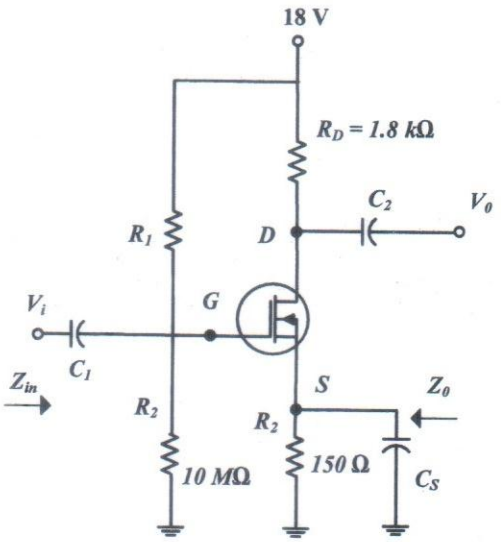

Fig. 8(c)

c) For the network of Fig. 8(c) V_{GS_Q} = 0.35 V, I_{D_Q} = 7.6 mA, I_{DSS} = 6 mA, V_P = -3V and g_{OS} = 10 μS. 10

i. Determine g_m and compare to g_{m0}
ii. Find r_d
iii. Sketch the ac equivalent network
iv. Find Z_i
v. Calculate Z_0
vi. Find A_v

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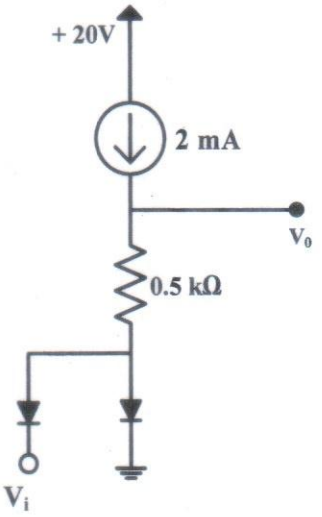
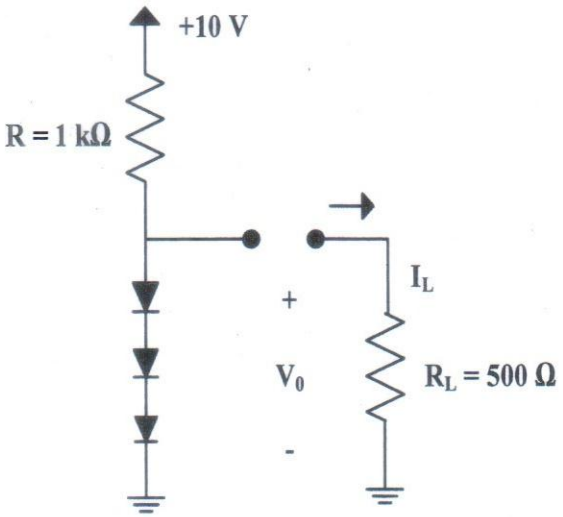


Fig. 1(a)



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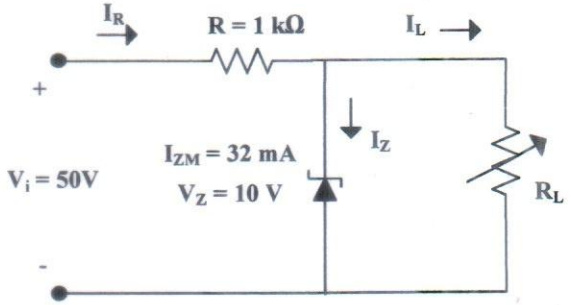

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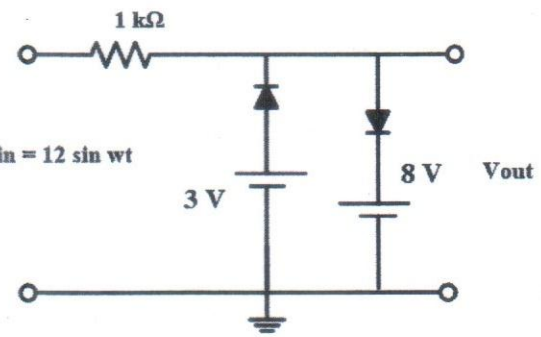

Fig. 2(a)

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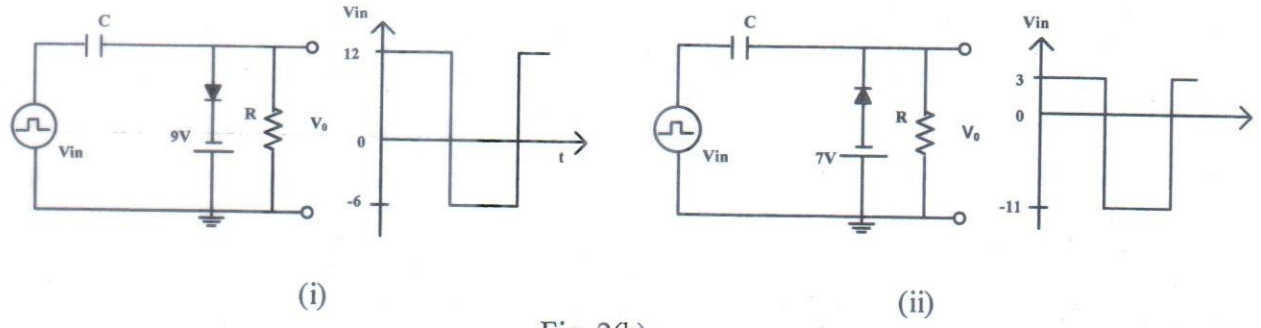

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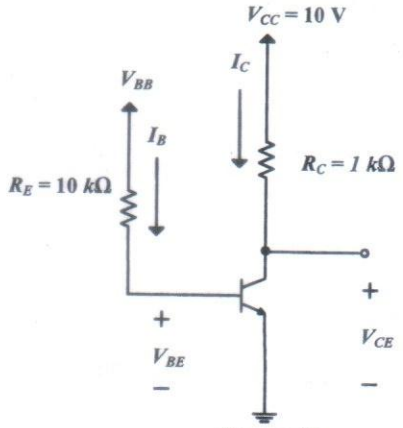

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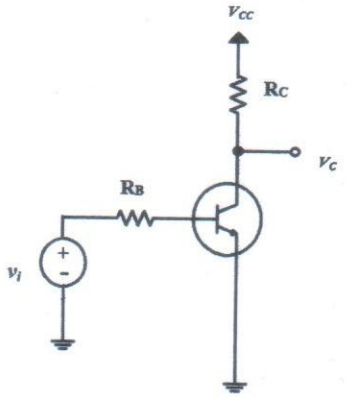

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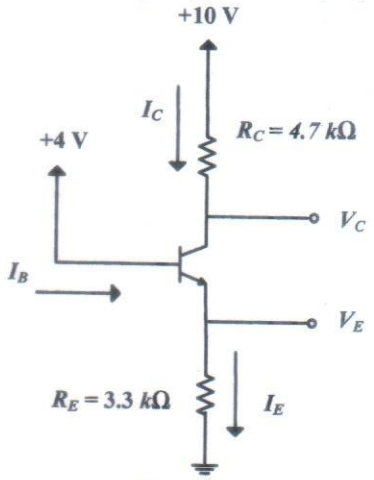

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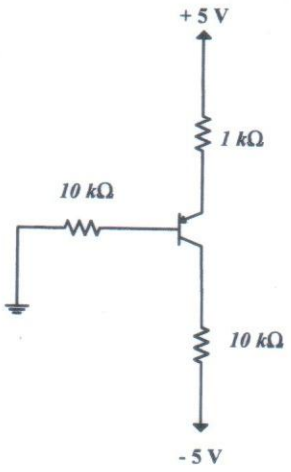

Fig. 4(b)

b) Analyze the circuit of Fig. 4(b) and find all the node voltages and branch currents. The minimum value of β is specified to be 30. 15

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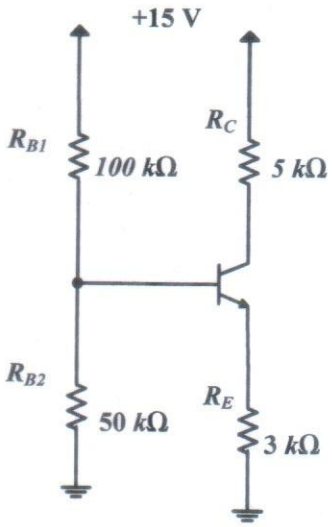
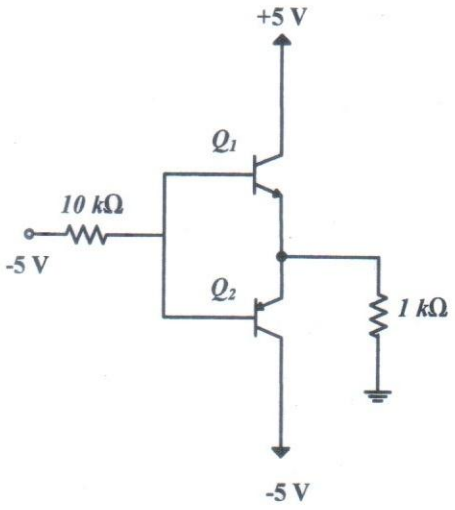


Fig. 5(a)



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6. a) Derive the expression of g_m , r_π and r_e for the small signal model of a BJT. 7

b) Analyze the transistor amplifier shown in Fig. 6(b) to determine its voltage gain v_0/v_i Assume, $\beta = 100$ and neglect the early effect. 8

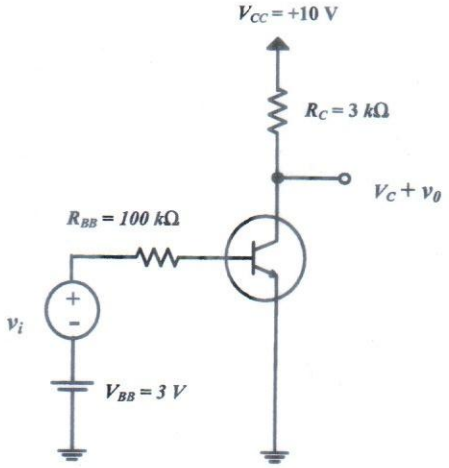


Fig. 6 (b)

c) A CE amplifier utilizes a BJT with β = 100 is biased at I_C = 1 mA and has a collector resistance R_C = 5 kΩ. Find R_{in}, R_0 and A_{v0}. If amplifier is fed with a signal source having a resistance of 5 kΩ and load resistance R_L = 5 kΩ is connected to the output terminal, find the resulting A_v and G_v. 10

7. a) What is the basic difference between JFET and BJT? Write down the advantages and disadvantages of JFET. 5

b) Determine (i) V_{GS_Q} (ii) I_{D_Q} (iii) V_{DS} (iv) V_S (iv) V_G (v) V_D for the circuit shown in Fig. 7(b). 10

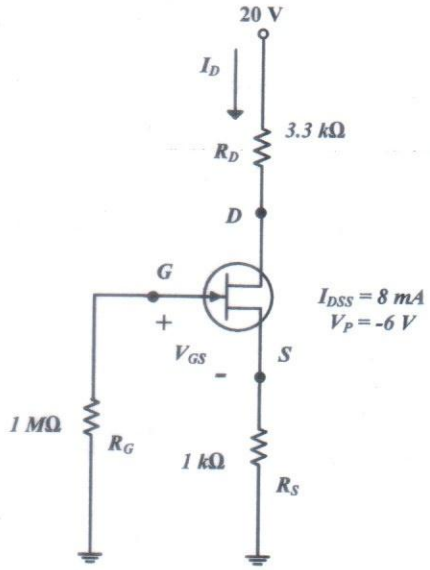


Fig. 7(b)

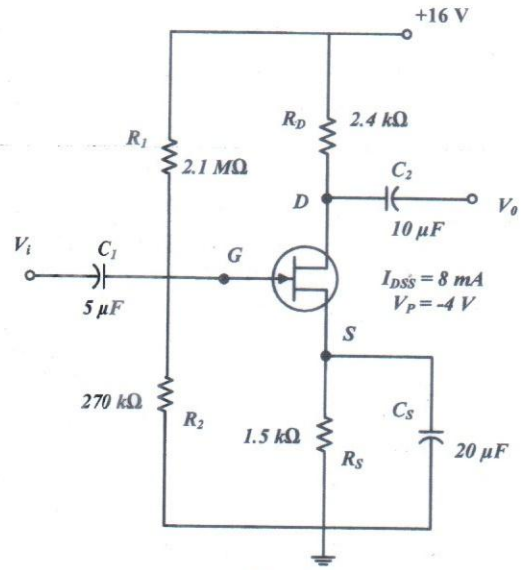


Fig. 7(c)

c) Determine (i) I_{D_Q} and V_{DS_Q} (ii) V_D (iii) V_S (iv) V_{DS} (v) V_{DG} for the network of Fig. 7(c). 10

8. a) What is the difference between depletion type MOSFET and enhancement type MOSFET with respect to transfer characteristics? 7

b) Determine I_{D_Q} and V_{DS_Q} for the enhancement type MOSFET shown in Fig. 8(b). 8

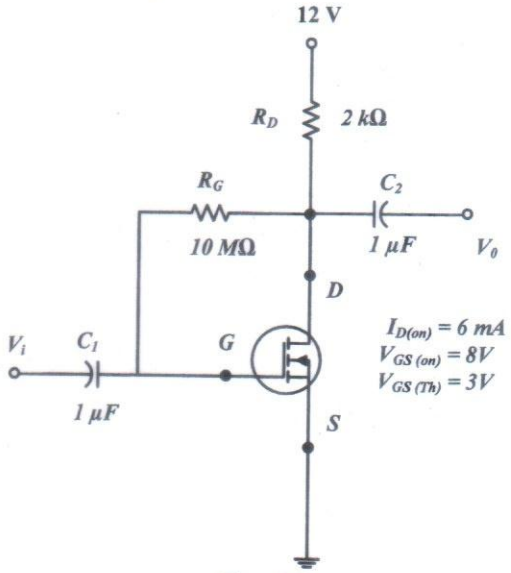


Fig. 8(b)

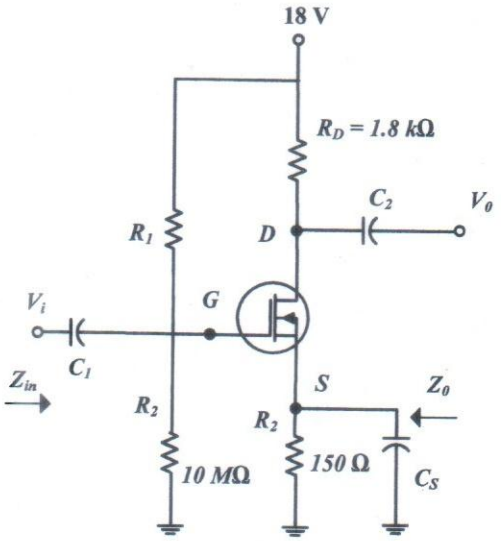


Fig. 8(c)

c) For the network of Fig. 8(c) V_{GS_Q} = 0.35 V, I_{D_Q} = 7.6 mA, I_{DSS} = 6 mA, V_P = -3V and g_{OS} = 10 μS. 10

i. Determine g_m and compare to g_{m0}
ii. Find r_d
iii. Sketch the ac equivalent network
iv. Find Z_i
v. Calculate Z_0
vi. Find A_v

B. Sc. Engg.(EE), 2nd Sem. Date: November 1, 2019

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
THE ORGANIZATION OF THE ISLAMIC COOPERATION (OIC)

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination
Course No. Phy 4221
Course Title: Engineering Physics II

Summer Semester A. Y. 2018-2019
Time: 3 Hours
Full Marks: 150

There are **8 (eight)** questions. Answer **any 6 (six)** questions taking at least three from each section. All questions carry equal marks. Marks in the margin indicate full marks. Programmable calculators are not allowed. Do not write on this question paper. Use separate answer scripts for Section A and Section B.

Section A

1. (a) Briefly explain classification of solids from the crystallographic point of view. 6

   (b) What do you mean by lattice parameters of a typical 3D unit cell? How many Bravais lattices in 3D? Briefly explain their classification with various crystal systems and lattice parameters. 14

   (c) What is the crystalline nature of lead (Pb) crystal? Draw a typical unit cell of this crystal. How many unit cells are in a Pb sheet of length *5.0 cm*, breadth *2.5 cm* and thickness 2.5 *mm*? How many Pb atoms are in that sheet? 5

2. (a) Sketch [100], [110] and [111] crystal directions in a unit cell of a typical face centered cubic crystal. What is linear density of atoms? Compute and compare linear density values for these crystal directions for copper. Atomic radius of copper atom is 0.1278 mm. 11

   (b) Sketch (100), (110) and (111) crystal planes in a unit cell of a typical body centered cubic crystal. What is planar density of atoms? Compute and compare planar density of atoms values for these planes for α-Fe crystal. Atomic radius of α-Fe is 0.1243 nm. 11

   (c) Niobium (Nb) is BCC with a density of 8.57 g/cm^3. Calculate the center to center distance between closest atoms of Nb crystal. 3

3. (a) Establish the differential equations for simple harmonic, damped harmonic and forced oscillators. 7

   (b) Solve the differential equation for damped harmonic oscillator to obtain an expression for the displacement. 12

(c) Two light springs of spring constants k_1 and k_2 and a block of mass m are in one line AB on a smooth horizontal table such that one end of each spring is on rigid support and the other end is free as shown in Fig. 3(c) below. The distance CD between the free ends of the springs is *60 cm*. If the block moves along AB with a velocity *120 cm/s* in between the springs, calculate the period of oscillation of the block. (k_1 = *1.8 N/m*, k_2 = *3.2 N/m* and m = *200 g*). 6

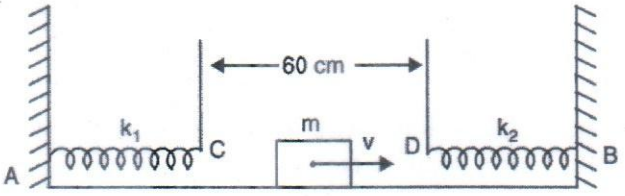


Fig. 3 (c)

4. (a) Two simple harmonic motions of same angular frequency ω 10

$$y_1 = a_1 \sin(\omega t + \alpha_1), \text{ and}$$

$$y_2 = a_2 \sin(\omega t + \alpha_2),$$

act on a particle along the y-axis simultaneously. Find the resultant motion.

(b) What are Lissajous figures? Two simple harmonic motions of same frequency ω but having displacements in two perpendicular directions act simultaneously on a particle: 15

$$x = a \sin(\omega t + \alpha), \text{ and}$$

$$y = b \sin \omega t.$$

Find the resultant motion for various values of the phase difference.

Section B

5. (a) What are Compton scattering and Compton wavelength? Show schematically the collision process in a Compton scattering. 7

(b) Derive the following expression for Compton shift of wavelength: 12

$$\lambda' - \lambda = \frac{h}{m_e c}(1 - \cos\phi)$$

where symbols have their usual meaning.

(c) Compare Compton scattering for x-rays ($\lambda \approx 20$ pm) and visible light ($\lambda \approx 500$ nm) at a particular angle of scattering. Which has greater [i] Compton shift, [ii] fractional wavelength shift, [iii] fractional photon energy change 6

6. (a) What is radioactive decay? Show that average life time of a radioactive substance is inversely proportional to decay constant. 7

(b) What is binding energy? Draw and explain the binding energy curve per nucleon as a function of mass number. 12

(c) Explain Nuclear fission and fusion with examples. 6

7. (a) Distinguish between longitudinal and transverse waves. Draw schematically two waves in which they are in phase and also out of phase. 7

(b) Show that, the average power of a wave depends on the square of its amplitude and also on the square of its angular frequency. 12

(c) A string along which waves can travel is 2.70 m long and has a mass of 260 g. The tension in the string is 36.0 N. What must be the frequency of traveling waves of amplitude 7.70 mm for the average power to be 85.0 W? 6

8. (a) What is the significance of neutral temperature and inversion temperature for thermocouple? Explain Seebeck and Peltier effects using free electron theory. 7

(b) How can Thomson effect provide a link between Seebeck effect and Peltier effect? Explain positive, negative and zero Thomson effect. 12

(c) Seebeck voltage for Copper (Cu) - Constantan (Cn) thermocouple is given by the linear relation, $V = a+bT$, where T is the absolute temperature of the hot junction and a and b are constants given by: 6

Cu: a = 0.6 mV, b = 0.008 mV/K

Cn: a = -20 mV, b = -0.056 mV/K

Calculate the thermoelectric power when the hot junction is at 100° C.

B.Sc. Engg.(CSE), 2nd Sem. Date: October 25, 2019

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination — Summer Semester, A.Y. 2018-2019
Course No.: Phy 4241 — Time: 3 Hours
Course Title: Physics II — Full Marks: 150

There are **8 (eight)** questions. Answer any **6 (six)** 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) Define power factor. Why power factor correction is important? 6

   b) Find the voltages and currents in the circuit shown in Figure 1(b) by applying Kirchhoff's voltage law (KVL) and Kirchhoff's current law (KCL), where $E_1 = 10$ V, $E_2 = 5$ V, $R_1 = 2\ \Omega$, $R_2 = 8\ \Omega$ and $R_3 = 4\ \Omega$. 6

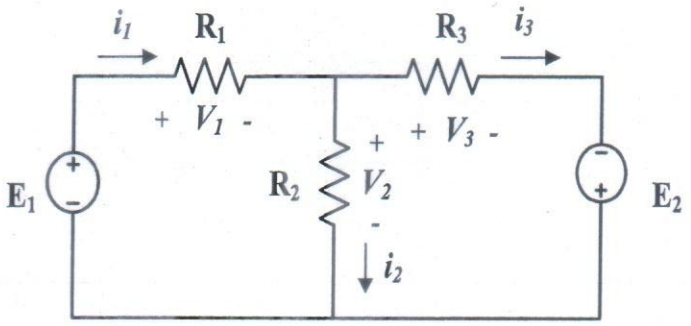


Figure 1(b)

   c) Find I_0 in the circuit in Figure 1(c). 13

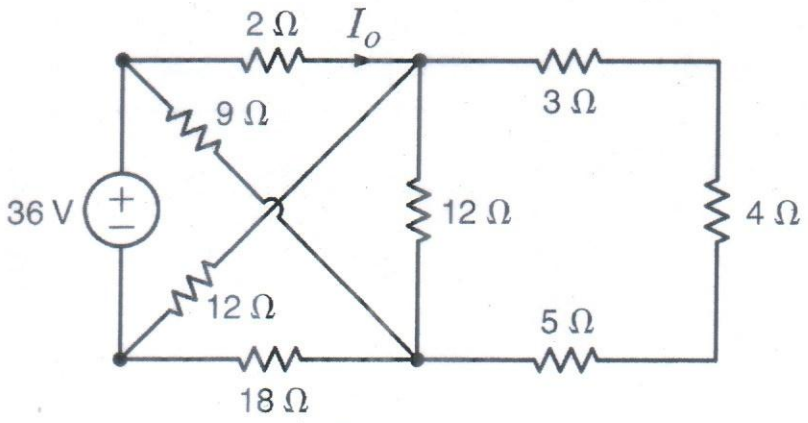


Figure 1(c)

2. a) Use nodal analysis to determine the node voltages defined in the circuit in Figure 2(a). 15

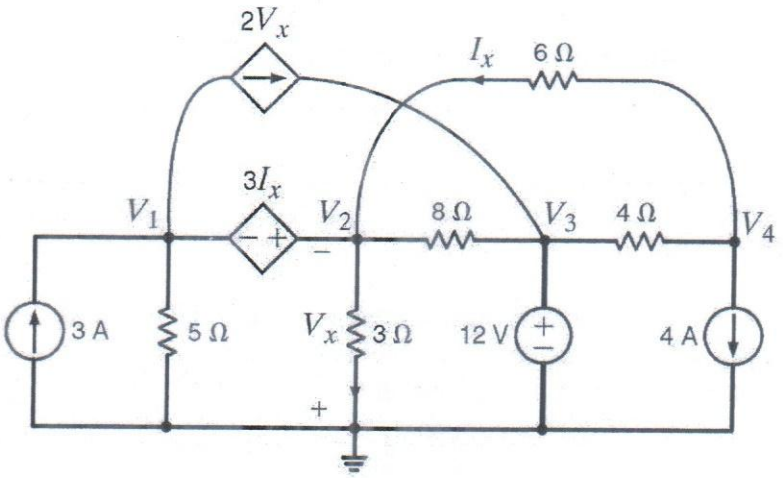


Figure 2(a)

b) Calculate the maximum power that can be transferred to R_L in the circuit of Figure 2(b). 10

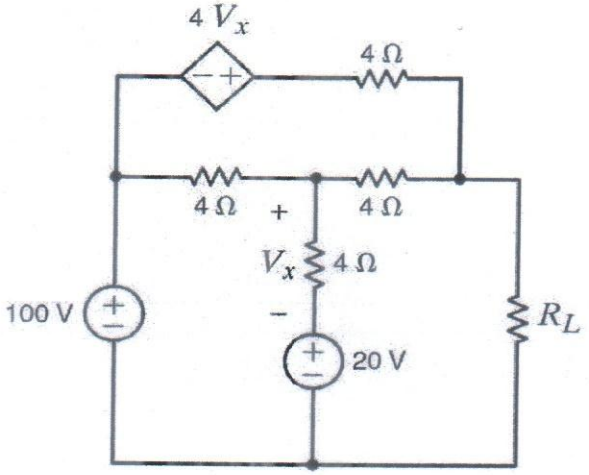


Figure 2(b)

3. a) Determine current I_0 in Figure 3(a) using Norton's theorem. 12

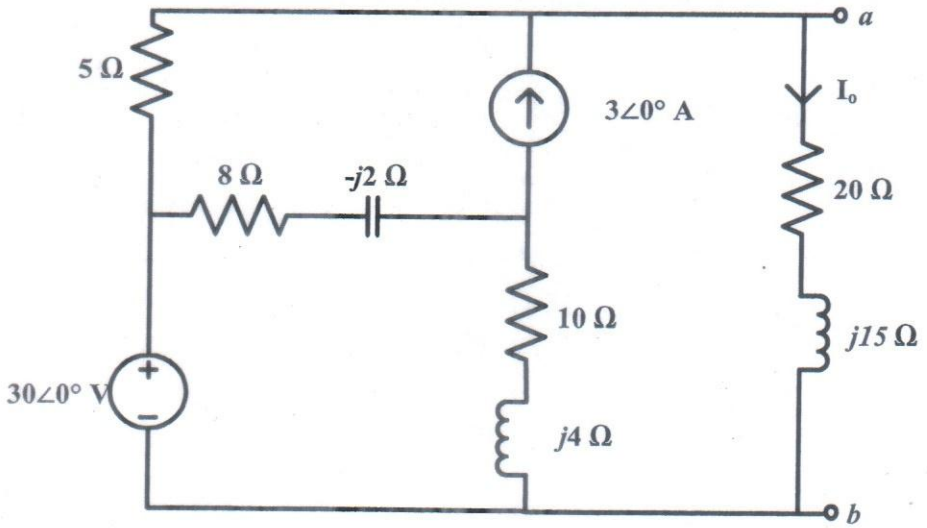


Figure 3(a)

b) What is average power? In Figure 3(b), the resistor R_L is adjusted until it absorbs maximum average power. Calculate R_L and the maximum average power absorbed by it. 8

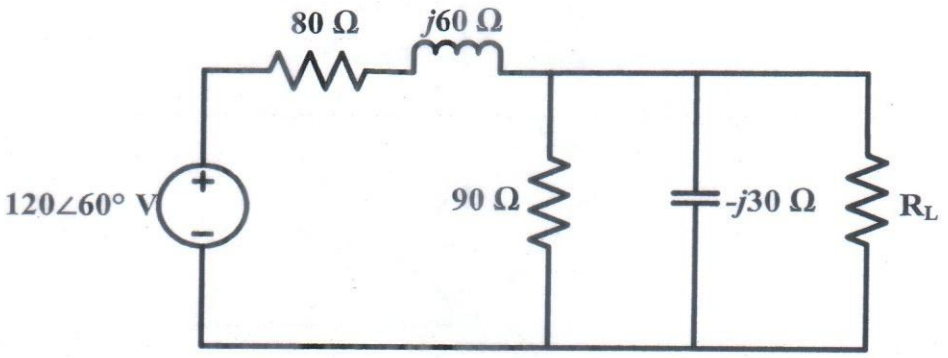


Figure 3(b)

c) When connected to a 120 V (rms), 60 Hz power line, a load absorbs 4 kW at a lagging power factor of 0.8. Find the value of capacitance necessary to raise the pf to 0.95. 5

4. a) Use nodal analysis to find v_0 in the circuit of Figure 4(a). Let $\omega = 2$ krad/s. 13

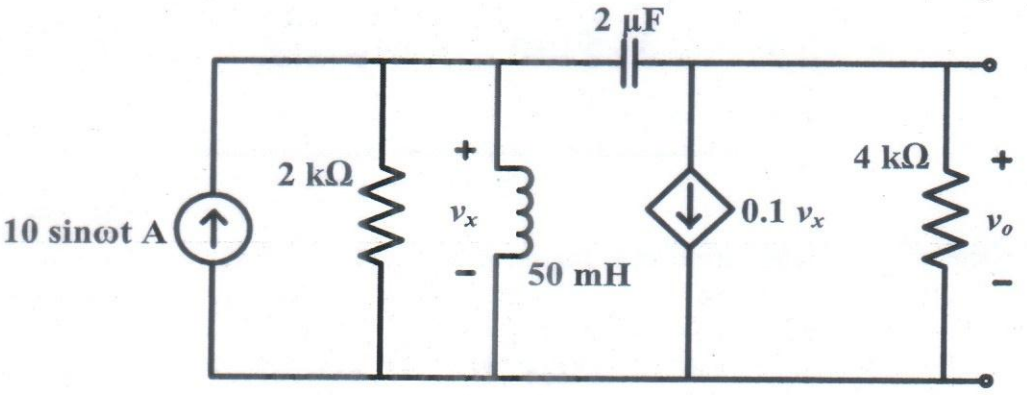


Figure 4(a)

b) What is admittance? Find I in the circuit of Figure 4(b). 12

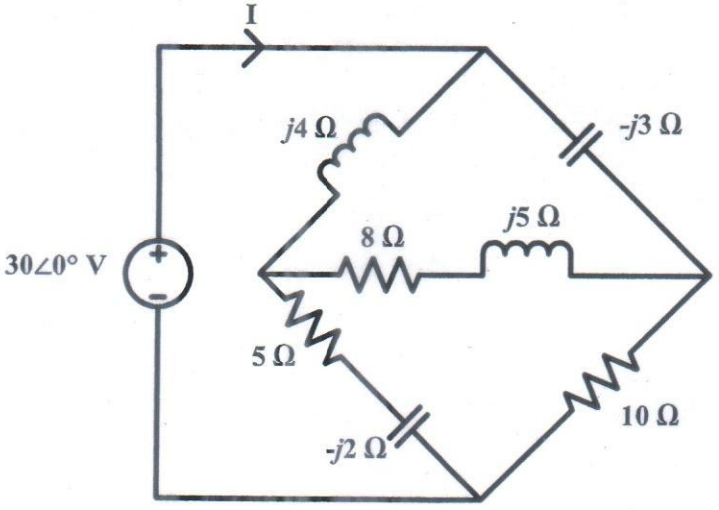


Figure 4(b)

5. a) Find V_o in the network in Figure 5(a) using superposition. 12

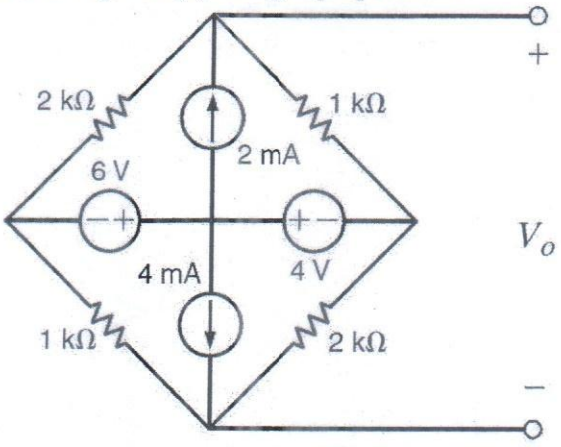


Figure 5(a)

b) Find the Thévenin's equivalent of the circuit shown in Figure 5(b). 13

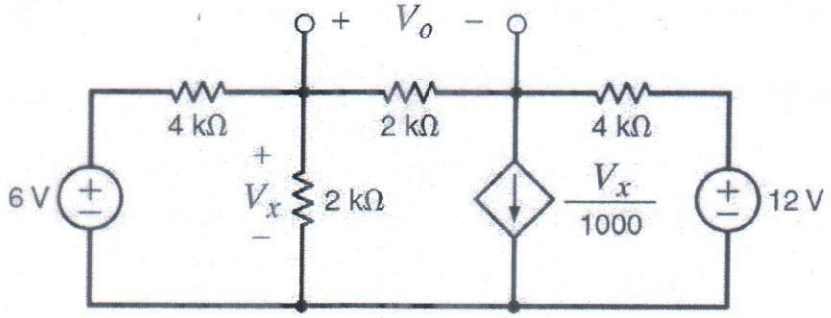


Figure 5(b)

