B.Sc. Engg. (EE)/ HDEE, 2nd Sem. Date: 23 October, 2018 (Morning)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination — Summer Semester, A.Y. 2017-2018
Course No.: EEE 4201 — Time: 3 Hours
Course Title: Electrical Circuit 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. Assume suitable values for any missing data.

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1. a) Design a bandpass filter with a lower cutoff frequency of 20.1 kHz and an upper cutoff frequency of 20.3 kHz assuming the resistance of the filter, R = 20 kΩ. Calculate L, C and Q for this filter. Find out its transfer function and plot its magnitude response. 20

   b) What is resonance? Summarize the states of different circuit parameters and components during resonance in a series RLC circuit. 05

2. a) For the circuit in Fig. 2(a), 20
   i) Determine the value of Z_L that maximizes the average power.
   ii) What is the value of maximum average power for this set-up?
   iii) Determine the value of the capacitance/inductance needed to improve the power factor of this load, Z_L to unity.

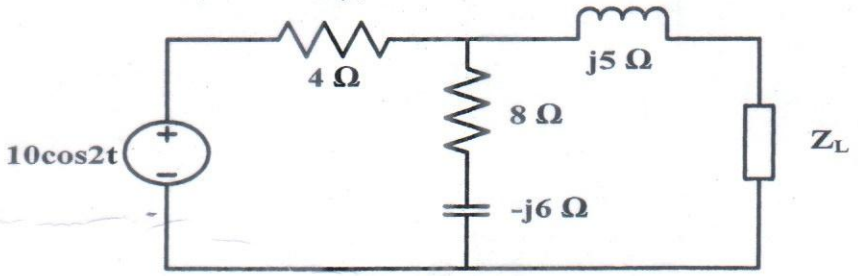

Fig. 2(a)

   b) For a passive linear network, sketch the response for the instantaneous power when the supply is a sinusoid. Explain the significance of difference regions of this curve. 05

3. a) Write short notes on the followings: 20
   i) dot convention for mutually inductive circuit,
   ii) coupling co-efficient and its significance,
   iii) reflected impedance for a linear transformer and
   iv) T equivalent of a linear transformer.

   b) For the mutually inductive circuit in Fig. 3(b), determine the equivalent inductance between the terminals a-b. 05

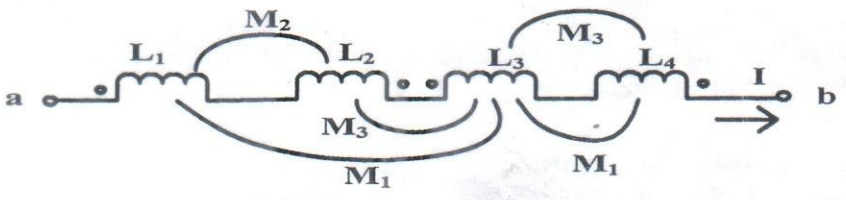

Fig. 3(b)

4. a) With necessary response curves and expressions, explain the interdependency of the quality factor and bandwidth for a parallel RLC resonant circuit. 10

   b) Determine the ratio of the volume of wire required in a single-phase 2-wire system to a three-phase 3-wire system provided that equal amount of power will be transferred and same material for the wire will be used. 10

   c) Determine the rms value of the current waveform in Fig. 4(c). 05

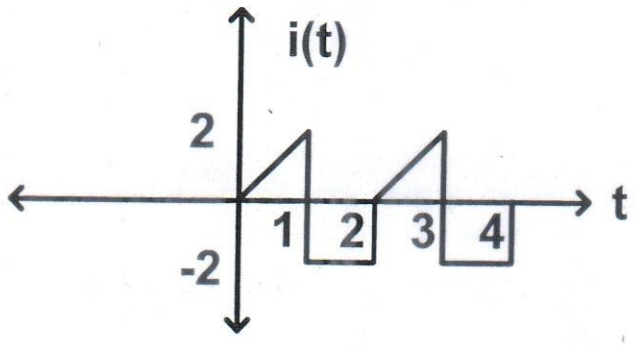

Fig. 4(c)

5. a) Calculate V_x for the circuit in Fig. 5(a). 10

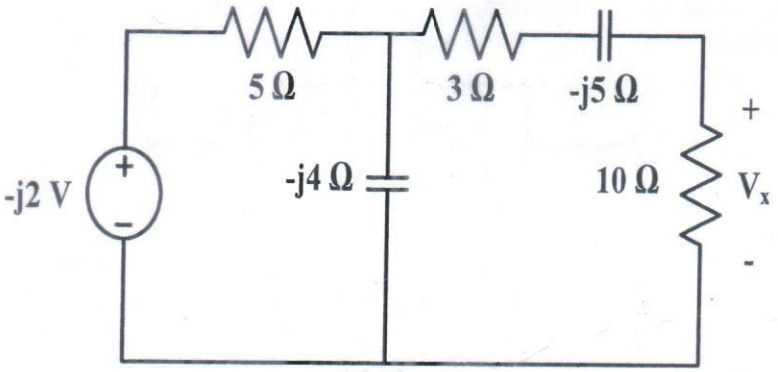

Fig. 5(a)

   b) Design an RC circuit that provides a 90^0 leading phase shift and justify your design. 10

   c) What are the steps to be followed in case of finding out the step response of a generalized second order circuit? 05

6. a) The following three parallel-connected three-phase loads are fed by a balanced three-phase source (wye-connected). 10

   Load 1: 250 kVA, 0.80 pf (lagging)
   Load 2: 300 kVA, 0.95 pf (leading)
   Load 3: 450 kVA, unity pf

   If the line voltage is 13.8 kV, calculate the line current and power factor of the source (assume the line impedance is zero).

   b) Explain the reasons for choosing the balanced delta-connected loads over balanced wye-connected loads and balanced wye-connected sources over balanced delta-connected sources. 10

7. a) For the circuit in Fig. 7(a), find out the equivalent admittance parameters. 10

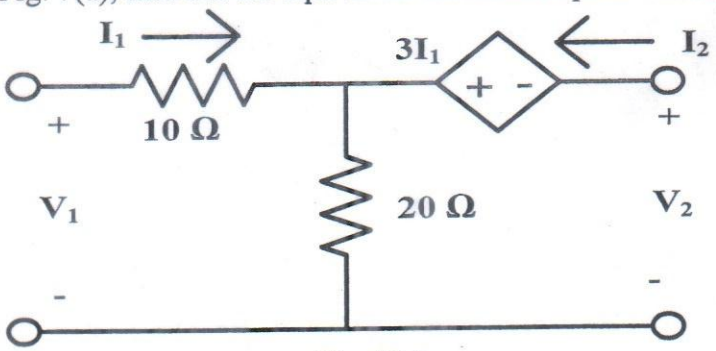

Fig. 7(a)

b) What are the hybrid parameters? Design an algorithm for finding out these parameters for a two-port network and draw the equivalent network model. 10

c) Determine the π-equivalent conductively coupled circuit for the linear transformer depicted in Fig. 7(c). 05

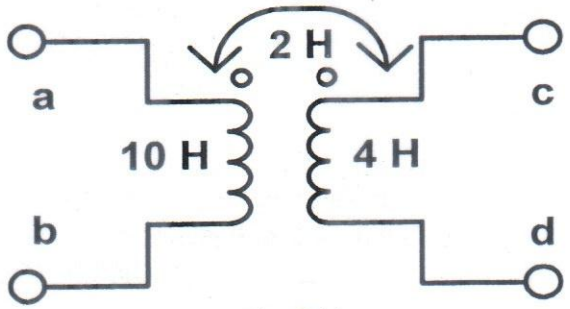

Fig. 7(c)

8. a) For the source-free RL circuit in Fig. 8(a), 10
   i) Find out the expression of natural response for i(t).
   ii) Draw the response curve for i(t).

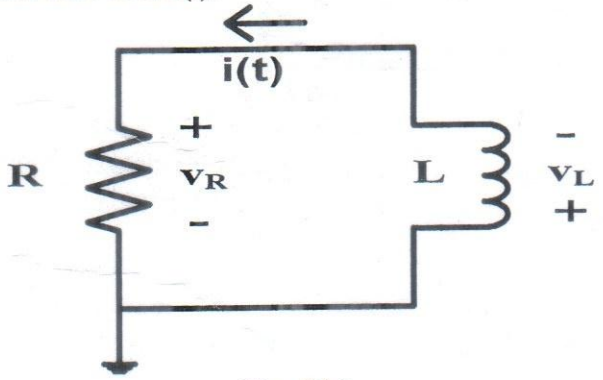

Fig. 8(a)

b) For a source-free and critically damped series RLC circuit, derive the expression for the series current, i(t). 10

c) Prove that a capacitor is fully charged or discharged in 5 time constants. 05

B.Sc. Engg. (EE) 2nd Semester 73 Date: October 30, 2018 (Morning)

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

DEPARTMENT OF ELECTRICAL & ELECTRONIC ENGINEERING

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

Summer Semester, A.Y. 2017-2018
Time: 3 Hours
Full Marks: 150

There are 8(Eight) questions. Answer **any 6 (Six)** questions. Programmable calculators are not allowed. Figures in the margin indicate marks of the part questions. Do not write on this question paper. Assume reasonable value for any missing data.

1(a) Find V_o and I for the circuit shown in the Fig. 1(a). v_I is a 1 kHz, 10 V peak sine wave, sketch the wave form resulting at v_o. What are its positive and negative peak values? Diodes are ideal. [09]

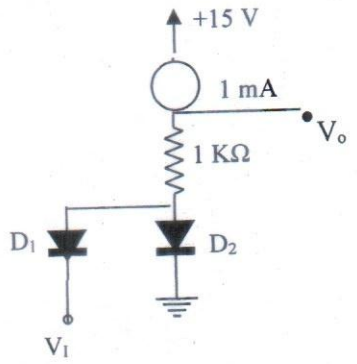

Fig. 1(a)

(b) For the circuit of Fig. 1(b), a string of three diodes are used to provide a constant voltage of about 2.1 V. Calculate percentage of change in this regulated voltage caused by [10]

(i) ±10% change in power-supply
(ii) connection of $R_L = 500\ \Omega$ load resistance. Assume n = 2.

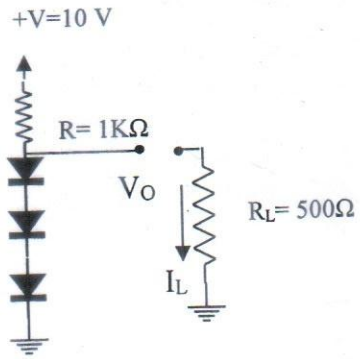

Fig. 1(b)

(c) Draw the circuit diagram of an AND gate using ideal diodes and describe how AND logic operation is performed in the circuit. 06

2.(a) Find the output wave-shapes for the following (Fig. 2(a)) clippers (diodes are ideal): [12]

(i) (ii)

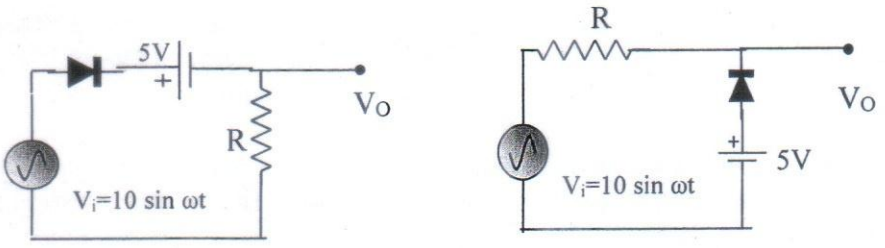

Fig. 2(a)

(b) Find the output wave-shapes for the following clampers (diodes are ideal) in Fig. 2(b): [13]

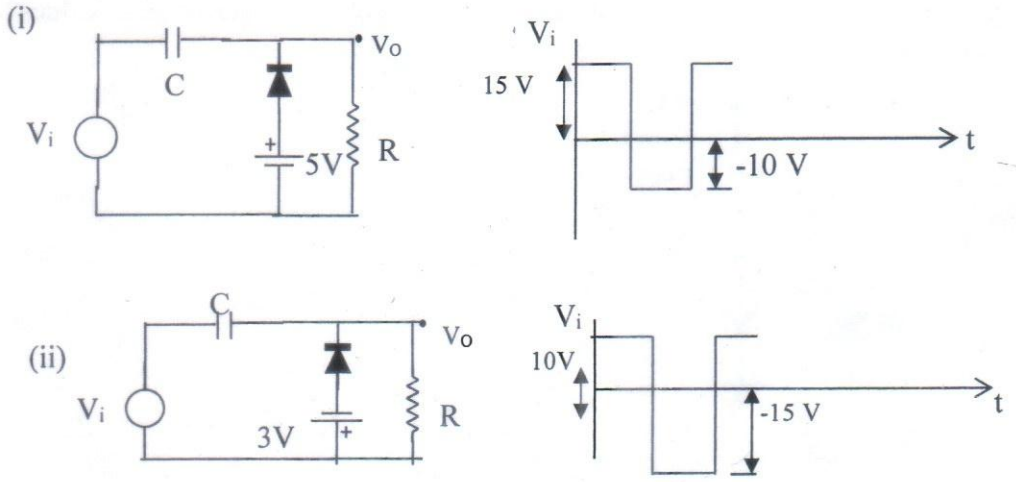

Fig. 2(b)

3.(a) Using the fact that a silicon diode has $I_S = 10^{-14}$ A at 25 °C and I_S increases by 15% per °C rise in temperature, find the value of I_S at 125 °C. [5]

(b) Using the diode equation in forward biasing region, find the expression of small signal resistance of a diode. What is the significance of this reisitance if the diode is used as a voltage regulator? [10]

(c) Determine the range of R_L and I_L that will result in load voltage being maintained at 10 V (assume $r_Z = 0$) for the following circuit shown the Fig. 3 (c) [10]

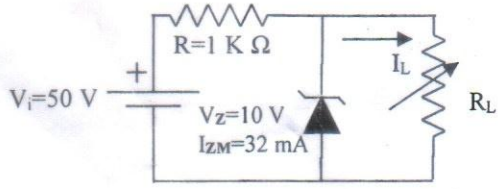

Fig. 3(c)

4.(a) Explain why a BJT is known as bipolar device. Define β and α of a BJT and establish the relation between them. If the value of α in a BJT is close to unity, what should be the value of the base current? [8]

(b) Calculate the value of R_1 and R_C for the circuit in Fig. 4(b). The collector current I_C = 1 mA and the collector to emitter voltage V_{CE} = 6 V. Neglect the base current. [8]

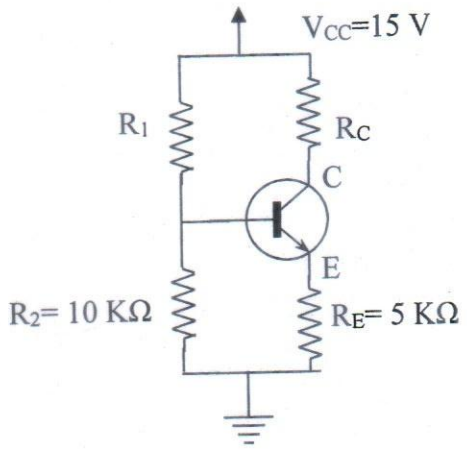

Fig. 4(b)

(c) For the circuit in the Fig. 4(c), it is required to determine the value of the voltage V_{BB} that results in the transistor operating [9]
(i) in the active mode with V_{CE} = 5 V,
(ii) at the edge of saturation,
(iii) deep in saturation with β_{forced}= 10.
For simplicity, assume that V_{BE} remains constant at 0.7 V. The transistor β is specified to be 50.

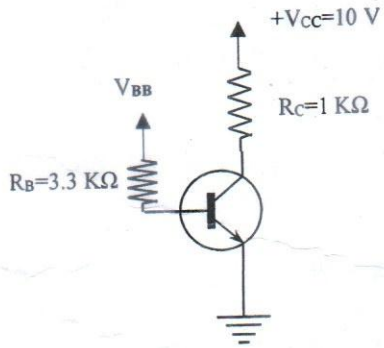

Fig. 4(c)

5.(a) The transistor in the circuit in Fig. 5(a) is specified to have β in the range of 50 to 150. Find the value of R_B that results in saturation with an ODF at least 10. [08]

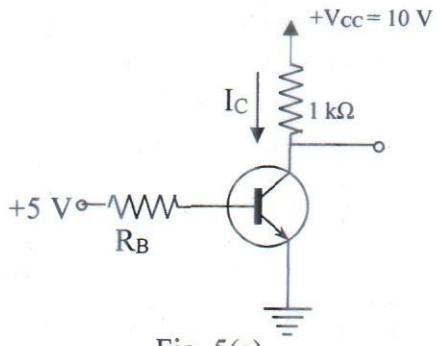

Fig. 5(a)

b) For the circuit in Fig. 5(b) determine whether the BJT is in active or saturation mode. Then determine V_E, V_C, V_B, I_E,, I_C and I_B. [12]

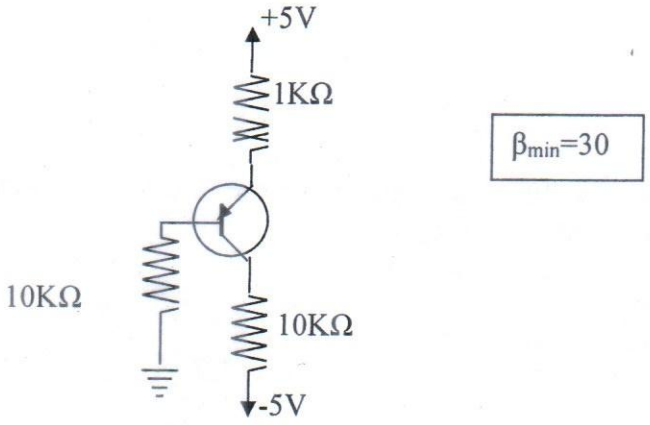

Fig. 5(b)

c) What is the sigficance of Q point in a BJT amplifier? Does its location affect the performance of the amplifier? [05]

6.(a) Draw a common emitter amplifier circuit. Draw its small signal equivalent circuit and find the expressions of (i) R_{in} (ii) A_v (iii) G_v (iv) A_{is} and (v) R_O. [15]

(b) For the above amplifier of Q. 6(a), R_B =100 kΩ, R_C = 8 kΩ, R_L = 5 kΩ, g_m = 40 mA/v, r_π = 2.5 kΩ, r_o = 100 kΩ, r_e = 25 Ω. If R_{sig}= 5 k Ω and the sine-wave v_π is limited to 5 mV peak, what is the maximum allowed peak of v_{sig} and the corresponding peak amplitude of v_o. [10]

7.(a) Describe the differences between BJTs and FETs. Why JFETs are widely used in digital ICs? [05]

(b) Describe the operation principle of a depletion type n-channel JFETs with proper diagrams including semiconductor structure and output characteristics. How can a JFET be used as a variable resistor? [10]

(c) Given I_{DSS} = 6 mA and V_P = - 4.5 V; Using Shockley's equation draw the transfer characteristics of a deletion type n-channel MOSFET. If V_{GS} is positive which region it will operate? What precaution has to be taken to have a positive gate to source voltage? [10]

8.(a) A depletion n-channel MOSFET amplifier has been biased with a configuration of a voltage divider configuration. Draw the circuit diagram for this arrangement. In the voltage divider branch set R_1= 110 MΩ, R_2=10 MΩ. The drain resistance, R_D=1.8 kΩ and source resistance R_S = 750 Ω. If I_{DSS} = 6 mA and V_P= -3 V, determine I_{DQ}, V_{GSQ} and V_{DS}. [12]

(b) The fixed bias configuration of a JFET has an operating point defined by V_{GSQ} = - 2 V and I_{DQ} = 5.625 mA, with I_{DSS} = 10 mA and V_P = - 8 V. The network is shown in Fig. 8(b) with an applied signal V_i. The value of y_{os} is provided as 40 μS. [13]

(i) Determine g_m.
(ii) Find r_d .
(iii)Determine Z_i .
(iv)Calculate Z_o .
(v) Determine the voltage gain A_v.
(vi)Determine Av ignoring the effects of r_d.