6. a) Determine the hybrid parameters for the network in Figure 6(a). 12

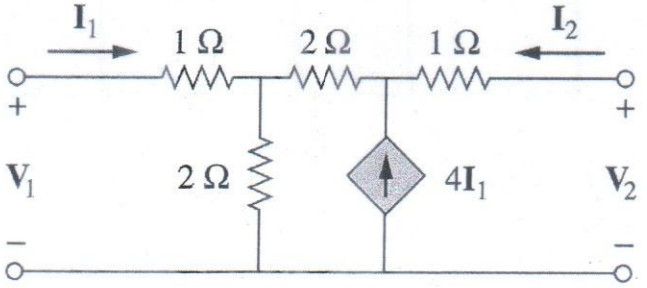


Figure 6(a)

b) For the circuit in Figure 6(b), at $\omega = 2$ rad/sec, $z_{11} = 10\ \Omega$, $z_{12} = z_{21} = j6\ \Omega$ and $z_{22} = 4\ \Omega$. Obtain the Thevenin equivalent circuit at terminals $a - b$ and calculate v_0. 13

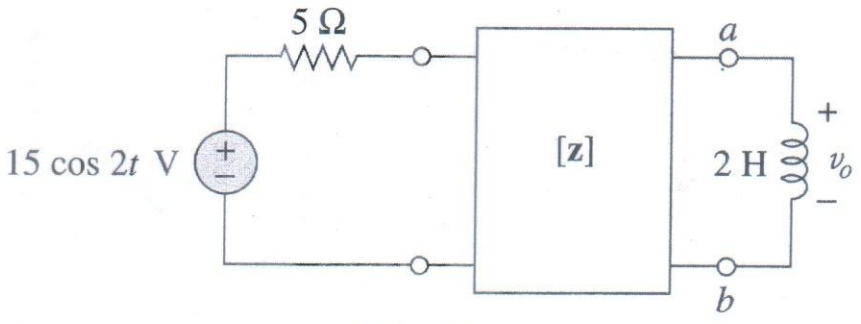


Figure 6(b)

7. a) Mathematically derive the condition for maximum power transfer in an AC circuit where source voltage is V_{Th}, line impedance is $Z_{Th} = R_{Th} + jX_{Th}$ and load impedance is $Z_L = R_L + jX_L$. 10

b) Using mesh analysis, find I_0 in the network in Figure 7(b). 15

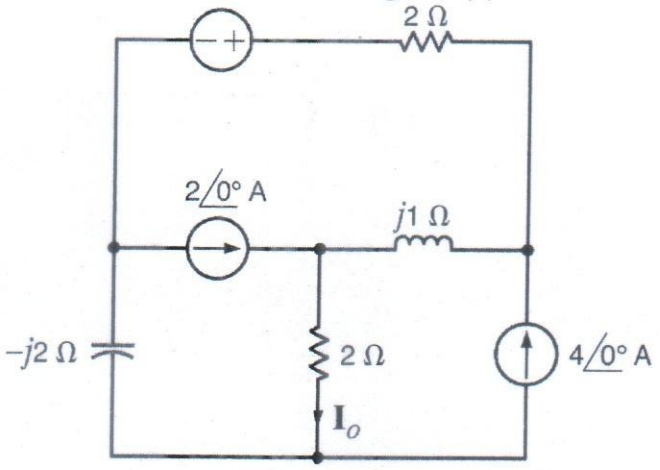
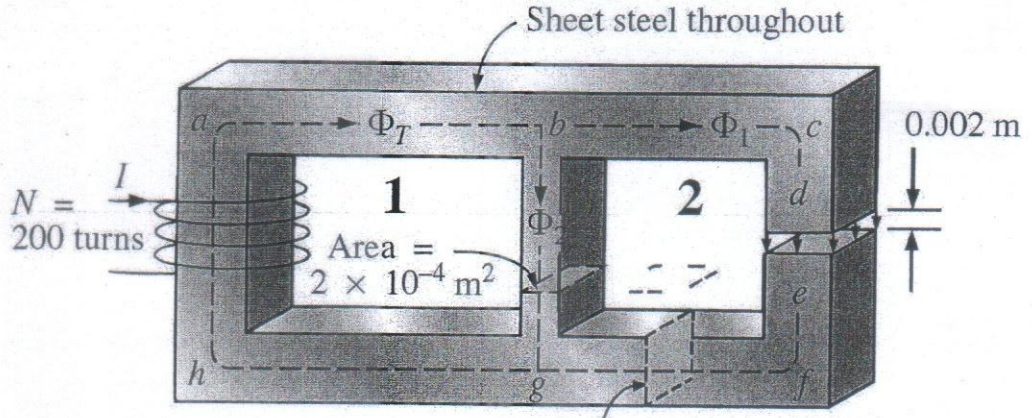


Figure 7(b)

8. a) For the series-parallel magnetic circuit shown in Figure 8(a), find the value of I required to establish a flux of $\phi_g = 2 \times 10^{-4}$ Wb in the air gap. Use the two B-H curves supplied at the end. 13



Area for sections other than $bg = 5 \times 10^{-4}$ m²

$l_{ab} = l_{bg} = l_{gh} = l_{ha} = 0.2$ m

$l_{bc} = l_{fg} = 0.1$ m, $l_{cd} = l_{ef} = 0.099$ m

Figure 8(a)

b) Calculate the value of Z_{ab} of the network shown in Figure 8(b). 12

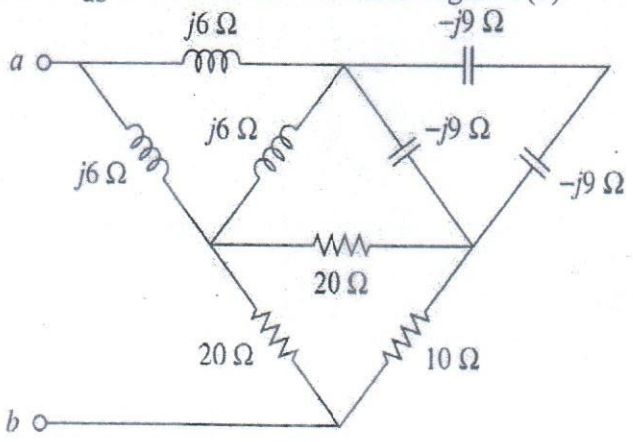
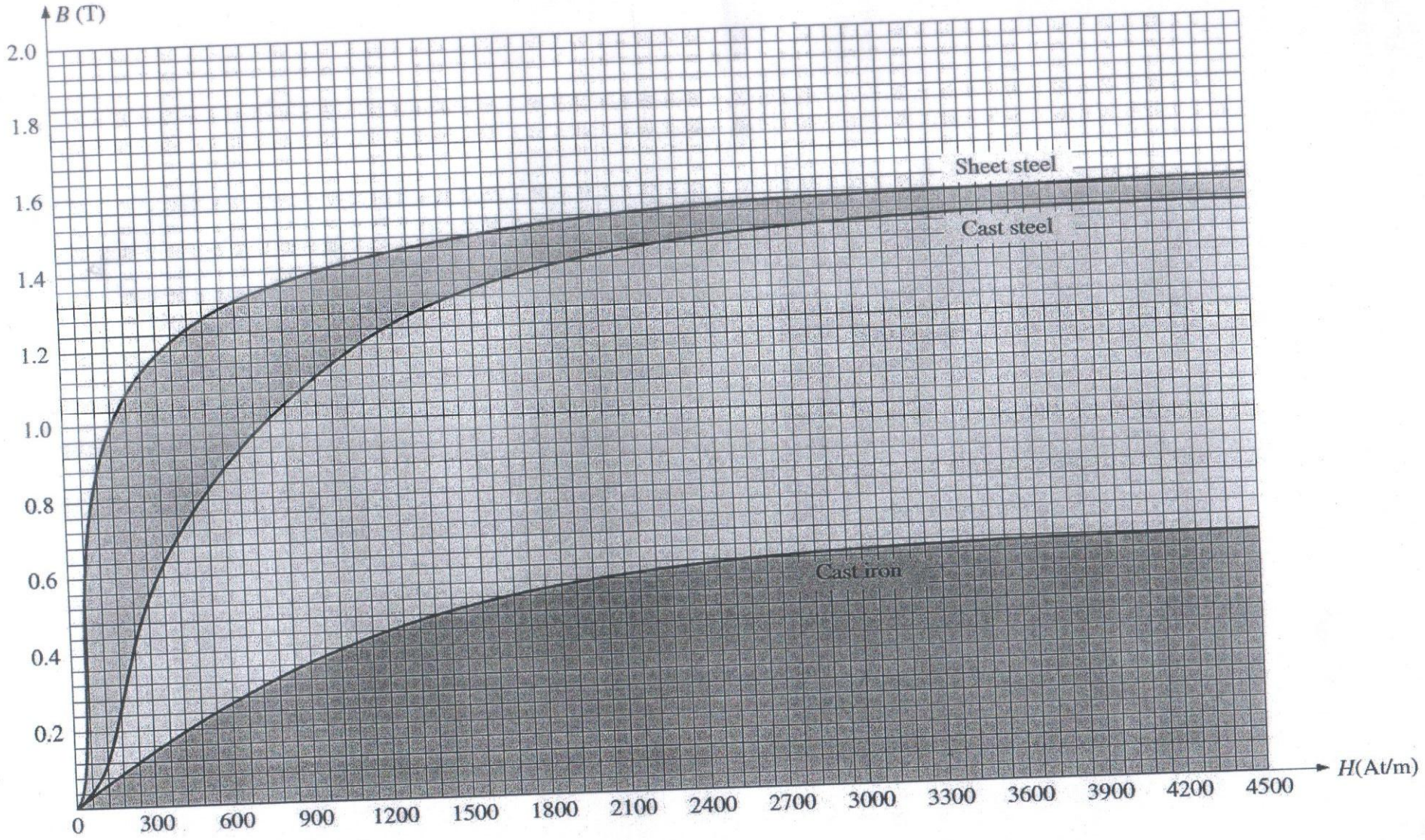
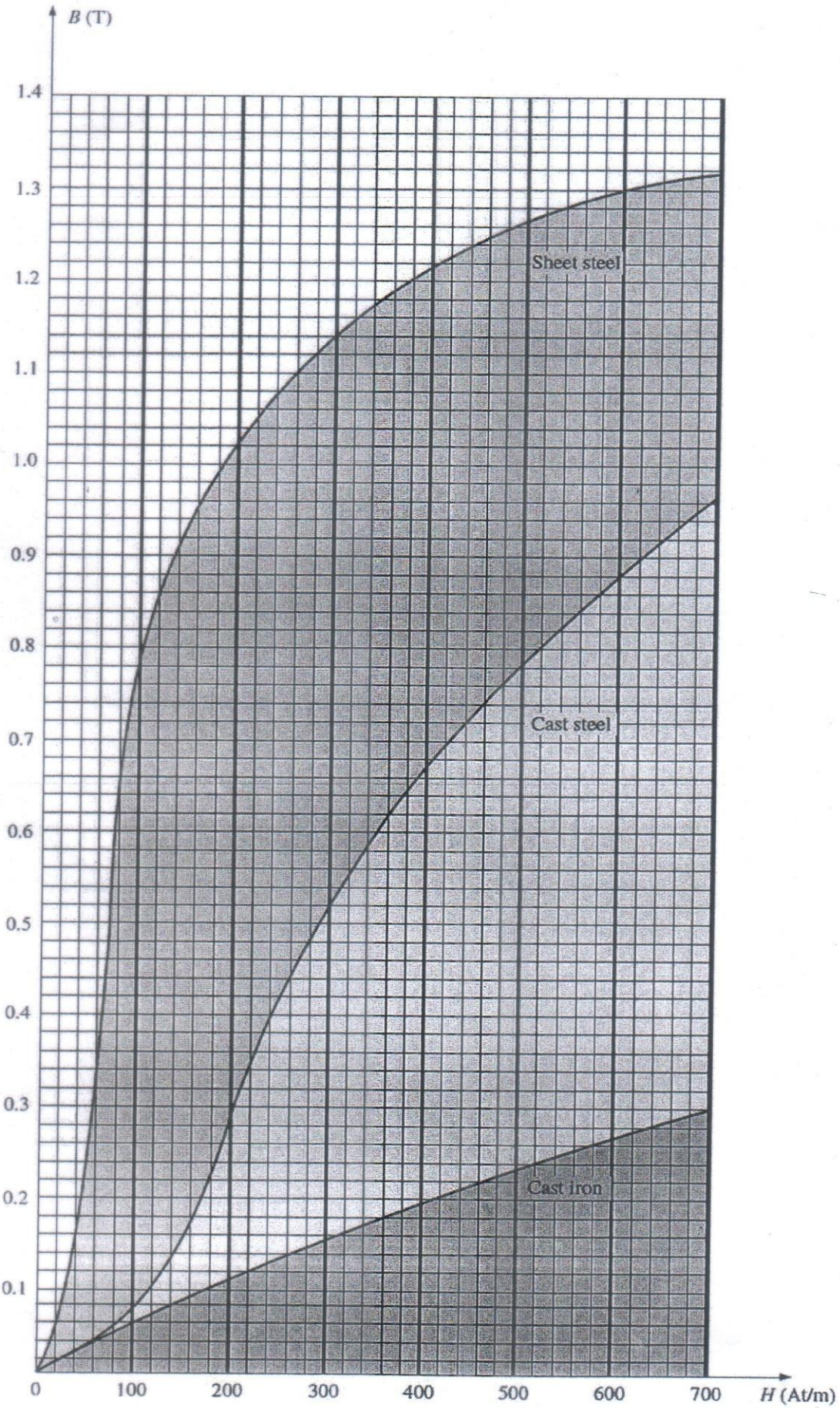


Figure 8(b)



B-H curve 1 for Q. 8(a)



B-H curve 2 for Q. 8(a)

B.Sc. Engg.(EEE) 2nd Sem. Date: November 05, 2019

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination — Summer Semester, A. Y. 2018-2019
Course No.: CSE 4271 — Time: 3 Hours
Course Title: Computer programming — Full Marks: 100

There are **8 (eight)** questions. Answer **any 6 (six)** 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. **Question number 1 (one) is compulsory.**

Question No. 1 is compulsory

1. a) Define the following with suitable examples: 10
   i. Computer program
   ii. Algorithm
   iii. Pseudo-code
   iv. Flowchart

   b) Write a C program to input electricity units spent and calculate total electricity bill according to the given condition: 10

Units	Cost
For first 50 units	$0.50/Unit
For next 100 units	$0.75/Unit
For next 100 units	$1.20/Unit
For unit above 250	$1.50/Unit
**An additional surcharge of 20% is added to the bill	

Sample Input	Sample Output
49.50	29.700000
50.50	30.450000

2. Write a C program to find the inverse of a 3 × 3 matrix. 16
[Hints: First calculate determinant of matrix. Then calculate adjoint of given matrix. Adjoint can be obtained by taking transpose of cofactor matrix of the given square matrix. Finally, multiply 1/determinant by adjoint to get inverse. $A^{-1} = \frac{1}{\det(A)} adj(A)$]

3. a) Write a C program to print a pyramid of prime numbers. 10

Sample input	Sample output
Enter the height of the pyramid: 7	2 3 5 7 11 13 17 19 23 29 31 37 41 43 47 53 59 61 67 71 73 79 83 89 97 101 103 107

b) Write the output of the following C program. 6

```
#include<stdio.h>
void sorting(int *a,int *b,int *c);
int main()
{  int a, b, c;
   a=22;
   b=32;
   c=98;
   printf("Values from small to big:\n");
   printf("a = %d \nb = %d \nc = %d\n",a,b,c);
   sorting(&a, &b, &c);
   printf("Values from big to small:\n");
   printf("a = %d \nb = %d \nc = %d",a, b, c);
   return 0;
}
void sorting(int *a,int *b,int *c)
{  int temp;
   temp = *b;
   *b = *a;
   *a = *c;
   *c = temp;
}
```

4. a) Write the output of the following C program. 6

```
#include<stdio.h>
int main()
{   int i, j;
   for (i = 0; i < 5; i++)
   {
      printf("\n");
      for (j = 0; j < 5; j++)
      {
         if (i == 0 || i == 4 || j == 0 || j == 4)
            printf("$");
         else
            printf("-");
      }
   }
   return 0;
}
```

b) Write a C program to accept records of different cities using array of structures. The number of cities should be taken as an input from the user. The structure should contain city, population, literacy rate, and income. Use a user defined function to find the city having the highest literacy rate and another city with the highest income. The structure should be passed to the user defined function by reference. 10

5. a) Write a C program to remove all characters in a string except the alphabets. 10

Sample Input	Sample Output
this? is.,not so?? easy..	thisisnotsoeasy

b) Describe the various assignment operators with proper example. 6

6. a) The properties and contents of a text file named "input.txt" are given below: 12

Properties		Contents
Name:	input.txt	A good person is someone who displays love, joy, peace, kindness, goodness, humility, patience and who is faithful and endures all things. It is someone who displays self control and considers others more important than self. It is someone who is a good friend, a good listener and someone who displays integrity dignity and accountability towards self and towards others. This person is not judgmental and holds no score of records against others but walks in forgiveness and understanding of others. This person does not bad mouth but rather stands up for someone. This is someone who would lay down his life for others not as a doormat, but as a true friend. There are few people today who fall into this category and if you find one, run with that person because that person is positive and someone you can always count on a true friend.
Type of file:	Text Document(.txt)	
Location:	C:\Users\Desktop	
Size:	841 bytes	
Attributes:	A	
Availability:	Available offline	

With the help of the above text file, write a C program which will generate another text file named "output.txt" having the following properties and contents:

Properties		Contents
Name:	output.txt	A Good Person Is Someone Who Displays Love, Joy, Peace, Kindness, Goodness, Humility, Patience And Who Is Faithful And Endures All Things. It Is Someone Who Displays Self Control And Considers Others More Important Than Self. It Is Someone Who Is A Good Friend, A Good Listener And Someone Who Displays Integrity Dignity And Accountability Towards Self And Towards Others. This Person Is Not Judgmental And Holds No Score Of Records Against Others But Walks In Forgiveness And Understanding Of Others. This Person Does Not Bad Mouth But Rather Stands Up For Someone. This Is Someone Who Would Lay Down His Life For Others Not As A Doormat, But As A True Friend. There Are Few People Today Who Fall Into This Category And If You Find One, Run With That Person Because That Person Is Positive And Someone You Can Always Count On A True Friend.
Type of file:	Text Document(.txt)	
Location:	C:\Users\Desktop	
Size:	841 bytes	
Attributes:	A	
Availability:	Available offline	

b) Write down the differences between *string* and *array* in C programming. 4

7. a) Given a string, reverse the letters of each word in the string. Note that the words positions will remain the same. 8

Sample Input	Sample Output
An irritating problem	nA gnitatirri melborp

b) Predict the output of the following code. 8

```
#include <stdio.h>
int a=2,b=1;
void swap(int a,int b)
{
   int temp=a;
   a=b;
   b=temp;
}
int run(int a)
{
   b+=1;
   a+=b;
   printf("run: %d %d\n",a,b);
   return a;
}
int main()
{
   int a,b;
   a=1;
   b=2;
   a+=run(b);
   printf("main: %d %d\n",a,b);
   swap(a,b);
   run(a);
   printf("main: %d %d",a,b);
   return 0;
}
```

8. a) A point in XY plane can be represented by 2 floating point numbers that represent its x, y coordinates, respectively. A circle in the XY plane can be represented by its center (which is a point in XY plane) and a radius (which is a floating point number). A square in XY plane, whose sides are parallel to the axes of the XY plane, can be represented by its bottom-left corner (which is a point in XY plane) and length of its sides (which is a floating point number). A cone, whose base is on the XY plane, can be represented by its circular base and a height. 12

   (i) Based on the above information, define suitable structures to represent a point, circle, square and cone.

   (ii) Read a circle, square and cone from console, store them in appropriate structure variables.

   (iii) Then print out the area of the circle and square; and volume of the cone.

   [Hints: Volume of a cone is one-third of height times its base area and the value of pi is 22/7]

b) Describe the use of *fseek()* in C with all its parameters. 4

Library

B.Sc. Engg. (MCE), 2nd Sem. Date: November 05, 2019 (Morning)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

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

Summer Semester, A.Y. 2018-2019
Time: 3 hours
Full Marks: 150

There are **8 (eight)** questions. Answer **any 6 (six)** questions. All questions carry equal marks. Marks in the margin indicate full marks. Programmable calculators are not allowed. Do not write on this question paper. **Assume reasonable value(s) for missing data if any.**

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1. a) Find the value of the unspecified resistances, voltage and current sources for the circuit shown in Fig. 1(a). The loop current equations are given as- 10

   i. $35\,I_1 - 15\,I_2 = 75$
   ii. $-15\,I_1 + 65\,I_2 - 15\,I_3 = -50$
   iii. $I_3 = -1$

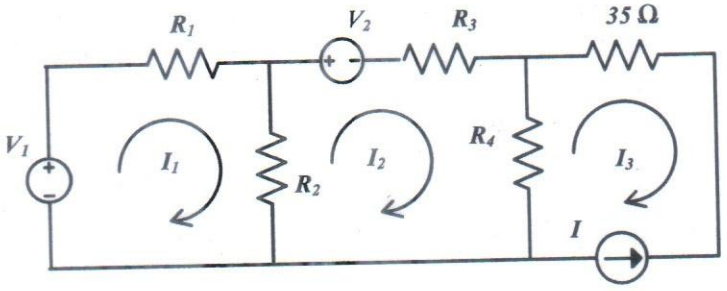

Fig. 1(a)

   b) The variable resistor (R_0) in the circuit in Fig. 1(b) is adjusted until the power dissipated in the resistor (R_0) is 250 Watt. Find the values of R_0 which satisfy this condition. 15

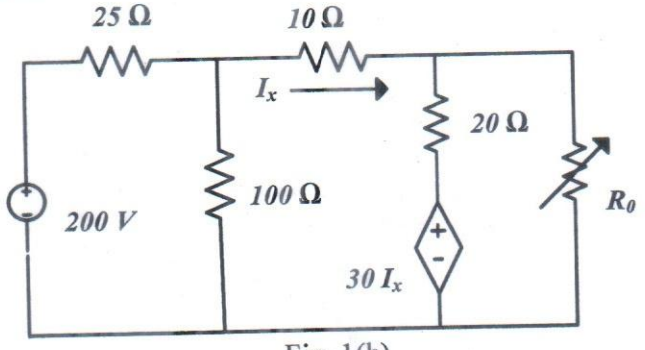

Fig. 1(b)

2. a) The readings of the voltmeter and the ammeter in the circuit shown in Fig. 2(a) are 10 V and 0.6 A respectively. Find the values of R_1 and R_2. 10

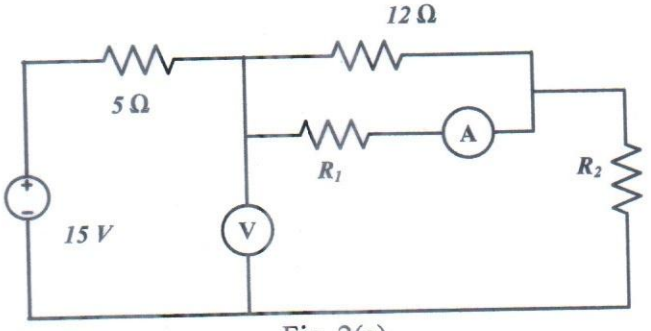

Fig. 2(a)

b) Find the power absorbed/delivered by the dependent source shown in Fig. 2(b) if $V_0 = 12$ V. 15

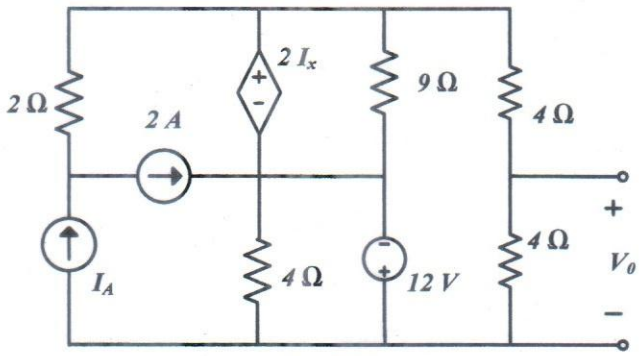

Fig. 2(b)

3. a) A consumer wants to buy an IPS. Find the suitable VA of the IPS if his Watt requirement is given in Table 1 below. Assume overall power factor 0.8. 4

Table 1

Item	Quantity	Watt
Fan	4	100
Light (Tube)	2	60
Light (Energy saving)	3	40

b) In a series AC circuit, the current is found to be $i(t) = \sin(1000t + 45°)$ A for an applied voltage $v(t) = 100 \sin(1000t)$ V. One element of the circuit is an inductor of 10 mH. 8
   i) Determine the values of the other elements.
   ii) Draw the quantitative phasor diagram of the circuit.

c) Find the value of L or C which will make the overall power factor, pf = 0.8 if $V_{in} = 100\angle 90$ V at f = 50 Hz in case of Fig. 3(c) 13

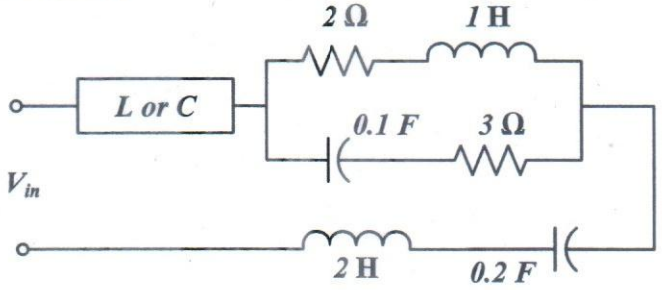

Fig. 3(c)

4. a) Draw the qualitative phasor diagram for the following circuit given in Fig. 4(a). Show necessary assumptions if necessary. 5

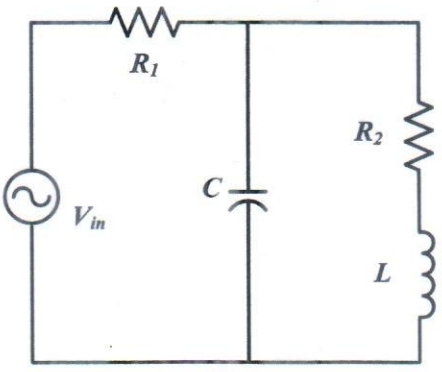

Fig. 4(a)

b) For the circuit shown in Fig. 4(b), determine the value for resistors R_1, R_2 & capacitor, C. Power consumed by the resistor, R_2 is 320 Watt. Given, the value of inductor, L is 10 mH, input voltage is 100 sin (ωt + 110°) V and input current is 200 cos (ωt + 10°) A. 10

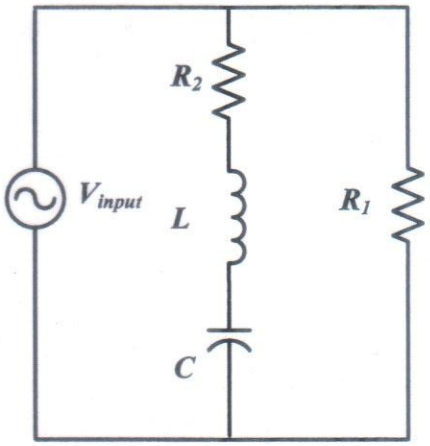

Fig. 4 (b)

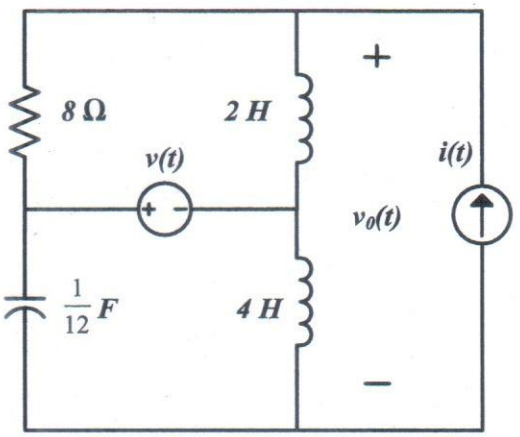

Fig. 4 (c)

c) Determine $v_0(t)$ for Fig. 4(c) where, $v(t) = 5 \sin 5t$ V and $i(t) = 4 \cos (3t + 15°)$ A. 10

5. a) What is the value of the resistance R in Fig. 5(a) that maximizes the average power delivered to the load? Calculate the maximum average power transferred to the load. 13

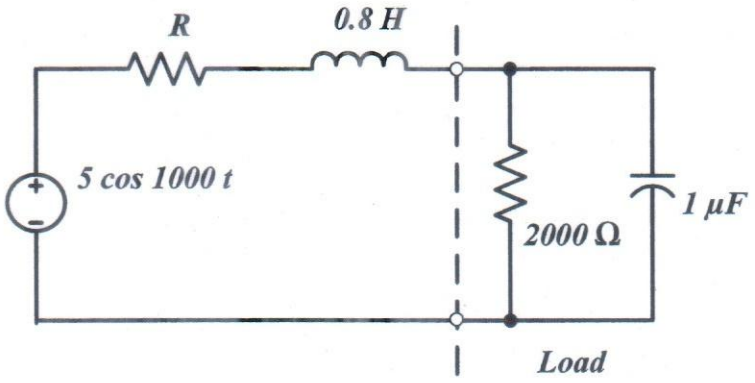

Fig. 5(a)

b) An industrial load operates at 30 kW, 0.8 pf lagging. The load voltage is 240 V. The real and reactive power losses in the transmission line are 1.8 kW and +2.4 kVAR respectively. Find the impedance of the transmission line and the input voltage to the line. 12

6. a) Find the average power absorbed by the network shown in Fig. 6(a). 10

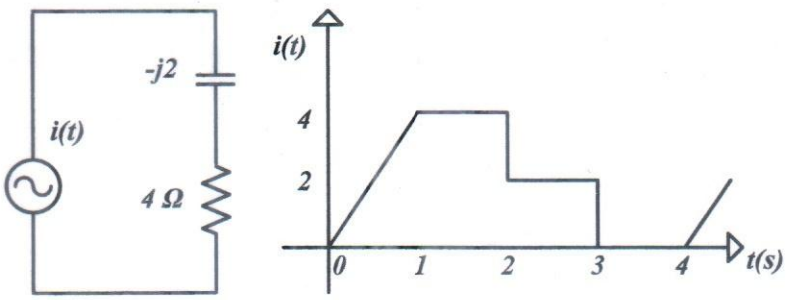

Fig. 6(a)

b) In a power plant, three types of loads (i.e. Motor loads, Electric furnace & Lights) are connected in parallel to a 600 V rms source. An industrial client is charged a penalty if the power factor of the plant drops below 0.85. The equivalent plant loads are shown in Fig. 6 (b) as follows. The frequency is 50 Hz. 15

i. Calculate total real power, reactive power & apparent power of the plant.

ii. What value of the capacitance is required to bring the power factor up to 0.85 lagging?

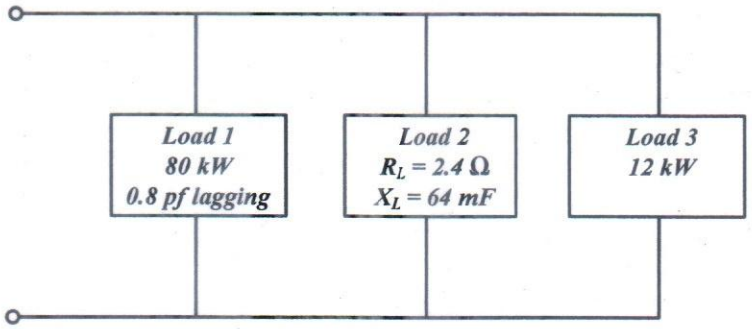

Fig. 6(b)

7. a) Show that for transmission of the same amount of power from one place to another place, the required amount of copper cable in single phase system is 33.33% higher than that of the balanced three phase system. 10

b) A Δ-connected load has $(9 - j6)\ \Omega$ in each phase and a Y-connected load has $(6 + j8)\ \Omega$ in each phase. They are connected in parallel across a 3-phase line voltage of 230 V. Calculate the total line current, power consumed and the power factor of the combination. 15

8. a) i. What are the advantages of two wattmeter method over single wattmeter method? 5
ii. How do you understand a balanced source and a balanced load in a three phase system?

b) For the three-phase three-wire system shown in Fig. 8(b), determine the line currents, line-to-line voltages at load end and draw phasor diagram showing line currents, line voltages, phase currents and phase voltages at load end. 20

Given,

i. Source voltages: $E_{an} = 1000\angle 0$ V, $E_{bn} = 1000\angle -120$ V, $E_{cn} = 1000\angle +120$ V

ii. Source impedances: $Z_{an} = Z_{bn} = Z_{cn} = 2 + j8\ \Omega$

iii. Line impedances: $Z_{aa'} = Z_{bb'} = Z_{cc'} = 1 + j1.8\ \Omega$

iv. Load impedances: $Z_{a'n'} = 19 + j18\ \Omega$, $Z_{b'n'} = 49 - j2\ \Omega$, $Z_{c'n'} = 29 + j50\ \Omega$

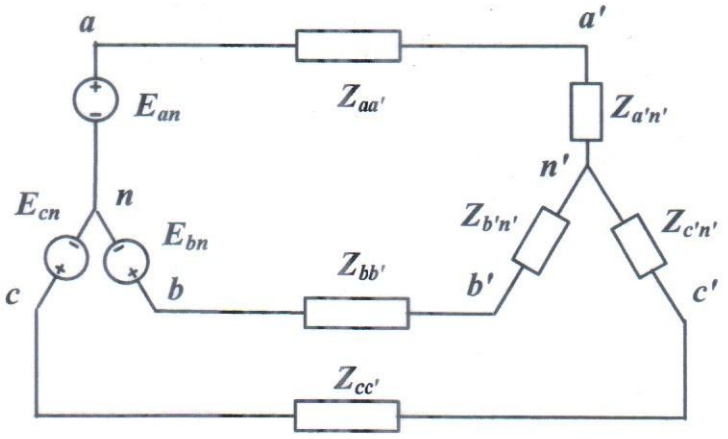

Fig. 8(b)

B.Sc. Engg. (EE)/HDEE, 4th Sem. Date: November 5, 2019 (Morning)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination — Summer Semester, A. Y. 2018-2019
Course No.: EEE 4403 — Time: 3 Hours
Course Title: Communication Engineering I — Full Marks: 150

There are **8 (eight)** questions. Answer **any 6 (six)** 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. Make reasonable approximation(s) for missing information.

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1. a) A carrier wave of frequency 91 MHz is frequency modulated by a sine wave of amplitude 10 volts and frequency 15 kHz. The frequency sensitivity of the modulator is 3 kHz / V. 9
   i. Determine the approximate bandwidth of FM wave using Carson's rule.
   ii. Repeat part (i), assuming that the amplitude of the modulating wave is doubled.
   iii. Repeat part (i), assuming that the frequency of the modulating wave is doubled.

   b) Draw the overall block diagram of FM containing pre-emphasis and de-emphasis networks. How can we distinguish narrowband and wideband FM in terms of their modulation index values? Derive the bandwidth expression from Carson's rule considering both sinusoidal modulation and non-sinusoidal modulation. 5+2+6

   c) Why is pre-emphasis necessary? What sort of filter is equivalent to a de-emphasis network? 2+1

2. a) Design an indirect FM transmitter with $f_1 = 200\,kHz, \Delta f_1 = 20Hz, f_{LO} = 10.8\,MHz,$ $n_1 = 64$ and $n_2 = 48$. Compute the carrier frequency and maximum frequency deviation of the output of this transmitter. 15

   b) Explain nonlinear modulation in detail and mention why it is also called a single balanced modulator. 10

3. a) An angle modulated signal is described by $x_c(t) = 5\cos[2\pi(10^6)t + 0.2\sin(10^3)\pi t]$. Find m(t) considering the following cases: 10
   I. $x_c(t)$ is a PM signal with $k_p = 5$,
   II. $x_c(t)$ is an FM signal with $k_f = 5\pi$.

   b) For the NRZ format binary pulse train 101001; show its corresponding ASK, PSK and FSK representations. 2+9

   c) What are the main advantage and disadvantage in direct method of FM generation? 4

4. a) Compare among OQPSK, MSK and GMSK modulation schemes. Show the time-frequency resource grid of OFDMA scheme. What is the allowed CDMA bandwidth in UMTS technology? 9+6+1

   b) For an analog sinusoidal signal show its PAM, PPM, PWM version. What is clipped PPM? 7+2

5. a) Mention the repeater spacing, original wire bandwidth, number of channels multiplexed and net total bandwidth of T1 time division multiplexing. How is this net capacity achieved here? 4+4

b) With a diagram, explain frame, framing bit and signaling bit for T1 time division multiplexing. 6

c) With an example show the model waveform of DPSK and from this comment on the pattern of high and low states in the modulating signal. Under which sort of PSK technique DPSK can be grouped into? What type of gate and modulator is available in DPSK modulator circuit? What additional elements are there in DPSK demodulator? 6+3+2

6. a) Derive the expression for sideband power and total power for amplitude modulation and from them find the expression for modulation efficiency. Show that a major portion of the power is utilized for transmitting the carrier in amplitude modulation. 6+4

b) What will be the required bandwidth of the modulated waveform in DSB, if the modulating/baseband signal bandwidth is 300 Hz? Find out the minimum value of carrier frequency, ω_c in this case to eliminate the possibility of spectral overlap (for a spectra centered at $\pm \omega_c$). What will be the minimum antenna height for efficient radiation of the baseband signal? Will it be a good choice to directly transmit the baseband signal? Explain. 5+6

c) Why are the single sideband (SSB) modulated outputs known as suppressed carrier signals? 4

7. a) Compute the baud rate for a 72 kbps 64-QAM signal. Draw the constellation diagram of 8-PSK. How is QAM different from PSK? Show a representation of 16-QAM using 2 amplitude, 8 phase level and 3 amplitude, 12 phase level. 5+5+6

b) State the principle and applications of DPCM. What does make DPCM more advantageous than PCM technique? Define delta modulation. 5+2+2

8. a) Represent the bit stream 10101110 with unipolar, polar, bipolar and Manchester signaling including both RZ and NRZ schemes. 13

b) Show mathematically why AM and PM are referred to as linear modulation and non-linear modulation, respectively. 12

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

Date: October 30, 2019 (Morning)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

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

Summer Semester, A. Y. 2018-2019
Time: 3 Hours
Full Marks: 150

There are **8 (eight)** questions. Answer **any 6 (six)** 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 bear their usual meanings.

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1 a) Answer the following questions in brief:

(i) What happens when large load is connected suddenly to a 3-phase induction motor? 1

(ii) Why does the rotor of an induction motor rotate slower than the revolving field? 2

(iii) Give two advantages of a wound-rotor motor over a squirrel-cage motor. 2

(iv) What will happen if a 3-phase induction motor is switched on with two phases disconnected? Describe the situation for both Y-connected and Δ-connected stator configurations. 4

(v) 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

(vi) Suppose a 3-phase induction motor has 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. 3

(vii) For a fixed load connected with a 3-phase induction motor, if the rotor resistance (R_2) is increased, what changes occur to its starting current and running current? 3

b) A 208 V, 3-phase, twelve-pole, 50 Hz induction motor is running at a slip of 0.03. 7

(i) What is the synchronous speed of this motor?

(ii) What is the rotor speed of this motor at the full-load?

(iii) What is the rotor current frequency of this motor at the full-load?

(iv) What is the stator current frequency of this motor at the starting of the motor?

(v) What is the stator current frequency of this motor at the full load?

(vi) What will happen to the synchronous speed if the supply frequency is changed to 60 Hz?

(vii) If the direction of the synchronous speed is reversed when the rotor is running at the full load, what will be the value of slip at that instance?

2. a) Answer the following questions in brief:

i. Sketch the shape of a typical torque-speed characteristic curve of a single phase induction motor when no auxiliary winding is connected. 2

ii. Draw the torque-speed curve of shaded pole motor. 1

iii. Which single-phase induction motor system has the highest starting torque? 2

iv. What is the function of centrifugal starting switch in a single-phase capacitor start capacitor-run induction motor? 2

3

v. In split phase induction motor why auxiliary winding current (I_A) leads main winding current (I_M)? 3

vi. Compare between capacitor start induction run motor and capacitor start capacitor run motor. 3

vii. If you increase the supply frequency of a capacitor-start-induction-run motor, what change will occur in the speed of the rotor? Explain using the torque-speed characteristics curve.

b) A single-phase, induction motor has stator windings in space quadrature and is supplied with a single-phase voltage of 200 V at 50 Hz. The standstill impedance of the main winding is (5.2 + j10.1) ohm and of the auxiliary winding is (19.7 + j14.2) ohm. Find the value of capacitance to be inserted in the auxiliary winding for maximum starting torque. 9

3. a) (i) Name any two important characteristics of a 3-phase synchronous motor not found in 3-phase induction motor. 2

(ii) Is it possible to get load angle (δ) equals to zero for a synchronous motor? Explain in brief. 2

(iii) Is a synchronous motor self-starting? If not, explain why and write the available methods of starting a synchronous motor. 3

(iv) Draw the equivalent circuit of a synchronous motor. Also, draw the phasor diagram under no-load condition. 3

(v) Suppose a synchronous motor is running without any mechanical load. Under running condition, if the field supply is disconnected what will happen to this motor? Will it be still running? Explain in brief. 3

(vi) If the load of the synchronous motor is increased, what will be the change in motor supply current (I_s)? What will happen to the real power consumption and the reactive power consumption? Clearly show all possible changes using separate phasor diagrams. 4

b) A 208 V, Y-connected synchronous motor is drawing 40 A at unity power factor from a 208 V power system. The field current under these conditions is 2.7 A. Its synchronous reactance is 0.8 Ω. 8

(i) Find the load angle δ.

(ii) How much field current would be required to make the motor operate at 0.8 pf leading? What is the new torque angle?

4. a) A synchronous generator is operating alone. Show the effects of an increase in generator loads at constant power factor upon the terminal voltage change for the following loading cases: 12

(i) loads with lagging power factor,

(ii) loads with unity power factor and

(iii) loads with leading power factor.

Draw the vector diagram, if all loads are removed from the above mentioned generator.

b) What is the basic difference between synchronous motor and alternator? 3

c) A 200 kVA, 480 V, 50 Hz, Y-connected synchronous generator with a rated field current of 5 A was tested and the following data were taken: 10

(i) $V_{T,OC}$ at the rated I_F was measured to be 540 V.

(ii) $I_{L,SC}$ at the rated I_F was found to be 300 A.

(iii) When a dc voltage of 10 V was applied to two of the terminals, a current of 25 A was measured.

5. a) Answer the following questions in brief: 12

(i) Briefly explain the operation of a synchronous condenser and how it can be used for improving the power factor.

(ii) Show the effect of load in the "V-curve" of a synchronous motor.

(iii) A synchronous motor operates at leading power factor. If you increase the field current, show the changes in real power consumption, reactive power consumption and power factor of the motor using phasor diagram.

b) The infinite bus in Fig.1 operates at 480 V. Load 1 is an induction motor consuming 100 kW at 0.78 pf lagging and load 2 is an induction motor consuming 200 kW at 0.8 pf lagging. Load 3 is a synchronous motor whose real power consumption is 150 kW. What should be the power factor of the synchronous motor to have the lowest transmission line current in this system? 13

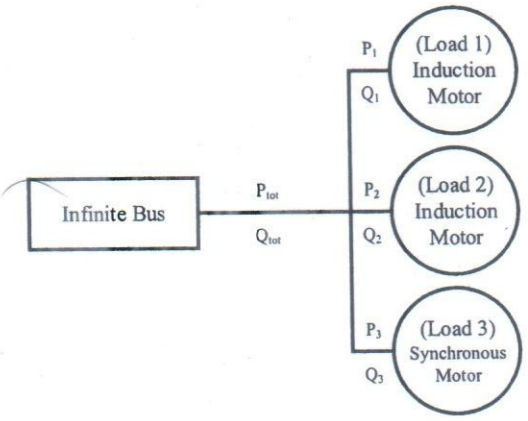

Fig. 1

6. a) Write down the conditions of parallel operation of alternators. What are the advantages of parallel operation of alternators? 5

b) Why do you need to make the frequency of the incoming generator a bit higher than the operating frequency while going for the parallel operation of alternators? Is there any problem if you make the frequency a bit lower? Explain using necessary diagrams. 8

c) Immediately after the synchronizing a generator with the infinite bus, 12

(i) show the effect of varying field excitation using phasor diagram and

(ii) show the effect of varying mechanical torque of the shaft using phasor diagram.

What will be the effects of the generator operating alone (not connected with the infinite bus) for the above mentioned cases?

7. a) Suppose two generators of IUT: generator 1 and generator 2 are operating in parallel under a certain electrical load (both real load and reactive load are present). Initially both the generators were sharing the load equally. Show the effects of the generators using 'house diagram' for the following cases: 12

(i) only the real power consumption is increased,

(ii) only the reactive power consumption is increased,

(iii) the mechanical torque of the generator 1 is increased,

(iv) the field excitation of the generator 2 is increased and

(v) the field excitations of both the generators are increased.

b) For the two generators of IUT mentioned in 7(a), consider a situation when generator 1 has a no-load frequency of 51.5 Hz and a slope S_{p1} of 1 MW/Hz and generator 3 has a no-load frequency of 51.0 Hz and a slope S_{p2} of 1 MW/Hz. The two generators are supplying a real load totaling 2.5 MW at 0.8 pf lagging. The resulting system house diagram is shown in Fig. 2. 13

(i) At what frequency is this system operating and how much power is supplied by each of the two generators?

(ii) Suppose an additional 1-MW load was attached to this power system. What would be the new system frequency, and how much power would generator 1 and generator 2 supply now?

(iii) With the system in the configuration described in (ii), what will be the system frequency and generator power if the governor set points of generator 2 are increased by 0.5 Hz?

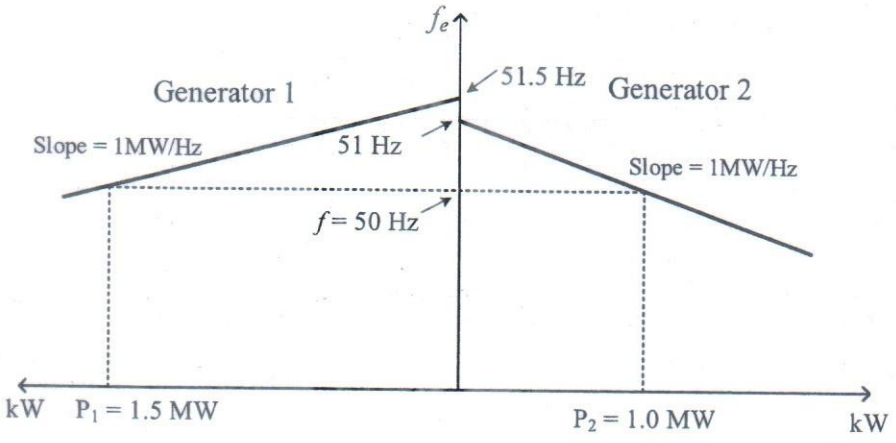

Fig. 2

8. a) Suppose that you are an engineer planning a new electric cogeneration facility for a plant with excess process steam. You have a choice of either two 10 MW turbine generators or a single 20 MW turbine-generator. What would be the advantages and disadvantages of each choice? 5

b) What do you understand by angular resolution of a stepper motor? What are the methods of increasing the angular resolution of a stepper motor? 6

c) Briefly explain the 'microstepping' of a stepper motor. 6

d) Draw the typical control circuit of stepper motor. 6

e) What are the major applications of stepper motor? 2

B.Sc. Engg. (EE) / HDEE, 4th Sem. Date: October 28, 2019 (Morning)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination — Summer Semester, A. Y. 2018-2019
Course No.: Math 4421 — Time: 3 Hours
Course Title: Random Signals and Processes — Full Marks: 150

There are **8 (eight)** questions. Answer **any 6 (six)** 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) A 3-dimensional random vector $K=[K_1 \quad K_2 \quad K_3]'$ has the joint PMF 15

$$P_K(k)=\begin{cases} p^3(1-p)^{k_3-3} & k_1<k_2<k_3; k_i \in \{1,2.....\}, \\ 0 & otherwise. \end{cases}$$

From the joint PMF $P_K(k)$, find the marginal PMFs for the following

i. $P_{K_1,K_2}(k_1,k_2)$,

ii. $P_{K_1,K_3}(k_1,k_3)$,

iii. $P_{K_2,K_3}(k_2,k_3)$,

iv. $P_{K_1}(k_1)$, $P_{K_2}(k_2)$ and $P_{K_3}(k_3)$.

b) Find the expected value E[X], the correlation matrix R_X, and the covariance matrix C_X of the 2-dimensional random vector X with PDF 10

$$f_X(x)=\begin{cases} 2 & 0 \le x_1 \le x_2 \le 1, \\ 0 & otherwise. \end{cases}$$

2. a) What is a Poisson process? What are the conditions for defining it? 5

b) Define stationary process and wide sense stationary process. Also discuss the differences between them. 5

c) In a production line for 1000 Ω resistors, the actual resistance in ohms of each resistor is a uniform (950, 1050) random variable R. The resistances of different resistors are independent. The resistor company has an order for 1% resistors with a resistance between 990 Ω and 1010 Ω. An automatic tester takes one resistor per second and measures its exact resistance. (This test takes one second). The random process N(t) denotes the number of 1% resistors found in t seconds. The random variable T_r seconds is the elapsed time at which r 1% resistors are found. 15

i. What is p, the probability that any single resistor is a 1%resistor?
ii. What is the PMF of N(t)?
iii. What is $E[T_1]$ seconds, the expected time to find the first 1% resistor?
iv. What is the probability that the first 1% resistor is found in exactly 5 seconds?
v. If the automatic tester finds the first 1% resistor in 10 seconds, what is $E[T_2|T_1=10]$, the conditional expected value of the time of finding the second 1% resistor?

3. a) Deer ticks can carry both Lyme disease and human granulocytic ehrlichiosis (HGE). In a study of ticks in the Midwest, it was found that 16% carried Lyme disease, 10% had HGE, and that 10% of the ticks that had either Lyme disease or HGE carried both diseases. 10

   i. What is the probability P[LH] that a tick carries both Lyme disease (L) and HGE(H)?

   ii. What is the conditional probability that a tick has HGE given that it has Lyme disease?

   b) Monitor a phone call where classify the call as a voice call (V) if someone is speaking, or a data call (D) if the call is carrying a modem or fax signal. Classify the call as long (L) if the call lasts for more than three minutes; otherwise classify the call as brief (B). Based on data collected by the telephone company, we use the following probability model: P[V]= 0.7, P[L]= 0.6, P[VL]= 0.35. Find the following probabilities: 9

   i. P [DL], ii. P [D ∪ L],
   iii. P [VB], iv. P [V ∪ L],
   v. P [V ∪ D], vi. P [LB].

   c) In a cellular phone system, a mobile phone must be paged to receive a phone call. However, paging attempts do not always succeed because the mobile phone may not receive the paging signal clearly. Consequently, the system will page a phone up to three times before giving up. If a single paging attempt succeeds with probability 0.8, sketch a probability tree for this experiment and find the probability P[F] that the phone is found. 6

4. a) The probability density function of the random variable Y is 12

$$f_Y(y) = \begin{cases} 3y^2/2 & -1 \le y \le 1, \\ 0 & otherwise. \end{cases}$$

   Sketch the PDF and find the followings:

   i. the expected value E [Y], ii. the second moment E[Y^2],
   iii. the variance Var [Y], iv. the standard deviation σ_Y.

   b) The peak temperature T, in degrees Fahrenheit, on a July day in Antarctica is a Gaussian random variable with a variance of 225.With probability 1/2, the temperature T exceeds 10 degrees. What is P [T > 32], the probability the temperature is above freezing? What is P [T < 0]? What is P[T > 60]? [Q(3.33) = 4.34×10^{-4}]. 13

5. a) A radio station gives a pair of concert tickets to sixth caller who knows the birthday of the performer. For each person who calls, the probability is 0.75 of knowing the performer's birthday. All calls are independent. 13

   i. What is the PMF of L, the number of calls necessary to find the winner?

   ii. What is the probability of finding the winner on the tenth call?

   iii. What is the probability that the station will need nine or more calls to find a winner?

   b) Suppose each day (starting on day 1) you buy 1 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 $P[W_{33}]$, $P[L_{87}]$, and $P[L_{99}]$?

   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 $P_D(d)$?

6. a) What are joint probability mass function and marginal probability? For a constant $a > 0$, random variables X and Y have joint PDF 13

$$f_{X,Y}(x,y) = \begin{cases} 1/a^2 & 0 \le x \le a, \quad 0 \le y \le a, \\ 0 & otherwise. \end{cases}$$

Find the CDF and PDF of random variable

$$W = \max\left(\frac{X}{Y}, \frac{Y}{X}\right).$$

b) Random variables X and Y have joint PDF 12

$$f_{X,Y}(x,y) = \begin{cases} \frac{5x^2}{2} & -1 \le x \le 1, \quad 0 \le y \le x^2, \\ 0 & otherwise. \end{cases}$$

i. What are $E[X]$ and $Var[X]$?
ii. What are $E[Y]$ and $Var[Y]$?
iii. What is $\mathrm{Cov}[X,Y]$?
iv. What is $E[X+Y]$?
v. What is $Var[X+Y]$?

7. a) What is moment generating function? Derive moment generating functions for Binomial, Pascal, Uniform and Exponential random variables. 13

b) J and K are independent random variables with probability mass functions 12

$$P_J(j) = \begin{cases} 0.2 & j = 1, \\ 0.6 & j = 2, \\ 0.2 & j = 3, \\ 0 & otherwise, \end{cases} \qquad P_K(k) = \begin{cases} 0.5 & k = -1, \\ 0.5 & k = 1, \\ 0 & otherwise. \end{cases}$$

Find the MGF of $M = J + K$. What are $E[M^3]$, $E[M^4]$ and $P_M(m)$?

8. a) Consider an experiment that produces a Bernoulli random variable with probability of success q. In order to estimate q, we perform the experiment that produces this random variable n. In this experiment, q is a sample value of a random variable, Q, with PDF 13

$$f_Q(q) = \begin{cases} 6q(1-q) & 0 \le q \le 1, \\ 0 & otherwise. \end{cases}$$

In Appendix A, we can identify Q as a beta ($i = 2, j = 2$) random variable. To estimate Q we perform n independent trials of the Bernoulli experiment. The number of successes in the n trials is a random variable K. Given an observation $K = k$, derive the following estimates of Q:

i. The blind estimate $\hat{q}_B$,
ii. The maximum likelihood estimate $\hat{q}_{ML}(k)$,
iii. The maximum a posteriori probability estimate $\hat{q}_{MAP}(k)$.

b) A telemetry voltage V, transmitted from a position sensor on a ship's rudder, is a random variable with PDF 12

$$f_V(v) = \begin{cases} 1/12 & -6 \le v \le 6, \\ 0 & \text{otherwise.} \end{cases}$$

A receiver in the ship's control room receives $R = V + X$, The random variable X is a Gaussian $(0, \sqrt{3})$ noise voltage that is independent of V. The receiver uses R to calculate a linear estimate of the telemetry voltage:

$$\hat{V} = aR + b$$

Find

i. the expected received voltage E[R],
ii. the variance Var[R] of the received voltage,
iii. the covariance Cov[V, R] of the transmitted and received voltages,
iv. a* and b*, the optimum coefficients in the linear estimate,
v. e*, the minimum mean square error of the estimate.

A.2 Continuous Random Variables

Beta (i, j)

For positive integers i and j, the beta function is defined as

$$\beta(i, j) = \frac{(i + j - 1)!}{(i - 1)!(j - 1)!}$$

For a $\beta(i, j)$ random variable X,

$$f_X(x) = \begin{cases} \beta(i, j)x^{i-1}(1 - x)^{j-1} & 0 < x < 1 \\ 0 & \text{otherwise} \end{cases}$$

$$E[X] = \frac{i}{i + j}$$

$$\text{Var}[X] = \frac{ij}{(i + j)^2(i + j + 1)}$$

Appendix B

Table for The standard normal CDF

z	$\Phi(z)$	z	$\Phi(z)$	z	$\Phi(z)$	z	$\Phi(z)$	z	$\Phi(z)$	z	$\Phi(z)$
0.00	0.5000	0.50	0.6915	1.00	0.8413	1.50	0.9332	2.00	0.97725	2.50	0.99379
0.01	0.5040	0.51	0.6950	1.01	0.8438	1.51	0.9345	2.01	0.97778	2.51	0.99396
0.02	0.5080	0.52	0.6985	1.02	0.8461	1.52	0.9357	2.02	0.97831	2.52	0.99413
0.03	0.5120	0.53	0.7019	1.03	0.8485	1.53	0.9370	2.03	0.97882	2.53	0.99430
0.04	0.5160	0.54	0.7054	1.04	0.8508	1.54	0.9382	2.04	0.97932	2.54	0.99446
0.05	0.5199	0.55	0.7088	1.05	0.8531	1.55	0.9394	2.05	0.97982	2.55	0.99461
0.06	0.5239	0.56	0.7123	1.06	0.8554	1.56	0.9406	2.06	0.98030	2.56	0.99477
0.07	0.5279	0.57	0.7157	1.07	0.8577	1.57	0.9418	2.07	0.98077	2.57	0.99492
0.08	0.5319	0.58	0.7190	1.08	0.8599	1.58	0.9429	2.08	0.98124	2.58	0.99506
0.09	0.5359	0.59	0.7224	1.09	0.8621	1.59	0.9441	2.09	0.98169	2.59	0.99520
0.10	0.5398	0.60	0.7257	1.10	0.8643	1.60	0.9452	2.10	0.98214	2.60	0.99534
0.11	0.5438	0.61	0.7291	1.11	0.8665	1.61	0.9463	2.11	0.98257	2.61	0.99547
0.12	0.5478	0.62	0.7324	1.12	0.8686	1.62	0.9474	2.12	0.98300	2.62	0.99560
0.13	0.5517	0.63	0.7357	1.13	0.8708	1.63	0.9484	2.13	0.98341	2.63	0.99573
0.14	0.5557	0.64	0.7389	1.14	0.8729	1.64	0.9495	2.14	0.98382	2.64	0.99585
0.15	0.5596	0.65	0.7422	1.15	0.8749	1.65	0.9505	2.15	0.98422	2.65	0.99598
0.16	0.5636	0.66	0.7454	1.16	0.8770	1.66	0.9515	2.16	0.98461	2.66	0.99609
0.17	0.5675	0.67	0.7486	1.17	0.8790	1.67	0.9525	2.17	0.98500	2.67	0.99621
0.18	0.5714	0.68	0.7517	1.18	0.8810	1.68	0.9535	2.18	0.98537	2.68	0.99632
0.19	0.5753	0.69	0.7549	1.19	0.8830	1.69	0.9545	2.19	0.98574	2.69	0.99643
0.20	0.5793	0.70	0.7580	1.20	0.8849	1.70	0.9554	2.20	0.98610	2.70	0.99653
0.21	0.5832	0.71	0.7611	1.21	0.8869	1.71	0.9564	2.21	0.98645	2.71	0.99664
0.22	0.5871	0.72	0.7642	1.22	0.8888	1.72	0.9573	2.22	0.98679	2.72	0.99674
0.23	0.5910	0.73	0.7673	1.23	0.8907	1.73	0.9582	2.23	0.98713	2.73	0.99683
0.24	0.5948	0.74	0.7704	1.24	0.8925	1.74	0.9591	2.24	0.98745	2.74	0.99693
0.25	0.5987	0.75	0.7734	1.25	0.8944	1.75	0.9599	2.25	0.98778	2.75	0.99702
0.26	0.6026	0.76	0.7764	1.26	0.8962	1.76	0.9608	2.26	0.98809	2.76	0.99711
0.27	0.6064	0.77	0.7794	1.27	0.8980	1.77	0.9616	2.27	0.98840	2.77	0.99720
0.28	0.6103	0.78	0.7823	1.28	0.8997	1.78	0.9625	2.28	0.98870	2.78	0.99728
0.29	0.6141	0.79	0.7852	1.29	0.9015	1.79	0.9633	2.29	0.98899	2.79	0.99736
0.30	0.6179	0.80	0.7881	1.30	0.9032	1.80	0.9641	2.30	0.98928	2.80	0.99744
0.31	0.6217	0.81	0.7910	1.31	0.9049	1.81	0.9649	2.31	0.98956	2.81	0.99752
0.32	0.6255	0.82	0.7939	1.32	0.9066	1.82	0.9656	2.32	0.98983	2.82	0.99760
0.33	0.6293	0.83	0.7967	1.33	0.9082	1.83	0.9664	2.33	0.99010	2.83	0.99767
0.34	0.6331	0.84	0.7995	1.34	0.9099	1.84	0.9671	2.34	0.99036	2.84	0.99774
0.35	0.6368	0.85	0.8023	1.35	0.9115	1.85	0.9678	2.35	0.99061	2.85	0.99781
0.36	0.6406	0.86	0.8051	1.36	0.9131	1.86	0.9686	2.36	0.99086	2.86	0.99788
0.37	0.6443	0.87	0.8078	1.37	0.9147	1.87	0.9693	2.37	0.99111	2.87	0.99795
0.38	0.6480	0.88	0.8106	1.38	0.9162	1.88	0.9699	2.38	0.99134	2.88	0.99801
0.39	0.6517	0.89	0.8133	1.39	0.9177	1.89	0.9706	2.39	0.99158	2.89	0.99807
0.40	0.6554	0.90	0.8159	1.40	0.9192	1.90	0.9713	2.40	0.99180	2.90	0.99813
0.41	0.6591	0.91	0.8186	1.41	0.9207	1.91	0.9719	2.41	0.99202	2.91	0.99819
0.42	0.6628	0.92	0.8212	1.42	0.9222	1.92	0.9726	2.42	0.99224	2.92	0.99825
0.43	0.6664	0.93	0.8238	1.43	0.9236	1.93	0.9732	2.43	0.99245	2.93	0.99831
0.44	0.6700	0.94	0.8264	1.44	0.9251	1.94	0.9738	2.44	0.99266	2.94	0.99836
0.45	0.6736	0.95	0.8289	1.45	0.9265	1.95	0.9744	2.45	0.99286	2.95	0.99841
0.46	0.6772	0.96	0.8315	1.46	0.9279	1.96	0.9750	2.46	0.99305	2.96	0.99846
0.47	0.6808	0.97	0.8340	1.47	0.9292	1.97	0.9756	2.47	0.99324	2.97	0.99851
0.48	0.6844	0.98	0.8365	1.48	0.9306	1.98	0.9761	2.48	0.99343	2.98	0.99856
0.49	0.6879	0.99	0.8389	1.49	0.9319	1.99	0.9767	2.49	0.99361	2.99	0.99861

The standard normal CDF $\Phi(y)$.

B.Sc. Engg. (EE), 4th Semester

Date : October 24, 2019 (Morning)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination
Course No.: Phy 4421
Course Title: Semiconductor Devices

Summer Semester, A.Y. 2018-2019
Time: 3 Hours
Full Marks: 150

There are **8 (eight)** questions. Answer **any 6 (six)** 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) Using suitable diagram, explain the formation of energy bands in solid Si. 13

   b) Define direct bandgap and indirect bandgap semiconductors with examples. Explain the concept of effective mass of charge carriers (for conductivity calculation) in semiconductors. 8+4

2. a) Derive the expression of average drift velocity of an electron in semiconductor under electric field and from that derivation obtain the equation of conductivity of the semiconductor. 9+4

   b) A Si bar with width $w = 0.1$ mm along y-axis, thickness $t = 10$ μm along z-axis and length $L = 5$ mm along x-axis carrying current $I_x = 1$ mA is placed in a magnetic field with $\beta_z = 10^{-4}$ wb/m^2 gives hall voltage of 5 mV across its width along positive y-axis and 100 mV along its length. Find out the type of the semiconductor, its resistivity, its majority carrier concentration and majority carrier mobility. 3×4

3. a) Define photoconductivity. In a semiconductor, derive the equation of instantaneous excess electron or hole concentration generated by short optical pulse and going through only direct recombination. From this derivation define recombination lifetime of carriers. 2+9 +2

   b) Using suitable diagram derive the diffusion equations for electrons and holes. 12

4. a) Describe the formation of potential barrier across a p-n junction just after the formation of the junction using suitable energy band diagrams. From this discussion derive the expression of contact potential of the junction in terms of carrier concentrations. 6+7

   b) An abrupt Si p-n junction has $N_a = 10^{16}$ cm^{-3} on p-side and $N_d = 10^{17}$ cm^{-3} on n-side. The junction has uniform cross-sectional area of 2×10^{-6} cm^2. Relative permittivity of Si is 11.8. Calculate: i) W, ii) x_{no}, iii) x_{po} and iv) $\mathscr{E}_0$ where symbols have their usual meanings. 4×3

5. a) Derive the equations of injected minority carrier concentrations in the neutral regions of a forward-biased p-n junction as functions of distance from the transition region and using the equations show how minority carrier concentrations vary with the distance in those regions. 7+6

   b) Explain the Zener breakdown and avalanche breakdown processes in reverse-biased p-n junctions. 6+6

6. a) A metal-semiconductor junction has been formed with $\Phi_m < \Phi_s$. The semiconductor is n-type. Draw the energy band diagram as the function of distance from the junction and explain why the junction is rectifying or ohmic. 6+7

   b) Using suitable diagrams explain the operation of MOSFET in different regions of operation (cut-off, linear etc.) 12

7. a) Using energy band diagram as a function of distance in an ideal MOS structure ($\Phi_m = \Phi_s$) with p-type semiconductor under strong inversion, show different components of minimum gate voltage required for strong inversion. Also draw the charge density, electric field and electrostatic potential as functions of distance in the MOS structure. 13

b) Using equation of threshold voltage, explain why and how it varies with substrate doping concentration in both nMOSFET and pMOSFET. 12

8. a) Using I-V characteristics and circuit diagrams explain how the same photodiode can be used either as a photodetector or as a solar cell. What are the considerations required for designing solar cells? 4+9

b) What is the compromise to be made in designing photodetectors and why is it so? Describe the conditions for successful laser operation. 4+8

B.Sc. Engg. (CSE)/HDCSE, 4th Sem. Date: November 5, 2019

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination — Summer Semester, A. Y. 2018-2019
Course No.: EEE 4483 — Time: 3 Hours
Course Title: Digital Electronics and Pulse Techniques — Full Marks: 150

There are **8 (eight)** questions. Answer **any 6 (six)** questions. All questions carry equal marks. Marks in the margin indicate full marks. Programmable calculators are not allowed. Do not write on this question paper. Assume values of the parameters if not provided.