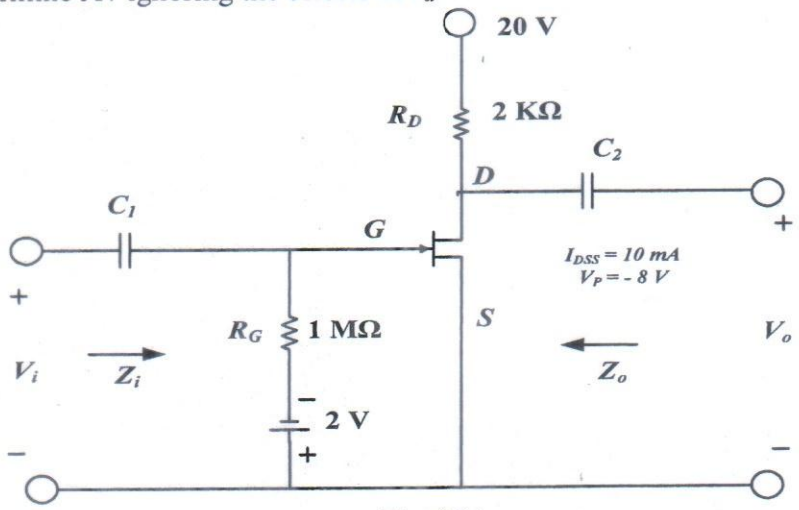

Fig. 8(b)

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B. Sc. Engg.(EE), 2nd Sem. Date: November 01, 2018 (Morning)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination — Summer Semester A. Y. 2017-2018
Course No.: Phy 4221 — Time: 3 Hours
Course Title: Engineering 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.

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1. (a) Define space lattice and basis of a crystal. 4
   (b) Briefly explain the terms unit cell and lattice parameters. Write down the lattice parameters for orthorhombic and cubic crystal systems. Draw the unit cells for various space lattices in orthorhombic and cubic crystal systems. 16
   (c) What is the crystalline nature of platinum crystal? Draw a typical unit cell of this crystal. Derive expressions for number of unit cells and atoms in a platinum foil of length *5.0 cm*, breadth *2.5* μm and thickness 25 nm? 5

2. (a) Define coordination number. What are the co-ordination numbers of (i) simple cubic, (ii) body centered cubic, (iii) face centered cubic, and (iv) hexagonal closed packed crystals; Explain with the help of neat sketches. 12
   (b) Assuming the atoms are hard spheres, show that for simple cubic, body centered cubic and face centered cubic crystal structures the lattice constants are related to the radius of the atoms, r, by the relation: (i) $a_{sc} = 2r$, ii) $a_{bcc} = \frac{4r}{\sqrt{3}}$ and (iii) $a_{fcc} = \frac{4r}{\sqrt{2}}$. 8
   (c) Calculate *c/a* ratio for an ideal hexagonal crystal structure. 5

3. (a) (i) What do you mean by defects in crystal? 'Real crystals are never perfect; some number of defects will always remain in crystal'- justify this statement. (ii) Explain various types of point defects. 16
   (b) Draw schematically the X-ray diffraction pattern for single crystal, polycrystalline and amorphous materials. 4
   (c) The experimental density of single crystal *Al* is 2.697 g/cm^3. The lattice constant for face centered cubic *Al* crystal is 0.4049 nm. If the discrepancy between calculated and the experimental density arises as a result of vacancies, (i) What fraction of atom is absent? (ii) How many vacancies are there per cm^3 ? 5

4. (a) What is simple harmonic motion? Mention some examples of this motion. Discuss its characteristics. 5

(b) Derive a differential equation of simple harmonic motion. Show that the mechanical energy of a linear oscillator is indeed constant and independent of time. 14

(c) Draw schematically the followings: 6
(i) Two simple harmonic motion (SHM) having same frequency and period but different amplitudes, (ii) Two SHM having same amplitudes but different frequency (iii) Two SHM having same amplitude and frequency but different phases.

5. (a) Briefly explain various types of waves. 4

(b) (i) Distinguish between traveling and standing waves. State equations of traveling and standing waves. (ii) Show that in a stationary wave nodes and antinodes are separated by half a wavelength. 14

(c) Derive expressions of potential energy density and kinetic energy density of a mechanical wave. 7

6. (a) What are reverberation and reverberation time? Discuss the importance of these in Acoustics. 6

(b) Derive Sabine's mathematical relation for reverberation time. 15

(c) The volume of a room is 600 m^3. The wall area of the room is 220 m^2, the floor area is 120 m^2 and the ceiling area is 120 m^2. The average sound absorption coefficient, (i) for the walls is 0.03; (ii) for the ceiling is 0.80, and (iii) for the floor is 0.06. Calculate the average sound absorption coefficient and the reverberation time. 4

7. (a) (i) What is radioactivity? Why some materials are radioactive? Explain briefly. 10
(ii) Distinguish between natural radioactivity and artificial radioactivity.

(b) Explain the term nuclear reaction and hence derive an expression for the energy produced in nuclear reaction. 7

(c) Briefly explain following terms: 8
(i) Binding energy, (ii) Fission, and (iii) Fusion.

8. (a) What is consequence of Compton scattering experiment? 3

(b) (i) Show that in Compton scattering experiment 18

$$\lambda' - \lambda = \frac{h}{m_0 c}(1 - \cos\phi)$$

where the symbols have their usual meanings.
(ii) What is Compton wavelength? Calculate the value of Compton wavelength for an electron.

(c) An X-ray photon of initial frequency 3.2×10^{19} Hz collides with an electron and is scattered through 90°. Find its new frequency. 4

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B.Sc. Engg. (CSE), 2nd Sem. Date: October 30, 2018

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination — Summer Semester, A. Y. 2017-2018
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.

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1. a) The circuit of Fig. 1(a) contains five identical capacitors. Find the value of C. 09

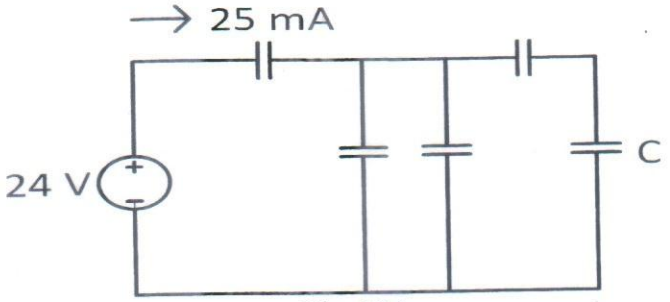

Fig. 1(a)

b) Determine L_{eq} of the inductive network of Fig. 1(b) at the terminals a-b. 13

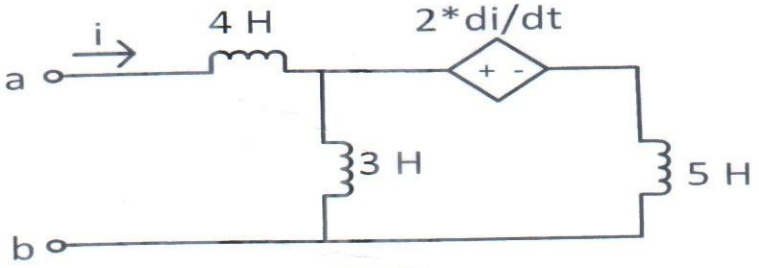

Fig. 1(b)

c) The current through a 12 mH inductor is 4 sin (100t) A. Find the voltage across the inductor for $0 < t < \frac{\pi}{200}$ s and the energy stored at $t = \frac{\pi}{200}$ s. 03

2. a) Calculate the mesh currents, I_1 and I_2 in the circuit of Fig. 2(a) 10

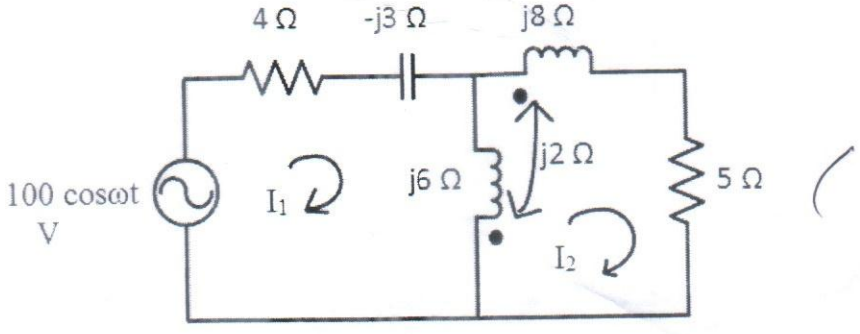

Fig. 2(a)

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b) For the network in Fig. 2(b), find Z_{ab} and I_0. 15

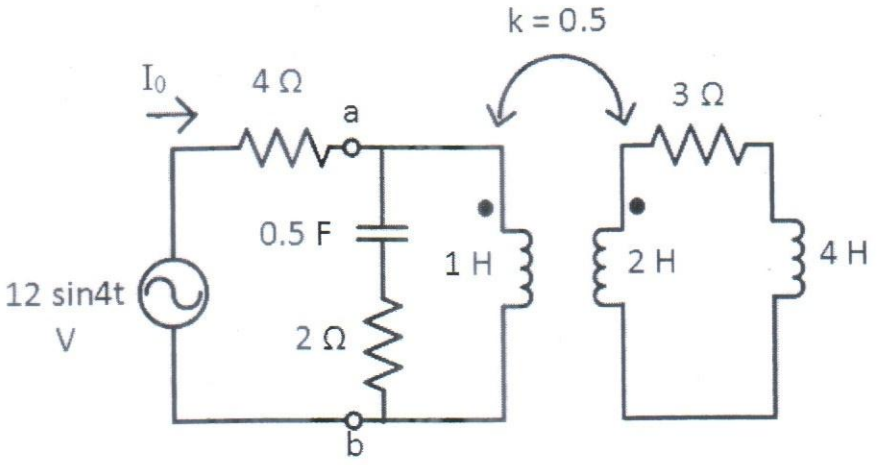

Fig. 2(b)

3. a) Find the current, *I* in the circuit of Fig. 3(a). 12

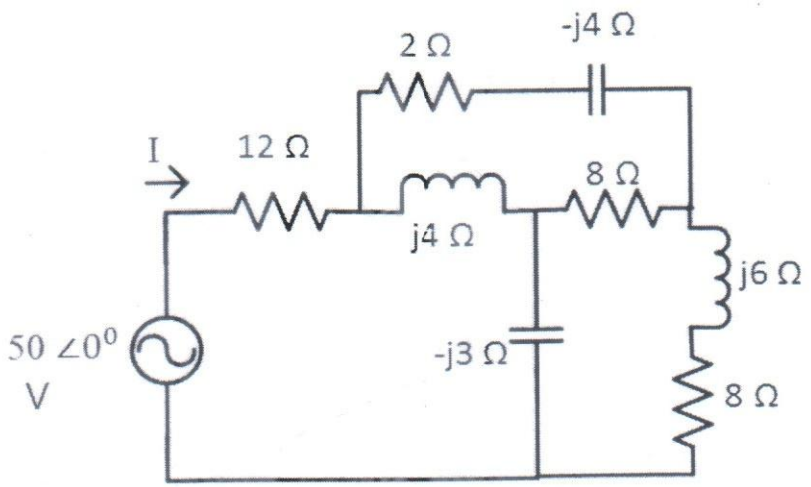

Fig. 3(a)

b) In the circuit of Fig. 3(b), find V_s if $I = 2\angle 0^0$ A. 13

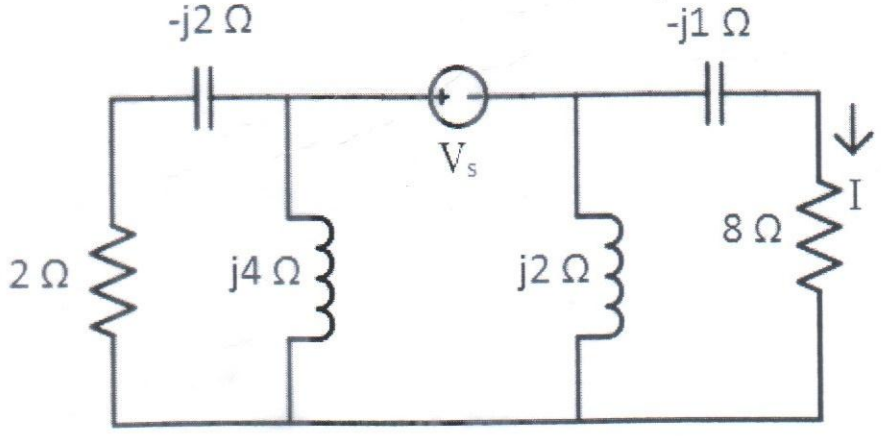

Fig. 3(b)

4. a) In solving for currents using mesh analysis, the following equations are obtained. Draw the circuit and find the currents. 12

$$15\, i_1 - 10\, i_2 = -10$$
$$10\, i_1 - 22\, i_2 + 10\, i_3 = 0$$
$$10\, i_2 - 15\, i_3 = 12$$

b) Find the current, i in the 10 kΩ resistor in the circuit shown in Fig. 4(b) by making a succession of appropriate source transformations. 13

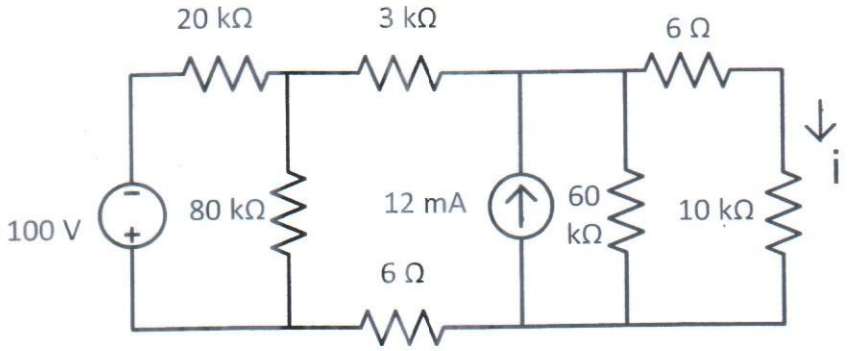

Fig. 4(b)

5. a) Find the average power absorbed by the 8 Ω resistor in the circuit shown in Fig. 5(a). 18

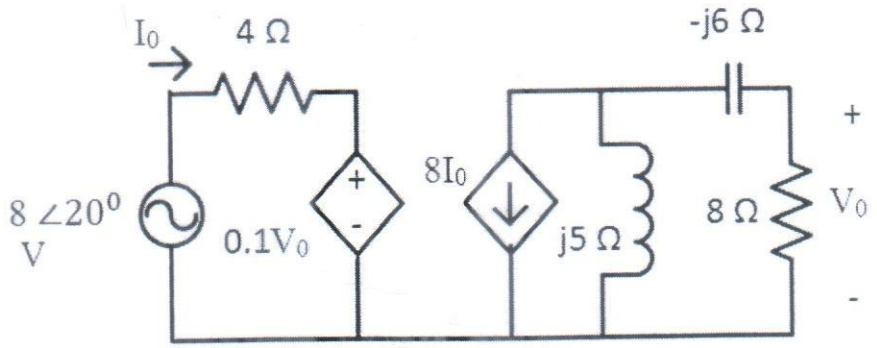

Fig. 5(a)

b) Determine the Thevenin equivalent of the circuit in fig. 5(b) as seen from the terminals a-b. 07

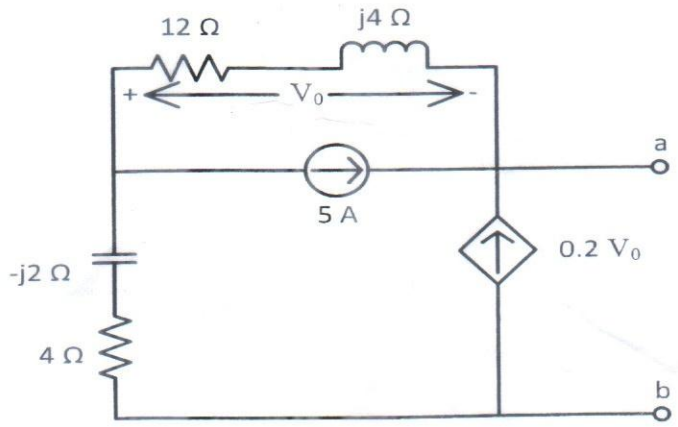

Fig. 5(b)

6. a) Obtain the inductor current, *i(t)* for both t < 0 and t > 0 in the circuit of Fig. 6(a). 10

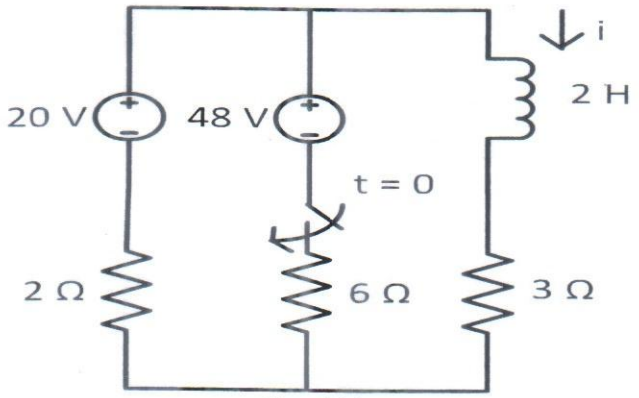

Fig. 6(a)

b) Find the current, *i(t)* for both t < 0 and t > 0 in the circuit shown in Fig. 6(b). 15

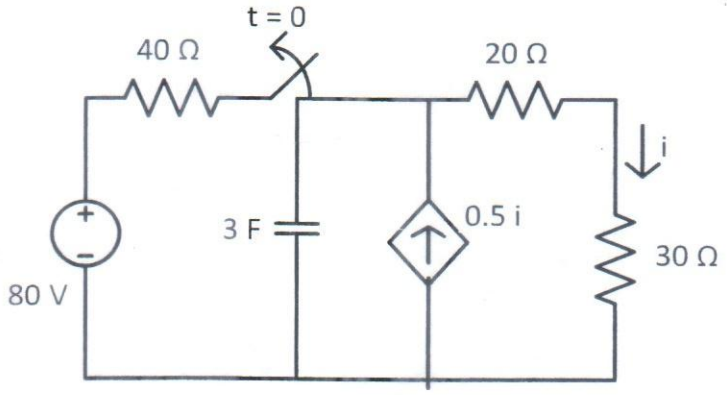

Fig. 6(b)

7. a) Compute the value of R that results in maximum power transfer to the 10 Ω resistor shown in Fig. 7(a). Find the maximum power. 10

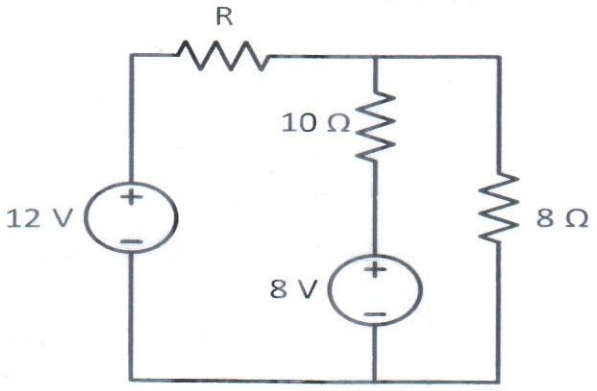

Fig. 7(a)

b) Obtain the Norton equivalent of the circuit shown in Fig. 7(b) to the left of terminals x-y. Use the result to find the current, *i*. 15

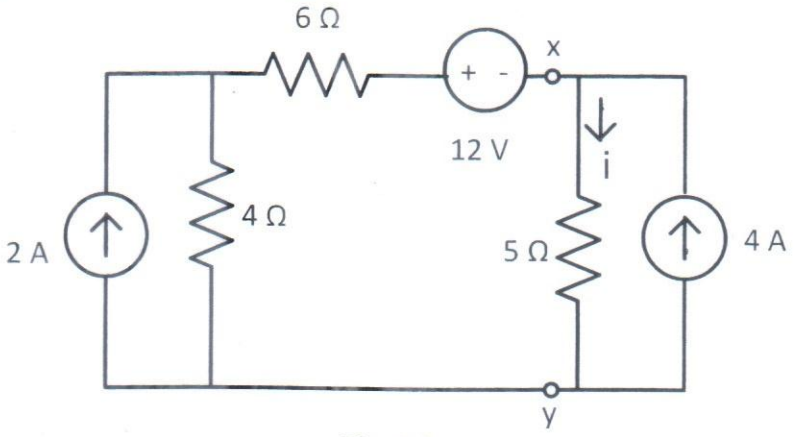

Fig. 7(b)

8. a) Select values for R_1 and R_2 in the circuit of Fig. 8(a) so that $V_R(0^+) = 10$ V and V_R (1 ms) = 5V. 12

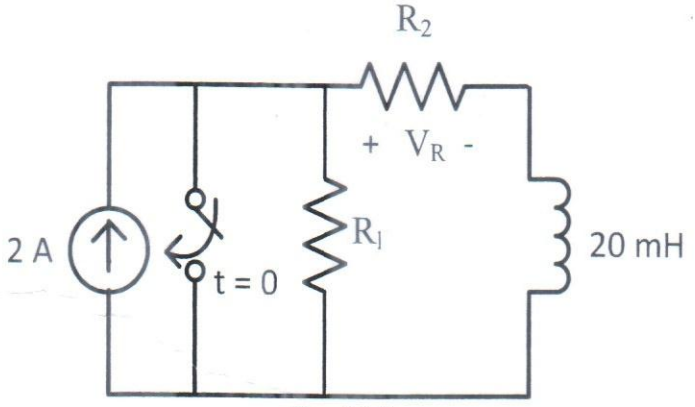

Fig. 8(a)

b) For the circuit shown in Fig. 8(b), Find equivalent resistance by looking into terminals a-b. For finding equivalent resistance, connect a 1 A current source across terminals a-b. (No other method will be acceptable). 13

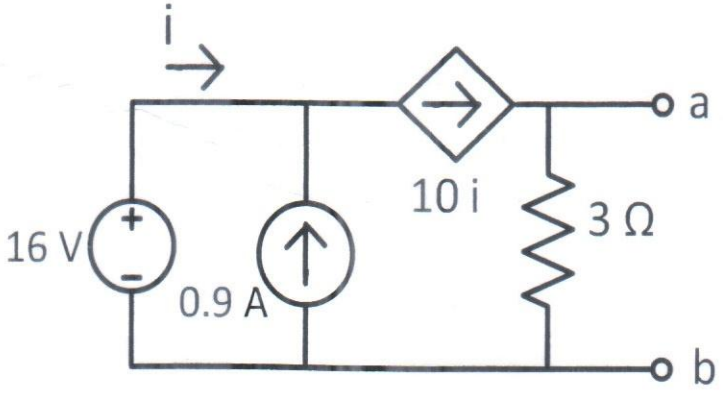

Fig. 8(b)

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BBA TM, 2nd Sem. Date: October 22, 2018 (Morning)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination — Summer Semester, A. Y. 2017-2018
Course No.: EEE 4261 — Time: 3 Hours
Course Title: Electrical and Electronic Technology 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.

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1. a) Describe the conditions established by forward and reverse bias conditions on a p-n junction diode and how the resulting current is affected. 6

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

   c) Considering $V_Z = 10$ V and $I_{ZM} = 32$ mA, for the network of Fig. 1(c), 14
      i. Determine the range of R_L and I_L that will result in V_{RL} being maintained at 10 V.
      ii. Determine the maximum wattage rating of the diode.

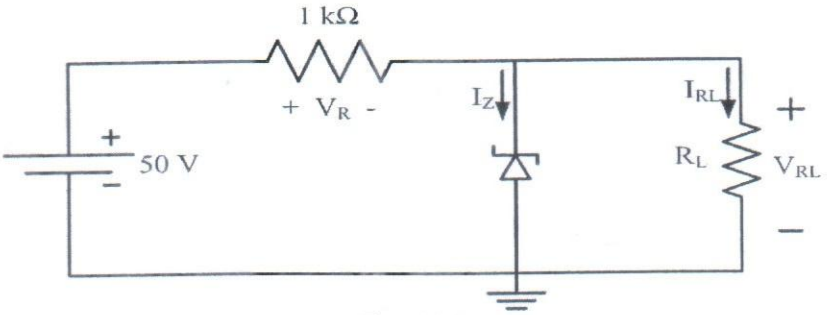

Fig. 1(c)

2. a) What are the modes of operation of a transistor? Write down the biasing condition of two junctions for each mode. 5

   b) Determine the dc bias voltage V_{CE} and collector current I_C for the configuration of Fig. 2(b). Consider $\beta = 90$. 8

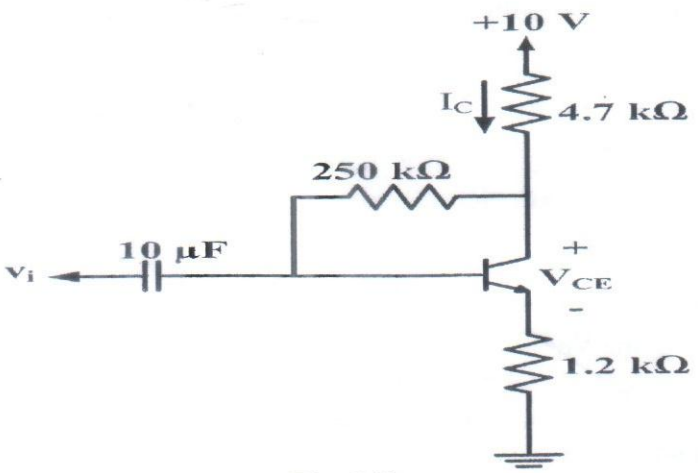

Fig. 2(b)

c) Determine the dc bias voltage V_{CE}, collector current I_C, base voltage V_B, Output Voltage V_O for the configuration of Fig. 2(c). Consider $\beta = 45$. 12

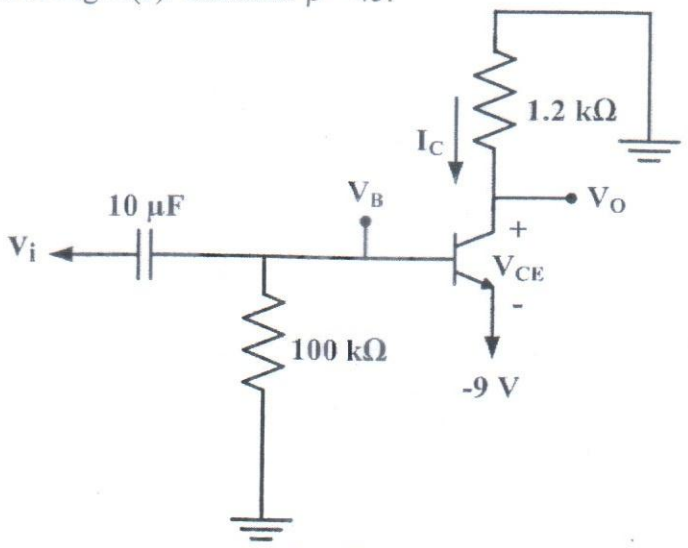

Fig. 2(c)

3. a) A full wave bridge rectifier with a 120 V_{peak} sinusoidal input has a load resistor of 1 kΩ. 12
   i. Draw the circuit diagram.
   ii. Sketch the input and output wave shapes.
   iii. Determine the dc voltage at the output considering ideal diodes.
   iv. Repeat part (ii) with a filter capacitor connected at the output.

   b) Design a free running (astable) Multivibrator which will produce output voltage of +13V for 1 ms and -13V for the next 2 ms and repeat the cycle. Draw the circuit diagram and show necessary calculations to obtain the output. Also draw the capacitor voltage and output voltage waveforms. 13

4. a) What is an op-amp? Write down the pin configuration of an op-amp IC. 5

   b) Implement the following equation using op-amps: 12

$$11x_1 - 7x_2 - 20\frac{d^2x_3}{dt^2} + \iint 12x_4 dt - 5\iint y = 0$$

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

   c) A square wave of amplitude 2 V and time period 4 s is used as the input of an integrator. Draw the circuit diagram, input and output wave shapes if the value of the resistor and capacitor are 5 kΩ and 0.2 μF, respectively. Show necessary calculations. 8

5. a) Draw the basic construction of a *p*-channel JFET. Apply the proper biasing between drain and source. Sketch the depletion region for $V_{GS} = 0$ V. 9

   b) Given, $I_{DSS} = 6$ mA and $V_P = -4.5$ V: 8
   i. Determine I_D at $V_{GS} = -2$ V and -3.6 V.
   ii. Determine V_{GS} at $I_D = 3$ mA and 5.5 mA.

   c) Sketch the transfer curve for an n-channel JFET with $I_{DSS} = 10$ mA and $V_P = -5$ V using shorthand method. 8

6. a) What is the significant difference between the construction of an enhancement-type MOSFET and a depletion-type MOSFET? Briefly describe the basic operation of an enhancement-type MOSFET. 12

   b) Design a NAND gate using TTL logic family. What is the major drawback of this design? Show an alternative design to overcome this drawback. 13

7. a) Implement the equation using CMOS logic family : 12

$$F = (AB + C) D + AD (C+D)$$

   b) Show the detailed comparison between BJT based logic circuits and CMOS logic circuits. Also write down the choices of logic family based on load driving capability, gain, high frequency operation and power consumption. 13

8. a) Design a 4-bit Digital to Analog Converter and find the output voltage for inputs 0100 and 0001. 13

   b) What is PLA? Program a PLA according to the data given in the table below: 12

A	B	C	X	Y
0	0	0	1	1
0	0	1	0	1
0	1	0	1	1
0	1	1	0	0
1	0	0	0	0
1	0	1	1	1
1	1	0	1	0
1	1	1	1	0

Where A, B and C are the inputs and X and Y are the outputs.

B.Sc. Engg.(MCE), 2nd Sem. Date: October 30, 2018 (Morning)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination — Summer Semester, A.Y. 2017-2018
Course No.: EEE 4281 — Time: 3 Hours
Course Title: Basic Electrical 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) Find current, I in the circuit of Fig. 1 (a). Assume, all resistors are of equal valued (assume any value) and E = 20V. 10

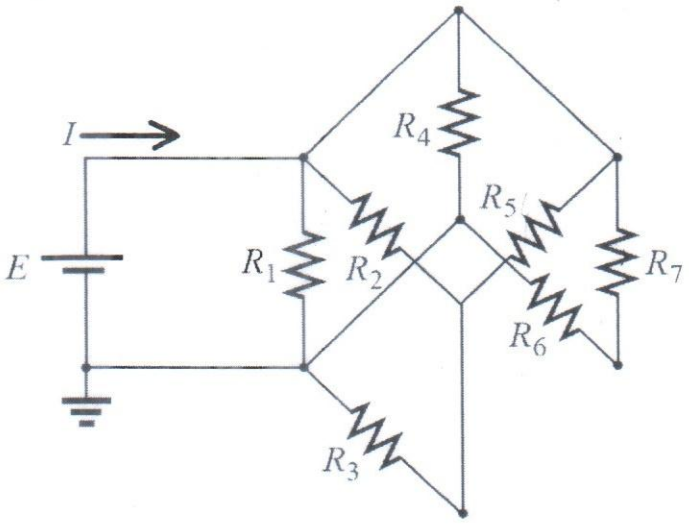

Fig. 1 (a)

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

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

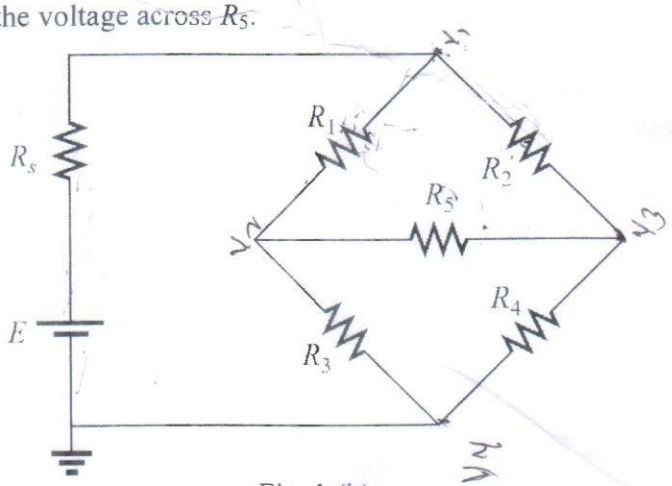

Fig. 1 (b)

2. a) Find current, i_s (t) in the circuit of Fig. 2 (a), if the voltage v_0 across the 2 Ω resistor is 10 cos 2t V and draw the qualitative phasor diagram. 15

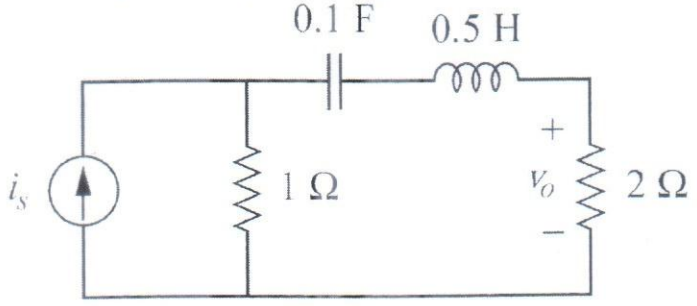

Fig. 2 (a)

b) Find I in the circuit of Fig. 2 (b). 10

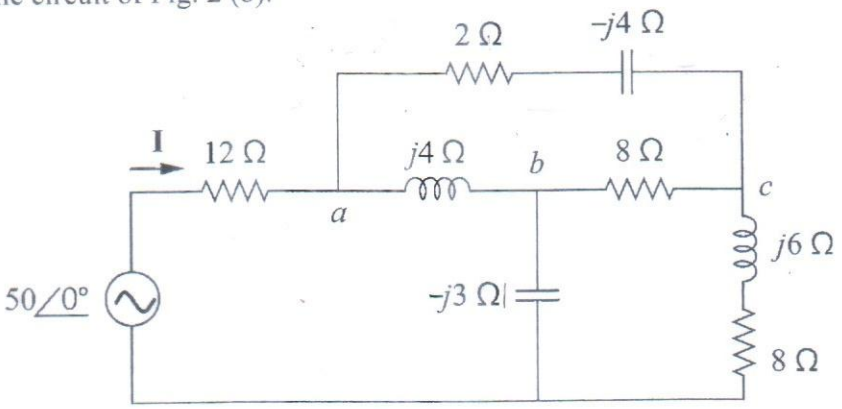

Fig. 2 (b)

3. a) Find I in the following circuit of Fig. 3 (a) using Nodal Analysis. 10

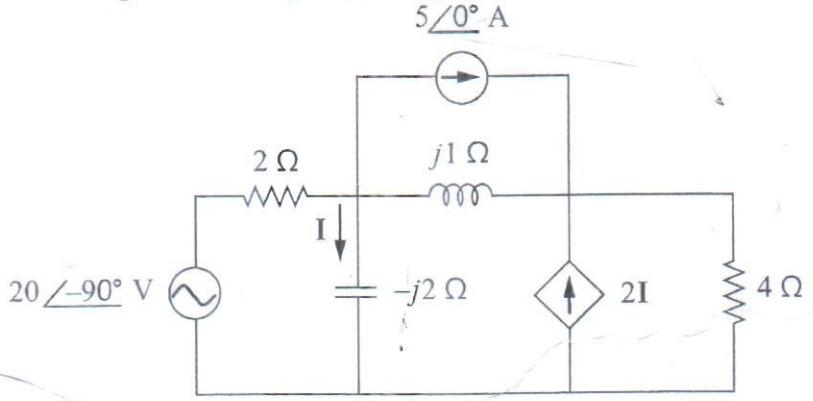

Fig. 3 (a)

b) Determine the Norton equivalent of the circuit shown in Fig. 3 (b) as seen from terminals a-b. Use the equivalent to find I_0. 15

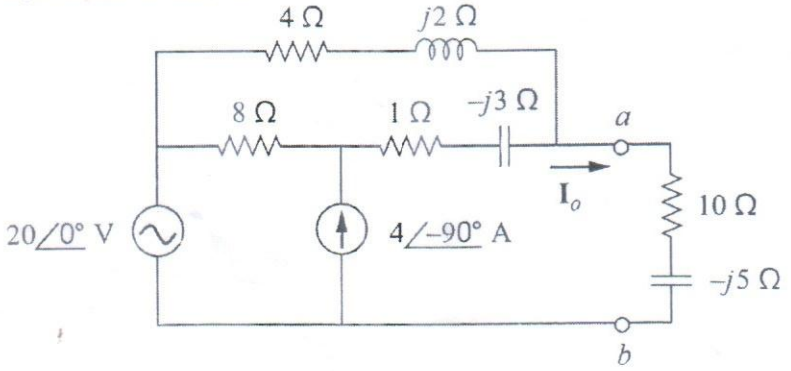

Fig. 3 (b)