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1. a) Draw the circuit diagram of a 6-bit successive approximation ADC. Consider the clock rate is 3 MHz and the range of the DAC output is $0\ V \le V_{DAC} \le V_{ref}$ in addition to the offset of +0.5 LSB. 10

   b) Calculate the conversion rate (in MHz) of the ADC from question 1(a). 7

   c) Draw the Programmable Array Logic (PAL) implementation of the following Boolean expressions. 8

$$F1 = C' + A'B'$$
$$F2 = A'BC' + AC + AB'$$
$$F3 = AD + BD + F1$$
$$F4 = AB + CD + F1'$$

2. a) What is loop gain in terms of oscillator? Draw a diagram of a simple oscillator with positive feedback. From the diagram derive the expression of overall system gain. 7

   b) Sketch i_1 and v_o for the network of Fig. 2(b) for the designated input V_I. 7

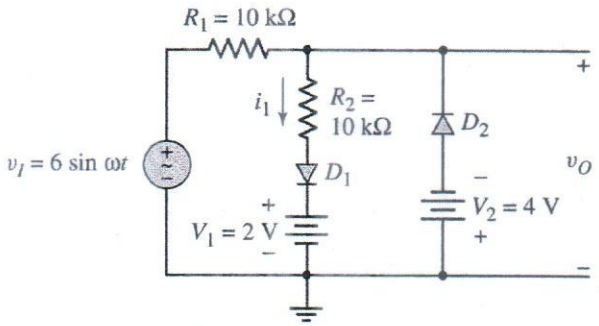

Fig. 2(b)

   c) Draw the circuit diagram of a Wein-bridge oscillator. Find the equivalent impedance of lag-lead network in the circuit. Why do we use such network in the oscillator? 7

   d) What is virtual ground of an OpAmp? Explain with necessary circuit diagram. 4

3. a) What is aliasing? How to lessen the effect of aliasing in a signal? 4

b) Draw the circuit diagram of a phase shift oscillator and derive the following loop gain. 5

$$T(s) = A(s)\beta(s) = \left(\frac{R_2}{R}\right)\left(\frac{sRC}{1+sRC}\right)^3$$

c) Why reconstruction filter is used? Explain with relevant figures. 6

d) A 5-bit DAC produces V_{out} = 0.2 V for a digital input of 00001. Find the value of V_{out} for an input of 11111. 2

e) A 5-bit (output) DAC has a current output. For a digital input of 10100, an output current of 10 mA is produced. What will I_{out} be for a digital input of 11101? 3

f) What is the largest value of output voltage from an 8-bit DAC that produces 1.0 V for a digital input of 00110010? 3

g) Provide an example of non-synthesizable code in VHDL? Why it can't be translated into actual hardware? 2

4. a) Determine the common mode output voltage of Fig. 4(a). Given CMRR = 65 dB. 7

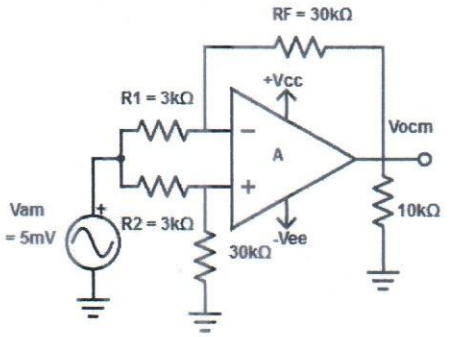

Fig. 4(a)

b) Draw the circuit diagram of monostable multivibrator using OpAmp and diodes. 5

c) With necessary diagram explain the working principle of sigma-delta ADC. 8

d) Draw the block diagram of a 555 timer with appropriate pin configuration. 3

e) Write a short note on industrial applications of servo motors. 2

5. a) Draw the general architecture of FPGA. 5

b) What are the difference between PAL, PLA and PROM. Illustrate with block diagrams. 8

c) Design a 4-bit synchronous up-down counter with system reset using VHDL. 12

6. a) What are the Barkhausen design criterion for oscillators. Briefly explain. 6

b) What are the steps of SPI data communication? 5

c) Show daisy-chained SPI connection for a single master and two slaves. 4

d) Draw the Schmitt Trigger circuit using OpAmp (Add $+V_R$ to the non-inverting terminal). Then Draw the waveforms of V_{in} (sinusoidal) and V_{out}. Derive the equations for UTP, LTP, and V_{Hys}. Now Draw the Hysteresis loop for the Schmitt Trigger circuit naming all relevant sections in the loop. 7

e) What are the differences between bit and std_logic? Why the entity section of a VHDL testbench is empty? 2+1

7. a) What is the duty cycle of the pulse width modulation (PWM) shown in Fig. 7(a)? Design an operational amplifier circuit to generate this PWM signal. 3+7

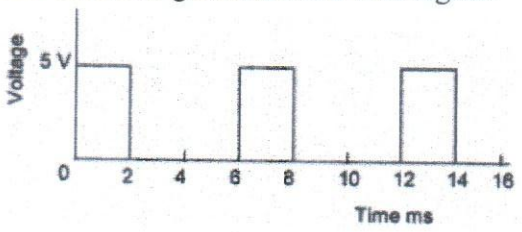

Fig. 7(a)

b) What are different types of PWM signals. Explain their differences with necessary figures. 5

c) Write a VHDL testbench code for 8-to-3 Bit Priority Encoder. 10

8. a) Draw a circuit diagram of crystal oscillator which includes operational amplifier. Draw the equivalent circuit of a crystal-controlled oscillator. 5

b) Mention two (2) advantages and disadvantages of SPI communication. 3

c) How multiple devices are connected to Physical I^2C Bus? Explain with relevant figure. 5

d) Sketch the output waveform for the following clamper circuits in Fig. 8(d) for a 10 V_{P-P} square wave signal. Assume the value of the R and C, if necessary. 12

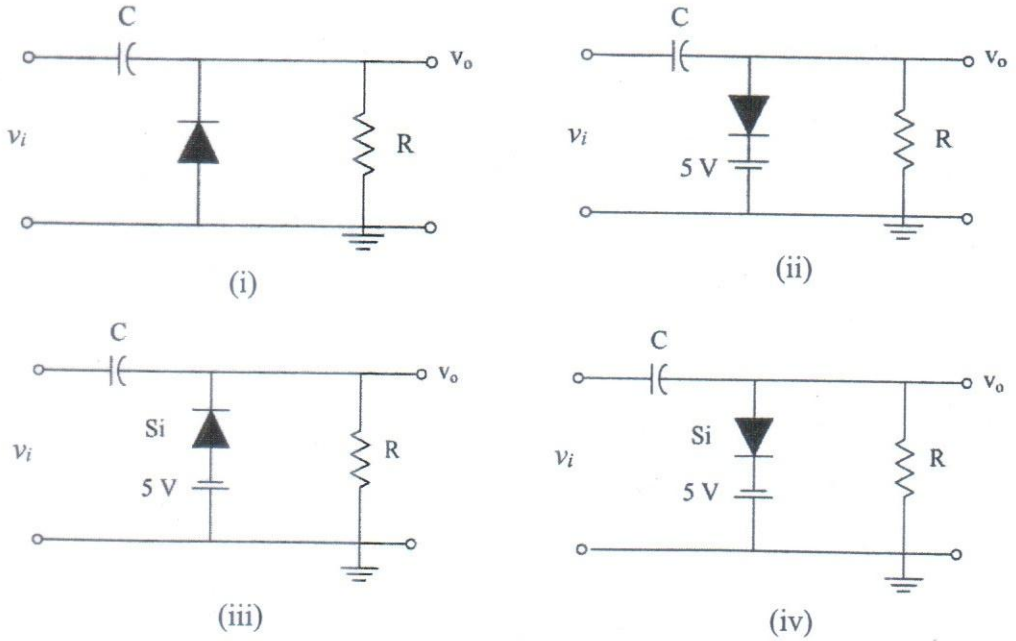

Fig. 8(d)

B.Sc. Engg. EE / HDEE, 6th Sem. Date: November 04, 2019

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination — Summer Semester, A. Y. 2018-2019
Course No.: EEE 4601 — Time: 3 Hours
Course Title: Signals and Systems — Full Marks: 150

There are **8 (eight)** questions. Answer **any 6 (six)** 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 with example (i) energy signal, (ii) power signal, (iii) periodic signal, (iv) even signal and (v) odd signal. 5

   b) A signal is defined as, 10

$$x(t)=\begin{cases} t, & 0\le t\le 1 \\ 1.0 & 1\le t\le 2 \\ 3-t & 2\le t\le 3 \end{cases}.$$

   Find:
   (i) the even and odd parts of the signal and sketch them
   (ii) energy and power of the signal.

   c) A discrete time (DT) system is both linear and time invariant. Suppose the output of the system due to an input $x[n]=\delta[n]$ is given in Fig. 1(c). Find the output due to an input $x[n]=\delta[n+1]-\delta[n]+2\delta[n-1]$. 10

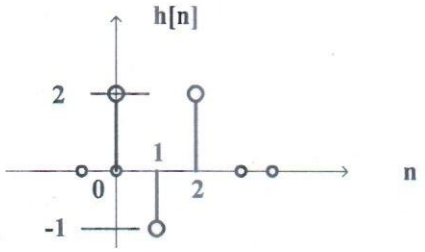

Fig. 1(c)

2. a) What is difference between a continuous time (CT) unit impulse $\delta(t)$ and a DT unit impulse $\delta[n]$. Show that a DT signal $x[n]$ can be expressed as a weighted sum of impulses as 10

$$x[n]=\sum_{k=-\infty}^{k=\infty} x[k]\delta[n-k].$$

   If this input is applied to a DTLTI system, show that its zero state response (ZSR) can be expressed as $y_{ZSR}[n]=\sum_{k=-\infty}^{k=\infty} x[k]h[n-k]$. Where $h[n]$ is the impulse response of the system.

b) An LTI system has the impulse response $h(t)$ depicted in Fig. 2(b). Use linearity and time invariance to determine the system output $y(t)$ if the input is $x(t)=\sum_{p=0}^{\infty}(-1)^p\delta(t-2p)$. Sketch the output. 10

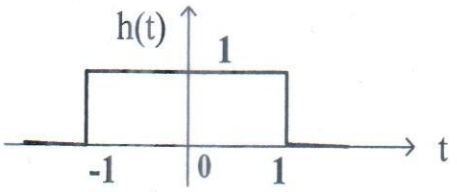

Fig. 2(b)

c) Evaluate the discrete convolution, 5

$$y[n]=u[n]*u[n-3].$$

3. a) Write a differential equation relating the output $y(t)$ to the input $x(t)$ for the system depicted in Fig. 3(a). Find the step response of the system by applying an input $x(t)=u(t)$ and obtain the impulse response from the step response. 13

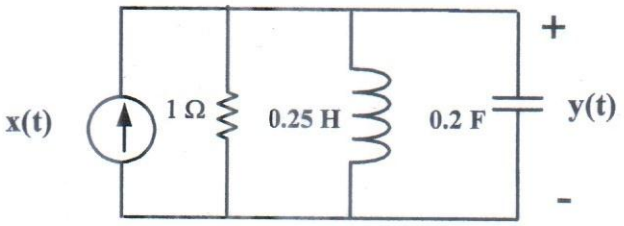

Fig. 3(a)

b) Determine the output of the system described by the differential equation with input and initial conditions as given below. 12

$$\frac{d^2y(t)}{dt^2}+6\frac{dy(t)}{dt}+8y(t)=2x(t)$$

$$y(0^-)=-1,\quad \frac{dy(t)}{dt}\Big|_{t=0^-}=1 \text{ and } x(t)=e^{-t}u(t).$$

4. a) In the op amp circuit shown in Fig. 4(a) $v_s(t)=4u(t)$ V, derive the I/O relation and find $v_o(t)$ for $t>0$. Assume that $R_1=R_2=10\ k\Omega$, $C_1=20\ \mu$F and $C_2=100\ \mu$F. 13

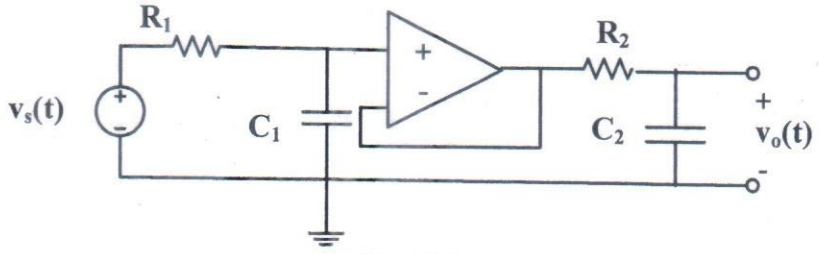

Fig. 4(a)

b) The I/O relation of a DTLTI system is given by the difference equation $y[n]-\frac{3}{4}y[n-1]+\frac{1}{8}y[n]=2x[n]$. Initial conditions and input are given as $y[-1]=1$, y[-2]=-1 and $x[n]=2u[n]$. Find the ZIR and impulse response of the system. 12

5. a) Find the Fourier Transform (FT) of $x(t)=e^{-at}u(t)$. Plot $x(t)$. Also draw the magnitude and frequency spectrums of FT of $x(t)$. 10

b) Express $z(t)$ in terms of $x(t)$ and find FT of $z(t)$ using FT properties (scaling and frequency shifting properties). $z(t)$ and $x(t)$ are given as follows. 10

$$x(t)=\begin{cases}1, & |t|<1\\ 0, & |t|>1\end{cases} \qquad \text{and} \qquad z(t)=\begin{cases}e^{-j20t}, & |t|<0.25\\ 0, & |t|>0.25\end{cases}$$

c) Explain Parseval's theorem. Write down its equation for non-periodic CT signal. 05

6. a) Let $x(t)$ be periodic signal. How Fourier Series (FS) and FT of $x(t)$ are related? Find the FT representation of $x(t)=\sin(\pi t)$ and plot time domain signal and FT representation of the signal. 10

b) A simplified transmitter and receiver are shown in Fig. 6(b). The effect of propagation and channel noise are ignored in this system. The signal at the receiver antenna, $r(t)$, is assumed equal to the transmitted signal. The passband of the low-pass filter in the receiver is equal to the message bandwidth, $-W<\omega<W$. Analyze this system in the frequency domain and show that $y(t)$ will be same as $m(t)$. 15

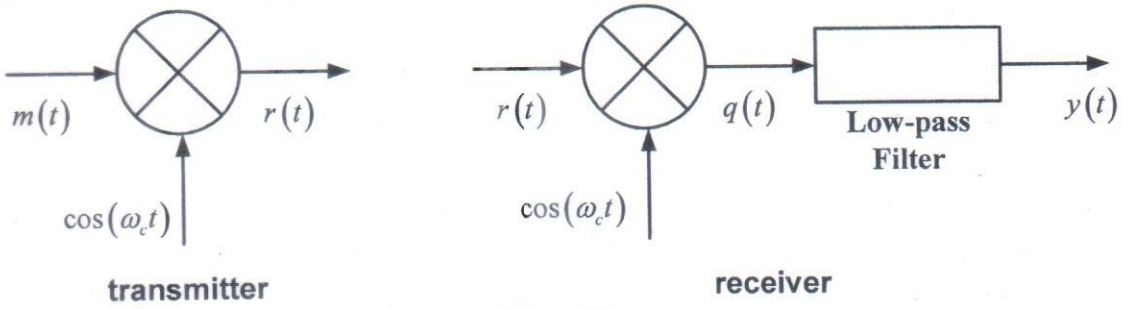

Fig. 6(b)

7. a) Consider the effect of sampling the sinusoidal signal $x(t)=\cos(\pi t)$. Determine the FT of the signal for the following sampling intervals: $T_s=1/4$, $T_s=3/2$. Also draw the frequency spectrum representations. Comment whether $x(t)$ can be reconstructed or not using $T_s=1/4$ and $T_s=3/2$. 08

b) For a signal, FT may not exist but Laplace Transform (LT) may exist. Explain. 05

c) Define Region of Convergence (ROC). Determine the LT of $x(t)=e^{3t}u(t)$ and show the ROC and locations of poles and zeros in s-plane. 12

8. a) Find $v_0(t)$ in the circuit of Fig. 8(a). Assume $v_0(0) = 5\,\text{V}$. 12

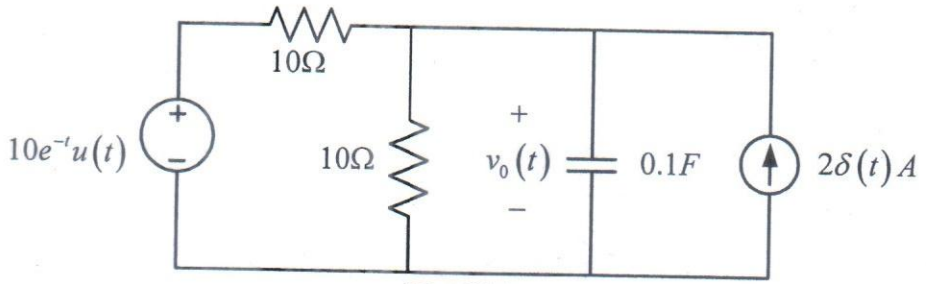

Fig. 8(a)

b) Define transfer function. The output of a linear system is $y(t) = 15e^{-3t}\cos(5t)u(t)$ when the input is $x(t) = 5e^{-4t}u(t)$. Find the transfer function of the system. 08

c) How impulse response and transfer function are related to network stability? 05

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

Date: October 23, 2018 (Morning)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

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

Summer Semester, A. Y. 2018-2019
Time: 3 Hours
Full Marks: 150

There are **8 (eight)** questions. Answer **question no. 1 and any 5 (five)** 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. **Open Book Examination**. Permissible to write anything related to the course on the book.

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1. **This question is compulsory.** 25

Design an 8051-microcontroller based system with following features using two 8255 chips:

i. Connect a 4K×8 NV-RAM with 8051. Specify address range of the memory chip.
ii. LCD is connected with PA and CU of first 8255 chip with an address
iii. Connect 4×4 hex keypad with PA and PB of second 8255 chip.
iv. Connect a serial ADC MAX1112 for measuring temperature using LM35 using port 1 of 8051.
v. Connect a unipolar stepper motor to the PC of second 8255 chip.

Make the address of the 8255 chips as follows:

Register	Address of first 8255	Address of second 8255
PA	FFFCH	FFC0H
PB	FFFDH	FFD0H
PC	FFFEH	FFE0H
CR	FFFFH	FFF0H

2. a) What is memory mapped I/O? 05

b) Use external hardware interrupt 1 to design an interrupt driven 4×4 hex keypad using port 2 and 3 of a separate 8051 microcontroller. Make external hardware interrupt 1 high priority. Show necessary connection recommendations and write corresponding program. 20

3. a) Why dynamic RAM is preferred over static RAM? 05

b) Write a program to read the ambient temperature in every 30 minutes and save it to the NV-RAM. Save the temperature on daily basis. Write the program for the system designed in question no. 1. 20

4. a) What is signal conditioning and calibration? 05

b) Write a program to generate a digital clock to display time in the LCD based on timer 1 interrupt. 20

5. a) Compare among different display devices: LED, LCD, Seven Segment Display and Dot Matrix. 05

   b) Assume that the stepper motor connected in question number 1 spins 0.75^0 per step. Write a program to enter how many degrees to rotate through the keypad of question no. 1 and accordingly the program should calculate the steps required and execute. 20

6. a) Discuss the reasons of using solid-state relay over the electro-mechanical relay despite being expensive. 05

   b) When it is necessary to use the optoisolator? 05

   c) Draw necessary connection diagram for bidirectional speed control of a DC motor. Write a program to control the speed of the DC motor with PWM signal applied through keypad. 15

7. Develop a monitor program for the system of question no. 1 that will ask for a 3-digit user name and 4-digit password at the first-time use. The user name and password need to be saved in the NV-RAM for the future use. The program also needs to verify saved user name and password for the future uses. Warning should be shown after three wrong attempts. 25

8. Write a program to use the system of the question no. 1 as a single digit calculator. Draw suitable diagram and flowchart if necessary. 25

B.Sc. Engg. (EE)/HDEE, 6th Sem. Date: October 25, 2019

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination — Summer Semester, A. Y. 2018-2019
Course No.: EEE 4625 — Time: 3 Hours
Course Title: Utilization of Electrical Energy — Full Marks: 150

There are **8 (eight)** questions. Answer **any 6 (six)** 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) Define diversity factor, utilization factor and load factor. Why is it better from a power supplier point of view to have higher value of load factor and diversity factor? 05

   b) What is meant by the most economic power factor? Derive the expression of the most economic power factor for a consumer. Mention the effects of low power factor. 10

   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) Explain in details about the different forms of power factor tariff. State Kelvin's law related to the most economical size of a conductor. Prove that this size is obtained whenever the variable part of annual charge equals the cost of energy losses in the year. Plot the graphical representation of the law. 15

   b) A load having a maximum value of 1000 kW at a power factor of 0.8 has an annual load factor of 40%. Find the cost per unit of the consumer if the tariff is Tk. 150 a year per kW demand plus 04 paisa/kWh plus 02 paisa per kVAR. 10

3. a) An equivalent rotational system of a motor-load combination is shown in Fig. 3(a). Derive the small signal model of the system with proper assumptions, conditions and necessary diagrams. Prove that any small change in speed can be represented by 15

$$\Delta\omega_m = (\Delta\omega_m)_0 \exp\left\{-\frac{1}{J}\left(\frac{dT_l}{d\omega_m} - \frac{dT}{d\omega_m}\right)t\right\}$$

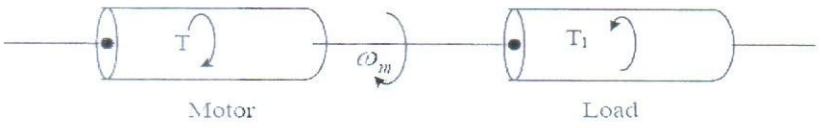

Fig. 3(a)

   b) What do you mean by cascaded speed control of motor? Derive the equation for cascaded speed control with necessary explanations. 10

4. a) Define heating and cooling time constant of a motor. Derive the expression of temperature rise of a motor due to heating with all necessary assumptions. 15

b) Calculate the maximum load that can be carried by a 20 kW motor, if the temperature rise is not to exceed 50°C after one hour on overload. The temperature rise on full load, after 1 hour is 30°C and after 2 hours is 40°C. Assume losses proportional to square of the load. 10

5. a) Define crest speed, scheduled speed and scheduled time of an electric traction system. Draw the quadrilateral speed-time curve of electric traction system and derive the relationship between speed and distance. 15

b) Assuming a simplified speed-time curve for a train which has got a scheduled speed of 50 km/hr between two stops 2 km apart, find the crest speed of the train over the run. The stoppage time is of 30 seconds duration and the values for acceleration and retardation are 2.5 km/hr/sec and 3.4 km/hr/sec respectively. 10

6. a) Why does the automotive engine require a starting motor? Explain the starting mechanism of an automotive system with relevant block diagrams. 09

b) Write the possible causes of any five (5) system troubles that an automotive system encounters while starting. Justify how to eliminate and correct those troubles associated with the starting system. 10

c) Draw a neat diagram of a charging system of an automobile including a voltage regulator containing zener diode. 06

7. a) Describe the vapor compression cycle of a refrigeration system with neat diagram. 09

b) Draw the electric circuit of an air conditioning system and explain the operation of different components of that circuit. 09

c) What are the common faults in a refrigeration system? Explain each of them. 07

8. a) Derive the expression of dielectric loss in a dielectric material due to heating when subjected to high frequency ac supply. What will be the loss if dc supply is used instead of ac? Draw the circuit configuration of the high frequency power supply required for dielectric heating and explain its operation. 12

b) A piece of insulating material is to be heated by dielectric heating. The size of the piece is $10 \times 10 \times 3$ cm^3. A frequency of 30 MHz is used and the power absorbed is 400 W. Determine the voltage necessary for heating and the current that flows in the material. The material has a permittivity of 5.0 and a power factor of 0.05. 08

c) Differentiate between induction heating and dielectric heating. 05

B.Sc. Engg.(EE)/ HDEE, 6th Sem. Date: October 31, 2019

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination — Summer Semester, A.Y. 2018-2019
Course No.: EEE 4635 — Time: 3 Hours
Course Title: Power Plant Engineering and Economy — Full Marks: 150

There are **8 (eight)** questions. Answer **any 6 (six)** questions. All questions carry equal marks. Marks in the margin indicate full marks. Programmable calculators are not allowed. Do not write on this question paper. Make necessary assumptions (if any).

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1. a) What are the different types of bus bar arrangements? What are the advantages of duplicate busbar arrangement over single busbar arrangement? What are the advantages of sectionalisation arrangement of busbars? Where and why is one a half breaker arrangement used? 15

   b) What are the different types of current limiting reactors? 10

2. a) Derive the transmission line loss formula for two plant system. 15

   b) A two-bus system is shown in Fig. 2(b), If 100 MW is transmitted from plant 1 to the load, a loss of 10 MW is incurred. System incremental cost is USD 30 / MWh. Find PG1, PG2 and power received by load if 10

$$\frac{dF_1}{dP_{G1}} = 0.02P_{G1} + 16\ USD/MWh$$
$$\frac{dF_2}{dP_{G2}} = 0.04P_{G2} + 20\ USD/MWh$$

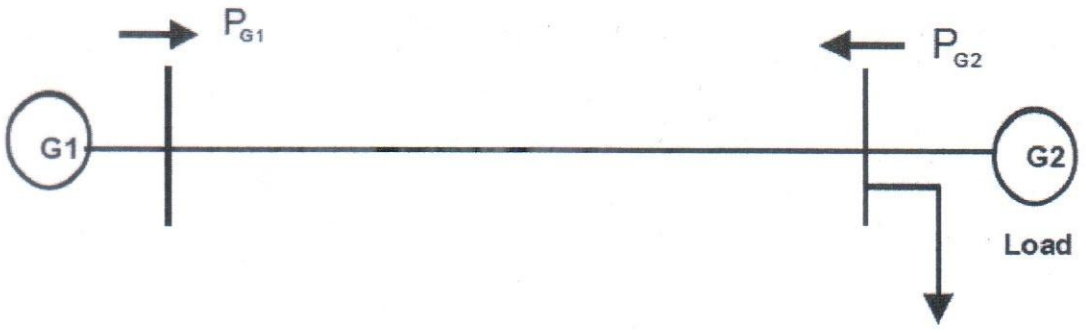

Fig. 2(b)

3. a) Concisely illustrate the performance curves of a power plant. Derive the original constraint for an economic generation of scheduling; including losses and generator limit. Consider a two-plant system for illustration. 15

   b) Incremental fuel costs in $ / MWh for two units are given below: 10

$$\frac{dF_1}{dP_{G1}} = 0.01P_{G1} + 2\ USD/MWh$$

$$\frac{dF_2}{dP_{G2}} = 0.012P_{G2} + 1.6\ USD/MWh$$

The limits on the plants are Pmin = 20 MW, Pmax = 125 MW. Obtain the optimal schedule if the load varies from 50 – 250 MW. What is the saving in fuel cost for the economic schedule compared to the case where the load is shared equally? The load is 180 MW.

4. a) Why is a big consumer charged at a lower rate than the small consumer? What are the differences between two-part tariff and maximum demand tariff? Why is maximum demand tariff not applicable to domestic consumers? 10

b) Two systems of tariff are available for a factory working 8 hours for 300 days in a year. 15

I. High-voltage supply at 5 cents per unit plus $4.5 per month per KVA of maximum demand.

II. Low-voltage supply at $5 per month per KVA of maximum demand plus 5.5 cents per unit.

The factory has an average load of 200 kw at 0.8 p.f. and a maximum demand of 250 kw at the same p.f. The high-voltage equipment cost is $50 per KVA and the losses can be taken as 4%. Interest and depreciation charges are 12%. Calculate the difference in the annual costs between the two systems.

5. a) A generating station has the following daily load cycle: 10

Time (hours)	0-6	6-10	10-12	12-16	16-20	20-24
Load (MW)	30	25	t^2	25	t	20

Draw the load curve and find

i) Units generated per day
ii) Average load
iii) Load factor

b) A generating station has the following daily load duration cycle: 15

Time (t) in hours	0-6	6-12	12-18	18-24
Load (y) in MW	40-t	30	40-t	10

Draw the Load Duration Curve and find

i) Units generated per day
ii) Average load
iii) Load factor
iv) Choose suitable generator units from 5 MVA, 10 MVA, 15 MVA, 20 MVA. Assume similarity between load cycle and load duration cycle. Adjust the operation schedule for the machines selected. Choose a suitable power factor.

6. a) Derive the condition for economic size of a conductor with graphical illustration. Mention the limitations of Kelvin's law. What modifications would be needed to vanquish the limitations? 15

b) Briefly describe the construction and reactions of nuclear power reactors. Rank different types of power reactors according to their power generation capacity. 10

7. a) Briefly describe the construction of PWR and BWR nuclear power reactors. 13

b) How are breeder reactors different from other nuclear reactors? What are the advantages of breeder reactors? Why is it not used for power generation on a mass scale? 12

8. IUT has two Diesel Generators to supply necessary electricity during power cut from the BREB feeder. Fig. 8 shows the electric network for the two generators. As the total load is exceeding the generators combined capacity, the Engineering Section has decided to obstruct the *Auditorium* and *Central cafeteria* from the supply. 25

Calculate the loss coefficients in pu and MW^{-1} on a base of 50MVA for the network during power cut. Corresponding data is given below.

Branch current	Branch Impedance
Ia = 1.2 – j 0.4 pu	Za = 0.02 + j 0.08 pu
Ib = 0.4 - j 0.2 pu	Zb = 0.08 + j 0.32 pu
Ic = 0.8 - j 0.1 pu	Zc = 0.02 + j 0.08 pu
Id = 0.8 - j 0.2 pu	Zd = 0.03 + j 0.12 pu
Ie = 1.2 - j 0.3 pu	Ze = 0.03 + j 0.12 pu
Ig = 0.8 - j 0.1 pu	Zg = 0.03 - j 0.12 pu
Ih = 1.2 + j 0.4 pu	Zh = 0.08 + j 0.32 pu

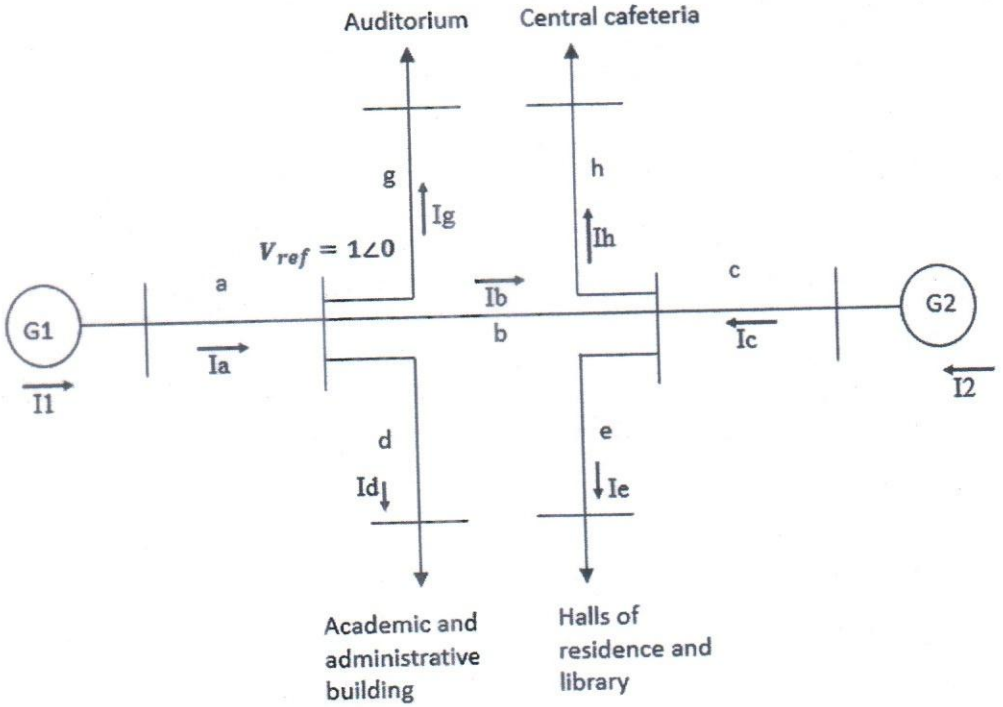

Fig. 8

B.Sc.Engg. (EE)/HDEE, 6th Sem. Date: October 25, 2019 (Morning)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination — Summer Semester, A. Y. 2018-2019
Course No.: EEE 4641 — Time: 3 Hours
Course Title: Cellular Communication — Full Marks: 150

There are **8 (eight)** questions. Answer **any 6 (six)** questions. All questions carry equal marks. Marks in the margin indicate full marks. Programmable calculators are not allowed. Do not write on this question paper.