4. a) Determine the rms value of the full-wave rectified sine wave shown in the Fig. 4 (a). Calculate the average power dissipated in a 6 Ω resistor. 10

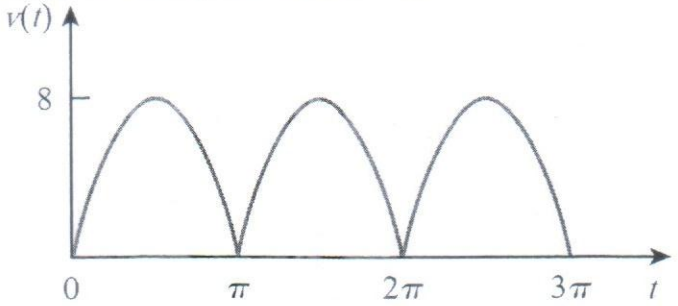

Fig. 4 (a)

b) Find v_o (t) of the following network in Fig. 4 (b) using superposition theorem. 15

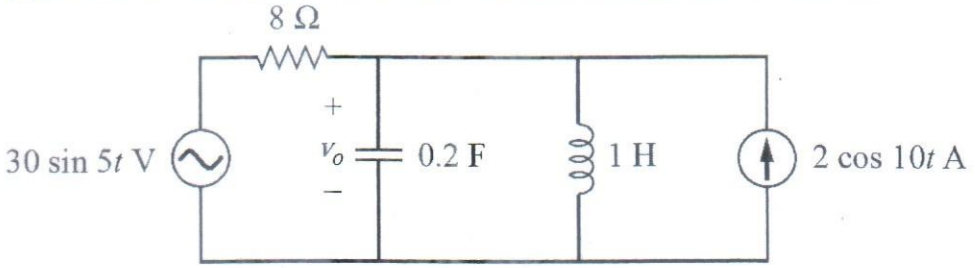

Fig. 4 (b)

5. a) What are the conditions for getting maximum average power transferred at the load for AC circuit analysis? Derive it using a general AC series circuit. Find out the maximum average power. 10

b) Find V_0 in the following circuit of Fig. 5 (b) using Mesh Analysis. 15

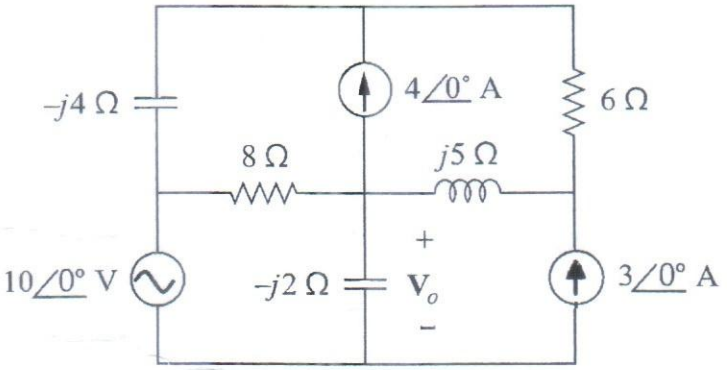

Fig. 5 (b)

6. a) In Fig. 6 (a), the resistor R_L is adjusted until it absorbs the maximum average power. Calculate R_L and the maximum average power absorbed by it. 9

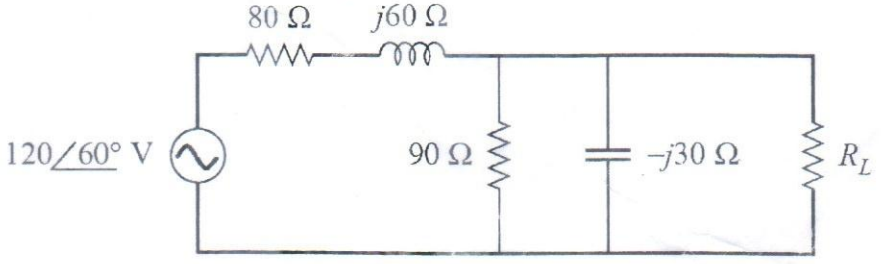

Fig. 6 (a)

b) Show that a resistive load (R) absorbs average power at all times, while a reactive load (L or C) absorbs zero average power. 8

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 power factor (pf) to 0.95. 8

7. a) Mention the advantages of three-phase system comapred to single-phase system in terms of materials used in the system. Justify your answers with necessary diagrams. 10

b) Two balanced loads are connected to a 240 kV 50-Hz line as shown in Fig. 7 (b) below. Load 1 draws 30 kW at a power factor of 0.6 lagging, while load 2 draws 45 kVAR at a power factor of 0.8 lagging. Assuming the abc sequence, determine the line currents, i_{a1}, i_{a2}, i_a, i_b and i_c indicated in the Fig. 7 (b). 15

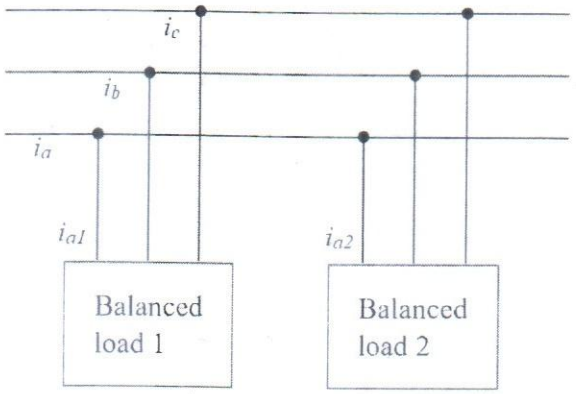

Fig. 7 (b)

8. a) For a balanced delta-wye system, determine the expressions for all the phase voltages, line voltages, phase currents and line currents for the b-a-c sequence along with phasor diagrams. 15

b) Find the line currents in the following unbalanced three-phase circuit shown in Fig. 8 (b). 10

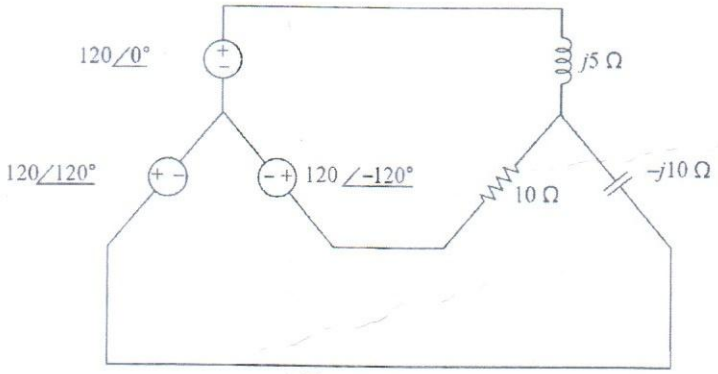

Fig. 8 (b)

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B.Sc. Engg. (EE) / HDEE, 4th Sem. Date: October 30, 2018 (Morning)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination
Course No.: EEE 4401
Course Title: Power System II

Summer Semester, A.Y. 2017-2018
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. Symbol(s) preserve their usual meanings. Assume reasonable value if necessary.

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1. One line diagram of a simple power system is shown in Fig. 1. Each generator is represented by an emf behind the transient reactance. All impedances are expressed in per unit on a common MVA base. The generators are operating on no load at their rated voltage with their emfs in phase. A three phase fault occurs at bus 1 through a fault impedance of $Z_f = j0.08$ per unit. 15+10
   i) Using Thevenin's theorem obtain the impedance to the point of fault and the fault current in per unit.
   ii) Determine the bus voltages and line currents during fault.

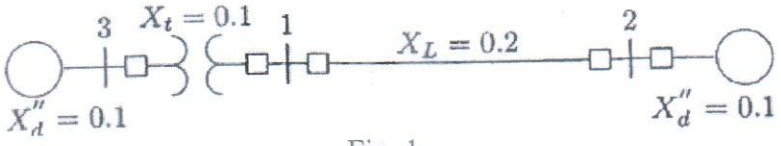

Fig. 1

2. a) Using the method of *bus building algorithm*, find the bus impedance matrix Z_{BUS} for the network shown in Fig. 2. 18

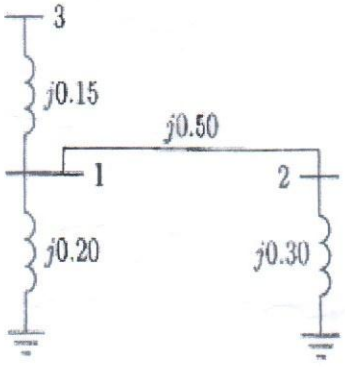

Fig. 2

b) A 400 V, 5 kVA load has a per unit impedance of 0.2 with its own rating as base. It is to be placed in a system with a base of 10 kVA and 800 V. Calculate the load per unit impedance in the new system. 07

3. a) Line to line voltages in an unbalanced three phase supply are $V_{ab} = 1000\angle 0°$, $V_{bc} = 866.0254\angle -150°$ and $V_{ca} = 500\angle 120°$. Determine the followings: 10
   i) The symmetrical components for line voltages.
   ii) The phase voltages.

   b) In the three phase system shown in Fig. 3, phase a is on no load and phase b and c are short circuited to ground. The following currents are given: $I_b = 91.65\angle 160.9°$, $I_n = 60 \angle 90°$. Find the symmetrical components of current I_a^0, I_a^1 and I_a^2. 15

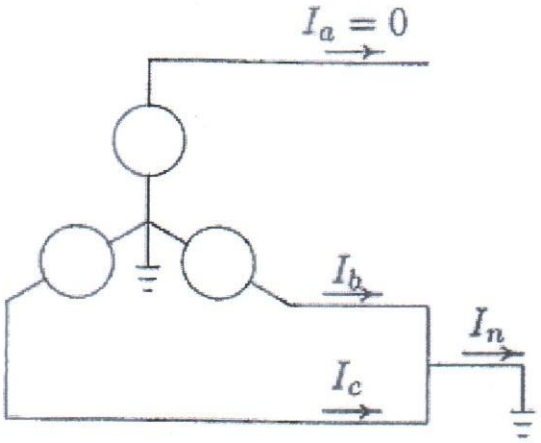

Fig. 3

4. Single line diagram of a power system is shown in Fig. 4 where neutral of each generator is grounded through a current limiting reactor of 0.25/3 per unit on a 100 MVA base. The system data expressed in per unit on a common base is tabulated below. 25

Item	Base MVA	Voltage Rating	X^1	X^2	X^0
G_1	100	20 kV	0.15	0.15	0.05
G_2	100	20 kV	0.15	0.15	0.05
T_1	100	20/220 kV	0.10	0.10	0.10
T_2	100	20/220 kV	0.10	0.10	0.10
L_{12}	100	220 kV	0.125	0.125	0.30
L_{13}	100	220 kV	0.15	0.15	0.35
L_{23}	100	220 kV	0.25	0.25	0.7125

Using the *bus impedance matrix method*, determine the bus voltage and line currents for symmetrical fault at bus 3 through a fault impedance $Z_f = j0.1$.

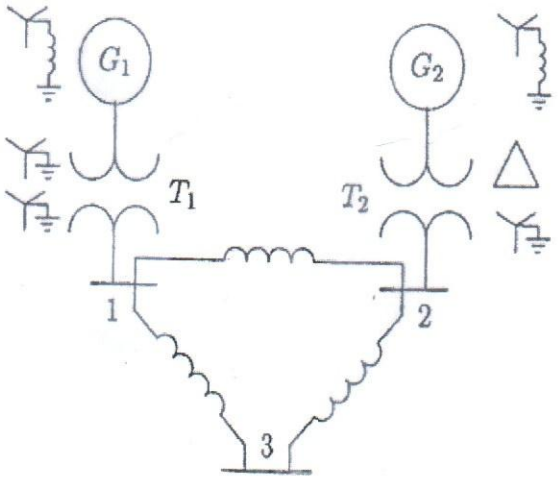

Fig. 4

5. a) Discuss different types of system buses that are generally used in load flow study. 07

b) One line diagram of a simple three bus power system with generation at bus 1 and 3 is shown in Fig. 5. The voltage at bus 1 is $V_1 = 1.025\angle 0^\circ$ per unit. Voltage magnitude at bus 3 is fixed at 1.03 pu with a real power generation of 300 MW. A load consisting of 400 MW and 200 Mvar is taken from bus 2. Line impedances are marked in per unit on a 100 MVA base. 9×2

Using Gauss-Seidel method and initial estimates of $V_2^{(0)} = 1.0 + j0$ and $V_3^{(0)} = 1.03 + j0$ and keeping $V_3 = 1.03$ pu, determine the phasor values of V_2 and V_3. Perform **two** iterations.

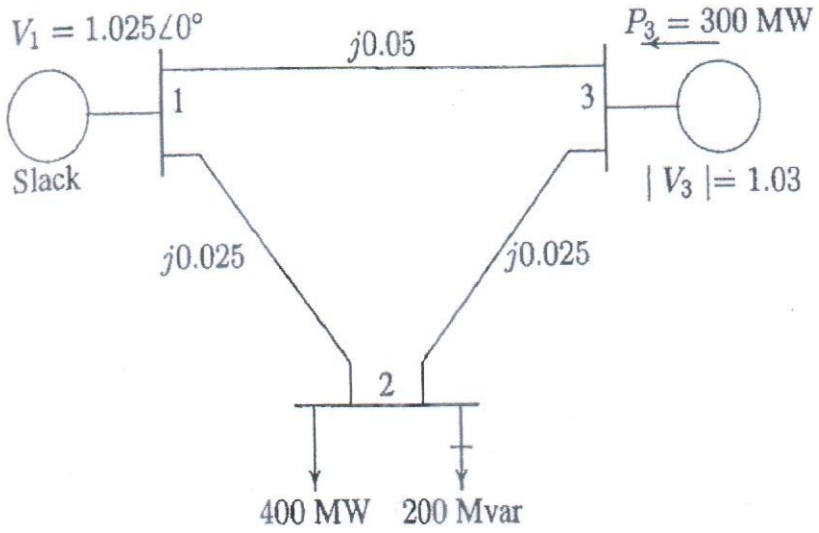

Fig. 5

6. a) For power flow study a fourth order polynomial equation is given by, 13

$$x^4 - 21x^3 + 147x^2 - 379x + 252 = 0.$$

Use Newton Raphson method to find one of the roots of the polynomial equation. Start with the initial estimate of $x^{(0)} = 0$ and continue until $\varepsilon = 0.001$.

b) Use Newton-Raphson method to find the solutions of the following nonlinear equations in load flow: 12

$$X_1^2 - 2X_1 - X_2 = 3$$
$$X_1^2 + X_2^2 = 41$$

Assume an initial estimate of $X_1^{(0)} = 2$, $X_2^{(0)} = 3$. Perform **three** iterations.

7. a) Three identical Y-connected resistors form a load bank with a three phase rating of 2300 V and 500 kVA. Load bank has per unit values of voltages: $V_{ab} = 0.8\angle 82.8^\circ$, $V_{bc} = 1.2\angle -41.4^\circ$, $V_{ca} = 1.0\angle 180^\circ$. Find the line voltages and currents in per unit into the load. Assume that the neutral of the load is not connected to the neutral of the system. 15

b) Three equal impedances of j21 Ω are connected in Δ. Determine the sequence impedances and circuits of the combination. 10

8. The zero, positive and negative sequence bus impedance matrices for a three bus power system are 25

$$\mathbf{Z}^0_{bus} = j\begin{bmatrix} 0.20 & 0.05 & 0.12 \\ 0.05 & 0.10 & 0.08 \\ 0.12 & 0.08 & 0.30 \end{bmatrix} \quad \text{pu}$$

$$\mathbf{Z}^1_{bus} = \mathbf{Z}^2_{bus} = j\begin{bmatrix} 0.16 & 0.10 & 0.15 \\ 0.10 & 0.20 & 0.12 \\ 0.15 & 0.12 & 0.25 \end{bmatrix} \quad \text{pu}$$

Determine the per unit fault current during fault for following conditions:

i) A bolted single line to ground fault at bus 2.
ii) A bolted line to line fault at bus 2.
iii) A bolted double line to ground fault at bus 2.

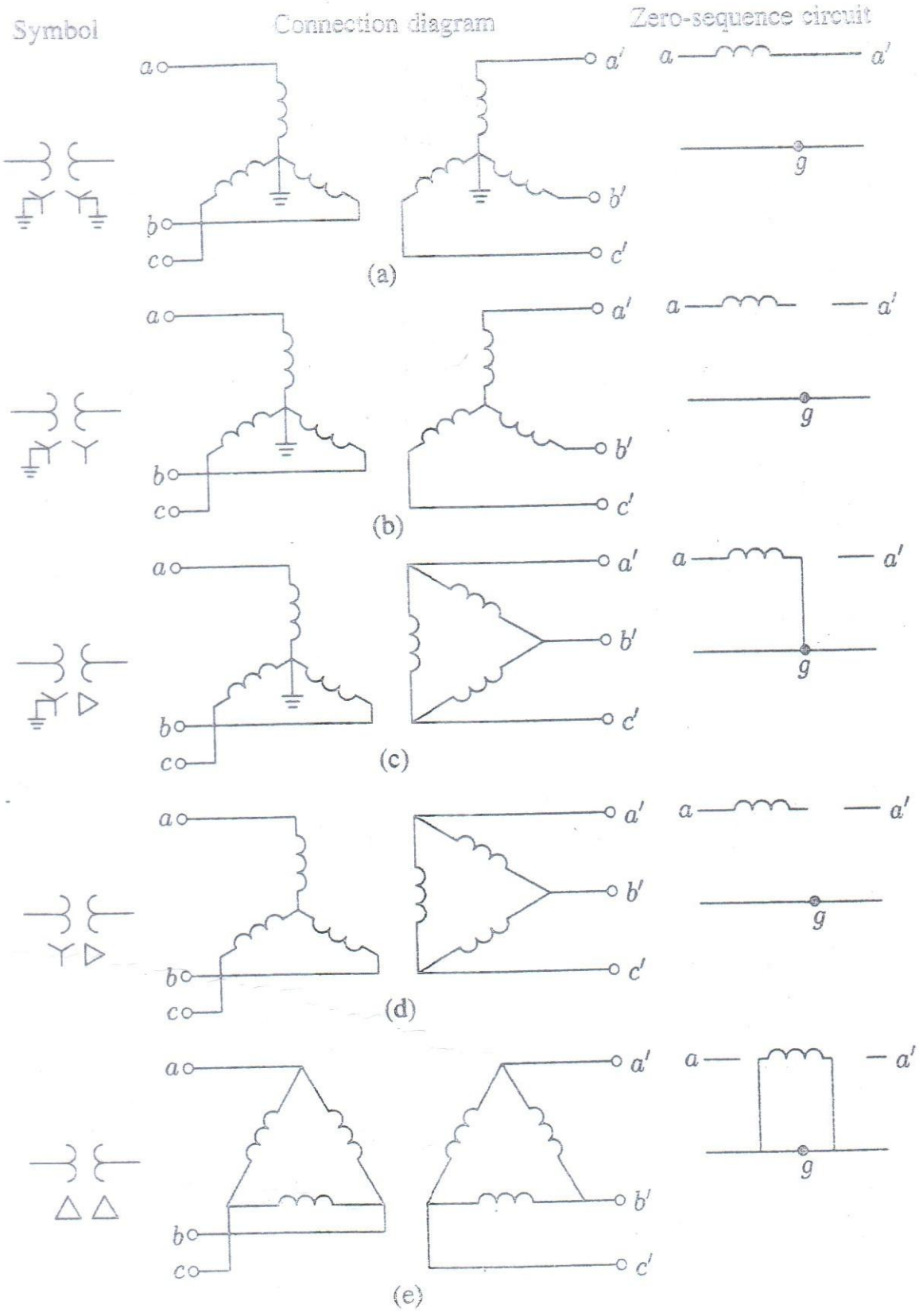

FIGURE 10.6
Transformer zero-sequence equivalent circuits.