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1. a) How many symbols are used in the control region in uplink bandwidth? How does the eNodeB come to know about the radio link quality of a UE at different frequencies in downlink and uplink (for the purpose of resource allocation at good quality frequencies)? 10

   b) What are the processes that can assign a new GUTI? Mention a short UE identity that can identify the MME group of the UE. 7

   c) Mention which channels carry channel quality indicator (CQI). Write down the difference between the functions of scheduling request (SR) and buffer status report (BSR). 8

2. a) Why does a PDCCH signaling on a particular subframe allocate resources for uplink transmission on a later subframe? Mention why the UE cannot prepare the transport block before its allocation. 8

   b) Consider uplink data transfer. What is the advantage of nonadaptive and synchronous HARQ retransmissions? Why are adaptive HARQ retransmissions used sometimes? What are the orders of redundancy versions (RVs) in nonadaptive and adaptive cases? 12

   c) Write down how many resource blocks (RBs) exist in 1 subframe for 15 MHz bandwidth. 5

3. a) How can the uplink synchronization be lost? 8

   b) What information does a master information block (MIB) message carry? Write down the names of two messages that carry S-TMSI. 7

   c) Mention which symbols can carry PHICH from the 14 symbols of a subframe. 5

   d) Mention which message is used to broadcast the system frame number (SFN) and bandwidth. 5

4. a) Explain the necessity of the relationship between the positions of symbols of cell-specific reference signal and coherence bandwidth and coherence time. Why are the positions staggered? 10

   b) What is the function of new data indicator (NDI)? 6

   c) For paging in a cell, the value of NB is set to 1/8. Determine the minimum number of radio frames between two consecutive transmissions of paging messages by the eNodeB. 9

5. a) Explain downlink power control procedure as specified in 3GPP standards. Why does the UE use the number of allocated resource blocks as it determines the uplink power level? 8

b) What is the difference between ciphering and integrity protection? Mention which type of information uses ciphering but not integrity protection. 8

c) How does hyper frame number (HFN) change in COUNT? 5

d) Which 3GPP release may first specify 6G cellular communication? 4

6. a) What is the ping-pong effect? Which parameters are scaled for speedy users in cell reselection and why is this scaling required? 10

b) What information does a UE send to the eNodeB using a measurement report? 5

c) What is missing neighbor problem and how is this problem avoided in LTE? 10

7. a) Mention which one between soft handover and hard handover is chosen for 2G, 3G and LTE technologies and give reasons for these choices. 8

b) If the UE is moving through many cells, how often the C-RNTI may change? 5

c) What is the maximum modulation order supported in 5G cellular communication? Mention the typical values of frequency reuse factor (FRF) for LTE. 6

d) What are the major factors in the decision of apportionment of radio resources among the users in the cell? 6

8. a) Mention when non-contention based random access procedure is usually used? Describe briefly the first two steps of contention based random access procedure. 10

b) Which one between VoLTE and CSFB is currently used for voice support in Bangladesh? Give reasons. 7

c) What is HetNets? What are the three techniques that can be used as in-building solution (IBS)? 8

B.Sc. Engg.(EE) / HDEE, 6th Sem. Date: 31 October 2019 (Morning)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination — Summer Semester, A. Y. 2018-2019
Course No.: EEE 4651 — Time: 3 Hours
Course Title: Data Communication and Networking II — Full Marks: 150

There are **8 (eight)** questions. Answer **any 6 (six)** 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) Why does the demand for wireless technologies increase day by day? What are the design goals of wireless LAN? Give examples of wireless technologies with suitable illustration. 5

   b) Why 802.11 (WiFi) is suitable for WLAN (wireless local area network) standard? What are the features of WiFi which help to adopt the wireless technology in LAN? 5

   c) You are asked to build an IUT-campus-network with the help of the WiFi-enabled smart devices. Your goal is to create a low-cost (or free) peer-to-peer (P2P) communication solution among the students and faculty members within the campus instead of using costly mobile communication. Explain all the detail steps of designing the IUT-campus-network with suitable illustrations, diagrams and flowcharts. 15

2. a) As a network engineer, to build a real-world sustainable practical product, you should generally follow the five steps below: 20

   Step1: Define the problem and find the expected solution and hypothesis,
   Step2: Create the mathematical model,
   Step3: Create the simulation model,
   Step4: Develop the prototype of the practical product,
   Step5: Find the socio-economic impact of your product.

   Briefly explain each step. Following the above five steps design vehicular Ad-hoc networking for an autonomous car (like Google or Tesla car). Use suitable illustrations, diagrams and flowcharts.

   b) What is Zigbee? In what kind of application do you use Zigbee? Why is Zigbee not suitable for the design of LAN? Design and explain Zigbee Star network and Zigbee Mesh Network with suitable illustrations. 5

3. a) You and your friend want to share data between two wireless enable devices with the help of Bluetooth. At the beginning of the data transferring, how does the Bluetooth device create a connection with another Bluetooth device? How does Bluetooth operate during data transferring? Briefly explain the operation state with suitable flowchart. What is spread-spectrum frequency hopping of Bluetooth? Briefly explain with examples. 13

   b) Suppose, there is a fire in the Sundarbans mangrove forest in Bangladesh. As a network specialist in the firefighter team, your task is to build a temperature-mapping with the help of the temperature sensors, so that the possible strategy of stopping the fire can be taken quickly. How do you design and deploy wireless sensors networks (WSN) to build temperature-mapping? Justify and explain your answer with suitable illustrations. 12

4. a) What is Delay Tolerant Networks (DTN)? What are the problems in the current TCP/IP model associated with the Internet? How does DTN overcome those problems? Explain the following characteristics of DTN: 7
   i) store-carry-forward,
   ii) custody transfer,
   iii) bundle layer.

   b) Discuss the networking technique in underwater communication. Explain with proper examples. Find out the problems in such networking and explain your possible solutions. 9

   c) For the recent flood affected area in the northern part of Bangladesh, how can you build a network for disaster area communication or communication during emergency? What are the challenges? How can you solve those? 9

5. a) What is Ad-hoc vehicular networking? Suppose there are two sink nodes located at the Export Processing Zones (EPZ) in Dhaka and Chittagong. How can you create networks to exchange data between these two sink nodes with the help of cooperative vehicular Ad-hoc networking? Explain and justify your techniques with illustration, diagram, and flowchart. 10

   b) For an intelligent building, you want to create a smart building management system (BMS). Considering humidity, ventilation, air conditioning (HVAC), room occupancy, temperature, airflow, mechanical stress monitoring, earthquakes predictions and over-all energy efficiency of the building, how do you design the BMS networks of the building with the help of wireless sensor networks? Explain your design with suitable illustrations. 15

6. a) What are the challenges faced by the Ad-hoc networks? What are the primary issues in the protocol design of the Ad-hoc network? 5

   b) What do you mean by on-demand or reactive routing of Ad-hoc network? Explain Ad-hoc On-demand Distant Vector (AODV) and Dynamic Source Routing (DSR). 14

   c) What is hierarchical routing in Ad-hoc network? Explain ClusterHead Gateway Switch Routing (CGSR). 6

7. a) What is Wireless Sensor Networks (WSN)? What are the major applications of WSN? What are the main three roles of sensor nodes in WSN? 10

   b) Suppose you are working in the forest ministry as a network specialist. Your task is to make a biodiversity-mapping of tigers in Sundarbans with the help of wireless sensor networks (WSN) to find out the cause of decreasing the number of population and characteristics of tigers. How do you design the biodiversity-mapping networks? Explain your design with suitable illustration, diagram and flowchart. 15

8. a) Explain the Internet of Things (IoT). How does it work? What are the benefits of IoT? 5

   b) Explain Internet of Energy (IoE) and Energy Network (EN) considering the Internet of Things (IoT), smart grids and smart energy management (Energy Cloud). 8

   c) You are asked to create an Internet of Energy (IoE) using the smart devices to provide suitable scheduling plan for the efficient utilization of smart home appliances such as light, fan, television, air-condition, washing machine, electric oven, hairdryer, refrigerator, etc. How do you create the IoE considering peak hour and off-peak hour, day and night, summer and winter season and the number of the occupant in the home? Use suitable illustrations. 12

B.Sc. Engg. (EE)/ HDEE, 6th Sem. Date: October 29, 2019 (Morning)
BScTE (2-Yr), 2nd Sem.

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination — Summer Semester, A. Y. 2018-2019
Course No.: EEE 4603 / EEE 4693 — Time: 3 Hours
Course Title: Measurement and Instrumentation — Full Marks: 150

There are **8 (eight)** questions. Answer **any 6 (six)** 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 error in measurement system. 07

   b) Sketch the circuit diagram of a Megger and explain its operating principle. 08

   c) 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.

2. a) Write short notes on photoconductive cells. 05

   b) Derive an expression for the gauge factor of a strain gauge. 10

   c) Derive the equations for the balance condition of Hay's bridge. Explain why this bridge can be a good choice for measurement of inductance with high quality factor (Q). 10

3. a) What is the difference between a discrete signal and a digital signal? 04

   b) Define the response parameters of a 'Sample and Hold' circuit with suitable diagram. 06

   c) Draw the block diagram of a 5-bit successive approximation A/D converter. For this 5-bit successive approximation A/D converter; assume that the reference voltage applied to the D/A converter circuit is $V_{REF} = 10$ V. For a particular instant of time; if an analog input voltage has the magnitude of $V_{IN} = 6$ V, what will be the corresponding output bit pattern of the A/D converter after completing the conversion process? (Show the changes in the output bit pattern after each cycle of the conversion process) 15

4. a) With proper diagrams, discuss the construction of a single-phase induction type energy meter. Explain how the driving torque is produced in this type of meter. 12

   b) With neat diagrams, explain how linear motion is converted to electrical signal using LVDT. Write down some of the advantages of LVDT. 10

   c) Distinguish between the terms accuracy and precision as related to measuring instruments. 03

5. a) Define voltmeter sensitivity and briefly describe the loading effect in case of PMMC-based DC voltmeter. 05

b) With neat diagram, discuss the basic working principle of electrodynamic meter movement. Show the expression of deflecting torque for this type of meters and discuss how damping and calibration is done for this type of meters. 10

c) Sketch the circuit diagram of an electrodynamic wattmeter. Explain how this instrument can be used for measuring DC power and true AC power. 10

6. a) Design a switching and amplifier gain selection circuit for an electronic analog DC voltmeter using FETs and an OPAMP. The input ranges of the voltmeter should be 50 mV, 100 mV, 1 V, 50 V, 100 V and 200 V. For upper voltage ranges, the input resistance of the voltmeter should be 10 MΩ. Assume that the multiplier resistor along with the PMMC meter is designed for a 1 V input. 15

b) The voltmeter in Fig. 6(b) uses a 1 mA meter movement with an internal resistance of 100 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. 10

(i) 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.

(ii) Determine the sensitivity of the AC voltmeter.

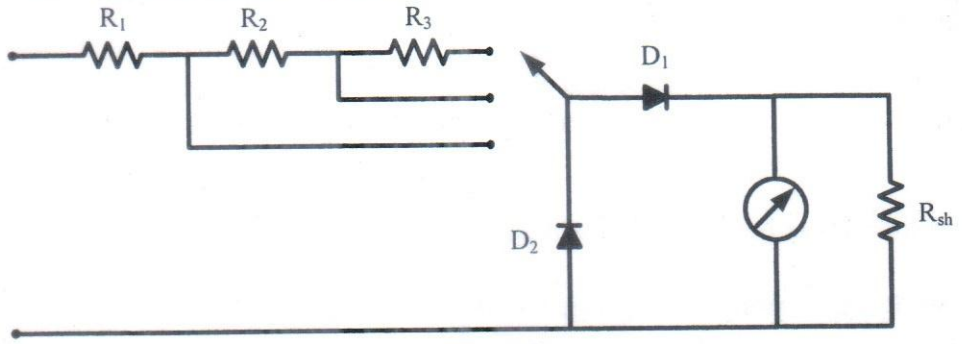


Fig. 6(b)

7. a) Draw the internal architecture of PLC. 07

b) With suitable diagrams, describe the internal circuit configuration of different type of output ports of PLC. 08

c) Consider that there are 3 participants in a quiz game. If a participant wants to get the chance of answering the question from the host, he must press the answer button on his table first, which will turn on a lamp and a buzzer in his respective table. After buzzing for 2 sec the buzzer will turn off, but the lamp will continue to glow. Inputs from other participants will be invalid if any participant presses the button before them. The host will have an option to reset the whole system. Draw a ladder diagram program with respect to the above-mentioned requirements. (Clearly define the input/output devices and the respective input/output ports that you are going to use for your program) 10

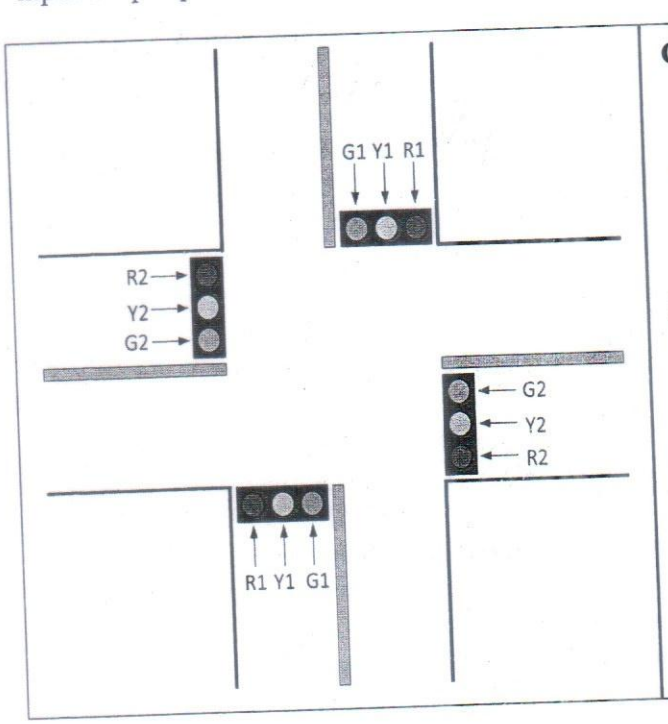
8. a) Draw the ladder diagram representation of the following Boolean equations: 05

(i) $Q = A + \bar{B}$

(ii) $Q = \bar{A}.B.C + D$

(iii) $Q = A.B + C.D$

b) Consider the crossroad shown in Fig. 8(b). In this figure, lights of two opposite lanes are considered to be operated simultaneously and thus the corresponding lights are indexed with the same symbol. The operator should have the option of manually activating or deactivating the system. Draw a ladder diagram program to implement the control sequences mentioned below. (Clearly define the input/output devices and the respective input/output ports that you are going to use for your program) 12



Control Sequence

(i) Turn on R1 and G2 for 30 sec

(ii) After 30 sec, turn off R1 and G2 while turning on Y1 and Y2 for 5 sec

(iii) After 5 sec delay, turn off Y1 and Y2 and turn on G1 and R2 for 30 secs

(iv) After this 30 sec delay, turn off G1 and R2 and turn on Y1 and Y2 again for 5 sec

(v) After this 5 sec delay, turn off Y1 and Y2 and continue from step (i)

Fig. 8(b)

c) Consider that some manufactured items are being moved in a particular direction with the help of a conveyor belt. The conveyor belt is driven by a motor. It is required to design a control system to direct 6 items along one path for packaging in a box and then 12 items along another path for packaging in another box. A photocell sensor is used to detect the presence of a moving item. The number of pulses from the sensor has to be counted and depending upon that a deflector plate has to be controlled to guide the item towards a particular box for packaging. The operator should have the option to start or stop the system manually. After packaging a total of 200 boxes, the system will automatically get deactivated until the operator manually starts the process again. Draw a ladder diagram program with respect to the above-mentioned requirements. (Clearly define the input/output devices and the respective input/output ports that you are going to use for your program) 08

Library

B.Sc. Engg.(EE), 8th Sem. Date: November 04, 2019

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination — Summer Semester, A.Y. 2018-2019
Course No.: EEE 4801 — Time: 3 Hours
Course Title: Power Generation — Full Marks: 150

There are **8 (eight)** questions. Answer **any 6 (six)** 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) Why is electrical energy preferred over other forms of energy? 05

   b) What is a steam power station? What factors are taken into account while selecting the site for a steam power station? 10

   c) A diesel engine power plant has one 700 kW and two 500 kW generating units. The fuel consumption is 0·25 kg per kWh and the calorific value of fuel oil is 10000 kcal/kg. Estimate (i) the fuel oil required for a month of 30 days and (ii) overall efficiency. Plant capacity factor is 40%. 10

2. a) Explain the terms load factor and diversity factor. 05

   b) Discuss the advantages of interconnected grid system. 10

   c) A generating station is to supply four regions of load whose peak loads are 10 MW, 5 MW, 8 MW and 7 MW. The diversity factor at the station is 1·5 and the average annual load factor is 60%. Calculate: (i) the maximum demand on the station, (ii) annual energy supplied by the station and (iii) suggest the installed capacity and the number of units. 10

3. a) What are the effects of high load factor on the operation of power plant? 05

   b) Discuss the diminishing value method of determining the depreciation of the power plant equipment. 10

   c) The equipment in a power station costs Tk 15,60,000 and has a salvage value of Tk 60,000 at the end of 25 years. Determine the depreciated value of the equipment at the end of 15 years using (i) straight line method, (ii) diminishing value method and (iii) sinking fund method at 5% compound interest annually. 10

4. a) What is meant by tariff? Write four objectives of tariff. 05

   b) Describe some of the important types of power factor tariff commonly used. 10

   c) The monthly readings of a consumer's meter are as follows: maximum demand = 50 kW, energy consumed = 36000 kWh and reactive energy = 23,400 kVARh. If the tariff is Tk 80 per kW of maximum demand plus 8 paise per unit plus 0·5 paise per unit for each 1% of power factor below 86%, calculate the monthly bill of the consumer. 10

5. a) What are the causes of low power factor of the supply system? 05

b) Derive an expression for the most economical value of power factor which may be attained by a consumer. 10

c) A factory has an average demand of 50 kW and an annual load factor of 0·5. The power factor is 0·75 lagging. The tariff is Tk 100 per kVA of maximum demand per annum plus 5 paise per kWh. If loss free capacitors costing Tk 600 per kVAR are to be utilised, find the value of power factor at which maximum saving will result. The interest and depreciation together amount to 10%. Also determine the annual saving effected by improving the p.f. to this value. 10

6. a) What is electric power supply system? Draw a single line diagram of a typical a.c power supply scheme. 05

b) Discuss the advantages of high transmission voltage. 10

c) What is the percentage saving in feeder copper if the line voltage in a 2-wire d.c. system is raised from 200 volts to 400 volts for the same power transmitted over the same distance and having the same power loss? 10

7. a) What is the difference between drag force and lift force based wind machine? 05

b) Define coefficient of performance for a wind machine. How is the coefficient of performance different from the capacity factor of the wind machine? What is the trade-off for choosing a variable speed and a constant speed wind turbine? 10

c) What is solar PV? Draw a typical structure of a solar cell. Why usually the actual output power from a PV module is less than its rated power? 10

8. a) Explain with a neat sketch the various parts of a nuclear reactor. 10

b) The daily load duration curve for a typical heavy load being served by a combined hydro-steam system may be approximated by a straight line; maximum and minimum loads being 60,000 kW and 20,000 kW, respectively. The hydro power available at the time of minimum regulated flow is just sufficient to take a peak load of 50,000 kWh per day. It is observed that it will be economical to pump water from tail race to the reservoir by utilizing the steam power plant during the off-peak periods and thus running the station at 100% load factor. Determine the maximum capacity of each type of plant. Assume the efficiency of steam conversion to be 60%. 15

B.Sc. Engg.(EE), 8th Sem. Date: 29 October, 2019

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination — Summer Semester, A. Y. 2018-2019
Course No.: EEE 4865 — Time: 3 Hours
Course Title: Digital Filter Design — Full Marks: 150

There are **8 (eight)** questions. Answer **any 6 (six)** questions. All questions carry equal marks. Marks in the margin indicate full marks. Programmable calculators are not allowed. Do not write on this question paper. Symbols preserve their usual meanings.

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1. a) What are the differences between FIR and IIR filters? 7

   b) Using impulse-invariant design method, derive the filter transfer function in z-domain and draw the DSP set-up of a third-order filter, given by: 18

$$H(s) = \frac{1}{[s + 1/2 + j(\sqrt{3}/2)][s + 1/2 + j(\sqrt{3}/2)][s + 1]}$$

2. a) What is frequency warping? 5

   b) Design an inverse Chebyshev digital low-pass IIR filter for unity pass-band gain, 120 rad/s cut-off frequency, 0.0316 attenuation, 500 rad/s as attenuation starting frequency and 900 rad/s sampling frequency. 20

3. a) With an example, show the steps to design the low-pass FIR filter without using window functions. 15

   b) With a same fifth order IIR system, show the Direct-form-I, Direct-form-II and Transposed-form structure. 10

4. a) Write short notes on: i) The Hamming window, ii) The Hanning window, and iii) The Blackman window. 7

   b) Design an FIR low-pass filter using frequency-sampling method from the specifications given below: 18

   Frequency of pass-band edge: 500 Hz
   Stop-band starts at: 900 Hz
   Sampling frequency: 2200 Hz
   Order of the filter: 8

5. a) Explain the design technique used in Kaiser's approach. 5

   b) Design a low-pass FIR filter using Kaiser's approach for the following specifications: 20

   Frequency of pass-band edge: 2000 Hz
   Gain in pass-band: -1 dB
   Frequency from which stop band begins: 3000 Hz
   Gain in stop band: -55 dB
   Sampling frequency: 12000 Hz

6. a) Discuss the types of FIR filters with graphical representation. 15

   b) Develop the expression of the desired transfer function $H(\omega)$ of a digital differentiator. 10

7. a) With an example, discuss the limitation of the limit-cycle oscillations in the First-order systems for an IIR filter. 13

   b) Obtain the filter coefficients of a three-stage lattice-structure FIR filter, to its equivalent third-order direct-form structure, whose coefficients are: 12

$$a_0 = 1, a_1 = 11/8, a_2 = 7/8, a_3 = 1/4.$$

8. a) What is the impact of the nonlinear phase filter to the final output of a filter? 5

   b) How can a nonlinear phase IIR filter be linearized? Explain it with proper steps. 10

   c) What is group delay? Derive the group delay for the Type-I FIR filter and explain the physical meaning of that term. 10

Formula related to Kaiser's Approach:

$$\begin{aligned} \alpha &= 0.1102\,(H_{2m} - 8.7), && H_{2m} > 50 \\ &= 0.5842(H_{2m} - 21)^{0.4} + 0.07886(H_{2m} - 21), && 21 \le H_{2m} \le 50 \\ &= 0.00 && H_{2m} < 21 \end{aligned}$$

$$M = \frac{N}{2} = \frac{H_{2m} - 7.95}{2.285(\Delta\omega)}$$

$$I_0(x) = \frac{0.3989e^x}{\sqrt{x}}\left(1 + \frac{1}{8x} + \frac{9}{128x^2}\right)$$

$$W_{KAI}(n) = \frac{I_0[\alpha\sqrt{1 - (n/M)^2}]}{I_0(\alpha)}, \qquad -M \le n \le M$$

Formula table:

Laplace Transform	Time function	z-Transform
$\frac{1}{s}$	$u_s(t)$	$\frac{z}{z-1}$
$\frac{1}{s^2}$	t	$\frac{Tz}{(z-1)^2}$
$\frac{2}{s^3}$	t^2	$\frac{T^2z(z+1)}{(z-1)^3}$
$\frac{1}{s+a}$	e^{-at}	$\frac{z}{z-e^{-aT}}$
$\frac{1}{(s+a)^2}$	te^{-at}	$\frac{Tze^{-aT}}{(z-e^{-aT})^2}$
$\frac{a}{s(s+a)}$	$1-e^{-at}$	$\frac{z(1-e^{-aT})}{(z-1)(z-e^{-aT})}$
$\frac{1}{(s+a)(s+b)}$	$\frac{1}{(b-a)}(e^{-at}-e^{-bt})$	$\frac{1}{(b-a)}\left(\frac{z}{z-e^{-aT}}-\frac{z}{z-e^{-bT}}\right)$
$\frac{a}{s^2(s+a)}$	$t-\frac{1}{a}(1-e^{-at})$	$\frac{Tz}{(z-1)^2}-\frac{(1-e^{-aT})z}{a(z-1)(z-e^{-aT})}$
$\frac{a}{s^2+a^2}$	$\sin(at)$	$\frac{z\sin(aT)}{z^2-2z\cos(aT)+1}$
$\frac{s}{s^2+a^2}$	$\cos(at)$	$\frac{z(z-\cos(aT))}{z^2-2z\cos(aT)+1}$
$\frac{b}{(s+a)^2+b^2}$	$e^{-at}\sin bt$	$\frac{z\sin(bT)e^{-aT}}{z^2-2z\cos(bT)e^{-aT}+e^{-2aT}}$
$\frac{s+a}{(s+a)^2+b^2}$	$e^{-at}\cos bt$	$\frac{z(z-\cos(bT)\,e^{-aT})}{z^2-2z\cos(bT)\,e^{-aT}+e^{-2aT}}$

B.Sc. Eng. (EE), 8th Semester

Date: 25 October, 2019

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination — Summer Semester, A. Y. 2018-2019
Course No. : HUM 4821 — Time : 3 Hours
Course Title : Business Communication Skill — Full Marks : 150

There are **8 (eight)** questions. Answer any **6 (six)** questions. All questions carry equal marks. Marks in the margin indicate full marks. Do not write on this question paper.

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1. a) You work in the Employee Relations Department at Mayfaire Clinic. Two years ago, the clinic was dealing with such a high volume of patient communication that it couldn't keep up. Some of the communication was, of course, essential (e.g,. a patient talking to a nurse about symptoms), but other communication (e.g., reordering contact lenses for patients, sending bills in the mail and processing payments, or checking on a patient's test results) was causing backlog and taking employees' time away from patients who needed them. The clinic's solution was to develop MyMayfaire.com, a website where patients could order contacts, pay bills, check results, schedule appointments, update their contact information, update insurance information, and receive their health profiles from their annual exams. It seemed like an ideal solution except for one thing –few people signed up for it. 15

   You think the patient response is slow for a few reasons: People are wary of having their health information available online; they think the process for signing up will take too much time, or they may have missed previous letters informing them of the MyMayfire.com option.

   You've looked at previous mailings sent to patients and determined that they were not very persuasive (you didn't write them). You decide you will create a well written persuasive message to get people to sign up.

   Write a persuasive letter to patients, selling them on the idea of using MyMayfaire.com.

   b) You are seeking an internship but have to yet found a job-posting that fits your interests and abilities. However, you have always wanted to work for "Electricity Generation Company of Bangladesh (EGCB) Ltd" and even though the company has no positions advertised, you decided to send an unsolicited cover letter, resume to this company. You want to analyze your purpose and goals, your audience; and the skills, experience, and qualifications you could bring to an internship with this company. 10

   Write a cover letter for an internship position to the "Electricity Generation Company of Bangladesh (EGCB) Ltd" focusing on "You view point".

2. a) A business model is a model by which a company uses its resources to offer its customers better value than its competitors and make money doing it. The "Business Model" is an addition to an old discuss of the sequence of strategies and actions which was a development over the times. Discuss the concept of a business model. 15

b) The basic idea is that a marketer or R&D starts with many business ideas that need to be examined and winnowed down, then shaped into concepts and tested until a final market offering is selected and launched. The innovation funnel provides a solution for explicitly defining the information requirements for managing the innovation process from idea to launch. Briefly describe about "innovation funnel" for generating new business idea. Discuss business opportunity analysis. 5

c) New ideas are not generally new-to-the-market. Only about 5–10 % of new market offerings are truly new, the rest are just differentiated. How do you examine your business is new? 5

3. a) You were recently hired as the office manager for Stormbird Designs, an upscale fashion studio specializing in the design and manufacture of high-end men's clothing. The company is doing well, but its start-up, so money is tight and employees often have to serve multiple roles within the company. 15

A couple of weeks ago, the owner of the studio, Susan Wong, was having some computer difficulties. Being a technologically savvy person, you were able to identify the problem and fix it. Susan was very impressed and now views you as the person to contact when there is any IT issue in the office! Yesterday, you were having lunch with Susan and she was mentioning the possibility of purchasing laptops for everyone in the office. This would enable employees to work remotely and would also improve productivity, as some of the current desktop computers in the office are slow and in need of upgrades. Susan asks you if you currently own a laptop, and you respond that you have had a Toshiba laptop for the last two years and have been very pleased with it. Intrigued, Susan asks you to recommend a Toshiba laptop that would be suitable for designers in the studio. You respond that you will have to do some research but that you will get back to her in three days.

Research the different options and make a recommendation to Susan. You were told that the budget for the laptop purchases would be $8000, and that you would need to purchase 6 laptops in total.

Write your recommendation in the form of a report highlighting the benefits of the option that you have chosen.

b) How many components you have to include for preparing a formal report? Write down the components with their explanation. 10

4. a) Storytelling is one of the most powerful tools available to effective communicators. Leaders and managers use stories to build trust, influence others and inspire action in the business sector. Storytelling makes an impact on your organization, by addressing the importance of storytelling. Briefly explain the significance of storytelling for conducting a business. 5

b) A carefully chosen story can help the leader of an organization to translate an abstract concept into a meaningful mandate for employees. The key is to know which narrative strategies are right for what circumstances. 10

Critically examine the power of a narrative in communication.

c) Stephen Denning identified that story telling is an increasingly accepted way to achieve management goals. But leaders need to use a variety of narrative patterns for different aims of storytelling. Briefly describe these aims with examples. 10

5. a) The more effectively you listen, the more effectively you communicate about engineering risk and cost. However, only about 25% of listeners grasp the central ideas in business communications. To improve listening skills, which issues will you consider? 10

b) Leadership, at any level, certainly isn't easy—but unclear, vague, roller-coaster pronouncements make many top managers' jobs infinitely more difficult than they need to be. Why do many organizations sink into chaos due to listening problem? Mention the reasons. 10

c) Listening is harder than "Speaking and Writing". Explain. 5

6. a) If you want to know why so many organizations sink into chaos, look no further than their leaders' mouths. Leadership, at any level, certainly isn't easy—but unclear, vague, roller-coaster pronouncements make many top managers' jobs infinitely more difficult than they need to be. 15
What are the five recommendations from Professor Dr. Hamm for crystal-clear communication of managers? Discuss.

b) Dr. Robert wrote a book on persuasion, it's been widely hailed as a seminal book. The most significant aspect of this book was the highlighting of Cialdini's six principles of persuasion. Explain these principles with business applications. 10

7. a) Discuss different types of approaches to case study analysis with relevant examples. 10

b) Write brief notes on: 15
(i) Exploratory case study (ii) Illustrative case study (iii) Critical instance case study

8. a) Mr. Monir was the manager of the 'XYZ' Leather Factory, Kanpur. In one of his vacations, he undertook a short course in management and public relations, in one of the third rated commercial institutions that have mushroomed in Noida. It then dawned upon him, that all these years he had been doing the wrong thing, by dealing only with the section heads under him. On his return to the factory, he was a new Monir. He began having lunch in the Workers' mess; he even exchanged a few smutty jokes. Over a cup of tea, he told them a story of his life and many spicy episodes about the lives of the directors all in the interest of better public relations. He even joined them once, in ragging a foreman, who wore an old-fashioned coat and topi. 15

Trouble started a few days later. There were thefts in the factory and absenteeism had increased. Further there were four incidents of workers refusing to carry out the orders of their supervisors and three workers were found in a drunken state on the plant.

i. Discuss the communication barriers in this case.
ii. If you were in the manager's place, what would you do? Sack the drunken worker? Or have a confidential talk with them?
iii. Explain how you would handle this situation and suggest for the solution.

b) List the types of external operational and internal operational communication that occur in an organization with which you are familiar (School/ College/ University). 10

Library

B.Sc. Engg. (EE), 8th Sem. Date: October 31, 2019

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination — Summer Semester, A. Y. 2018-2019
Course No.: Phy 4821 — Time: 3 Hours
Course Title: Engineering Materials — Full Marks: 100

There are **8 (eight)** questions. Answer **any 6 (six)** 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 Heisenberg uncertainty principle? 8.67
Consider an electron confined to a region of size 0.1 nm. What will be the uncertainty in its momentum and hence its kinetic energy? Estimate also the minimum velocity.

b) What will be the minimum velocity of an apple of mass 100 g confined to a crate of size 1 m? Can it be measured by any instrument? 8

2. a) Define the followings: 6
i. Quantum leak,
ii. Degeneracy and
iii. Scanning tunneling microscope.

b) Consider two copper wires separated only by their surface oxide layer (CuO).
i. Is there any possibility of current passing through two copper wires classically? 10.67
ii. Suppose that for the free electrons in copper, the surface oxide layer looks like a potential energy barrier of height 10 eV. Consider an oxide layer thickness of 5 nm and evaluate the transmission co-efficient for free electrons in copper, which have a kinetic energy of about 7 eV. Is there any chance of electron tunneling? Now if the layer thickness reduces by 5 times, what is the transmission probability? ($h = 6.6 * 10^{-34}$ Js, $m_e = 9.1 * 10^{-31}$ kg and 1 eV= $1.6 * 10^{-19}$ J)

3. a) Draw the diagram which shows Fermi-Dirac function for different temperatures. Comment on the fermi energy based on that diagram. 6

b) Assume that the Fermi energy level for a particular material is 6.25 eV. The electrons in this material follow the Fermi-Dirac distribution function. 10.67
i. Determine the probability that an energy level 3kT above the Fermi energy is occupied by an electron?
ii. Suppose, there is 1 percent probability that a state at 5.95 eV energy level will not contain an electron. Calculate the temperature on that state.
($k = 1.38 * 10^{-23}$ JK^{-1})

4. a) Describe in brief the polarization mechanisms. 6

b) Consider the CsCl crystal which has one Cs^+-Cl^- pair per unit cell and a lattice parameter a of 0.412 nm. The electronic polarizability of Cs^+ and Cl^- ions is 3.35 x 10^{-40} F m^2 and 3.40 x 10^{-40} F m^2, respectively, and the mean ionic polarizability per ion pair is 6 x 10^{-40} F m^2. What is the dielectric constant at low frequencies and that at optical frequencies? 10.67
(ε_o=8.85 x 10^{-12} F m^{-1})

5. a) Describe the frequency dependence of dielectric constant with suitable figure and give an example of dielectric loss utilization. 6

b) Consider the dielectric materials listed in Table 5(b) with the real and imaginary dielectric constants, ε_r' and ε_r''. The power dissipated per unit capacitance is given by 10.67

$$W_{cap} = V^2 \omega \frac{\varepsilon_r''}{\varepsilon_r'}.$$

At a given voltage, which dielectric will have the lowest power dissipation per unit capacitance at 1 kHz and at an operating temperature of 50 °C? Is this also true at 120 °C?

Material	T =50 °C		T = 120 °C	
	ε_r'	ε_r''	ε_r'	ε_r''
Polycarbonate	2.47	0.003	2.535	0.003
PET	2.58	0.003	2.75	0.027
PEEK	2.24	0.003	2.25	0.003

Table 5(b)

6. a) Define the following: 6
   i. Piezoelectricity,
   ii. Clausius-Mosotti Equation and
   iii. Electric Dipole Moment

b) Consider a piezoelectric sample in the form of a cylinder as shown in Figure 6(b). Suppose that the piezoelectric coefficient is $d = 250 \times 10^{-12}$ m V^{-1} and $\varepsilon_r = 1000$. The piezoelectric cylinder has a length of 10 mm and a diameter of 3 mm. The spark gap is in air and has a breakdown voltage of about 3.5 kV. Induced polarization is given by 10.67

$$P = d\frac{F}{A}.$$

P leads to induced surface polarization charges given by $Q = AP$ and capacitance is given by

$$C = \frac{\varepsilon_o \varepsilon_r A}{L}.$$

What is the force required to spark the gap? Is this a realistic force? If yes, how the force can be applied? (ε_o=8.85 x 10^{-12} F m^{-1})

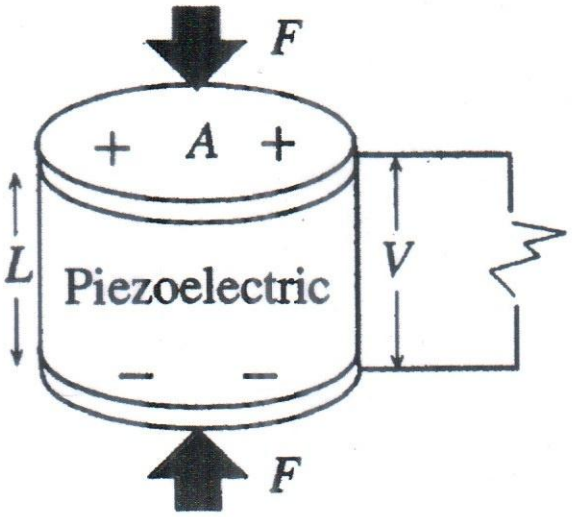

Figure 6(b)

7. a) Describe in brief different types of magnetic materials. 6

b) Consider a long solenoid with a core that is an iron alloy as shown in Figure 7(b). Suppose that the diameter of the solenoid is 2 cm and the length of the solenoid is 20 cm. The number of turns on the solenoid is 200. Ampere's law states that 10.67

$$H = \frac{NI}{l}.$$

The current is increased until the core is magnetized to saturation at about I = 2 A and the saturated magnetic field B_{sat} is 1.5 T.

i. What is the saturated magnetic field intensity H_{sat} at the center of the solenoid?
ii. What is the saturation magnetization M_{sat} of this iron alloy?
iii. What is the total magnetization current on the surface of the magnetized iron alloy specimen?
iv. If we were to remove the iron-alloy core and attempt to obtain the same magnetic field of 1.5 T inside the solenoid, how much current would we need? Is there a practical way of doing this?
($\mu_o = 4\pi \times 10^{-7}$ Wb A^{-1} m^{-1})

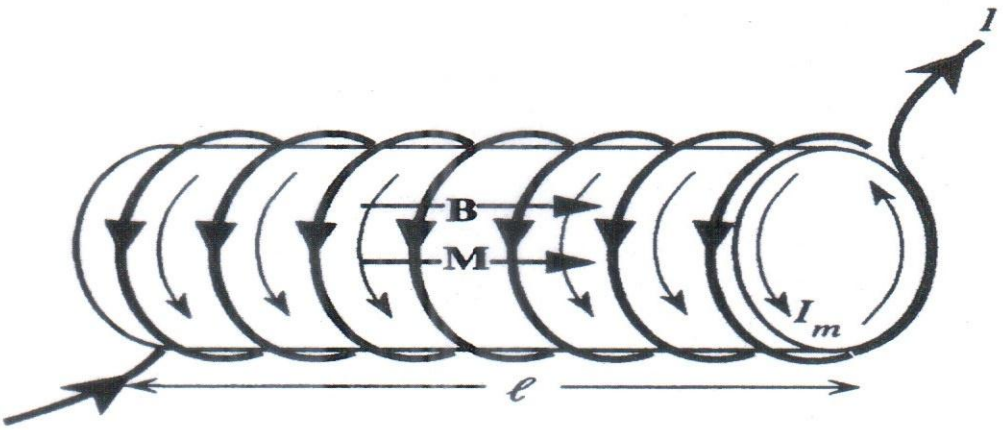

Figure 7(b)

8. a) How many factors define the limits of superconductivity? Describe briefly with suitable figure and highlight the Meissner effect? 6

b) Consider two superconducting wires, tin (Sn; Type I) and Nb_3Sn (Type II), each having radius 0.5 mm. The magnetic field on the surface of a current-carrying conductor is given by 10.67

$$B = \frac{\mu_o I}{2\pi r}.$$

i. Calculate the maximum current and hence the critical current density that can be passed through the Sn wire near absolute zero temperature. Assume that Sn wire loses its superconductivity when the field at the surface reaches the critical field $B_c = 0.2$ T.
ii. Calculate the maximum current and critical current density for the Nb_3Sn wire using the same assumption as in part (i) but taking the critical field to be the upper critical field, B_{c2}, which is 24.5 T at 0 K.
($\mu_o = 4\pi \times 10^{-7}$ Wb A^{-1} m^{-1})

B.Sc. Engg. (EE), 8th Sem. Date: October 23, (Morning)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination — Summer Semester, A.Y. 2018-2019
Course No.: EEE 4835 — Time: 3 Hours
Course Title: Power System Operation and Control — Full Marks: 150

There are **8 (eight)** questions. Answer **any 6 (six)** 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) Explain the concept of *penalty factor* for a large power system. Derive the expression of it. How does it affect the numerical value of the incremental cost of a system? 10

   b) The total transmission loss equation for a power system is given as: $P_L = P_1^2 B_{11} + P_2^2 B_{22} + 2P_1 P_2 B_{12}$. For fulfilling the demand of 1.8 per unit, the required generations are obtained as: $P_1 = 0.95$ per unit and $P_2 = 0.99$ per unit. If the values of $B_{11} = 0.012$ per unit and $B_{22} = 0.021$ per unit, find out the value of total loss P_L and the value of B_{12}. 05

   c) Describe the concept of *security constrained dispatch* with numerical example. 10

2. a) The detail of three generating units are given as follows: 15

Unit No.	Unit Min (MW)	Unit Max (MW)	Cost Function (MBTU/h)	Fuel Cost ($/MBTU)
1	100	650	$H_1 = 510 + 7.2P_1 + 0.00142P_1^2$	1.2
2	120	410	$H_2 = 310 + 7.85P_2 + 0.00194P_2^2$	1.1
3	45	205	$H_3 = 78 + 7.97P_3 + 0.00482P_3^2$	1.3

   i) Identify the feasible and infeasible unit combinations if the load demand is 580 MW.
   ii) Obtain the economic dispatch for each feasible combination.

   b) The data for the interconnected power system shown in Fig. 2(b) is presented below. 10

Region	Unit No.	Unit Capacity (MW)	Unit output (MW)	Regional Load MW)
1	1	1000	900	1500
	2	800	410	
2	3	1200	1050	1210
	4	600	350	
Total	1-4	3600	2710	2710

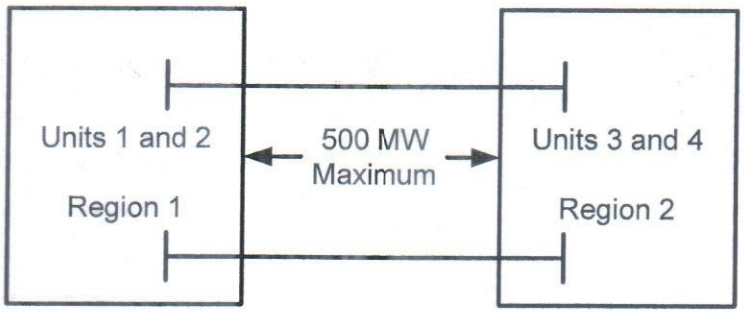

Fig. 2(b)

i) Calculate the total spinning reserve available in the system. ii) Find out the tie-line flow (interchange) between the regions under current scenario. iii) How would the failure of unit 3 be handled by the operator?

3. a) The detail of three thermal units to be committed are listed in the following table. 18

Unit	P_{min} (MW)	P_{max} (MW)	No- load cost ($)	Marginal cost ($/MWh)	Start- up cost ($)
A	70	250	110	12	600
B	50	100	85	10	500
C	10	50	95	15	200

Assume units A and B are in operation initially. The hourly load demand is shown in the following table.

Hour	1	2
Load (MW)	110	300

Following a strict priority ordering scheme, find out the optimal unit-commitment solution. (Neglect minimum-up time, minimum-down time and shut-down cost).

b) The operating cost data of a thermal generating unit is given below. 07

Generation (MW)	Operating Cost ($/MWh)
100	10
150	15
200	18
250	20

Plot the unit operating cost characteristics and incremental cost characteristics. (Assume linear transitions between data points.)

4. a) Why is the line outage scenario of a power system modeled by power injection at two ends of the line instead of excluding the line from the system? 05

b) The line data of a three-bus power system is presented in the following table. 20

Line data

Line no.	From Bus	To bus	R (pu)	X (pu)	B_{shunt} (pu)
1	1	2	0.08	0.9	0.06
2	1	3	0.06	0.55	0.03
3	2	3	0.01	0.43	0.002
4	2	4	0.005	0.8	0.01
5	3	4	0.03	0.75	0.03

The corresponding B' matrix for the system is calculated as:

$$B' = \begin{bmatrix} 4.6857 & -2.3256 & -1.25 \\ -2.3256 & 5.477 & -1.33 \\ -1.25 & -1.33 & 2.5833 \end{bmatrix}.$$

Calculate the line outage distribution factors if line 3 goes out of operation.

5. a) What are the basic differences between convention load flow and optimal power flow? Explain different ways of formulating an optimal power flow problem. 15

b) How is the *successive relaxation* method advantageous in solving an optimal power flow problem? How does the *tight* and the *loose* relaxations affect the solution? 05

c) Why is the DC power flow preferred over the full AC power flow during an optimal power flow solution? 05

6. a) Derive the generalized expression of *compensated generation shift factors.* 05

b) The detail of the power system of Fig. 6(b) is provided in the following tables. 20

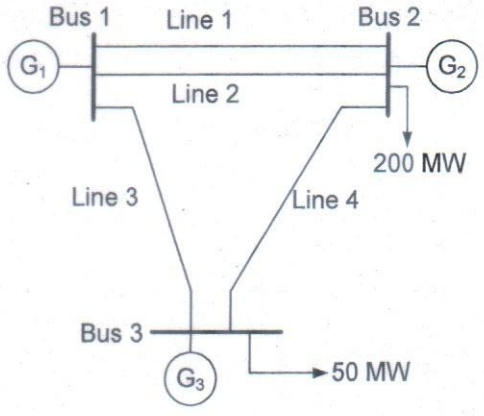

Fig. 6(b)

Line Data (100-MVA base)

Line No.	b_l (pu)	f_l^{max} (MW)
1	5	90
2	5	90
3	5	50
4	5	65

Generator Data

Gen. No.	g_{min} (MW)	g_{max} (MW)	Cost ($/MWh)
1	100	250	20
2	30	150	35
3	10	60	55

i) Determine the B' and C matrices. ii) Plot the unit optimal dispatches in g_2-g_3 plane. iii) Find out the associated cost. iv) Identify the overloaded lines.

7. a) The schematic diagram of the LFC and AVR systems of a synchronous generator is shown in Fig. 7(a). Obtain the close loop transfer function of the LFC system. 15

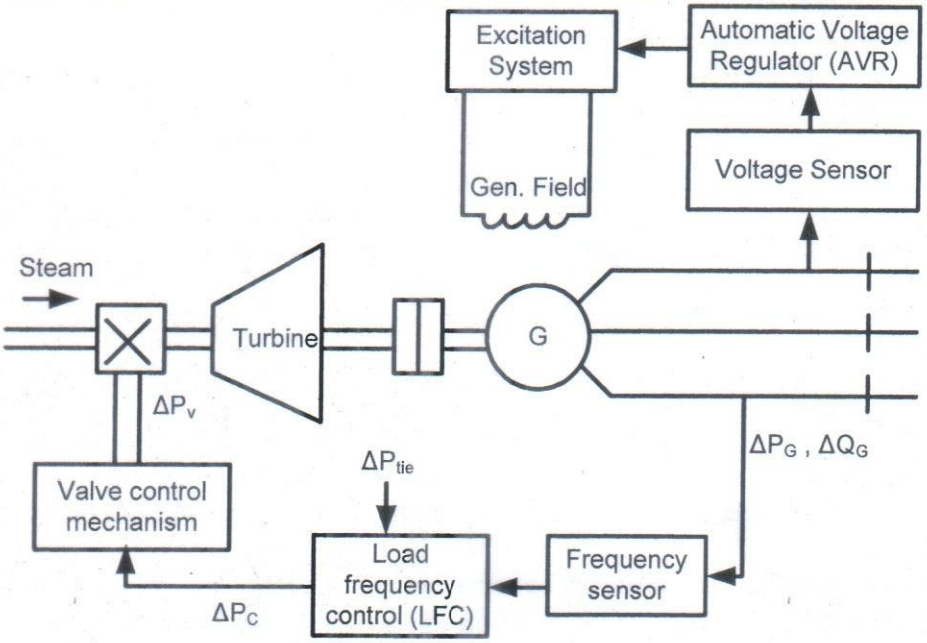

Fig. 7(a)

b) An isolated power system is represented by the following parameters: 10
Turbine time constant = 0.4 sec, Governor time constant = 0.25 sec, Generator inertia constant = 5 sec, Governor speed regulation = R per unit.
The load varies by 0.75 percent for a 1 percent change in frequency.
i) Use the Routh-Hurwitz array to find the range of R for control system stability.
ii) Find the system poles for marginal stability.

8. a) The schematic diagram of the speed-governor mechanism of a steam-turbine power plant is shown in Fig. 8(a). Discuss the operation of this mechanism once a drop or rise in speed is sensed by the flyball governor. How does the system settle to a new steady state? 15

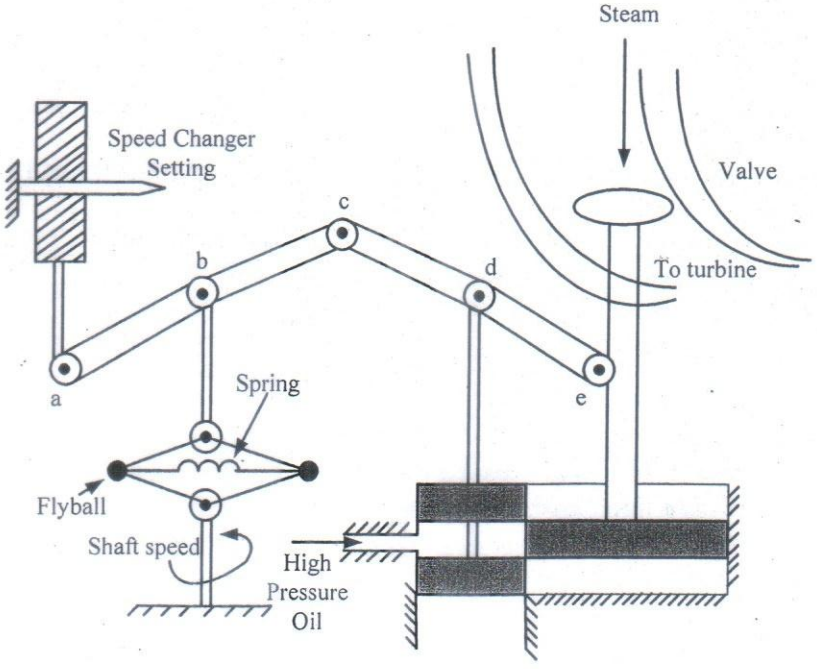

Fig 8(a)

b) A single area consists of three generating units with the following characteristics. 10

Unit	Rating (MVA)	Speed regulation R (pu on unit MVA base)
1	650	6.5%
2	530	4.0%
3	455	3.8%

The units are operating in parallel, sharing 920 MW at the nominal frequency of 50 Hz. The outputs of the units are 400, 300 and 220 MW, respectively. The load is increased by 90 MW. The load varies 1.5 percent for every 1 percent change in frequency. Find the steady-state frequency deviation and the new generation on each unit.

B.Sc. Engg.(EE), 8th Sem. Date: October 29, 2019

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination — Summer Semester, A. Y. 2018-2019
Course No.: EEE 4841 — Time: 3 Hours
Course Title: Microwave Engineering — Full Marks: 150

There are **8 (eight)** questions. Answer **any 6 (six)** 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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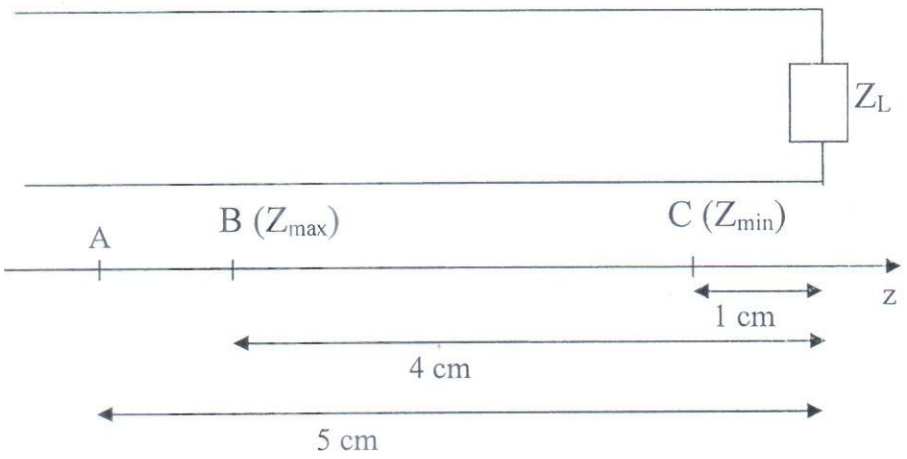
1. a) The incident voltage and the reflected voltage on an ideal transmission line are given by $|V_+|\cos\omega\left(t-\frac{z}{v_p}\right)$ and $|V_-|\cos\left[\omega\left(t+\frac{z}{v_p}\right)+\theta_P\right]$, respectively. Derive an expression for reflection coefficient at the point of load in terms of characteristic impedance and load impedance. Also, show that the phase change of incident wave up to the position of minimum voltage amplitude from the point of load is as follows. 10

$$\beta l_{min} = \frac{\theta_P}{2} + (2n+1)\frac{\pi}{2} \qquad \text{where n} = -1, 0, 1, 2, 3 \ldots\ldots$$

b) The maximum impedance point and the minimum impedance point closest to the load are located at B and C. The values of maximum impedance and minimum impedance are $Z_{max} = 80\ \Omega$ and $Z_{min} = 45\ \Omega$, respectively. The reflected current is $0.1\angle 0^0$ amp at point C. The distances of A, B, and C from the load are shown in the figure below. Determine both incident voltage and incident current at point A. 15



2. a) Show that the propagation constant, $\gamma = \sqrt{(R+j\omega L)(G+j\omega C)} = \alpha + j\beta$, where $V(z) = Ve^{-\gamma z}$ represents the voltage wave equation for lossy transmission line. Mention the significance of the attenuation constant, α. 13

b) The load connected to a transmission line is capacitive. The distance to the first maximum current point from the load is 0.5 cm. The operating frequency is 6 GHz. Determine the angle of the reflection coefficient at load. 12

a) Compare the advantages and disadvantages of open-circuited stub and short-circuited stub. Define tapered lines. How can the forbidden region be made smaller in double-stub matching? 10

b) Design double-stub shunt tuner in order to match a load. The value of normalized load admittance is $y_L = 0.33 + j0.10$. Use open circuited stubs and $\lambda/5$ spacing between stubs. Show distances and lengths in terms of λ. 15

a) Derive the following expression from Maxwell's equation. 13

$$H_y = -\frac{j}{k_c^2}\left(\omega\epsilon \frac{\partial E_z}{\partial x} + \beta \frac{\partial H_z}{\partial y}\right)$$

Also, show that the characteristic wave impedance for TEM wave is $Z_{TEM} = \sqrt{\frac{\mu}{\epsilon}}$.

b) A transmission line with characteristic impedance 50 Ω has its end open-circuited. The total voltage at the open-circuited end is 10V. Determine the incident current, the reflected current, and the total current at a point 3.5 cm away from the point of open-circuited end. The operating frequency is 15 GHz. 12

a) Derive the field equations for TE wave in parallel plate waveguide. Write down the magnetic field equations for TE_1 wave and then draw and explain the magnetic field distribution on Y-Z plane from those equations. 13

$$[For\ TE\ wave,\ H_x = -\frac{j\beta}{k_c^2}\frac{\partial H_z}{\partial x},\ H_y = -\frac{j\beta}{k_c^2}\frac{\partial H_z}{\partial y},\ E_x = -\frac{j\omega\mu}{k_c^2}\frac{\partial H_z}{\partial y},\ E_y = \frac{j\omega\mu}{k_c^2}\frac{\partial H_z}{\partial x}]$$

b) The cutoff frequency for the dominant mode is 3 GHz for a circular waveguide. The waveguide is allowed to carry six modes at the maximum. Determine the maximum possible bandwidth of operation. Use Table 5(b). 12

	Roots of Bessel Function				Roots of Derivative of Bessel Function			
n	ρ_{n1}	ρ_{n2}	ρ_{n3}	ρ_{n4}	ρ'_{n1}	ρ'_{n2}	ρ'_{n3}	ρ'_{n4}
0	2.4	5.52	8.66	11.79	3.83	7.02	10.17	13.32
1	3.83	7.02	10.17	13.32	1.84	5.33	8.54	11.71
2	5.14	8.42	11.62	14.77	3.05	6.71	9.97	13.17
3	6.38	9.76	13.02	16.22	4.2	8.015	11.35	14.59
4	7.56	11.06	14.37	17.62	5.32	9.28	12.68	15.96

Table 5(b)

6. a) Derive an expression for average power flow in a rectangular waveguide with TE_{10} mode, assuming that the width and height of the waveguide are a and b, respectively. 13

$$For\ TE_{10}\ mode, \quad E_y = -\frac{j\omega\mu a}{\pi} A \sin\frac{\pi x}{a}, \quad H_x = \frac{j\beta a}{\pi} A \sin\frac{\pi x}{a}$$

b) The characteristic impedance of a transmission line is $Z_0 = 30\ \Omega$ and the load impedance is $120\ \Omega$. To remove this mismatch, a piece of air-filled coaxial line is used as a quarter-wave transformer and it provides perfect matching. The inner radius of the coax is 0.5 cm and the length of the piece of coax is 1.25 cm. The peak voltage at the load is 5 volts. Determine the outer radius of the coax, the operating frequency and the maximum electric field intensity in the coax. 12

7. a) Show that the reflection coefficients towards load and towards source are required to be conjugate of each other for maximum power transfer. Assume that the characteristic impedance of the transmission line is purely resistive. 10

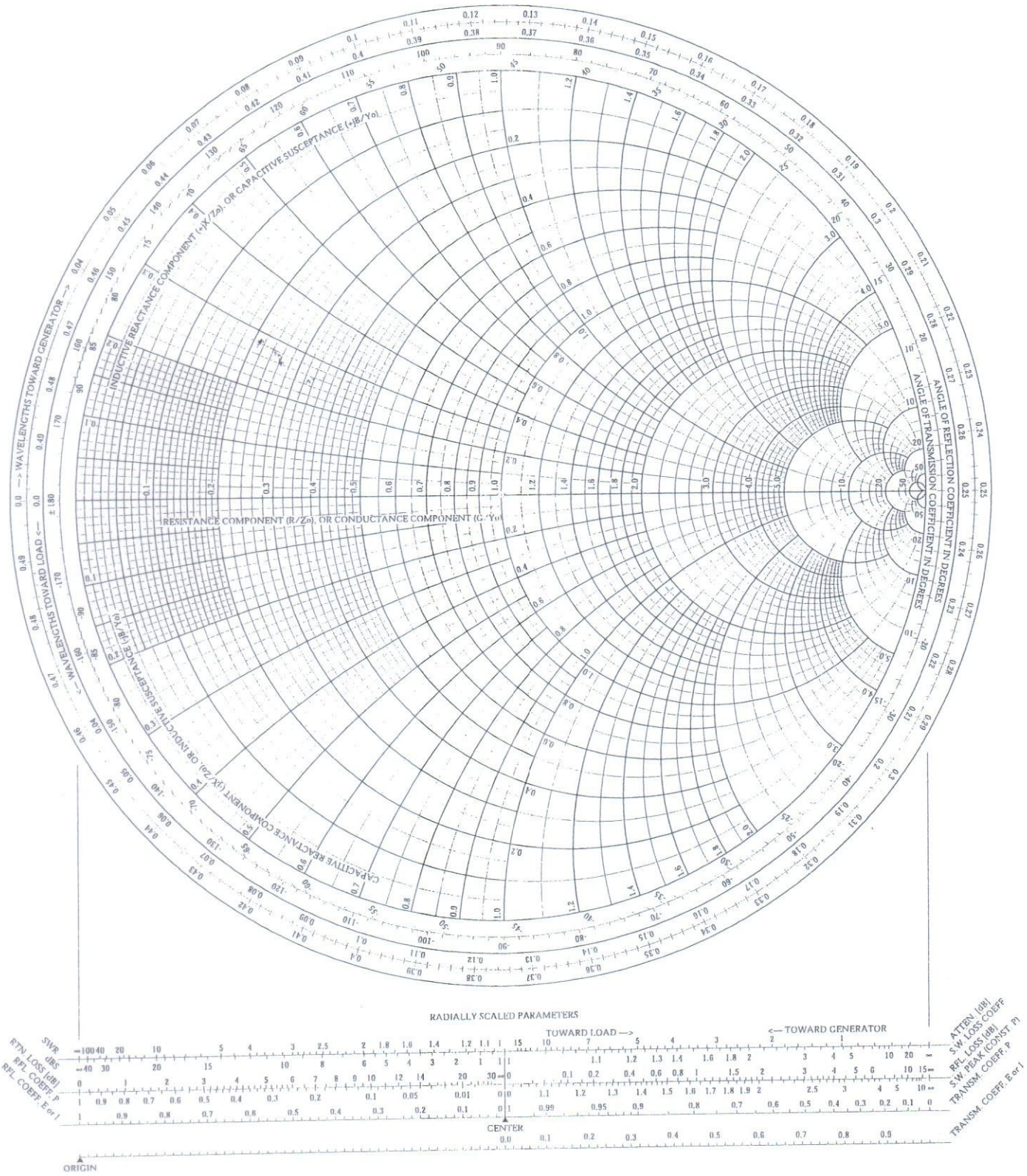
b) The S parameters of a transistor are $S_{11} = 0.7\angle{-110^0}$, $S_{12} = 0.02\angle{60^0}$, $S_{21} = 3.5\angle{60^0}$, and $S_{22} = 0.8\angle{-70^0}$. Determine if an amplifier based on this transistor will be stable for load impedance $Z_L = 120 + j50\ \Omega$ and characteristic impedance $Z_0 = 50\ \Omega$. 15

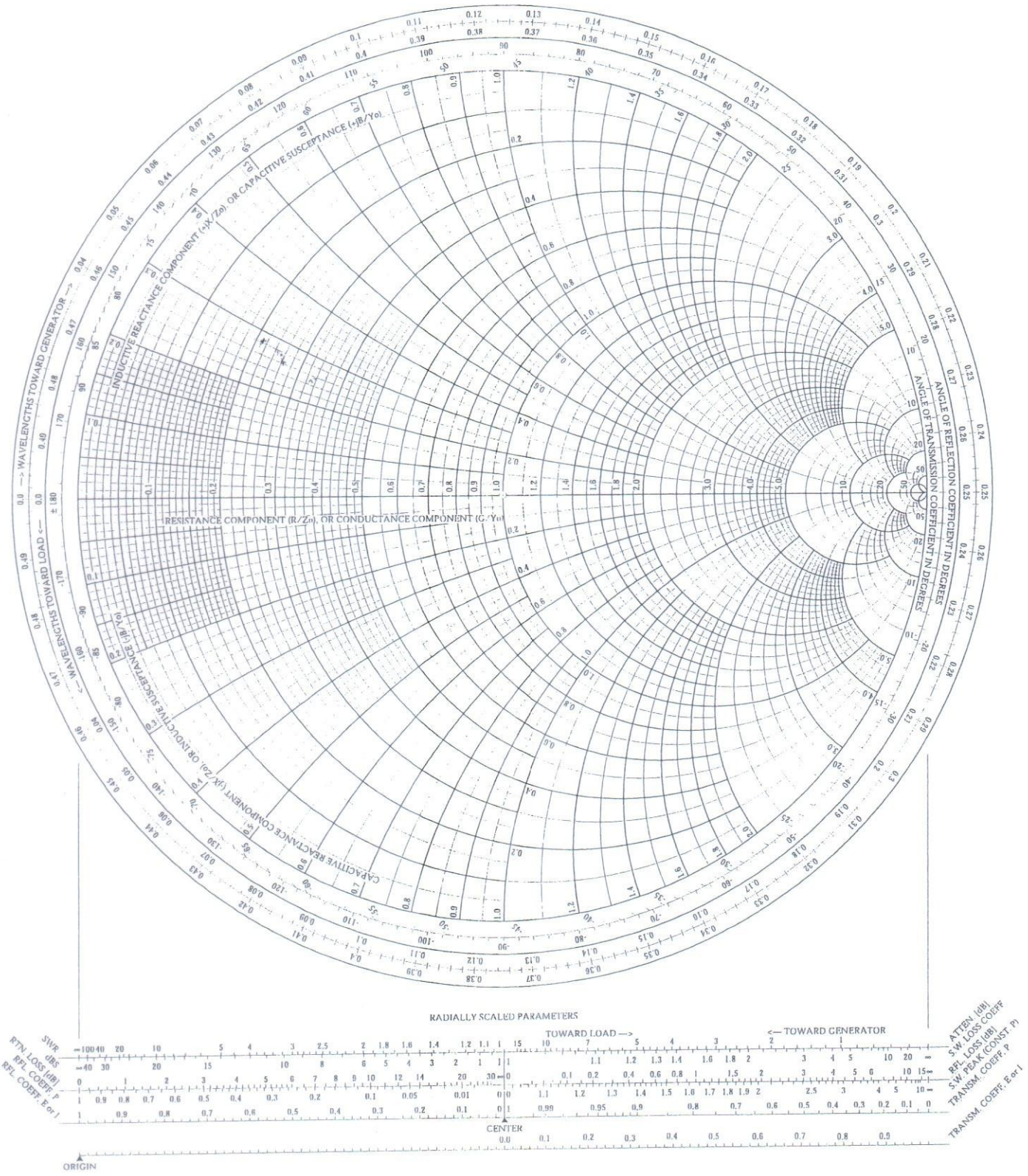
$$C_L = \frac{(S_{22} - \Delta S_{11}^{*})^{*}}{|S_{22}|^2 - |\Delta|^2} \qquad R_L = \left|\frac{S_{12}S_{21}}{|S_{22}|^2 - |\Delta|^2}\right|$$