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

Date: October 25, 2018 (Morning)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

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

Summer Semester, A. Y.2017-2018
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) Explain with suitable diagrams, how a uniformly rotating magnetic field of equal magnitude is produced from 2-phase supply currents which are 90^0 apart. 5.5

   b) Answer the following questions in brief: 6+3
   (i) Write different methods of making single-phase induction motor 'self-starting'.
   (ii) For a single phase split-phase motor, the auxiliary winding is designed to have higher resistance/reactance (R_A/X_A) ratio than the main winding (R_M/X_M). How is this accomplished in the motor industries?

   c) A 480 V, three phase, four-pole, 50 Hz induction motor is running at a slip of 5 percent. 10.5
   (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 full-load?
   (v) If the rotor is blocked, what will be rotor current frequency and the stator current frequency of this motor?
   (vi) If the supply voltage is reduced to 240 V, will the synchronous speed of this motor change? What will be the synchronous speed under this condition?
   (vii) If the load is decreased by 10 percent, will the synchronous speed of this motor change? What will be the synchronous speed under this condition?

2. a) Answer the following questions in brief: 8
   (i) Name the principal components of an induction motor.
   (ii) What happens to the rotor speed and rotor current when the mechanical load on a 3-phase induction motor increases?
   (iii) Give two advantages of a wound-rotor motor over a squirrel-cage motor.
   (iv) Both the voltage induced (E_2) and frequency (f_2) in the rotor of an induction motor decrease as the rotor speeds up. Explain with necessary formulation.

   b) Sketch and briefly explain the shape of a typical induction motor torque speed characteristic curve. Show the stable and unstable regions. Why will the motor remain stable and unstable in those regions respectively? 5

c) A 3-phase induction motor having 6 pole per phase, star-connected stator winding runs on 240 V, 50 Hz supply. The rotor resistance and standstill reactance are 0.12 Ω and 0.85 Ω per phase respectively. The effective ratio of stator to rotor turns is 1.8. Full load slip is 4%. 12

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

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

3. a) Why can't a synchronous motor start by itself? What approaches can be taken to safely start a synchronous motor? 5

b) (i) Draw the equivalent circuit of a synchronous motor. Hence draw the phasor diagram under no-load condition. 10
(ii) Is it possible to get load angle (δ) equals to zero for a synchronous motor? Explain in brief.
(iii) 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 different phasor diagrams.
(iv) 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.

c) 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. 10

(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) Answer the following questions in brief (use phasor diagram if necessary) 12

(i) A synchronous motor operates at lagging power factor. If you increase the field current, show the changes in real power consumption and reactive power consumption of the motor.
(ii) What will be the change in motor's power factor.
(iii) If you increase both the field excitation and load simultaneously, what will be the new phasor diagram?

b) A 440 V three phase Y-connected synchronous motor has a synchronous reactance of 1.5 Ω per phase. The field current has been adjusted so that the load angle δ is 28^0 when the power supplied by the generator is 90 kW. 13

(i) What is the magnitude of the internal generated voltage E_A in this machine?
(ii) What are the magnitude and angle of the armature current in the machine? What is the motor's power factor?
(iii) If the field current remains constant, what is the absolute maximum power this motor could supply?

5. 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: 9

(i) Loads with lagging power factor,
(ii) Loads with unity power factor and
(iii) Loads with leading power factor.

b) A 480 V, 50 Hz, Y connected, six pole synchronous generator has a per phase synchronous reactance of 1.0 Ω. Its full-load armature current is 60 A at 0.8 pf lagging. This generator has friction and windage losses of 1.5 kW and core losses of 1.0 kW at full load. Assume that the I^2R losses are negligible. The field current has been adjusted so that the terminal voltage is 480 V at no load. 16

(i) What is the speed of rotation of this generator?
(ii) What is the terminal voltage of this generator if the following are true?
- It is loaded with the rated current at 0.8 pf lagging.
- It is loaded with the rated current at 1.0 pf.
- It is loaded with the rated current at 0.8 pf leading.

(iii) What is the efficiency of this generator (ignoring the unknown electrical losses) when it is operating at the rated current and 0.8 pf lagging?
(iv) What is the voltage regulation of this generator at
- 0.8 pf lagging?
- 1.0 pf?
- 0.8 pf leading?

6. a) What is an infinite bus? What constraints does it impose on a generator paralleled with it? 5

b) What do you mean by the term "float on the line" of a generator when it is connected with the infinite bus? Show the house diagram under "float on the line" condition. 5

c) Immediately after the synchronizing a generator with the infinite bus, 15

(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: 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: 15

(i) only the real power consumptions is increased,
(ii) only the reactive power consumptions 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 excitation of both the Generators are increased.

b) Two parallelly connected generators are supplying a load. Generator 1 has a no-load frequency of 61.5 Hz and slope of 1 MW/Hz. Generator 2 has a no load frequency of 61.0 Hz and slope of 1 MW/Hz. The two generators are supplying a real load totaling 2.5 MW at 0.8 pf lagging. What will be the operating frequency of the system? How much power is supplied by each of the two generators? 10

8. a) Suppose that you were 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) Explain the operating principle of a 'stepper motor'. What are the major applications of stepper motors? 8

   c) 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

   d) Briefly explain the 'Microstepping' of a stepper motor. 6

B.Sc. Engg. (EE) / HDEE, 4th Sem. Date: October 27, 2018 (Morning)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination
Course No.: Math 4421
Course Title: Random Signals and Processes

Summer Semester, A. Y. 2017-2018
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 carry their usual meanings.

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1. a) Suppose traffic engineers have coordinated the timing of two traffic lights to encourage a run of green lights. In particular, the timing was designed so that with probability 0.8 a driver will find the second light to have the same color as the first. Assuming the first light is equally likely to be red or green, what is $P[G_2]$, the probability that the second light is green? Also, what is P[W], the probability that you wait for at least one light? Lastly, what is $P[G_1|R_2]$, the conditional probability of a green first light given a red second light? 7

b) You have a shuffled deck of three cards: 2, 3 and 4 and you deal out the three cards. Let E_i denote the event that i-th card dealt is even numbered. 8

i) What is $P[E_2|E_1]$, the probability the second card is even given that the first card is even?
ii) What is the conditional probability that the first two cards are even given that the third card is even?
iii) Let O_i represent the event that the i-th card dealt is odd numbered. What is $P[E_2|O_1]$, the conditional probability that the second card is even given that the first card is odd?
iv) What is the conditional probability that the second card is odd given that the first card is odd?

c) In an experiment, A, B, C, and D are events with probabilities $P[A] = 1/4, P[B] = 1/8, P[C] = 5/8$ and $P[D] = 3/8$. Furthermore, A and B are disjoint, while C and D are independent. 10

i) Find $P[A \cap B]$, $P[A \cup B]$, $P[A \cap B^C]$, and $P[A \cup B^C]$.
ii) Are A and B independent?
iii) Find $P[C \cap D]$, $P[C \cap D^C]$ and $P[C^C \cap D^C]$.
iv) Are C^C and D^C independent?

2. a) Let X have the binomial PMF 13

$$P_X(x) = \binom{4}{x}\left(\frac{1}{2}\right)^4.$$

i) Find the standard deviation of the random variable X.
ii) What is $P[\mu_X - \sigma_X \leq X \leq \mu_X + \sigma_X]$, the probability that X is within one standard deviation of the expected value?

b) Determine the expected values of Poisson and Geometric random variables. 12

3. a) X is a continuous uniform $(-5, 5)$ random variable. 12

i) What is the PDF $f_X(x)$?
ii) What is the CDF $F_X(x)$?
iii) What is $E[X]$?
iv) What is $E[X^5]$?
v) What is $E[e^X]$?

b) Long-distance calling plan A offers flat rate service at 10 cents per minute. Calling plan B charges 99 cents for every call under 20 minutes. For calls over 20 minutes, the charge is 99 cents for the first 20 minutes plus 10 cents for every additional minute. (Note that these plans measure your call duration exactly, without rounding to the next minute or even second). If your long-distance calls have exponential distribution with expected value τ minutes, which plan offers a lower expected cost per call? 13

4. a) Random variable X and Y have joint PDF 12

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

i) Find the constant c.
ii) Find $P[X > Y]$ and $P[Y < X^2]$.
iii) Find $P[min(X, Y) \le 1/2]$.
iv) Find $P[max(X, Y) \le 3/4]$.

b) Random variable X and Y have joint PMF 13

$$P_{X,Y}(x,y) = \begin{cases} cxy & x = 1,2,4;\ y = 1,3. \\ 0 & otherwise. \end{cases}$$

i) What is the expected value of $W = Y/X$?
ii) What is $E[XY]$?
iii) What is $Cov[X, Y]$?
iv) What is $\rho_{X,Y}$?
v) What is $Var\ [X + Y]$?

5. a) The joint PMF is 13

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

Find the following marginal PMFs:

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) **X** is a two dimensional random vector with PDF 12

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

Let $\mathbf{Y} = \mathbf{AX} + \mathbf{b}$, where,

$$\mathbf{A} = \begin{bmatrix} 1 & 0 \\ 6 & 3 \\ 3 & 6 \end{bmatrix} \text{ and } \boldsymbol{b} = \begin{bmatrix} 0 \\ -2 \\ -2 \end{bmatrix}$$

Calculate:
i) the expected values, $\boldsymbol{\mu_X}$, $\boldsymbol{\mu_Y}$,
ii) the covariances, $\mathbf{C_X}$, $\mathbf{C_Y}$,
iii) the correlations, $\mathbf{R_X}$, $\mathbf{R_Y}$.

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 have the joint probability mass function. 12

$P_{J,K}(j,k)$	$k=-1$	$k=0$	$k=1$
$j=-2$	0.42	0.12	0.06
$j=-1$	0.28	0.08	0.04

i. What is the MGF of J?
ii. What is the MGF of K?
iii. What is the PMF of M=J+K?
iv. What is $E[M^4]$?

8. a) The duration of a cellular telephone call is an exponential random variable with expected value of 150 seconds. A subscriber has a calling plan that includes 300 minutes per month at a cost of \$30.00 plus \$0.40 for each minute if the total calling time exceeds 300 minutes. In a certain month, the subscriber has 120 cellular calls. 13

i) Use the central limit theorem to estimate the probability that the subscriber's bill is greater than \$36. Assume that the durations of all phone calls are mutually independent and that the telephone company measures call duration exactly and charges accordingly, without rounding up fractional minutes.

ii) Suppose the telephone company does charge a full minute for each fractional minute used. Recalculate your estimate of the probability that the bill is greater than \$36.

b) Telephone calls can be classified as voice (V) if someone is speaking or data (D) if there is a modem or fax transmission. Based on a lot of observations taken by the telephone company, we have the following probability model: $P[V] = 3/4$, $P[D] = 1/4$. Data calls and voice calls occur independently of one another. The random variable K_n is the number of voice calls in a collection of n phone calls. 12

i) What is $E[K_{48}]$, the expected number of voice calls in a set of 48 calls?
ii) What is σ_{K48} the standard deviation of the number of voice calls in a set of 48 calls?
iii) Use the central limit theorem to estimate $P[30 \leq K_{48} \leq 42]$, the probability between 30 and 42 voice calls in a set of 48 calls.
iv) Use the De Moivre-Laplace formula to estimate $P[30 \leq K_{48} \leq 42]$.

Appendix : 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

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B.Sc. Engg. (EE) / HDEE, 4th 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 — Summer Semester, A.Y. 2017-2018
Course No.: Phy 4421 — Time: 3 Hours
Course Title: Semiconductor Devices — 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) What is the Einstein relation? Derive the expression for induced electric field. 7

   b) What do you mean by electron diffusion current and electron diffusion coefficient? Derive the expression for diffusion current density for both electrons and holes. 8

   c) Consider a semiconductor that is uniformly doped with $N_d = 10^{14}\ cm^{-3}$ and $N_a = 0$, with an applied electric field of $E = 100\ V/cm$. Assume the following parameters. 10

$\mu_n = 1000\ cm^2/V-s$	$\mu_p = 0$
$N_c = 2 \times 10^{19}(T/300)^{3/2}\ cm^{-3}$	$N_v = 1 \times 10^{19}(T/300)^{3/2}\ cm^{-3}$
$E_g = 1.10\ eV$	

   (i) Calculate the electric-current density at $T = 300\ K$.
   (ii) At what temperature will this current increase by 5 percent? (Assume mobilities are independent of time)

2. a) Derive the thermal equilibrium holes concentration in the valance band. 7

   b) What will be the condition for the intrinsic Fermi level is at the midgap energy? 5

   c) Sketch a graph of n_0 versus temperature for an n-type material. 4

   d) A sample of silicon at $T = 450\ K$ is doped with boron at a concentration of $1.5 \times 10^{15}\ cm^{-3}$ and with arsenic at a concentration of $8 \times 10^{14}\ cm^{-3}$. 9
   (i) Is the material n or p type?
   (ii) Determine the electron and hole concentrations.
   (iii) Calculate the total ionized impurity concentrations.

3. a) What is the difference between direct and indirect bandgap semiconductor? 5

   b) What is quanta? The lowest energy of a particle in an infinite potential well with a width of 100 Å is $0.025\ eV$. What is the mass of the particle? 6

   c) Calculate the energy in terms of kT and E_F, at which the difference between the Boltzman approximation and the Fermi-Dirac function is 1% of the Fermi function. 8

   d) What are the laws for determining the distribution of particles among available energy states? 6

4. a) What is ambipolar transport? From Poisson's equation, define the dielectric relaxation time constant. 6

b) For an n-type semiconductor at $T = 300\,K$ with carrier concentration of $n_0 = 10^{15}\,cm^{-3}$, $n_i = 10^{10}\,cm^{-3}$ and $p_0 = 10^5\,cm^{-3}$, in nonequilibrium, assume that the excess carrier concentrations are $\delta n = \delta p = 10^{13}\,cm^{-3}$. Calculate the quasi-Fermi energy levels and show them in energy band diagram. 9

c) Light is incident on a silicon sample starting at $t = 0$ and generating excess carriers uniformly throughout the silicon for $t > 0$. The generation rate is $g' = 5 \times 10^{21}\,cm^{-3}s^{-1}$. The silicon $(T = 300\,K)$ is n type with $N_d = 5 \times 10^{16}\,cm^{-3}$ and $N_a = 0$. The following parameters are also given. 10

$n_i = 1.5 \times 10^{10}\,cm^{-3}$,	
$\tau_{n0} = 10^{-6}\,s$	$\tau_{p0} = 10^{-7}\,s$
$\mu_n = 1000\,cm^2/V-s$	$\mu_p = 420\,cm^2/V-s$

Determine the conductivity of the silicon as a function of time for $t \geq 0$.

5. a) What is called depletion layer capacitance? Derive the expression for depletion layer capacitance for reverse bias. 8

b) Define one-sided pn junction and linearly graded junction. 5

c) A silicon pn junction is to be designed which meets the following specifications at $T = 300\,K$. At a reverse-bias voltage of 1.2 V, 10 percent of the total space charge region is to be in the n region and the total junction capacitance is to be $3.5 \times 10^{-12}\,F$ with a cross sectional area of $5.5 \times 10^{-4}\,cm^2$. Determine: 12

(i) N_a ,
(ii) N_d ,
(iii) V_{bi} .

6. a) What is a tunnel diode? Draw the I-V characteristics of the tunnel diode for both forward bias and reverse bias. 4

b) What are the assumptions for deriving the ideal current-voltage relationship? 4

c) What is called ideal diode equation? Derive that equation and draw its corresponding curve. 7

d) A GaAs pn junction diode at $T = 450\,K$ has the following parameters: 10

$N_d = 8 \times 10^{16}\,cm^{-3}$ $\quad N_a = 2 \times 10^{15}\,cm^{-3}$
$D_n = 207\,cm^2/s$ $\quad D_p = 9.80\,cm^2/s$
$\tau_{no} = 5 \times 10^{-7}s$ $\quad \tau_{po} = 1 \times 10^{-7}s$

Cross sectional area is $A = 10^{-3}cm^2$.

Determine the diffusion resistance and diffusion capacitance if the diode is forward biased at $V_a = 0.970\,V$.

7. a) Define heterojunction. Draw the ideal energy band diagram of an nN hetrojunction in thermal equilibrium with proper leveling. 5

b) What is an ideal Schottky barrier height? Indicate the Schottky barrier height on an energy band diagram. 5

c) Determine the Schottky barrier lowering and the position of the maximum barrier height. Consider a GaAs metal-semiconductor contact in which the electric field in the semiconductor is assumed to be $E = 6.8 \times 10^4\ V/cm$. 6

d) Consider an ideal gold-to-n-type silicon Schottky diode at $T = 300\ K$. Assume the semiconductor is dopped at a concentration of $N_d = 3 \times 10^{15}\ cm^{-3}$. From the following table determine: 9
(i) the ideal Schootky barrier height,
(ii) Built-in potential barrier,
(iii) peak electric field with an applied reverse-bias voltage of $V_R = 5\ V$ and
(iv) junction capacitance per unit area for $V_R = 5\ V$.

Element	Work function, Φ_m	Element	Electron affinity, χ
Ag	4.26	Ge	4.13
Al	4.28		
Au	5.1	Si	4.01
Cr	4.5		
Ni	5.15	GaAs	4.07
Pt	5.65		
Ti	4.33	AlAs	3.5
W	4.55		

8. a) Draw the hybrid-pi equivalent circuit diagram for an n-p-n transistor. Mention the names and effects of each parameter in the circuit. 5

b) Define early effect and current crowding for an n-p-n transistor. 5

c) Describe the time-delay factors in the frequency limitation of the bipolar transistor. 6

d) Consider a silicon npn bipolar transistor at $T = 300\ K$ with the following parameters: 9

$$n_i = 1.5 \times 10^{10}\ cm^{-3}$$

$D_E = 8\ cm^2/s$ $\quad N_E = 1 \times 10^{18}\ cm^{-3}$

$D_B = 15\ cm^2/s$ $\quad N_B = 5 \times 10^{16}\ cm^{-3}$

$D_c = 12\ cm^2/s$ $\quad N_c = 1 \times 10^{15}\ cm^{-3}$

$\tau_{E0} = 1 \times 10^{-8}\ s$ $\quad x_B = 0.70\ \mu m$

$\tau_{B0} = 5 \times 10^{-8}\ s$ $\quad x_E = 0.80\ \mu m$

$\tau_{c0} = 1 \times 10^{-7}\ s$ $\quad V_{BE} = 0.60\ V$

$J_{r0} = 3 \times 10^{-8}\ A/cm^2$ $\quad V_{cE} = 5.0\ V$

Calculate
(i) The currents J_{nE}, J_{pE}, J_{nC} and J_R
(ii) The current gain factors γ, α_T, δ, α and β

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

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Date: October 22, 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. 2017-2018
Time: 3 Hours
Full Marks: 150

There are **8 (eight)** questions. Answer **question no. 1** and any **5 (five)** questions from remaining seven questions. All question carry equal marks. Marks in the margin indicate full marks. Programmable calculators are not allowed. Do not write on this question paper. **Open book examination (Hand-written contents on the book is allowed)**.

Question No. 1 is compulsory

1. Design (circuit diagram) a microcontroller (AT89S52) based system in which the following peripherals are interfaced according to the given specifications. [6+4+4+4+4+3]
   i. Two 8255s' are needed to be interfaced with the following addresses 20H-23H and 30H-33H. Address aliases not allowed.
   ii. 16x2 LCD has to be connected to first 8255 using Port A and Port B.
   iii. Unipolar stepper motor should be interfaced to Port C of first 8255 using ULN2803.
   iv. Interrupt (INT0) based 4x4 matrix keypad should be interfaced to the microcontroller using Port 1 and Port 2.
   v. Handshake enabled temperature sensor (LM35) needs to be connected through ADC0804 using Port A and Port B of second 8255.
   vi. Four LEDs and four switches need to be connected respectively to upper and lower portion of Port C of second 8255.

2. a) Is it possible to use I2C bus protocol based EEPROM as program memory? Justify your answer. [5]

   b) Based on the design of Question No. 1, write the program for interrupt driven keypad recognition. The pressed key should be displayed on LCD. [20]

3. Write a software interface for the system designed in Question No. 1 that will ask for user name and password at system boot-up. After validation of user name (EEE2015) and password (B15), system will operate with different peripherals as per following button press. [25]

Button	Task	Code Memory Location
1	Temperature sensing and display	0030h
2	Stepper motor control	0034
3	RTC Clock Display	0038
4	Calculator	003C
5	Bi-directional control of DC motor	0040

Only use the sub-routine names for the aforementioned tasks.

4. a) Explain how a RAM can be used as program memory. [05]

   b) Write a program to rotate the stepper motor by a specific angle to be entered through the keypad. Assume the step angle of the stepper motor is 1.5 degree. [20]

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5. a) Differentiate between memory mapped I/O and direct I/O. Which peripherals of question no. 1 are memory-mapped I/O and which are direct I/O? [05]

   b) Write a program to display time in LCD using Timer 1 of AT89S52. Explain how the clock differs from real time clock. [20]

6. Design (circuit diagram) an interrupt based system that can be used to measure the width of a pulse, which can be used either to design a power factor meter or an LC meter. Write a program to measure the pulse width. [25]

7. a) Explain signal conditioning with example. [5]

   b) Why is interrupt better than polling? [5]

   c) Write a program to turn on specific LED connected to Port C of second 8255 based on following condition: [15]

Temperature	LED
$T < 23^0$	Bit 4 of Port C
$23^0 \leq T < 27^0$	Bit 5 of Port C
$27^0 \leq T \leq 33^0$	Bit 6 of Port C
$T < 33^0$	Bit 7 of Port C

8. a) Mention the advantages of LCD over seven segment display. [5]

   b) Design a system for bidirectional PWM based control for a DC motor connected through opto-isolator and L293D to the Port 3 of AT89S52. Use switches connected to the Port C of second 8255 for directional (clockwise/anticlockwise) and PWM control (25%, 50% and 75%). Write corresponding program. [20]

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B.Sc. Engg. (EE)/HDEE, 6th Sem. Date: October 24, 2018 (Morning)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination — Summer Semester, A. Y. 2017-2018
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? 08

   b) Derive the following expression of the most economic power factor for a consumer considering kW demand constant where φ_2 has its usual meaning. 07

$$cos\varphi_2 = \sqrt{1 - sin^2\varphi_2}$$

   c) The daily demands of three consumers are given below: 10

Time	Consumer 1	Consumer 2	Consumer 3
12 A.M to 8 A.M	No Load	200 W	No Load
8 A.M to 2 P.M	600 W	No Load	200 W
2 P.M to 4 P.M	200 W	1000 W	1200 W
4 P.M to 10 P.M	800 W	No Load	No Load
10 P.M to 12 A.M	No Load	200 W	200 W

   Draw the daily load curve and find (i) load factor of individual consumer (ii) diversity factor (iii) load factor of the station (iv) utilization factor.

2. a) Define three - part tariff. Write the different characteristics of tariff. 06

   b) State Kelvin's law related to the most economical size of a conductor. Plot the graphical representation of the law. Prove that the most economic conductor size is obtained whenever the variable part of annual charge equals the cost of energy losses in the year. 09

   c) A factory takes a load of 200 kW at 0.85 (lagging) power factor for 2500 hours per annum. The tariff is Tk. 150 per kVA plus 5 paisa per kWh consumed. If the power factor is improved to 0.9 (lagging) by means of capacitors costing Tk. 420 per kVAR and having a power loss of 100 W per kVA then calculate the annual savings due to power factor improvement. Allow 10% per annum for interest and depreciation. 10

3. a) Define steady state stability of a motor-drive system. Derive the small signal model of an equivalent rotational system of a motor-load system and prove that any small change in speed can be represented by the following equation: 10

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

   b) What is meant by electrical drives? A motor-driven pulley system is carrying a cage of 5 kg at one end of a rope and the other end is counter balanced by a weight of 10 kg. Determine the operating mode of the motor-driven pulley if the cage is loaded with 3 kg and it is 09

desired to move the cage (i) up and (ii) down by the motor. Draw the figure and show the direction of movement (speed) of the motor, the torque directions and the quadrant of operation in these two cases.

c) Draw and explain the block diagram of an electric drive system. 06

4. a) Define regenerative and rheostatic braking. Derive the expression of braking torque of D.C series motor for rheostatic braking with proper diagram. 09

b) Draw the trapezoidal speed-time curve of electric traction system and derive the expression of crest speed, V_m. 10

c) A suburban electric train has a maximum speed of 65 km/hr. The schedule speed including a station stop of 30 seconds is 43.5 km/hr. The acceleration is 1.3 km/hr/s and the average distance between two stops is 3 km. Determine the value of retardation. 06

5. a) What are the different types of motor ratings used in industries? Define cooling time constant of a motor. Derive the expression of temperature rise of a motor due to heating. 15

b) The following temperature variations are observed in the temperature rise test of a DC motor. 10
After 1 hour : 15° C
After 3 hours : 25° C
Find out (i) the final steady temperature rise and rise time constant of the motor
(ii) the steady temperature rise after 1 hour at 60% overload, from cold. Assume that the final temperature rise on 50% overload is 70° C.

6. a) Why does the automotive engine require a starting motor? Explain the starting motor mechanism of an automotive starting system with proper diagrams. 08

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 of starting system. 10

c) Draw a neat diagram of an air conditioner electrical circuit and discuss the operation. 07

7. a) Describe the vapor compression cycle of a refrigeration system with neat diagram. 10

b) Draw the electric circuit of a refrigeration system and explain the operation of different components of that circuit. 10

c) What do you mean by ton in refrigeration system? What are the different properties of refrigerants? 05

8. a) Derive the expression of dielectric loss in a dielectric material due to heating when subjected to high frequency AC supply. Draw the circuit configuration of the high frequency power supply required for dielectric heating and explain its operation. 10

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 and a power factor of 0.05. 09

c) Define different types of illumination. 06

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B.Sc. Engg. (EE)/HDEE, 6th Sem. Date: October 26, 2018 (Morning)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination — Summer Semester, A. Y. 2017-2018
Course No.: EEE 4631 — Time: 3 Hours
Course Title: Renewable 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. A list of required formulae is provided at the end of the question.

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1. a) State the Stefan-Boltzman law of radiation and Wein's displacement rule for maximum wavelength. Show the variation of solar intensity with respect to change in wavelength and temperature. How does the maximum solar intensity vary with the change in wavelength? 07

   b) Define air-mass ratio. How is this ratio expressed for a flat earth surface? Determine the value of air-mass ratio with the sun positioned directly overhead. 05

   c) How does the distance between the earth and the sun vary throughout a year? Depending on that, find out the distances between them on autumnal equinox, vernal equinox, summer solstice and winter solstice for northern and southern hemispheres. 13

2. a) Define solar declination angle. Does it remain fixed throughout a day (24-hour period)? Compute this angle for the 20th day of each month of the year 2020. 10

   b) Explain the concept of altitude and azimuth angles with neat diagrams. How are those related with hour angle of a certain location? Show the difference between sun's meridian and local meridian with a neat diagram. 07

   c) Calculate the clock time for solar noon in N'Djamena (longitude 15.045° W) on July 1st. The local time meridian for N'Djamena is 15°. 08

3. a) Distinguish among different components of solar radiation incident on the earth's surface. Which one of those is negligible? Mention the reason. 07

   b) Define optical depth. A south-facing collector at latitude 40° is tipped up at an angle equal to its latitude. Compute the followings for January 31st at solar noon: i) The direct beam insolation normal to the sun's rays. ii) Beam insolation on the collector. iii) Diffuse radiation on the collector. iv) Reflected radiation on the collector with ground reflectivity 0.2. 12

   c) What is the necessity of a solar tracking system? Explain different kinds of solar tracking system in short. Which one of them should yield higher output? Justify your answer. 06

4. a) What is solar constant? How does the band gap of a semiconductor material affect the photovoltaic efficiency? Explain in brief. Mention the factors responsible for reduction in the theoretical efficiency of a solar cell. 10

b) A PV module is made up of 48 identical cells, all wired in series. With 1-sun insolation, each cell has short-circuit current $I_{sc} = 4.5$ A at 25°C. Its reverse saturation current is $I_0 = 2\times 10^{-10}$ A. Parallel resistance $R_P = 6\ \Omega$ and series resistance $R_S = 0.003\Omega$. i) Find the voltage, current, and power delivered when the junction voltage of each cell is 0.48 V. ii) Prepare a spreadsheet for I, V and P. Consider an array of V_d = [0.45: 0.01: 0.50] for your calculation in part (ii). Identify the maximum module power for this range of V_d. 15

5. a) Discuss the necessity of maximum power point tracking for a photovoltaic system. How does a dc-dc converter help in achieving this sort of tracking? 07

b) What is net-metering? How is it different from conventional metering system? The daily load profile of a domestic consumer along with the output of a rooftop solar PV system is shown in Figure 5 (b). Considering net-metering system is being installed for the consumer, identify the duration of the day where the meter deflection will be positive and negative. 06

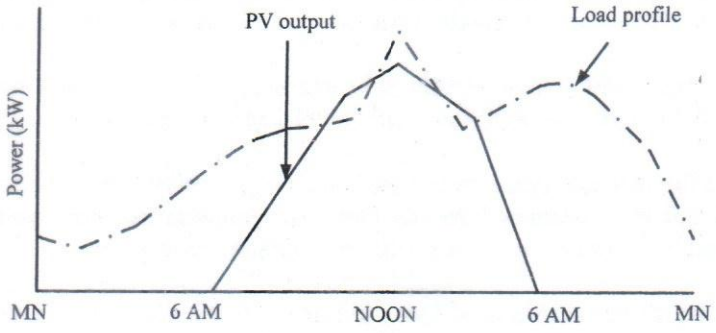

Figure 5 (b)

c) An energy efficient house in Dhaka (23.81° N) is to be fitted with a rooftop PV array that will annually displace all of the 4800 kWh/year of electricity that the home uses. The PV collector is titled at an angle 10° from the latitude (L-10). The average annual solar insolation of the location is 5.1 kWh/m^2. Consider dc to ac conversion efficiency of 75% and collector efficiency of 14%.How many kW (dc, STC) of panels will be required and what area will be needed? 06

d) Explain the reason for output power reduction from a PV cell for increased temperature with relevant mathematical expressions. 06

6. a) Distinguish between horizontal axis wind turbine and vertical axis wind turbine with neat diagrams. 05

b) Compare the energy at 15° C,1 atm pressure, contained in 1 m^2 of the following wind regimes: 08
i) 90 hours of 8 m/s winds, ii) 30 hours at 4.5 m/s plus 50 hours at 11 m/s.

c) State Betz law for wind power generation. A 45-m, 3 bladed wind turbine produces 700 kW at a wind speed of 12 m/s. Air density is the standard 1.225 kg/m^3. Under these conditions, 12
i) At what rpm does the rotor turn when it operates with a Tip-Speed Ratio (TSR) of 3.0?
ii) What is the tip speed of the rotor?
iii) If the generator needs to turn at 1500 rpm, what gear ratio is needed to match the rotor speed to the generator speed?
iv) What is the efficiency of the complete wind turbine (blades, gear box, generator) under these conditions?

7. a) What is a fixed speed wind generation system? Why is it named so? Which type of generator is used for this system? What are the other types of generators used for wind energy conversion system (WECS)? Draw the schematic diagrams of different WECSs showing relevant components. 10

b) An example of wind speed measurement at a certain site is listed in Table 7(b). Draw the discrete histogram and find the average wind speed and the average power in the wind (W/m^2). Assume the standard air density of 1.225 kg/m^3. 15

Table 7(b): Wind speed vs Hours/year

Wind speed, v (m/s)	Hours/ year	Wind speed, v (m/s)	Hours/ year
0	24	13	243
1	278	14	170
2	529	15	113
3	729	16	74
4	869	17	46
5	941	18	28
6	946	19	16
7	896	20	9
8	805	21	5
9	690	22	3
10	563	23	1
11	442	24	1
12	336	25	0

8. a) Define cut-in, cut-out and rated speed for wind turbine. Mention the basic differences between pitch-control and stall-control mechanism for wind turbine blades. Which one of this is termed as active control? Explain in short. 07

b) The Weibull probability density function (PDF)for a wind profile at a certain site is expressed as $f(v)=\frac{k}{c}\left(\frac{v}{c}\right)^{k-1}\left\{\exp\left[-\left(\frac{v}{c}\right)^{k}\right]\right\}$. What will be the corresponding expression for Rayleigh PDF? How does the Rayleigh approximation help in calculating the average wind power? Show the variation of Rayleigh PDF with different values of 'c'. What information could be extracted regarding the average wind speed from this variation? 08

c) What is a wind park? How does the array efficiency get affected due to unplanned spacing of wind turbines in a wind park? A NEG Micon 1500/60 wind turbine (1500-kW rated power, 60-m-diameter rotor) has a cut-in wind speed = 5 m/s, rated wind speed = 15 m/s, and a cut-out wind speed = 26 m/s. If this machine is located in Rayleigh winds with an average speed of 11 m/s, find the following: i) How many h/yr is the wind below the cut-in wind speed? ii) How many h/yr will the turbine be shut down due to excessive winds? 10

Formula:

$$d = 1.5\times10^{8}\left\{1+0.017\sin\left[\frac{360(n-93)}{365}\right]\right\}$$

$$\delta = 23.45\sin\left[\frac{360}{365}(\mathrm{n}-81)\right]$$

$$B = \frac{360}{364}(n-81)$$

$$E = 9.87\sin 2B - 7.53\cos B - 1.5\sin B$$

$$CT = ST - 4(\mathrm{min}/^{\circ})(Local\ time\ meridian - Local\ longitude) - E(\mathrm{min})$$

$$I_0 = 1370\left[1+0.034\cos\left(\frac{360n}{365}\right)\right]$$

$$m = \frac{1}{\sin\beta}$$

$$I_B = Ae^{-km}$$

$$A = 1160 + 75\sin\left[\frac{360}{365}(\mathrm{n}-275)\right]$$

$$k = 0.174 + 0.035\sin\left[\frac{360}{365}(\mathrm{n}-100)\right]$$

$$I_{BC} = I_B\cos\theta$$

$$\cos\theta = \cos\beta\cos(\phi_s - \phi_c)\sin\Sigma + \sin\beta\cos\Sigma$$

$$I_{BH} = I_B\sin\beta$$

$$I_{DH} = CI_B$$

$$C = 0.095 + 0.04\sin\left[\frac{360}{365}(n-100)\right]$$

$$I_{DC} = I_{DH}\left(\frac{1+\cos\Sigma}{2}\right)$$

$$I_{RC} = \rho I_B(\sin\beta + C)\left(\frac{1-\cos\Sigma}{2}\right)$$

$$I = I_{SC} - I_0\left\{\exp\left[\frac{q(V+IR_s)}{kT}\right]-1\right\} - \frac{(V+IR_s)}{R_P}$$

$$T_{cell} = T_{amb} + \left(\frac{NOCT - 20^{\circ}}{0.8}\right).S$$

$$P_{ac} = P_{dc,\mathrm{STC}}\times(Conversion\ Efficiency)$$

$$Energy(\mathrm{kWh/\ day}) = Insolation\left(\frac{kWh/m^2}{day}\right).A(\mathrm{m}^2).\overline{\eta}$$

$$P_w = \frac{1}{2}\rho A v_w^3$$

$$P_b = \frac{1}{2}\rho A v^3.C_p$$

$$TSR = \frac{Rotor\ Tip\ speed}{Wind\ speed}$$

$$\overline{P} = \frac{6}{\pi}\frac{1}{2}\rho A\overline{v}^3$$

$$v_{avg} = \sum_i\left[v_i.(Fraction\ of\ hours@v_i)\right]$$

$$probability(v_1 \le v \le v_2) = \int_{v_1}^{v_2} f(v)dv$$

$$F(\mathrm{V}) = prob(v \le V) = 1 - \exp\left[-\left(\frac{V}{c}\right)^k\right]$$

$$F(\mathrm{V}) = prob(v \ge V) = 1 - \left\{1 - \exp\left[-\left(\frac{V}{c}\right)^k\right]\right\}$$

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B.Sc. Engg. (EEE), 6th Sem. Date: October 26, 2018 (Morning)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination — Summer Semester, A. Y. 2017-2018
Course No.: EEE 4651 — Time: 3 Hours
Course Title: Data Communication & 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. All symbols bear their usual meaning. Assume reasonable values for missing data.