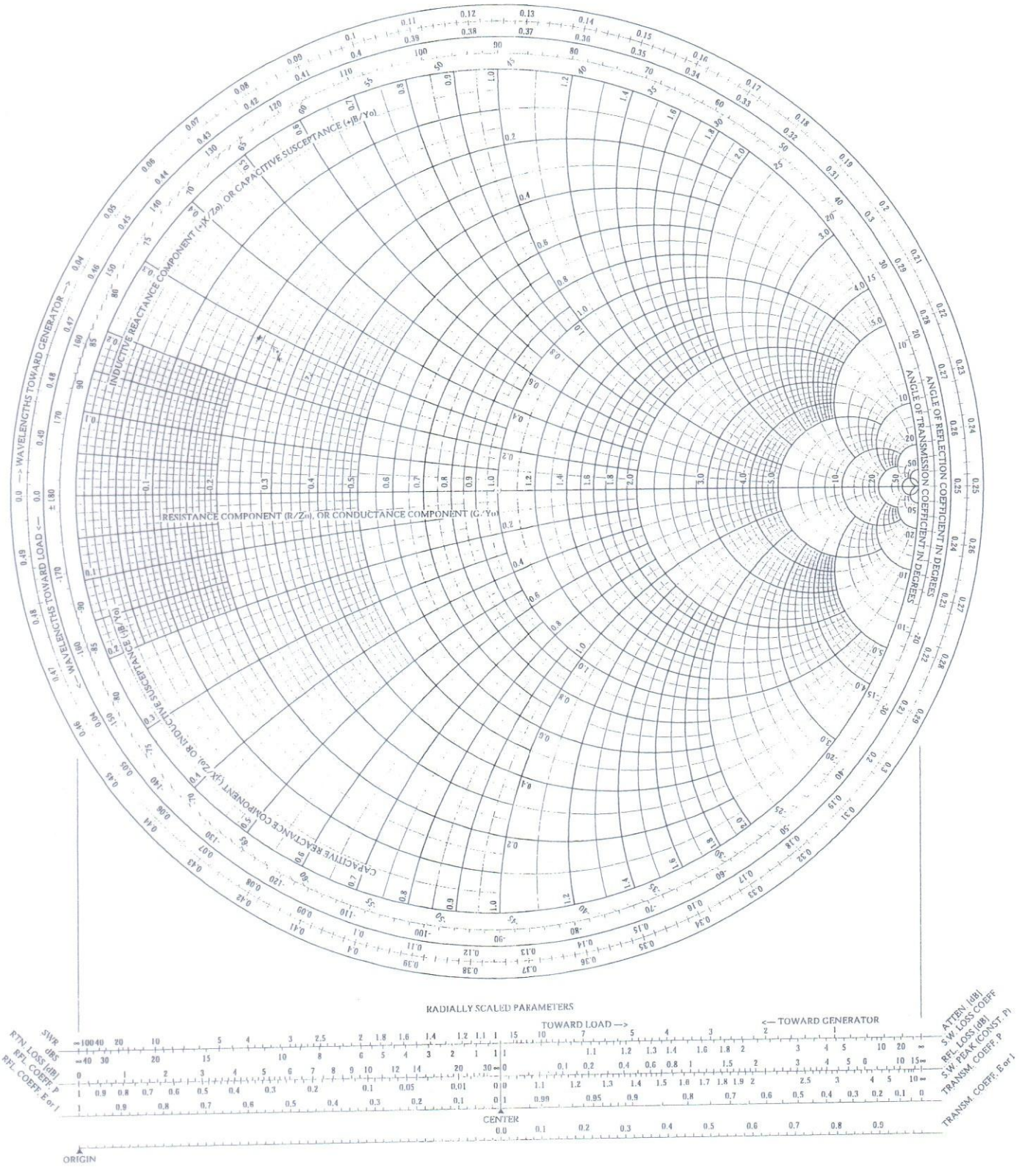
$$\text{K-}\Delta \text{ test: } K = \frac{1 - |s_{11}|^2 - |s_{22}|^2 + |\Delta|^2}{2|s_{12}\, s_{21}|} > 1 \quad \text{and} \quad |\Delta| = |s_{11}\, s_{22} - s_{12}\, s_{21}| < 1$$

8. a) Compare between solid state and microwave tube solutions. Compare cross-field amplifier (CFA) with linear beam or O type amplifiers. 10

b) A microwave amplifier is to be designed for maximum gain using a transistor with S parameters $S_{11} = 0.72\angle{-116^0}$, $S_{12} = 0.03\angle{57^0}$, $S_{21} = 2.6\angle{76^0}$, and $S_{22} = 0.73\angle{-54^0}$. The required value of ρ_S is $0.872\angle{123^0}$ for the maximum gain. Design only the input section for the amplifier. 15


RESISTANCE COMPONENT (R/Zo), OR CONDUCTANCE COMPONENT (G/Yo)
INDUCTIVE REACTANCE COMPONENT (+jX/Zo), OR CAPACITIVE SUSCEPTANCE (+jB/Yo)
CAPACITIVE REACTANCE COMPONENT (-jX/Zo), OR INDUCTIVE SUSCEPTANCE (-jB/Yo)
ANGLE OF REFLECTION COEFFICIENT IN DEGREES
ANGLE OF TRANSMISSION COEFFICIENT IN DEGREES
--> WAVELENGTHS TOWARD GENERATOR -->
<-- WAVELENGTHS TOWARD LOAD <--
RADIALLY SCALED PARAMETERS
TOWARD LOAD -->
<-- TOWARD GENERATOR
SWR
RTN LOSS (dB)
RFL. COEFF. P
RFL. COEFF. E or I
ATTEN. (dB)
S.W. LOSS COEFF
RFL. LOSS (dB)
S.W. PEAK (CONST. P)
TRANSM. COEFF. P
TRANSM. COEFF. E or I
CENTER
ORIGIN


RESISTANCE COMPONENT (R/Z0), OR CONDUCTANCE COMPONENT (G/Y0)
INDUCTIVE REACTANCE COMPONENT (+jX/Z0), OR CAPACITIVE SUSCEPTANCE (+jB/Y0)
CAPACITIVE REACTANCE COMPONENT (-jX/Z0), OR INDUCTIVE SUSCEPTANCE (-jB/Y0)
ANGLE OF REFLECTION COEFFICIENT IN DEGREES
ANGLE OF TRANSMISSION COEFFICIENT IN DEGREES
— WAVELENGTHS TOWARD GENERATOR —>
<— WAVELENGTHS TOWARD LOAD —
RADIALLY SCALED PARAMETERS
TOWARD LOAD —>
<— TOWARD GENERATOR
SWR
RTN. LOSS (dB)
RFL. COEFF. P
RFL. COEFF. E or I
ATTEN. (dB)
S.W. LOSS COEFF.
RFL. LOSS (dB)
S.W. PEAK (CONST. P)
TRANSM. COEFF. P
TRANSM. COEFF. E or I
CENTER
ORIGIN



RADIALLY SCALED PARAMETERS

TOWARD LOAD —> <— TOWARD GENERATOR

SWR

RTN. LOSS (dB)

RFL. COEFF. P

RFL. COEFF. E or I

ATTEN. (dB)

S.W. LOSS COEFF

RFL. LOSS (dB)

S.W. PEAK (CONST. P)

TRANSM. COEFF. P

TRANSM. COEFF. E or I

CENTER

ORIGIN

B.Sc. Engg. (EE), 8th Sem. Date: October 23, 2019 (Morning)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination — Summer Semester, A. Y. 2018-2019
Course No.: EEE 4851 — Time: 3 Hours
Course Title: Advanced Communication Techniques — Full Marks: 150

There are **8 (eight)** questions. Answer **any 6 (six)** 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 followings with respect to a satellite: 10
   i) Geostationary earth orbit (GEO) ii) Geosynchronous orbit.

   b) A satellite is in elliptical orbit with a perigee of 1000 km and an apogee of 4000 km. Using a mean earth radius of 6378.14 km, find the period of the orbit. Also find the value of 'e' of the orbit. 7

   c) Explain free space path loss in respect of a receiver. 8

2. Consider an MFSK scheme with carrier frequency f_c equal to 250 kHz, difference frequency f_d equal to 25 kHz, and M equal to 8 (L equal to 3 bits). 25
   i) Make a frequency assignment for each of the eight possible 3-bit data combinations. We wish to apply FHSS to this MFSK scheme with k = 2; that is, the system will hop among four different carrier frequencies. Suppose the data rate is R bps, so the duration of a bit is $T = 1/R$ seconds.
   ii) Consider a slow FHSS with T_c (the period at which the MFSK carrier frequency changes) being $2T_s$, where T_s is the duration of a signal element. Show the sequence of frequencies used, and the times the frequency changes occur, for transmitting the bit string 011110001.
   iii) Consider a fast FHSS with T_s being $4T_c$. Show the sequence of frequencies used, and the times the frequency changes occur, for transmitting the bit string 011110001.

3. a) Explain the followings: 10
   i) Pseudo-noise sequences, ii) Code division multiple access (CDMA)

   b) Assume that a sensor node is only operating in transmit and receive modes where the energy to run circuitry is 50 nJ/bit and energy for radio transmission is 100 pJ/bit/m^2. What is the energy consumption if 1 Mbit of information is transferred from the source to the sink? Assume that the source and sink are separated by 100 meters, the broadcast radius of each node is 5 meters and the neighbor nodes are overhearing each other's broadcast. 5

   c) Explain frequency hopping spread spectrum (FHSS) using BPSK and MFSK. 10

4. a) For an optical heterodyning technique, prove that optical LO linewidth is sum of the linewidth of individual lasers. 10

   b) Compare OSI model with TCP/IP. 5

c) Describe route discovery, route reply and data delivery for Dynamic Source Routing (DSR). How DSR optimization can be possible using route caching? 10

5. a) For a contention-based protocol describe the followings: 5
i) Aloha ii) CSMA iii) CSMA/CA.

b) Assuming that some sensor nodes are evenly distributed in the sensor field, determine the node density if 200 sensor nodes are deployed in a 50×50 m^2 region where each sensor node has a broadcast radius of 5 m. 5

c) Describe the followings: 15
i) Proactive vs reactive routing, ii) Flooding for data delivery,
ii) Distance vector protocols.

6. a) Explain procedure of route requests and route reply for Ad Hoc On-Demand Distance Vector Routing (AODV). 10

b) How many sensor nodes are needed within a broadcast radius (range) to have 99% fault tolerated network assuming all sensors within the radio range has same reliability. 5

c) Explain low-energy adaptive clustering hierarchy (LEACH) for a wireless sensor network (WSN). 10

7. a) In Figure 7, node S wants to send a packet to node D, Explain route discovery in dynamic source routing (DSR) for the following nodes. 10

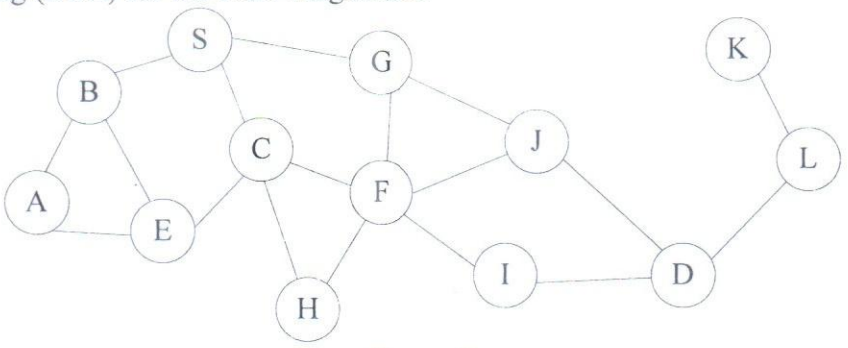

Figure 7.

b) Explain how the use of route caching can reduce propagation of route requests for the case shown in Figure 7. Also explain how the concept of route Error (RERR) works for this network. 15

8. Explain the followings: 25
i) LiFi,
ii) Energy efficient routing,
iii) Photonic Generation of RF carriers,
iv) Phased Array Antenna.

B.Sc. Engg.(EE), 8th Sem. Date: 29 October, 2019

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination — Summer Semester, A. Y. 2018-2019
Course No.: EEE 4865 — Time: 3 Hours
Course Title: Digital Filter Design — Full Marks: 150

There are **8 (eight)** questions. Answer **any 6 (six)** questions. All questions carry equal marks. Marks in the margin indicate full marks. Programmable calculators are not allowed. Do not write on this question paper. Symbols preserve their usual meanings.

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1. a) What are the differences between FIR and IIR filters? 7

   b) Using impulse-invariant design method, derive the filter transfer function in z-domain and draw the DSP set-up of a third-order filter, given by: 18

$$H(s) = \frac{1}{[s + 1/2 + j(\sqrt{3}/2)][s + 1/2 + j(\sqrt{3}/2)][s + 1]}$$

2. a) What is frequency warping? 5

   b) Design an inverse Chebyshev digital low-pass IIR filter for unity pass-band gain, 120 rad/s cut-off frequency, 0.0316 attenuation, 500 rad/s as attenuation starting frequency and 900 rad/s sampling frequency. 20

3. a) With an example, show the steps to design the low-pass FIR filter without using window functions. 15

   b) With a same fifth order IIR system, show the Direct-form-I, Direct-form-II and Transposed-form structure. 10

4. a) Write short notes on: i) The Hamming window, ii) The Hanning window, and iii) The Blackman window. 7

   b) Design an FIR low-pass filter using frequency-sampling method from the specifications given below: 18

   Frequency of pass-band edge: 500 Hz
   Stop-band starts at: 900 Hz
   Sampling frequency: 2200 Hz
   Order of the filter: 8

5. a) Explain the design technique used in Kaiser's approach. 5

   b) Design a low-pass FIR filter using Kaiser's approach for the following specifications: 20

   Frequency of pass-band edge: 2000 Hz
   Gain in pass-band: -1 dB
   Frequency from which stop band begins: 3000 Hz
   Gain in stop band: -55 dB
   Sampling frequency: 12000 Hz

6. a) Discuss the types of FIR filters with graphical representation. 15

   b) Develop the expression of the desired transfer function $H(\omega)$ of a digital differentiator. 10

7. a) With an example, discuss the limitation of the limit-cycle oscillations in the First-order systems for an IIR filter. 13

   b) Obtain the filter coefficients of a three-stage lattice-structure FIR filter, to its equivalent third-order direct-form structure, whose coefficients are: 12
   $$a_0 = 1, a_1 = 11/8, a_2 = 7/8, a_3 = 1/4.$$

8. a) What is the impact of the nonlinear phase filter to the final output of a filter? 5

   b) How can a nonlinear phase IIR filter be linearized? Explain it with proper steps. 10

   c) What is group delay? Derive the group delay for the Type-I FIR filter and explain the physical meaning of that term. 10

Formula related to Kaiser's Approach:

$$\alpha = \begin{cases} 0.1102\,(H_{2m} - 8.7), & H_{2m} > 50 \\ 0.5842(H_{2m} - 21)^{0.4} + 0.07886(H_{2m} - 21), & 21 \le H_{2m} \le 50 \\ 0.00 & H_{2m} < 21 \end{cases}$$

$$M = \frac{N}{2} = \frac{H_{2m} - 7.95}{2.285(\Delta\omega)}$$

$$I_0(x) = \frac{0.3989e^x}{\sqrt{x}}\left(1 + \frac{1}{8x} + \frac{9}{128x^2}\right)$$

$$W_{KAI}(n) = \frac{I_0[\alpha\sqrt{1 - (n/M)^2}]}{I_0(\alpha)}, \qquad -M \le n \le M$$

Formula table:

Laplace Transform	Time function	z-Transform
$\frac{1}{s}$	$u_s(t)$	$\frac{z}{z-1}$
$\frac{1}{s^2}$	t	$\frac{Tz}{(z-1)^2}$
$\frac{2}{s^3}$	t^2	$\frac{T^2z(z+1)}{(z-1)^3}$
$\frac{1}{s+a}$	e^{-at}	$\frac{z}{z-e^{-aT}}$
$\frac{1}{(s+a)^2}$	te^{-at}	$\frac{Tze^{-aT}}{(z-e^{-aT})^2}$
$\frac{a}{s(s+a)}$	$1-e^{-at}$	$\frac{z(1-e^{-aT})}{(z-1)(z-e^{-aT})}$
$\frac{1}{(s+a)(s+b)}$	$\frac{1}{(b-a)}(e^{-at}-e^{-bt})$	$\frac{1}{(b-a)}\left(\frac{z}{z-e^{-aT}}-\frac{z}{z-e^{-bT}}\right)$
$\frac{a}{s^2(s+a)}$	$t-\frac{1}{a}(1-e^{-at})$	$\frac{Tz}{(z-1)^2}-\frac{(1-e^{-aT})z}{a(z-1)(z-e^{-aT})}$
$\frac{a}{s^2+a^2}$	$\sin(at)$	$\frac{z\sin(aT)}{z^2-2z\cos(aT)+1}$
$\frac{s}{s^2+a^2}$	$\cos(at)$	$\frac{z(z-\cos(aT))}{z^2-2z\cos(aT)+1}$
$\frac{b}{(s+a)^2+b^2}$	$e^{-at}\sin bt$	$\frac{z\sin(bT)e^{-aT}}{z^2-2z\cos(bT)e^{-aT}+e^{-2aT}}$
$\frac{s+a}{(s+a)^2+b^2}$	$e^{-at}\cos bt$	$\frac{z(z-\cos(bT)\,e^{-aT})}{z^2-2z\cos(bT)\,e^{-aT}+e^{-2aT}}$

B.Sc. Engg. (ME)/8th Sem. 29 October 2019

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
DEPARTMENT OF MECHANICAL AND CHEMICAL ENGINEERING

Semester Final Examination — Summer Semester, A. Y. 2018-19
Course No MCE 4887 — Time: 3 Hours
Course Title: Fundamentals of Road Vehicle Dynamics — Full Marks: 150

There are **8 (Eight)** questions. Answer any **6 (Six)** of them.

Figures in the margin indicate full marks. Programmable calculators are not allowed. Do not write on this question paper. Symbols have their usual meanings. Some formulas are provided at the end of the question.

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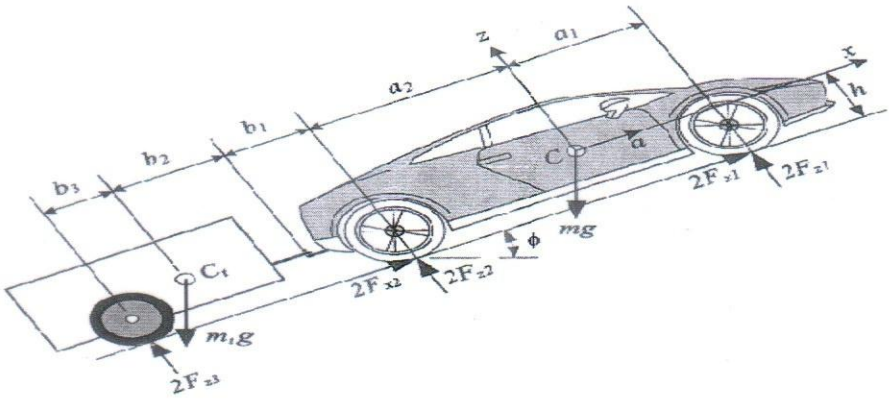
1. a) Describe basic components of a tire with appropriate figures. [13]
   b) Write down three main functions of tires. In a tire sidewall the following is written: P 215/60 R 15 95 H Write down the information that you may obtain from it. Also find out the section height of the tire [12]

2. a) Derive dynamic axle loads mathematical expressions for a car with a trailer attached while is moving up making an angle with acceleration. [13]
   b) A four wheel drive car is parked on a level road. Find the force at the hinge when the following information is provided. [12]
   For the car, m = 2500 kg , wheelbase, l= 2800 mm, a_1=a_2
   For the trailer, m_t = 600 kg, b_1= 850 mm, b_2= 1300 mm, b_3=150 mm, hinge is located at the same height of the centre of gravity of the trailer thus



3. a) What do you understand by road loads? Briefly describe rolling resistance phenomena by mentioning hysteresis effect. [12]
   b) A car weighing 72000 lb rolls along at a speed of 67 mph. The air temperature is 55^0F and barometric pressure is 26 inches of Mercury. It is 8 feet wide by 13.5 feet high, and has an aerodynamic drag coefficient of 0.65. The car uses bias-ply tires and assume road surface coefficient is 1 Calculate the aerodynamic drag, the rolling resistance and the road load horsepower at these conditions. [13]

4. a) Derive dynamic axle loads mathematical expressions for a car moving up on a dip in an inclined road. [13]

b) A car is moving on a plane surface with acceleration. Its mass is 1500 kg, wheelbase is 2600 mm, distance from the road surface to the centre of gravity is 700 mm, and coefficient of friction with the road surface is 0.8. Assume distance from the centre of gravity to the front axle and rear axle is equal. Now determine the maximum acceleration if the car is *rear-wheel drive*. [12]

5. a) Derive the equations for stopping distance and time to stop under constant deceleration condition. [13]
   b) If a light truck weighing 3000 lb performing full stop from 60 mph on a level surface with a brake application that develops a steady brake force of 1800 lb, determine the deceleration, stopping distance, time to stop, energy dissipated and brake horsepower at initial application as well as averaged over the stop. Neglect aerodynamic and rolling resistance forces. [12]

6. a) Write short notes on the following topics: [9]
   i) Characteristic speed ii) Caster angle iii) Ackerman Angle
   b) What do you understand by rollover? Derive the appropriate mathematical expression for threshold Lateral Acceleration for rollover [16]

7. What do you understand by Anti-squat and anti-pitch? Derive the appropriate mathematical expression for anti-pitch and anti squat geometry by first using two control arms and then by equivalent trailing arm. [25]

8. a) Describe steering geometry error that causes toe change and roll steer with example [10]
   b) Describe any two types of suspensions with their advantages and disadvantages. [15]

-----OOOO-----

Formulas:

$$\rho = 0.00236 \left(\frac{P_r}{29.92}\right)\left(\frac{519}{460 + T_r}\right)$$

$f_r = (0.0041 + 0.000041\ V)\ C_h$ **Radial tires**

$f_r = (0.0066 + 0.000046\ V)\ C_h$ **Bias-ply tires**

B.Sc.TE, 4th Sem.(2-Yr)/ B.Sc.TE, 2nd Sem.(1-Yr) Library Date: 23 October, 2019

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination
Course No.: EEE 4891
Course Title: Medical Electronics

Summer Semester, A. Y. 2018-2019
Time: 3 Hours
Full Marks: 150

There are **8 (eight)** questions. Answer **any 6 (six)** questions. All questions carry equal marks. Marks in the margin indicate full marks. Programmable calculators are not allowed. Do not write on this question paper. Symbols preserve their usual meaning.

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1. a) Write a short note on the following characteristics of a sensor: 12
   i) Sensitivity, ii) Dynamic range,
   iii) Precision, iv) Accuracy.

   b) Describe the basic concept of biomedical instrumentation by using block-diagram. 8

   c) What is the physiological effect of electricity on human body? 5

2. a) What is synaptic potential? How does the synaptic potential initiates and propagates from one neuron to another neuron? 15

   b) What are the differences between action potential and synaptic potential? 10

3. a) How do the guarded terminal solve the ground loop problem for medical instruments? 10

   b) Explain the effect of bias current on output voltage for Op-Amp. Discuss the processes to reduce bias current effect. 15

4. a) Draw the electric power delivery system from the pole transformer to the medical equipment. 12

   b) Why do we need the third lead to install strain gauge? Describe the fact with proper example. 13

5. a) What would be the value of the resistance R, with respect to R_i and R_f for the following circuit (Fig. 5.1) to minimize the offset current effect to the output? Show the related calculation to determine the value of R. 13

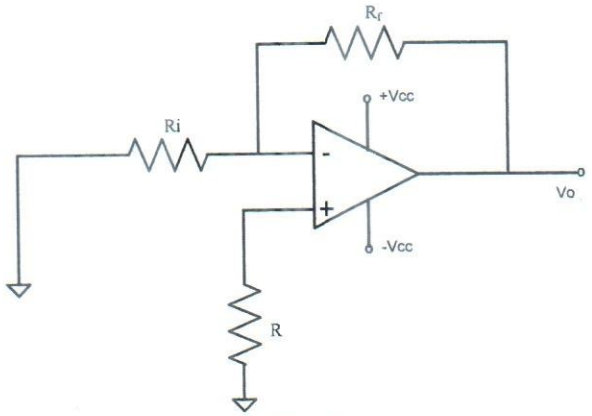

Fig. 5.1

a b) With proper diagram, describe the pressure measurement system. 12

6. a) Write short note on three medical imaging modalities. 12

b) Why is the guarding important for medical electronics? Show the guarding layout for any operational amplifier on the PCB. 13

7. a) For the following ECG signal shown in figure 7(a), 11
i. calculate the heart rate, ii. determine regularity,
iii. assess the P wave, iv. determine PR interval,
v. determine QRS duration.

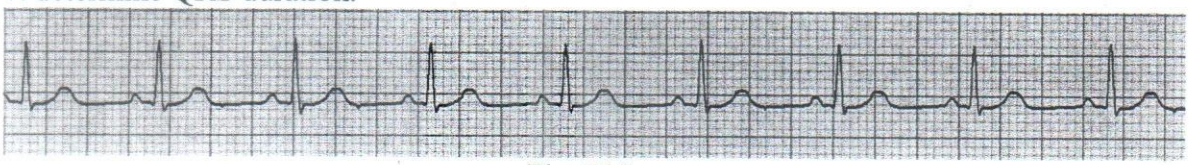

Fig. 7(a)

b) Draw the complete circuit diagram to extract EEG signal for a single point. How can the noise of EEG signal be minimized? 8

c) Draw the flow chart to process the ECG signal from a human body. 6

8. a) If one pregnant woman has fracture of her leg, which kind of medical imaging will you suggest for that patient and why? 10

b) What are the relaxation modes of MRI? Describe those modes with proper diagram. 15

B.Sc.TE, 2nd Sem (1-Yr), 4th Sem (2-Yr) Date: November 04, 2019 (Morning)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination
Course No.: EEE 4895
Course Title: Power Station

Summer Semester, A.Y. 2018-2019
Time: 3 Hours
Full Marks: 150

There are **8 (eight)** questions. Answer **any 6 (six)** 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 meant by *connected load* of a plant? Discuss its significance in designing a power station. 05

   b) The chronological load variation of a certain consumer is shown in Table 1 (b). 20

Table 1(b): Hourly load variation for a day

Time	MW	Time	MW
00:00	15	12:00 (noon)	30
2 A.M.	10	1 P.M.	50
6 A.M.	30	5 P.M.	70
8 A.M.	100	6 P.M.	90
11 A.M.	40	00:00	15

i) What are the maximum and minimum demands and the corresponding durations?
ii) What is the average demand for the consumer?
iii) What is the total energy consumed in a day?
iv) What would be the load factor if there is load shedding during 8:00 AM – 11:00 AM on that day?

2. a) Define maximum *protected* demand and *spinning reserve* of a power station. 05

   b) The capacities and order of efficiency of a six unit power station is presented in Table 2 (b). Prepare a capacity scheduling chart for the power station considering the system should be able to maintain the continuity of supply even with the failure of the highest unit in operation. What is the maximum protected demand for the station? 20

Table 2 (b): Unit capacities and order of efficiency

Unit No.	Capacity, MW	Order of Efficiency
1	5	6
2	10	5
3	20	3
4	40	2
5	30	1
6	50	4

3. a) The load duration curve of a system for the whole year of 8760 hours is as shown in Figure: 03. The system is supplied by two stations A and B having the following annual costs : 15

Station A : Tk (75000 + 80 * kW + 0.02 * kWh)
Station B : Tk (50000 + 50 * kW + 0.03 * kWh)

Determine the installed capacity required for each station and for how many hours per year peak load station should be operated to give the minimum cost per unit generated.

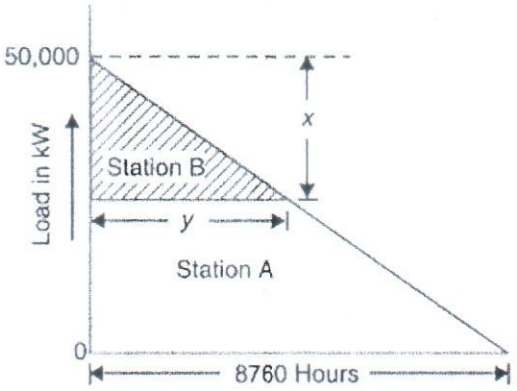

Figure: 03

b) A factory has a maximum load of 240 kW at 0.8 p.f. lagging with an annual consumption of 50,000 units. The tariff is Tk. 50 per kVA of maximum demand plus 10 paisa per unit. Calculate the flat rate of energy consumption. What will be annual saving if p.f. is raised to unity? 10

4. a) Prove that, between two load points relationship of average input (millions of BTU/hr) to average output (MW) can be represented by a straight line. 15

b) Prove that, when two generating stations are working together, load division between them for having minimum input consumption will be such that their incremental rates are equal. 10

5. A generating station is to be designed to supply a constant load of 400 MW. The alternatives considered are: one 400-MW unit; two 200-MW units; four 100 MW units and eight 50 MW units. The probability of unit failure is 0.02. 25

i) Prepare the capacity outage probability table (COPT).
ii) Calculate the loss of load probability (LOLP).
iii) Find out the loss of load expected (LOLE) in days per year.
iv) Determine the expected load loss (ELL) in MW.

6. a) The equipment in a power station costs Tk. 15,60,000 and has a salvage value of Tk. 60,000 at the end of 20 years. Determine the depreciated value at the end of 15 years in the following methods : 10

i) Straight line method
ii) Diminishing value method

b) The maximum demand of a consumer is 20 A and 220 V and his total energy consumption is 8760 kWh. If the energy is charged at the rate of 20 paisa per unit for 500 hours use of the maximum demand per annum plus 10 paisa per unit for additional units, calculate : 15

i) Annual bill

ii) Equivalent flat rate

7. A power station has two generating units with the curves given in Table 7. 25

Table 7 : Detail of the generating units

Unit	Capacity, MW	Input-output curve
A	12	$I = 13 + 9L + 0.04L^2 + 0.02L^3$
B	12	$I = 10 + 8L + 0.4L^2$

i) Plot the individual incremental rate curves for A and B.

ii) Plot the combined incremental rate curve.

iii) Devise a load-division schedule among the units for the most economic operation of the station starting from 2 MW and with an increment of 2 MW.

8. a) Write the name of the major components of hydro-electric power station. Define Pondage and Water-Hammer effect. 07

b) The run-off data of a river is as under: 18

January	80 millions m^3/ month	July	150 millions m^3/ month
February	50 millions m^3/ month	August	200 millions m^3/ month
March	40 millions m^3/ month	September	250 millions m^3/ month
April	20 millions m^3/ month	October	120 millions m^3/ month
May	0 millions m^3/ month	November	100 millions m^3/ month
June	100 millions m^3/ month	December	80 millions m^3/ month

i) Plot hydrograph, flow duration curve and mass curve.

ii) Find mean flow.

iii) Find power available at mean flow if head available is 100 m and efficiency of generation is 80%. Assume each month of 30 days.

M.Sc. TE. (EE), 2nd Sem. Date: October 28, 2019 (Morning)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination — Summer Semester, A. Y. 2018-2019
Course No.: EEE 6293 — Time: 3 Hours
Course Title: Power System Stability — Full Marks: 150

There are **8 (eight)** questions. Answer **any 6 (six)** questions. All questions carry equal marks. Marks in the margin indicate full marks. Programmable calculators are not allowed. Do not write on this question paper. Assume reasonable values for any missing data.

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1. a) What are the different types of power system stability study? Explain with reasonable examples. 10

   b) Show that the dynamics of a synchronous machine can be represented by the classical model (swing equation) $\frac{d^2\delta}{dt^2} = \frac{\pi f}{H}(P_m - P_e)$. 15

2. a) Figure 2 (a) represents the current injection model of a single machine infinite bus system. 15

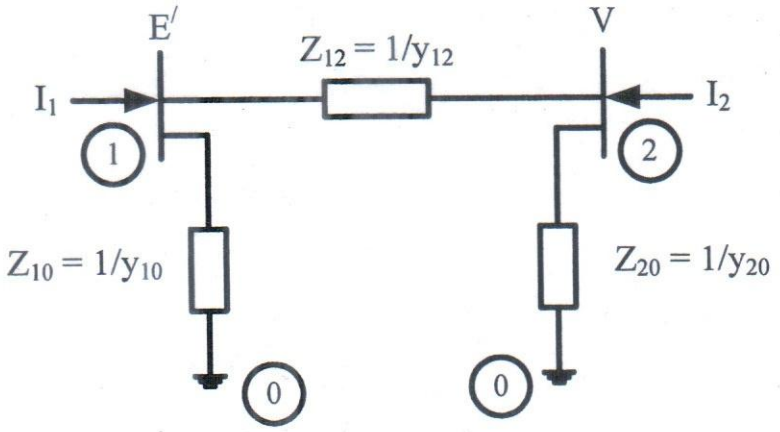

Figure 2 (a)

   i) Derive the expressions for the entries of the bus admittance matrix.
   ii) Considering a lossless system, find out the expressions of real and reactive power transfer from bus (node) 1 to bus (node) 2.
   iii) Find out the expression of maximum real power transfer over the transmission line (Z_{12}).

   b) A 50-Hz synchronous generator has a transient reactance of 0.2 per-unit and an inertia constant of 6.0 MJ/MVA. The generator is connected to an infinite bus through a transformer and a double circuit transmission line, as shown in Figure 2(b). Resistances are neglected and reactances are expressed on a common base and are marked in the diagram. The mechanical input power to the generator is 0.80 per-unit. The transient internal voltage magnitude is 1.25 per-unit and the infinite bus voltage V_2 is $1.0\angle 0^\circ$ per-unit. 10

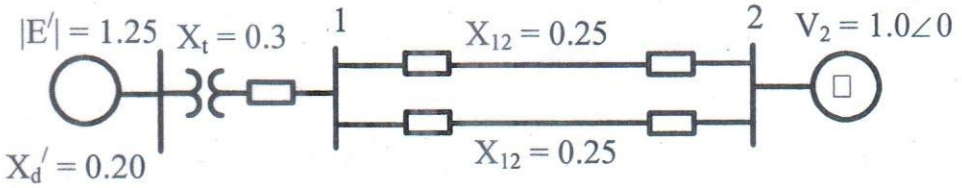

Figure 2(b)

i) How much real power (P_e) is supplied to the infinite bus?
ii) Calculate the initial rotor angle at equilibrium state.
iii) Calculate the current supplied by the generator.