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1. a) Draw IEEE 802.11 reference model including user, control and management plane. Define and explain BSS, IBSS and coordination function in terms of IEEE 802.11 architecture. 7+8

   b) Compare between the service categories of IEEE 802.11. What are the functionalities of PLCP and PMD in IEEE 802.11 frame formatting. 5+5

2. a) What is interframe space? Mention slot time, SIFS, PIFS, DIFS, EIFS period in μs for IEEE 802.11. How is EIFS different from DIFS? 2+5+3

   b) Explain the backoff and post-backoff procedure in IEEE 802.11 based collision avoidance scheme. What is contention window? Why does the channel wastage grow with smaller packets and higher bitrates? 7+2+2

   c) What is the maximum length of MSDU? Define fragmentation and defragmentation process. 1+3

3. a) Mention the functionalities of TSF under synchronization and cell search. What is TBTT? How does it affect beacon transmission by AP during channel idle state? 3+2+3

   b) State the service type of PCF and DCF (i.e. whether they provide contention or contention free service). What is superframe? Differntiate between CFP and CP. 2+2+3

   c) List some similarities and differences between MANET and WSN. 5+5

4. a) What is CGSR AdHoc Protocol? Differentiate between DSR and AODV protocols. Prepare a comparative analysis between cellular and AdHoc wireless network. 4+6+7

   b) Give two examples of hybrid wireless network and mention its advantages. Define wireless mesh network. 3+3+2

5. a) Define and compare homogeneous and heterogeneous WSNs. 6

   b) Explain Adaptive Modulation and Coding (AMC) in WiMAX through allocation of 64-QAM and BPSK. Why is IEEE 802.16 termed as connection oriented technology? 4+2

   c) How is bluetooth piconet formed? Explain spread spectrum frequency hopping and its effect in bluetooth. Prepare a comparative analysis among LAN, WAN and MAN. 6+7

6.	a)	Define and explain delay tolerant network (DTN). How does it work? What are the challenges of DTN?	13
	b)	How is self organizing network (SON) different from conventional networks? How does Vehicular AdHoc Network (VANET) work?	12
7.	a)	Describe and show a nuts and bolts view of Internet. Why is Internet called network of networks?	10
	b)	Define protocols and standards in terms of a computer network. Show how data pass through different layers in a computer network (five layer system) while traveling from source to destination.	3+7
	c)	Suppose we are trying to take a closer look at the network structure. How will you define network edge, network core and access network?	5
8.	a)	Define routing metric. How can you calculate link ETX, route ETX and ETT?	3+10
	b)	Define and explain CSMA/CD. How can we imitate this in wireless environment?	12

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

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Date: October 24, 2018 (Morning)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination
Course No.: EEE 4641/ EEE 4697
Course Title: Cellular Communication

Summer Semester, A. Y. 2017-2018
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) For both uplink and downlink data transfer, write down the names of the physical channels which carry HARQ ACK/NACK. How many times can the data be retransmitted in HARQ operation in LTE? How many HARQ operations can run in parallel and why is this number of parallel operations chosen? 10

   b) What is the purpose of PCFICH? What is the advantage of the variable size of the control region? 5

   c) The radio frames are numbered using SFN and the subframes are numbered from 0 through 9. On subframe 4 of a radio frame with SFN 750, the PDCCH allocates both uplink and downlink resources. Because of the poor radio link, all three HARQ retransmissions have occurred for both uplink and downlink. For downlink data transfer, all retransmissions have used the gap of 6 subframes instead of 4. For both uplink and downlink, determine the subframe number and radio frame SFN, on which the last retransmissions have occurred. 10

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. Write down the cases in which the extended cyclic prefix may be used. 8

   b) How can the uplink synchronization be lost? What type of transmission can the UE do after it loses the uplink synchronization? Why is the maximum value of timing offset on the Timing Advance Command of MAC RAR is set to 0.67 ms? 9

   c) A UE is 3 km away from eNodeB. Determine the value of timing offset. 8

3. a) Explain the difference between the functions of Scheduling Request (SR) and Buffer Status Report (BSR). How can a good receiver of UE send higher Channel Quality Indicator (CQI) level? 8

   b) Explain how semi-persistent scheduling is used, which applications are suitable for it and how the PDCCH instance indicates that it has been used. What is the drawback of redirection procedure in CSFB? 10

   c) Mention when non-contention based random access procedure is usually used? Describe briefly the first two steps of contention based random access procedure. 7

4. a) State how the UE can determine that a Tracking Area Update (TAU) is required. Explain the advantage of overlapping of areas covered by different tracking area identity (TAI) lists. Based on the relationship between MME group and TAI list, state how the support of MMEs changes with the movement of the UE. 10

b) If the UE is moving through many tracking areas, how often its S-TMSI may change? 6

c) Explain the use of inactivity timer, short cycles and long cycles for discontinuous reception (DRX) in RRC_CONNECTED state. What are the advantage and disadvantage of longer DRX cycle in RRC_CONNECTED state? 9

5. a) Briefly describe the EPS Authentication and Key Agreement (EPS AKA) procedure. 8

b) What is the difference between ciphering and integrity protection? Mention which type of information uses ciphering but not integrity protection. 7

c) What are the two possible lengths of PDCP Sequence Number (SN) for RLC UM? Why is there the provision for two different lengths? How does Hyper Frame Number (HFN) change in COUNT? When is SRB0 used? 10

6. a) What is the use of P-RNTI? Why does the paging message normally use S-TMSI instead of IMSI? When may the paging message use IMSI? What is the advantage of grouping users in the cell for paging? 10

b) Write down the relationship between DRX cycle of RRC_IDLE state and paging cycle. Is it possible to have paging in RRC_CONNECTED state? 5

c) The paging uses DefaultPagingCycle = 256, NB = 1/16. The IMSI of a user is 10248. Determine the number of radio frame that the UE monitors in the DRX cycle. Also, determine the gap between two paging frames transmitted by the eNodeB. 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. Write down the difference in handover procedure between RLC AM and RLC UM cases for LTE. 8

b) When is C-RNTI assigned to a UE? If the UE is moving through many cells, how often the C-RNTI may change? Show which parts of GUTI are used to construct S-TMSI. 7

c) Justify the requirement of Q_{Hyst} and $T_{reselection}$ in triggering a cell reselection. A UE is served by LTE and there is a UMTS cell, which has a priority lower than the LTE cell. The S_{rxlev} of the UMTS cell exceeds $Thresh_{XLow}$ at time 9:40:15 am. The S_{rxlev} of the LTE cell falls below $Thresh_{ServingLow}$ at time 9:45:30 am. TreselectionRAT is 6 seconds. Determine the time instant when a cell reselection occurs. 10

8. a) Which TCP releases are used by default in Microsoft Windows and in Linux? How does TCP detect whether or not a duplicate packet has arrived? Explain the slow start procedure. 10

b) Assume that all bytes are sequentially numbered in TCP buffers. The buffer on the receiving side can accommodate a maximum of 1024 bytes. The congestion window size is 512 bytes. The sequence numbers of different parameters for the buffers are LastByteRead = 394, LastByteRcvd = 765, LastByteSent = 1034, LastByteAcked = 880. Determine the effective window size for transmission. 10

c) How many data radio bearers can be supported simultaneously in LTE? When are separate bearers required? 5

B.Sc. Engg. (EE), 8th Sem.
B.Sc.TE (2Yr), 4th Sem.
B.Sc.TE (1Yr), 2nd Sem.

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Date: October 31, 2018

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination
Course No.: EEE 4803/ EEE 4895
Course Title: Power Station

Summer Semester, A. Y. 2017-2018
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. Use graph papers where necessary.

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1. a) A 100 MW generating station system experiences changes in load such that its daily load curve is described as in Table 1(a). 20

Table 1(a): Hourly load variation for a day

Time	MW	Time	MW
00:00 / 12:00 (Midnight)	20	12:30 P.M.	40
2 A.M.	10	1 P.M.	50
6 A.M.	10	5 P.M.	50
8 A.M.	50	6 P.M.	70
11 A.M	50	00:00 / 12:00 (Midnight)	20

i. Plot the chronological load curve and load-duration curve for the system.
ii. Plot the load-energy curve for the system.
iii. Find the load factor, capacity factor and utilization factor.
iv. What would be the load factor if there is load shedding during 8:00 AM – 11:00 AM on that day?

b) Write down the significance of group diversity factor and utilization factor. 5

2. a) Obtain the locus for the upper limit of average input for a load factor of 75% and varying capacity factor. Assume that the plant operates within 10% to 100% maximum load of the capacity. 10

b) Write down the rules of capacity scheduling. The capacities and order of efficiency of a six unit power station is presented in Table 2(b). Prepare a capacity scheduling chart including spinning reserve 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? 15

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) A new housing development is to be added to the lines of a public utility. There are 1,000 apartments, each having a connected load of 4 kw; the characteristics of the commercial loads are given in Table 3(a): 15

Table 3(a): Characteristics of commercial load.

Services	Connected Load (kw)	Demand Factor (%)
1 laundry	20	68
2 churches	10 each	56
1 herfy	60	52
1 bookstore	5	66
1 gymnasium	7	76
2 drugstores	10 each	79
2 grocery stores	5 each	73
1 shoe store	2	67
1 clothing store	4	53
1 cineplex	100	49

The demand factor of the apartments is 45%. The GDF of the residential load for this system is 3.5, and the PDF is 1.4. The commercial load GDF is 1.5 and the PDF is 1.1. Find the increase in peak demand on the total system delivery from the station bus resulting from addition of this development on the distribution system. Assume line losses at 5% of delivered energy.

b) Prove that $I' = \left[I_a - \frac{L_a(I_b - I_a)}{L_b - L_a} \right] + \left[\frac{I_b - I_a}{L_b - L_a} \right] L'$ 10

where I' =average input rate for total period of t hr.

L' =average load for total period of t hr.

I_a =instantaneous input rate for instantaneous output of L_a.

I_b =instantaneous input rate for instantaneous output of L_b.

t_a =hours of operation at load L_a.

t_b =hours of operation at load L_b.

4. Turbo-generator units A and B, each of 10 MW capacity, have the following input-output characteristics: 25

Unit A : $I_a = 12 + 1.9L_a + 0.1L_a^2$

Unit B : $I_b = 20 + 1.1L_b + 0.2L_b^2$

i. If either unit were to be placed in operation alone, which unit should be selected? Justify your answer?

ii. Plot the incremental rates of units A and B and their combined incremental rate curve in the same graph paper.

iii. What should be the load division schedule for a total demand of 12 MW?

5. a) A pumping station has 3×5 MW units, each having an unavailability of 0.03 and 4×3.33 MW units, each having an unavailability of 0.02. Generate the combined COPT and final COPT for reliability evaluation.

b) Describe the various components of a Hydroelectric power plant. Mention its advantages and disadvantages. 10

6. a) A generating plant is to be designed to satisfy a constant 20 MW load. Four alternatives are being considered: 20

   i. 1×20 MW unit
   ii. 2×15 MW units
   iii. 3×10 MW units
   iv. 4×6.66 MW units.

   The probability of unit failure is assumed to be 0.04.

   Generate the COPT, ELL, LOLP and LOLE in days per year and comment which alternative should be chosen if priority is given on avoiding maximum outage. Explain your choice.

   b) Explain pondage and water hammer. How many types of hydro power plants are there? 5

7. a) A common form of residential rate appears as follows: 15

   Demand:
   First kw of maximum demand at $6 per kw per month.
   Next 4 kw of maximum demand at $5 per kw per month.
   Excess over 5 kw of maximum demand at $4 per kw per month.

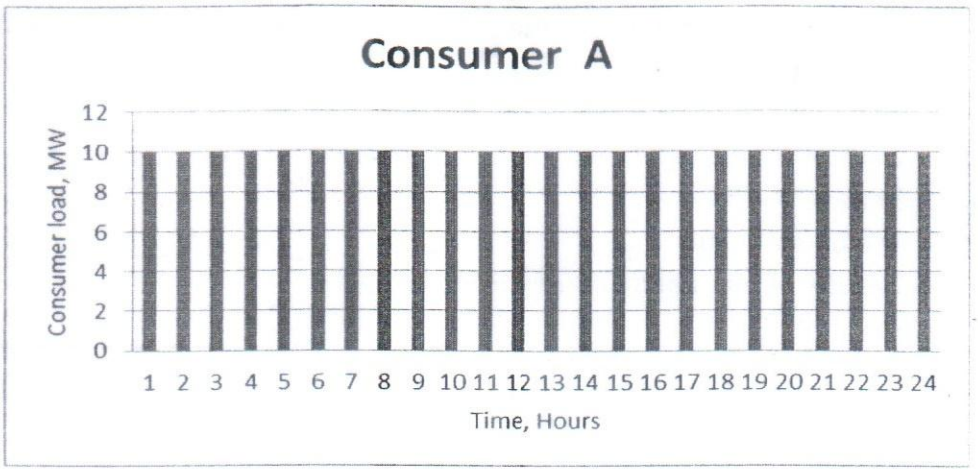
   Energy:
   First 50 kwhr at 6 cents per kwhr.
   Next 50 kwhr at 4 cents per kwhr.
   Next 200 kwhr at 3 cents per kwhr.
   Next 400 kwhr at 2.5 cents per kwhr.
   Excess over 700 kwhr at 2 cents per kwhr.

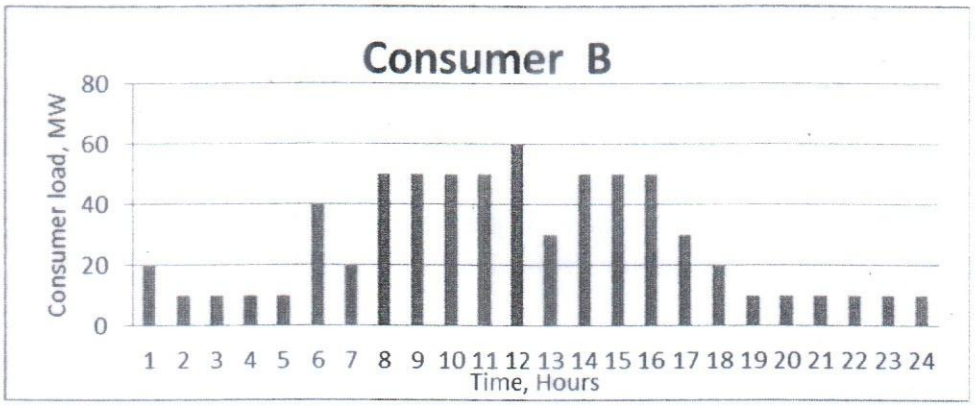
   i. Compute the total bills and average unit cost using block meter rate for consumption of 100, 250, 600 and 900 kwhr.
   ii. Compute the total monthly bill and average unit cost using Hopkinson demand rate for a total consumption of 1500 kwhr and a maximum demand of 12 kw.
   iii. If the month contains 30 days, what is the lowest possible bill for the given energy consumption in part (b)? Compute the corresponding unit energy cost.

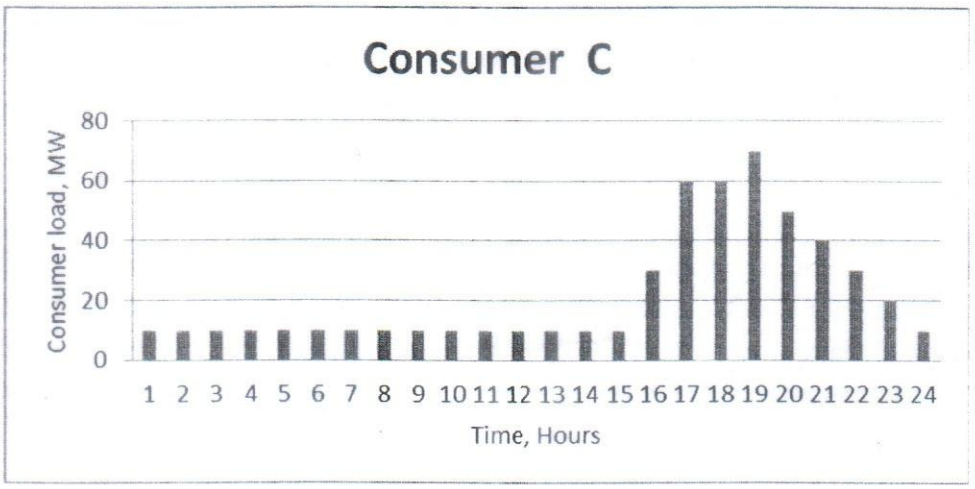
   b) Explain any five energy rates. 10

8. a) What is meant by *maximum demand* of a plant? Can it be higher than the plant capacity? How would you supply power to the loads if the demand goes beyond the plant capacity? 5

   b) The daily load variation of four different consumers connected to a central power station is shown in Figure 8(b). Compare the annual allocation of fixed charges to different consumers based on peak responsibility allocation, noncoincident-demand allocation and two-element methods. Given an annual fixed charge of $15,00,000 has to be recovered. 20


Consumer A
Consumer load, MW
0
2
4
6
8
10
12
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Time, Hours


Consumer B
Consumer load, MW
0
20
40
60
80
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Time, Hours


Consumer C
Consumer load, MW
0
20
40
60
80
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Time, Hours

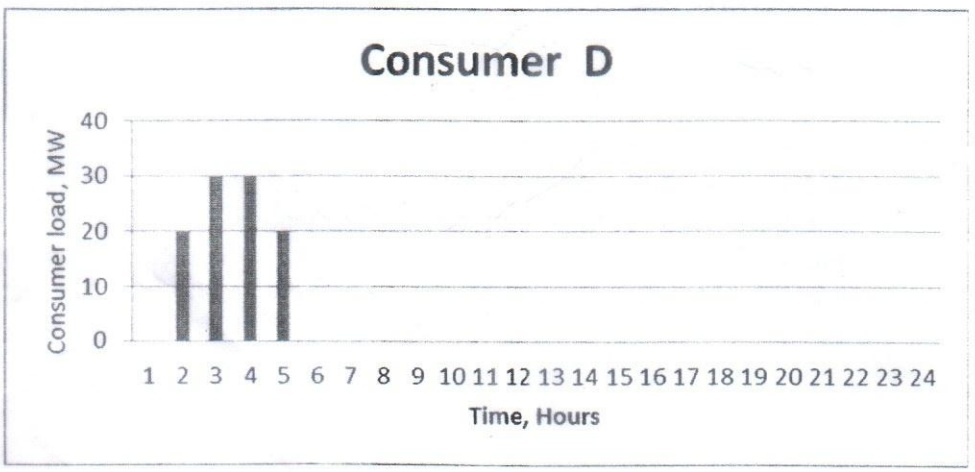

Consumer D
Consumer load, MW
0
10
20
30
40
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Time, Hours

Figure 8(b)

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B.Sc. Engg.(EE), 8th Sem., B.Sc.TE(2-Yr), 4th Sem. Date: October 22, 2018 (Morning)

B.Sc.TE(1-Yr), 2nd Sem.