3. The power angle curve of a single machine infinite bus system is shown in Figure 3 The steady state operating points are denoted by 'a' and 'b' corresponding to rotor angles δ_0 and δ_{max}, respectively. The generator speed N_s = 1800 rpm, inertia constant H = 4.0 MJ/MVA and number of poles P = 4. If the maximum power transfer P_{emax} = 2.50 per unit and δ_0 = 0.5236 rad, 25

i) Find out the small disturbance stability of the two points 'a' and 'b' with the help of synchronizing power coefficient (P_s).
ii) Calculate the natural frequency of oscillation for the two operating points.

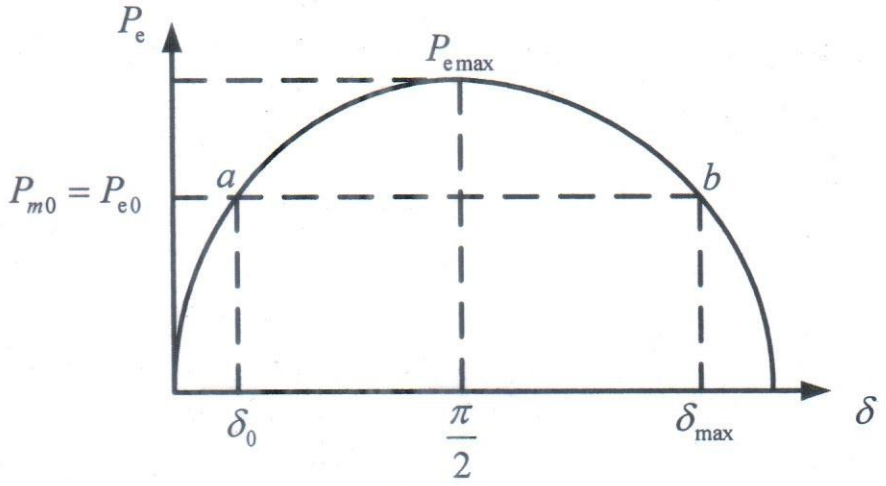

Figure 3

4. a) Mention the basic difference between salient pole and non-salient pole machines. Derive the expressions of q-axis transient voltage (E_q') and rotor angle (δ) for a salient pole machine. 15

b) Consider a salient-pole synchronous machine characterized by the following parameters: X_d = 1.2, X_q = 0.8, X_d' = 0.5, R_a = 0 per unit. The machine is directly connected to an infinite bus of voltage 1.05 per unit. The amount of real power delivered by the machine is 0.8 per unit at 0.9 power factor lagging. i) Calculate the q-axis transient voltage (E_q') for the machine. ii) Find out the expression of real power transfer of the machine. 10

5. a) Explain the concept of damping power for a synchronous machine. 05

b) A 50-Hz synchronous generator having inertia constant H = 10 MJ/MVA and a transient reactance X_d' = 0.3 per unit is connected to an infinite bus through a purely reactive circuit as shown in Figure 5(b). Reactances are marked on the diagram on a common system base. The generator is delivering real power of 0.65 per unit, 0.85 power factor lagging to the infinite bus at a voltage of V = 1.1 per unit. Assume the per unit damping power coefficient is D = 0.14. Consider a small disturbance of $\Delta\delta = 12^0$. Calculate i) the voltage behind transient reactance, 20

ii) the rotor angle at this operating point, iii) the synchronizing power coefficient, iv) the natural angular frequency of oscillation, v) the damped angular frequency of oscillation. Obtain equations describing the motion of the rotor angle and the generator frequency.

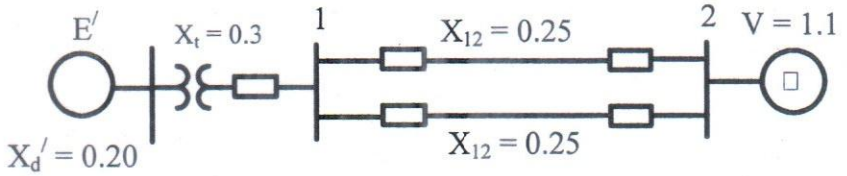

Figure 5(b)

6. a) Mention the advantage of the *equal area criteria* method of determining stability of a single machine infinite bus power system. Is there any drawback associated with it? 05

b) Derive the expression of *equal area criteria* for a single machine infinite bus power system. Show the accelerating and decelerating areas on the power-angle diagram. 20

7. a) Derive the expression of *critical clearing angle* for a single machine infinite bus power system experiencing a three phase fault at one end of a double circuit transmission line. 10

b) A 50-Hz synchronous generator has an inertia constant of 5.0 MJ/MVA. The generator is connected to an infinite bus through a double circuit transmission line as shown in Figure 7(b). The generator is delivering complex power S = 0.8 + j0.074 to the infinite bus. 15

i) A temporary three phase fault occurs at the sending end of the line at point F_1. When the fault is cleared, both lines are intact. Calculate the critical clearing angle and critical clearing time.

ii) Show the accelerating area, the decelerating area and the post-fault equilibrium point on power-angle curves.

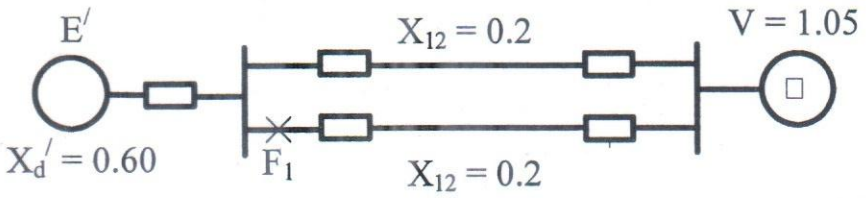

Figure 7(b)

8. Consider a synchronous generator connected to an infinite bus through a transformer and a double circuit transmission line as shown in Figure 8. The generator is delivering 0.8 per unit real power at 0.9 power factor lagging to the infinite bus at steady state. Using iterative method, calculate the maximum rotor swing (δ_{max}) and determine the transient stability limit. Assume $\delta_{max} = 110°$ as the initial estimate of the iterative solution. 25

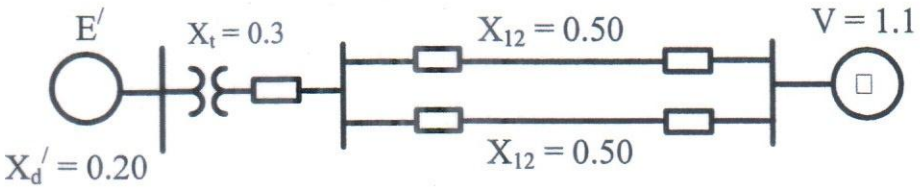

Figure 8

M.Sc. Engg. (EE) / PhD (EE) Date: November 01, 2019 (Morning)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination — Summer Semester, A. Y. 2018-2019
Course No.: EEE 6407 — Time: 3 Hours
Course Title: Digital Communication — Full Marks: 150

There are **8 (eight)** questions. Answer **any 6 (six)** 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. Assume any data if necessary.

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1. a) Write the properties of autocorrelation of an energy signal and a power signal. Given the spectrum 15

$$G_x(f) = 10^{-4}\left\{\frac{\sin[\pi(f-10^6)10^{-4}]}{\pi(f-10^6)10^{-4}}\right\}^2$$

find the value of the signal bandwidth using the following bandwidth definitions:
i) Half-power bandwidth.
ii) Noise equivalent bandwidth.
iii) Null-to-null bandwidth.

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

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

2. a) What is correlative coding? Explain Duobinary Coding and Decoding with a demonstration. Also explain precoding with an Illustration. 13

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

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

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) Explain bit error probability versus symbol error probability for multiple phase signaling and orthogonal signaling. 07

4. a) Why do BPSK and QPSK manifest the same bit error probability relationship? Explain the demodulator for non-coherent detection of 3 FSK. 13

b) Prove that the probability of bit error $P_B = Q\left(\frac{a_1 - a_2}{2\sigma_0}\right)$, where symbols carry their usual meanings. How can you optimize the error performance? Use antipodal and orthogonal signals to support your answer. 12

5. a) Explain the trade offs in using error correcting codes. Also explain rectangular code. 15

b) Compare the message error probability for a communication link with and without the use of error-correction coding. Assume that the uncoded transmission characteristics are: BPSK modulation, Gaussian noise, $\frac{P_r}{N_0} = 43.776$, data rate $R = 4800$ bits/s. For the coded case, also assume the use of a (15, 11) error-correcting code that is capable of correcting any single-error pattern within a block of 15 bits. Consider that the demodulator makes hard decisions and thus feeds the demodulated code bits directly to the decoder, which in turn outputs an estimate of the original message. 10

6. a) Explain the operational procedure for different automatic repeat requests. Explain rectangular code. 15

b) Consider a hamming code with m = 3. The generator matrix of this hamming code is given below. 10

$$G = \begin{bmatrix} 1 & 1 & 1 & 1 & 0 & 0 & 0 \\ 1 & 0 & 1 & 0 & 1 & 0 & 0 \\ 0 & 1 & 1 & 0 & 0 & 1 & 0 \\ 1 & 1 & 0 & 0 & 0 & 0 & 1 \end{bmatrix}$$

i) Find all the codewords of the code.
ii) Find H, the parity-check matrix of the code.
iii) Compute the syndrome for the received vector 1 1 0 1 1 0 1. Is this a valid code vector?
iv) What is the error-correcting capability of the code?
v) What is the error-detecting capability of the code?

7. a) What is a standard array? How can a vector space be represented by a standard array? Describe the process for error correction decoding using a (6, 3) code. Use the parity check matrix $H = \begin{bmatrix} 1 & 0 & 0 & 1 & 0 & 1 \\ 0 & 1 & 0 & 1 & 1 & 0 \\ 0 & 0 & 1 & 0 & 1 & 1 \end{bmatrix}$. 15

b) Draw and explain the implementation of a (6, 3) decoder using simple circuitry. 10

8. a) Explain Hamming codes, Extended Golay code and BCH codes. 13

b) Consider a data sequence encoded with a (127, 64) BCH code and then modulated using coherent 16-ary PSK. If the received E_b/N_0 is 10 dB, find the MPSK probability of symbol error, the probability of code-bit error and the probability of information-bit error. 12

Appendix : Table for Q(x)

x	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0000	.5000	.4960	.4920	.4880	.4840	.4801	.4761	.4721	.4681	.4641
.1000	.4602	.4562	.4522	.4483	.4443	.4404	.4364	.4325	.4286	.4247
.2000	.4207	.4168	.4129	.4090	.4052	.4013	.3974	.3936	.3897	.3859
.3000	.3821	.3783	.3745	.3707	.3669	.3632	.3594	.3557	.3520	.3483
.4000	.3446	.3409	.3372	.3336	.3300	.3264	.3228	.3192	.3156	.3121
.5000	.3085	.3050	.3015	.2981	.2946	.2912	.2877	.2843	.2810	.2776
.6000	.2743	.2709	.2676	.2643	.2611	.2578	.2546	.2514	.2483	.2451
.7000	.2420	.2389	.2358	.2327	.2296	.2266	.2236	.2206	.2177	.2148
.8000	.2119	.2090	.2061	.2033	.2005	.1977	.1949	.1922	.1894	.1867
.9000	.1841	.1814	.1788	.1762	.1736	.1711	.1685	.1660	.1635	.1611
1.000	.1587	.1562	.1539	.1515	.1492	.1469	.1446	.1423	.1401	.1379
1.100	.1357	.1335	.1314	.1292	.1271	.1251	.1230	.1210	.1190	.1170
1.200	.1151	.1131	.1112	.1093	.1075	.1056	.1038	.1020	.1003	.9853E-01
1.300	.9680E-01	.9510E-01	.9342E-01	.9176E-01	.9012E-01	.8851E-01	.8691E-01	.8534E-01	.8379E-01	.8226E-01
1.400	.8076E-01	.7927E-01	.7780E-01	.7636E-01	.7493E-01	.7353E-01	.7215E-01	.7078E-01	.6944E-01	.6811E-01
1.500	.6681E-01	.6552E-01	.6426E-01	.6301E-01	.6178E-01	.6057E-01	.5938E-01	.5821E-01	.5705E-01	.5592E-01
1.600	.5480E-01	.5370E-01	.5262E-01	.5155E-01	.5050E-01	.4947E-01	.4846E-01	.4746E-01	.4648E-01	.4551E-01
1.700	.4457E-01	.4363E-01	.4272E-01	.4182E-01	.4093E-01	.4006E-01	.3920E-01	.3836E-01	.3754E-01	.3673E-01
1.800	.3593E-01	.3515E-01	.3438E-01	.3362E-01	.3288E-01	.3216E-01	.3144E-01	.3074E-01	.3005E-01	.2938E-01
1.900	.2872E-01	.2807E-01	.2743E-01	.2680E-01	.2619E-01	.2559E-01	.2500E-01	.2442E-01	.2385E-01	.2330E-01
2.000	.2275E-01	.2222E-01	.2169E-01	.2118E-01	.2068E-01	.2018E-01	.1970E-01	.1923E-01	.1876E-01	.1831E-01
2.100	.1786E-01	.1743E-01	.1700E-01	.1659E-01	.1618E-01	.1578E-01	.1539E-01	.1500E-01	.1463E-01	.1426E-01
2.200	.1390E-01	.1355E-01	.1321E-01	.1287E-01	.1255E-01	.1222E-01	.1191E-01	.1160E-01	.1130E-01	.1101E-01
2.300	.1072E-01	.1044E-01	.1017E-01	.9903E-02	.9642E-02	.9387E-02	.9137E-02	.8894E-02	.8656E-02	.8424E-02
2.400	.8198E-02	.7976E-02	.7760E-02	.7549E-02	.7344E-02	.7143E-02	.6947E-02	.6756E-02	.6569E-02	.6387E-02
2.500	.6210E-02	.6037E-02	.5868E-02	.5703E-02	.5543E-02	.5386E-02	.5234E-02	.5085E-02	.4940E-02	.4799E-02
2.600	.4661E-02	.4527E-02	.4396E-02	.4269E-02	.4145E-02	.4025E-02	.3907E-02	.3793E-02	.3681E-02	.3573E-02
2.700	.3467E-02	.3364E-02	.3264E-02	.3167E-02	.3072E-02	.2980E-02	.2890E-02	.2803E-02	.2718E-02	.2635E-02
2.800	.2555E-02	.2477E-02	.2401E-02	.2327E-02	.2256E-02	.2186E-02	.2118E-02	.2052E-02	.1988E-02	.1926E-02
2.900	.1866E-02	.1807E-02	.1750E-02	.1695E-02	.1641E-02	.1589E-02	.1538E-02	.1489E-02	.1441E-02	.1395E-02
3.000	.1350E-02	.1306E-02	.1264E-02	.1223E-02	.1183E-02	.1144E-02	.1107E-02	.1070E-02	.1035E-02	.1001E-02
3.100	.9676E-03	.9354E-03	.9043E-03	.8740E-03	.8447E-03	.8164E-03	.7888E-03	.7622E-03	.7364E-03	.7114E-03
3.200	.6871E-03	.6637E-03	.6410E-03	.6190E-03	.5976E-03	.5770E-03	.5571E-03	.5377E-03	.5190E-03	.5009E-03
3.300	.4834E-03	.4665E-03	.4501E-03	.4342E-03	.4189E-03	.4041E-03	.3897E-03	.3758E-03	.3624E-03	.3495E-03
3.400	.3369E-03	.3248E-03	.3131E-03	.3018E-03	.2909E-03	.2802E-03	.2701E-03	.2602E-03	.2507E-03	.2415E-03
3.500	.2326E-03	.2241E-03	.2158E-03	.2078E-03	.2001E-03	.1926E-03	.1854E-03	.1785E-03	.1718E-03	.1653E-03
3.600	.1591E-03	.1531E-03	.1473E-03	.1417E-03	.1363E-03	.1311E-03	.1261E-03	.1213E-03	.1166E-03	.1121E-03
3.700	.1078E-03	.1036E-03	.9961E-04	.9574E-04	.9201E-04	.8842E-04	.8496E-04	.8162E-04	.7841E-04	.7532E-04
3.800	.7235E-04	.6948E-04	.6673E-04	.6407E-04	.6152E-04	.5906E-04	.5669E-04	.5442E-04	.5223E-04	.5012E-04
3.900	.4810E-04	.4615E-04	.4427E-04	.4247E-04	.4074E-04	.3908E-04	.3747E-04	.3594E-04	.3446E-04	.3304E-04
4.000	.3167E-04	.3036E-04	.2910E-04	.2789E-04	.2673E-04	.2561E-04	.2454E-04	.2351E-04	.2252E-04	.2157E-04
4.100	.2066E-04	.1978E-04	.1894E-04	.1814E-04	.1737E-04	.1662E-04	.1591E-04	.1523E-04	.1458E-04	.1395E-04
4.200	.1335E-04	.1277E-04	.1222E-04	.1168E-04	.1118E-04	.1069E-04	.1022E-04	.9774E-05	.9345E-05	.8934E 05
4.300	.8540E-05	.8163E-05	.7801E-05	.7455E-05	.7124E-05	.8807E-05	.6503E-05	.6212E-05	.5934E-05	.5668E-05
4.400	.5413E-05	.5169E-05	.4935E-05	.4712E-05	.4498E-05	.4294E-05	.4098E-05	.3911E-05	.3732E-05	.3561E-05
4.500	.3398E-05	.3241E-05	.3092E-05	.2949E-05	.2813E-05	.2682E-05	.2558E-05	.2439E-05	.2325E-05	.2216E-05
4.600	.2112E-05	.2013E-05	.1919E-05	.1828E-05	.1742E-05	.1660E-05	.1581E-05	.1506E-05	.1434E-05	.1366E-05
4.700	.1301E-05	.1239E-05	.1179E-05	.1123E-05	.1069E-05	.1017E-05	.9680E-06	.9211E-06	.8765E-06	.8339E-06
4.800	.7933E-06	.7547E-06	.7178E-06	.6827E-06	.6492E-06	.6173E-06	.5869E-06	.5580E-06	.5304E-06	.5042E-06
4.900	.4792E-06	.4554E-06	.4327E-06	.4111E-06	.3906E-06	.3711E-06	.3525E-06	.3448E-06	.3179E-06	.3019E-06
5.000	.2867E-06	.2722E-06	.2584E-06	.2452E-06	.2328E-06	.2209E-06	.2096E-06	.1989E-06	.1887E-06	.1790E-06
5.100	.1698E-06	.1611E-06	.1528E-06	.1449E-06	.1374E-06	.1302E-06	.1235E-06	.1170E-06	.1109E-06	.1051E-06

M.Sc. TE., 4th Sem.

Date: 04 November, 2019 (Morning)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination — Summer Semester, A. Y. 2018-2019
Course No.: EEE 6499 — Time: 180 Minutes
Course Title: Laser Theory and Optical Communication — Full Marks: 150

There are **8 (eight)** questions. Answer **any 6 (six)** 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) Discuss the advantages of optical fiber over coaxial fiber. Draw a schematic diagram of an optical fiber link consisting of transmitter and receiver systems. 10

   b) Discuss different kinds of attenuation occurred in an optical fiber operation. 10

   c) Mention the nonlinear phenomena that are most relevant for fiber-optic communications. 5

2. a) Discuss the operation principle of a laser and a p-n photodiode. 10

   b) Explain the principle of fiber bifringence. 5

   c) A graded- index fiber with a core diameter d = 50 μm and NA = 0.2 is to be operated at a wavelength of λ = 1 μm. How many modes are capable of propagation in this fiber? 10

3. a) Explain material and waveguide dispersion. 10

   b) To obtain single mode, discuss what one must do in relation to the V parameter and how to do that. 5

   c) Explain the principle of Stimulated Brillouin Scattering. 10

4. a) Explain the principle of Stimulated Raman Scattering. 10

   b) Discuss emission and absorption rates and explain the condition of population inversion. 10

   c) Draw the energy band diagram for heterostructure p-n junction. 5

5. a) Discuss the criteria of choice of Group III-V semiconductors. 10

   b) What is the responsivity of a photo detector and express its relation with wavelength. 10

   c) What are the advantages of p-n photodiode over p-i-n photodiode? 5

6. a) Draw a schematic diagram of point-to-point fiber links. 5

   b) Present various distribution networks of an optical communication system. 10

c) Explain the operation principle of an EDFA. 10

7. a) Draw a schematic diagram of WDM lightwave system. 5

b) Draw a block diagram of a heterodyne receiver and explain how it differs from a homodyne receiver. 15

c) Compare single-mode and multi-mode fiber. 5

8. Discuss the following: 25

i) Material dispersion,

ii) MZM and

iii) Optical amplifier.

M.Sc. Engg./Ph.D.(EE) Date: October 24, 2019 (Morning)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination — Summer Semester, A.Y. 2018-2019
Course No.: EEE 6601 — Time: 3 Hours
Course Title: Antennas and Propagation — Full Marks: 150

There are **8 (eight)** questions. Answer **any 6 (six)** questions. All questions carry equal marks. Marks in the margin indicate full marks. Programmable calculators are not allowed. Do not write on this question paper. Symbols carry their usual meanings.

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1. a) Draw an antenna equivalent circuit. What is the main difference between the antenna equivalent circuit and an RLC circuit? What is stub matching? Briefly explain the design procedure of double stub matching. 15

   b) Design a stub to match a transmission line which is connected to a load impedance of $z_L = (450 - j600)\ \Omega$. The characteristic impedance of the line is 300 Ω. The operating frequency is 20 MHz. 10

2. a) Define: radiation resistance, directivity and antenna bandwidth. Derive the expression for radiation resistance of a half-wave dipole. 15

   b) Find the directivity of a half-wave dipole. 10

3. a) Draw the radiation patterns of horizontal dipole for dipole length = λ/2, λ, and 2λ. Define first side lobe ratio (SLR) and show that the SLR for uniform array is -13.5 dB. 15

   b) Two dipoles of gain 1.64 each are used for transmitting and receiving purposes. They are separated by a distance of 10 m. The radiated power by the transmitting antenna is 15 W at a frequency of 60 MHz. Determine the receiving power. 10

4. a) What are the typical shapes of patch antenna? Derive the equation of line source design by Fourier Transform method. 15

   b) Design a line source to obtain a radiation pattern given by 10
   $$E(\phi) = 1 \text{ for } 45° \leq \phi \leq 135° \text{ and}$$
   $$E(\phi) = 0 \text{ outside this angular region.}$$

5. a) What are the advantages of array antenna? Derive the expression for resultant radiation pattern of two-element array. 15

   b) A uniform linear array is required to produce an end-fire beam when it is operated at a frequency of 10 GHz. It contains 50 radiators which are spaced at 0.5λ. Find the array length. 10

6. a) Discuss the gain measurement by two antenna and three antenna methods. 15

   b) A circular loop antenna has a diameter of 1.5λ. Find its directivity and radiation resistance. 10

7. a) What is radio horizon? Derive an equation for calculating the radio horizon distance between transmitting and receiving antennas. 15

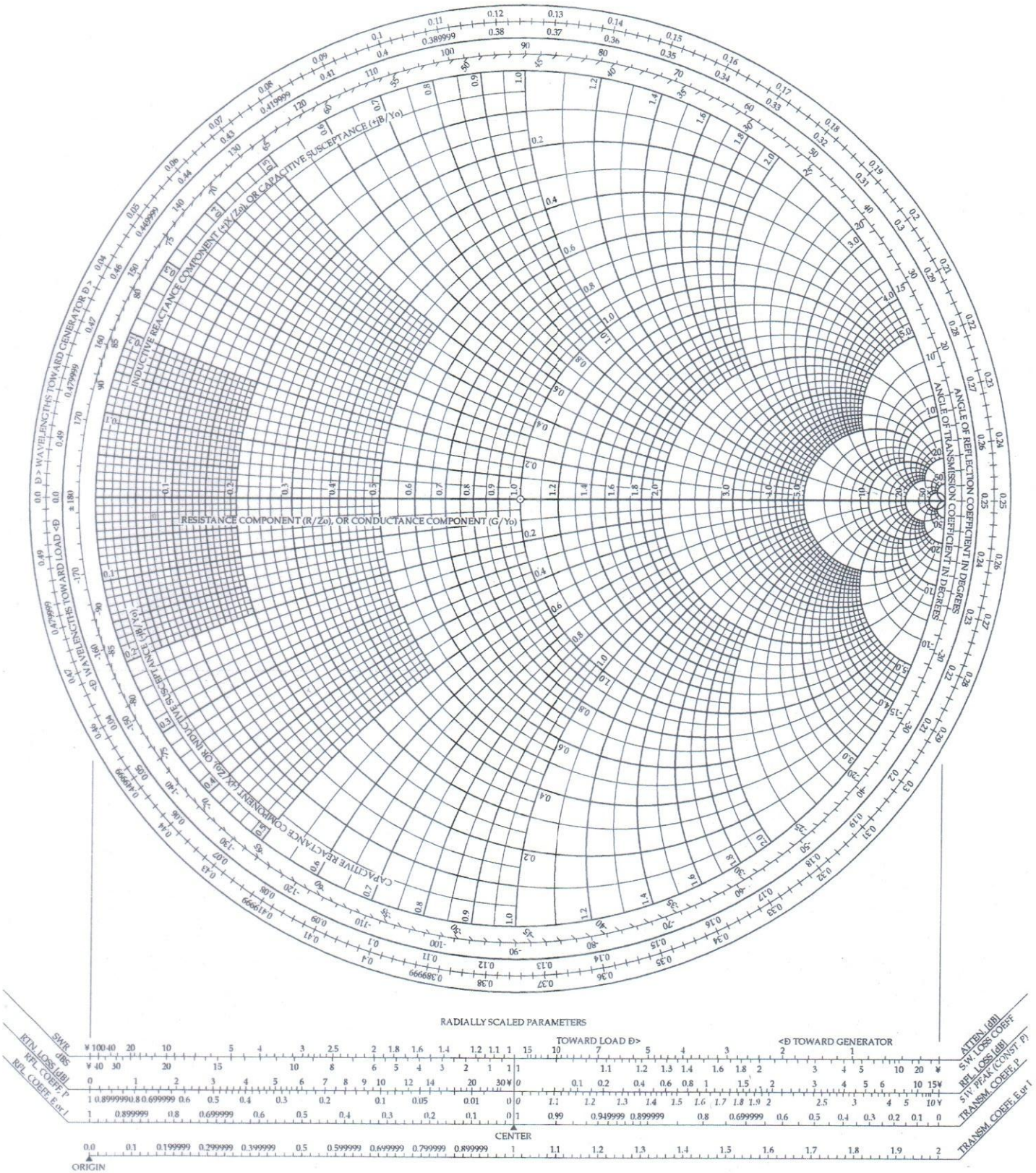
b) A communication system is to be established at a frequency of 60 MHz with a transmitted power of 1 kW. The field strength of the directive antenna is 3 times than that of a half wave antenna, transmitting antenna height h_t = 50 m and receiving antenna height h_r = 5 m. A field strength of 80 μV/m is required to give satisfactory reception. Find the range of the system. 10

8. Write short notes on: (any four) 25

i) isotropic radiators,
ii) folded dipole antennas,
iii) omni-directional antennas,
iv) antenna aperture efficiency and
v) duct propagation.

IMPEDANCE SMITH CHART

Introduction to RF Circuit Design



M.Sc. Engg. (EE)/Ph.D. Library – Date: October 28, 2019

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination — Summer Semester, A. Y. 2018-2019
Course No.: EEE 6701 — Time: 3 Hours
Course Title: Nonlinear Control System — Full Marks: 150

There are **8 (eight)** questions. Answer **any 6 (six)** questions. All questions carry equal marks. Marks in the margin indicate full marks. Programmable calculators are not allowed. Do not write on this question paper.

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1. a) Briefly explain the necessity of nonlinear control. 05

   b) Briefly explain some common nonlinear system behaviors. 05

   c) Consider the following nonlinear systems: 15

   i. $\dot{x}_1 = x_2 - x_1\left(x_1^2 + x_2^2 - 1\right) \quad \dot{x}_2 = -x_1 - x_2\left(x_1^2 + x_2^2 - 1\right)$,

   ii. $\dot{x}_1 = x_2 + x_1\left(x_1^2 + x_2^2 - 1\right) \quad \dot{x}_2 = -x_1 + x_2\left(x_1^2 + x_2^2 - 1\right)$,

   iii. $\dot{x}_1 = x_2 - x_1\left(x_1^2 + x_2^2 - 1\right)^2 \quad \dot{x}_2 = -x_1 - x_2\left(x_1^2 + x_2^2 - 1\right)^2$.

   Find the stability of the limit cycles of the systems.

2. a) Consider the nonlinear system: 8

$$\dot{x}_1 = g\left(x_2\right) + 4x_1x_2^2$$
$$\dot{x}_2 = h\left(x_1\right) + 4x_1^2x_2$$

   Find whether there is any limit cycle for the system.

   b) Draw the phase portrait and discuss the properties of the linear, unity feedback control system of the open-loop transfer function 17

$$G(p) = \frac{10}{p(1+0.1p)} .$$

3. a) State the three theorems (Poincare, Poincare-Bendixson, Bendixson) that are used to find the existence of limit cycles. Prove the Bendixson theorem with the help of Stokes' theorem. 11

   b) A pendulum is an example of a nonlinear system. Draw the phase-portrait of the motion of the pendulum. 14

4. a) Define positive definite function Lyapunov function. State and explain Lyapunov theorem for local and global stability. Use suitable diagrams to illustrate the theorems. 12

   b) A nonlinear system is defined by 8

$$\dot{x}_1 = x_1\left(x_1^2 + x_2^2 - 2\right) - 4x_1x_2^2$$
$$\dot{x}_2 = 4x_1^2x_2 + x_2\left(x_1^2 + x_2^2 - 2\right) .$$

   Find the stability of the system using a suitable Lyapunov function.

   c) Compare the stability of the linear and nonlinear systems. 5

5. a) Define the invariant set. State and explain with suitable diagrams the local and global version of invariant set theorem. Explain, what is the necessity of invariant set theorems while there were stricter Lyapunov theorems. 13

b) Define the autonomous and non-autonomous system, equilibrium point. Define Lyapunov, Asymptotic and Exponential stability. How do the local and global versions change? 12

6. a) What is describing function? In what applications can the describing function analysis be used? 5

b) State the assumptions of the limit cycle. 4

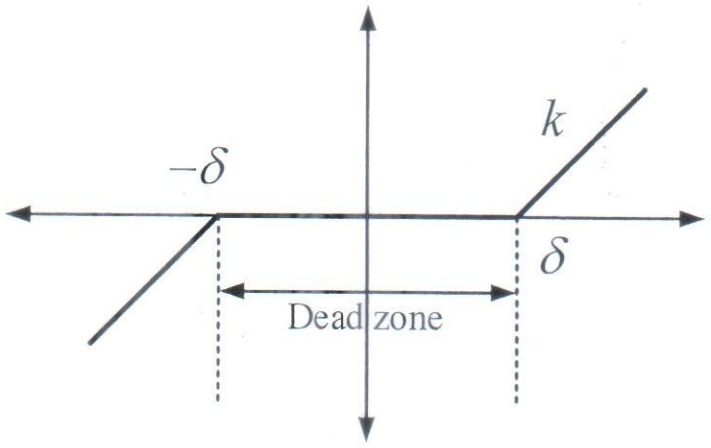
c) For the following Van Der Pol equation determine whether there exists a limit cycle in this system if so, calculate the amplitude and the frequency of the limit cycle. 16

$$\ddot{x}+\alpha\left(x^2-1\right)\dot{x}+x=0$$

Explain the effect of α on the shape of the limit cycle.

7. a) Derive the following describing function of dead-zone nonlinearity: 13

$$N(A)=\frac{2k}{\pi}\left(\frac{\pi}{2}-\sin^{-1}\frac{\delta}{A}-\frac{\delta}{A}\sqrt{1-\frac{\delta^2}{A^2}}\right).$$



The width of the dead-zone is 2δ , and its slope is k. Assume $x(t)=A\sin(\omega t)$.

b) Explain using suitable diagram and necessary equations the following aspect of describing function analysis: 12
   i. Determining the existence of limit cycles
   ii. Stability of limit cycles
   iii. Reliability of describing function analysis.

8. a) Explain the stabilization and tracking problems of a nonlinear dynamic system. 5

b) Write the steps of the standard procedure of control design. 5

c) Explain the following available methods of nonlinear control design in brief: 3×5
   i. Trial and error,
   ii. Feedback linearization,
   iii. Robust control,
   iv. Adaptive control and
   v. Gain-scheduling.