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

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

Summer Semester, A.Y. 2017-2018
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 carry their usual meanings.

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1. a) What is meant by energy conversion? Give any 4 (four) examples for direct and indirect energy conversion process. 5

   b) Electromechanical energy conversion involves energy in four forms. State the relation among these forms for motor action. 5

   c) What is the physical significance of co-energy? Show that, $W_{fld} = \int_0^{\lambda} i(\lambda)d\lambda = \int_0^{\varphi} F(\varphi)d\varphi$. 5

   d) In an electromechanical energy conversion device show that $dW_{elec} = eidt$. 5

   e) Determine the energy of a photon having wavelength of 0.708×10^{-8} cm. 5

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

   b) Define leakage and magnetizing inductance with appropriate figure. 5

   c) Write down the total primary and secondary flux linkages in terms of leakage and magnetizing inductances. 5

   d) Draw a doubly excited magnetic system with rotor and stator and write down the equations of e_1 and e_2. 5

   e) Assume that the functional relationship of mmf F, flux ϕ, and the position coordinate x is given by $F = \phi^2 x^2$. Find the mechanical force f acting in the x direction using the co-energy expression. 5

3. a) In electric field and magnetic field quantities what are the duals of each other write down with appropriate units. 5

   b) In an electrostatic field in which condition the field energy and co-energy are equal. 5

   c) What happened in a singly excited magnetic system during the transient period while the armature is moving? 5

d) In an electromagnetic circuit show that, $L = \frac{N^2 \mu_0 A_c}{g}$. 5

e) A bus having a mass of 6000 kg moves at a speed of 100 km/h. If it carries 40 passengers having a total mass of 2400 kg, calculate the total kinetic energy of the loaded vehicle. What happens to this energy when the bus is braked to a stop? 5

4. a) Briefly discuss about the statement "Solar PV system is very modular". 5

b) What are the two main parameters of solar cell technology? What are the typical wattages of the PV modules available in the market? 5

c) A solar PV system design can be done in four steps, what are these steps? 5

d) What are the losses from solar thermal energy systems that limit their efficiency? 5

e) Calculate the power available in the wind flowing with velocity 5.4 mps for a horizontal axis wind machine having rotor diameter of 60 m.

5. a) What is solar PV? Draw a typical structure of a solar cell. 5

b) Why usually the actual output power from a PV module is less than its rated power? 5

c) Where solar PV modules can be used without a battery and an inverter? Justify your answer. 5

d) Is it possible to generate 1000,000 Watt power using solar PV modules? Justify your answer 5

e) How much power will be produced by a 0.5 m^2 area PV module with an efficiency of 13%? 5

6. a) What are the sources of heat energy? Which one is the clean energy option to us and why is it so? 5

b) Define concentration ratio. In what context, concentration ratio is used in solar thermal technologies? 5

c) What are the types of the solar cooker available and how much temperatures attain by these? 5

d) Briefly discuss the types of biomass and their applications. 5

e) For community-based solar cooker system installed at a hostel in a school, total investment required was Tk. 80000. The usage of solar cooker reduced the LPG cylinder consumption by 36 (thirty six) cylinders per year. Calculate simple payback period, if the price of an LPG cylinder is Tk. 1500. 5

7. a) Define coefficient of performance for a wind machine. How is the coefficient of performance different from the capacity factor of the wind machine? 5

b) What is the trade-off for choosing a variable speed and a constant speed wind turbine? 5

c) Name the five different parts of a typical speed/time curve for electric trains operating on passenger services. 5

d) Through photosynthesis process, biomass helps in balancing the CO_2 in the atmosphere. Explain it. 5

e) A train has schedule speed of 60 kmph between the stops which are 9 km apart. Determine the crest speed over the run, assuming trapezoidal speed/time curve. The train accelerates at 3 km/h/s and retards at 4.5 km/h/s. Duration of stops is 75 seconds. 5

8. a) What is electric traction? Mention the advantage and disadvantage of electric traction. 5

b) What is the difference between drag force and lift force based wind machine? 5

c) Draw a schematic diagram of a biogas plant and write the three processes that take place in biogas formation. 5

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

e) An atomic power reactor can deliver 300 MW. If the energy released is 200 MeV due to fission of each atom of uranium ($_{92}U^{235}$), calculate the mass of uranium fissioned per hour. 5

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B.Sc. Engg. (EE), 8th Sem. Date: October 26, 2018 (Morning)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid-Semester Examination — Summer Semester, A.Y. 2017-2018
Course No.: EEE 4831 — Time: 3 Hours
Course Title: Semiconductor Devices — 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 meaning. Assume appropriate values for any missing data. Properties table for silicon is added for your convenient.

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1. a) With the help of Balmer series as well as the radius of hydrogen atom, prove that, 10

$$cR = \frac{mq^4}{2k^2\frac{h}{4\pi^2}}$$

Here, c is the velocity of light; R is the Rydberg's constant; m and q are the mass and charge of electron; h is the Planck's constant; and $k = 4\pi\epsilon_0$.

b) Calculate the minimum uncertainty of momentum for an electron having a position within 1 $\AA$. Also calculate the minimum uncertainty of energy for the same particle if the time of energy measurement is $3.3 \times 10^{-18}\ s$. 3+3=6

c) What is the de Broglie wavelength (in $\AA$) of an electron at 100 eV ? What is the wavelength for electrons at 12 keV, which is typical of electron microscopes? Comparing this to visible light, comment on the advantages of electron microscopes. 3+3=6

d) The work function of platinum (Pt) is 4.09 eV. What retarding potential will be required to reduce the photocurrent to zero in a photoelectric experiment with Pt electrodes if the wavelength of incident light is 2440 $\AA$? 3

2. a) A hypothetical semiconductor has an intrinsic carrier concentration of 1.5×10^{10} atoms/cm^3 at 300 K, it has conduction and valence band effective densities of states N_c and N_v, both equal to 10^{19} atoms/cm^3. The value of Boltzmann constant is 1.38064852×10^{-23} JK^{-1}. 3+5+5=13

   i. What is the band gap E_g (in term of eV)?
   ii. If the semiconductor is doped with 10^{17} As atoms/cm^3. What is the equilibrium hole and electron concentration? Where is E_F relative to E_i?
   iii. If the same piece of semiconductor, already having 10^{17} As atoms/cm^3, is also doped with $N_a = 2 \times 10^{17}$ acceptors/cm^3, what are the new equilibrium electron and hole concentrations at 300 K? Where is E_F relative to E_i?

b) At room temperature, an unknown indirect band gap, intrinsic, cubic semiconductor has the following band structure: there are 6 X minima along the (100) directions. If $m^*(\Gamma) = 0.065\ m_o$, $m^*(X) = 0.30\ m_o$ (for each of the X minima) and $m_p^* = 0.47\ m_o$. At what temperature, the number of electrons in the Γ minima and the X minima are equal if the Γ to X energy separation is 0.35 eV, and the bandgap is 1.7 eV ? Here, m_o = free electron mass. 6

c) Si bar 0.1 cm long and 100 μm^2 in cross-sectional area is doped with 10^{17} cm^{-3} phosphorus. Find the current at 300 K with 10 V applied. 6

3. a) Hall measurements are made on a p-type semiconductor bar 500 μm wide and 20 μm thick. The Hall contacts A and B are displaced 2 μm with respect to each other in the direction of current flow of 3 mA. The voltage between A and B with a magnetic field of 10 kG (1 kG = 10^{-5} Wb/cm^2) pointing out of the plane of the sample is 3.2 mV. When the magnetic field direction is reversed the voltage changes to -2.8 mV. What is the hole concentration and mobility? 7

b) Assume that a conduction electron in Si (μ_n = 1350 cm^2/V-s) has a thermal energy of kT, related to its mean thermal velocity by $E_{th} = m_0 v_{th}^2/2$. This electron is placed in an electric field of 100 V/cm. Show that the drift velocity of the electron in this case is small compared with its thermal velocity. Repeat for a field of 10^4 V/cm, using the same value of μ_n. Comment on the actual mobility effects at this higher value of the field. 6

c) Show schematic band diagram, density of state, Fermi-Dirac distribution, and carrier concentration for (i) intrinsic, (ii) n-type and (iii) p-type semi-conductor. 2+2+2=6

d) Illustrate with diagram for (i) saturation of electron drift velocity at high electric fields for silicon, (ii) variation of mobility with total doping impurity concentration for germanium, silicon, and gallium arsenide at 300K. 3+3=6

4. a) A Si sample with 10^{16} atoms/cm^3 donors is optically excited such that 10^{19} atoms/cm^3 electron-hole pairs are generated per second uniformly in the sample. The laser causes the sample to heat up to 450 K. Find the quasi-Fermi levels and the change in conductivity of the sample upon shining the light. Electron and hole lifetimes are both 10 μs. D_p = 12 cm^2/s; D_n = 36 cm^2/s; $n_i = 10^{14}$ cm^{-3} at 450 K. 5+5=10

b) For a 2 cm long doped Si bar ($N_d = 10^{16}$ cm^{-3}) with a cross-sectional area of 0.05 cm^2, what is the current if we apply 10V across it? If we generate 10^{20} electron-hole pairs per second per cm^3 uniformly in the bar and the lifetime $\tau_n = \tau_p = 10^{-4}s$, what is the new current? Assume the low-level α_r doesn't change for high-level injection. If the voltage is then increased to 100,000 V, what is the new current? Assume μ_p = 500 cm^2/V-s and μ_n = 1070 cm^2/V-s. 4+4+4=12

c) Discuss how a pulse of electrons created at a point x = 0, and at time t = 0 in a semiconductor disappears in time. 3

5. a) A 0.46 μm thick sample of GaAs is illuminated with monochromatic light 2 eV. The absorption coefficient is 5×10^4 cm^{-1}. The power incident on the sample is 10 mW. 2+2+2=6

i. Find the total energy absorbed by the sample per second (J/s).
ii. Find the rate of excess thermal energy given up by the electrons to the lattice before recombination (J/s).
iii. Find the number of photons per second given off from recombination events, assuming perfect quantum efficiency.

b) In a p-type semiconductor bar, there is an increase in hole concentration from right to left and an electric field pointing to the right. With a suitable sketch, indicate the directions of the hole drift and diffusion current flow and explain why? If we double the hole concentration everywhere, what happens to the diffusion current and the drift current? If we add a constant concentration of holes everywhere, what happens to the drift and diffusion currents? Explain your answers with appropriate equations. 3+2+2= 7

c) An n-type Ge sample is used in the Haynes-Shockley experiment. The length of the sample is 1 cm, and the probes (1) and (2) are separated by 0.95 cm. The battery voltage E_0 is 2 V. A pulse arrives at the point (2) 0.25 ms after injection at (1); the width of the pulse is 117 μs. Calculate the hole mobility and diffusion coefficient, and check the results against the Einstein relation. 2+2+1= 5

d) Define (i) luminescence (ii) photoluminescence (iii) cathodoluminescence (iv) electroluminescence (v) fluorescence (vi) phosphorescence and (vii) phosphors. 7

6. a) Derive contact potential in terms of donor concentration. 7

b) An abrupt silicon p-n junction has $N_a = 10^{18}$ cm^{-3} on one side and $N_d = 5 \times 10^{15}$ cm^{-3} on the other. 2×4=8

i. Calculate the Fermi level positions at 300 K in the p and n regions.
ii. Calculate minority carrier concentration for each side of the junction.
iii. Draw an equilibrium band diagram for the junction and determine the contact potential V_0 from the diagram.
iv. Compare the results of part (b) with the equation derived in 6(a).

c) The junction described in 6(b) has a circular cross section with diameter of 10 μm. Calculate penetration and charges in both n and p side along with electric field generated for this junction at equilibrium (300 K). 2×5= 10

7. a) With the help of minority carrier injection, derive the diode equation. 6

b) An abrupt silicon p-n junction ($A = 10^{-4}$ cm^2) has the properties at 300 K as shown in the Table 7(b): 4+2+4+ 2 =12

Table 7(b)

p side	n side
$N_a = 10^{17}$ cm^{-3}	$N_d = 10^{15}$ cm^{-3}
$\tau_n = 0.1$ μs	$\tau_p = 10$ μs
$\mu_p = 200$ cm^2/V-s	$\mu_n = 1300$ cm^2/V-s
$\mu_n = 700$ cm^2/V-s	$\mu_p = 450$ cm^2/V-s

i. The junction is forward biased by 0.5 V. What is the forward current?
ii. What is the current at a reverse bias of -0.5 V?
iii. Calculate depletion capacitance at 100 V with $\epsilon_r = 11.8$.
iv. Calculate depletion width prior to avalanche breakdown ($V_{br} = 300$ V).

c) Derive the capacitance of p-n junction and prove its analogy with conventional parallel plate capacitor. 6+1=7

8. a) Show the band diagram for an ideal MOS structure at (i) equilibrium, (ii) negative voltage causes hole accumulation, (iii) positive voltage depletes hole for semiconductor surface and (iv) larger positive voltage causes inversion. Also show the variation of space charge density in the semiconductor as a function of the surface potential Φ_S for p-type silicon with Na = 4 $\times 10^{15}$ cm^{-3} at room temperature. p_s and n_s are the hole and electron concentration at the surface, Φ_F is the potential difference between the Fermi level and the intrinsic level of bulk. 10

b) An n+ polysilicon gate n-channel MOS transistor is made on a p-type Si substrate with $N_a = 5\times10^{15}$ cm^{-3}. The SiO_2 thickness is 100 $\AA$ in the gate region, and the effective interface charge Q_i is 4×10^{10} qC/cm^2. Find C_i, C_{min}, W_m, V_{FB} and V_T. Here, the magnitude of metal-semiconductor work potential difference is 0.95 V. 2×5= 10

c) Illustrate with a diagram for capacitance-voltage relationship for an n-channel (p-substrate) MOS. 5

Properties Table of Silicon

E_g	1.1 eV
n_i	1.5×10^{10} cm^{-3}
μ_p	480 cm^2/V-s
μ_n	1350 cm^2/V-s
ϵ_r	11.8

B.Sc. Engg.(EE), 8th Sem. 132 Date: October 24, 2018 (Morning)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination
Course No.: EEE 4835
Course Title: Medical Electronics

Summer Semester, A. Y. 2017-2018
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 meanings.

---

1. a) Mention and describe five significant characteristics of a sensor. 12

   b) What are the most significant challenges to design medical electronics? How can those be minimized? 13

2. a) What is synaptic potential? How does the synaptic potential initiate and propagate from one neuron to another neuron? 13

   b) What are the impacts of capacitance, which is connected to different terminals of the amplifier? 12

3. a) For an EEG amplifier, electrode 1 has impedance of 5 kΩ and electrode 2 has impedance of 10 kΩ. Ground electrode has impedance of 2.5 kΩ. The input impedance of EEG amplifier is 10 MΩ and CMRR is 80 dB. Power line displacement current is 400 nA and the amplitude of the patient EEG 12 μV. 13
      i) Calculate the common mode voltage of the patient.
      ii) Calculate the power line interference seen on the EEG signal.

   b) Describe capacitive and inductive coupling mechanisms in case of biomedical measurement. 12

4. a) What is the significance of CMRR for an amplifier? How can you improve CMRR for medical electronics purpose? 12

   b) What is the DRL system? Show the circuit diagram for a complete system where the DRL circuit is also connected. Why do you use the DRL circuit? 13

5. Write short note on the following topics with relevant diagrams **(any five)**: 25
      i) Nanotechnology in cancer treatment,
      ii) Optogenetics,
      iii) Pacemaker,
      iv) Detection of drug substance in hair ,
      v) Biosensing through light,
      vi) Colorimetric sensing of sweat and
      vii) Immunotherapy.

6. a) Draw the circuit diagram for a sensitive photodiode amplifier and describe the purpose of each component used in that circuit. What are the uses of this circuit in medical diagnosis? 15

   b) Why is the guarding important for medical electronics? Show the guarding layout for any operational amplifier on the PCB. 10

7. a) Describe the Electrode-Skin interface model. Describe the classification of the Bio-potential electrodes. 18

   b) What is polarizable and non-polarizable electrodes? 07

8. a) How many magnets used in MRI? How can be a particular slice selected in MRI? 10

   b) What are the relaxation modes of MRI? Describe those modes with a proper diagram. 15

B.Sc. Engg. (EE), 8th Sem. Date: October 24, 2017 (Morning)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination — Summer Semester, A. Y. 2017-2018
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) Assuming 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 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) Assume 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

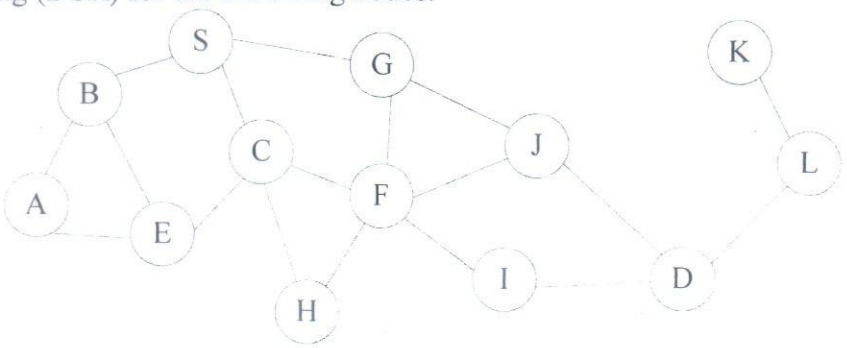

Figure 7.

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

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

M.Sc. Engg.(EE)/PhD(EE) 136 Date: 29 October, 2018 (Morning)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination
Course No.: EEE 6105
Course Title: Advanced Engineering Analysis

Winter Semester, A. Y. 2017-2018
Time: 3 Hours
Full Marks:150

There are **8 (eight)** questions. Answer **any 6 (six).** Figures in the left margin indicate full marks. Do not write on this question paper. Assume reasonable value for any data missing.

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1. a) Define Green's function (GF). What are the properties of causal GF of a second order LTI system? 10

   b) How is the impulse response of a causal LTI system determined from its GF? 5

   c) A causal LTI system is described by the I/O relation, $\frac{d^2y}{dt^2}+4y=8x(t)$. Find the GF for the system. Use the GF to find the zero state response of the system for $x(t)=u(t)$. 10

2. a) What is meant by stationary point of a dynamical system? A nonlinear system is characterized by multiple stationary points . Justify the statement using suitable examples. Draw the phase portrait(Flow on line) of the 1-D dynamical system $\frac{dy}{dt}=\frac{1}{2}+\cos(y)$. Examine the nature of the fixed points. 12

   b) A 1-D dynamical system described as $\frac{dy}{dt}=e^{-y}\sin(y)$, draw the phase portrait and sketch the typical solutions. Verify the nature of the fixed point by using linear stability analysis. 13

3. a) What is meant by bifurcation? Compare the characteristics of different types of bifurcation that may occur in a 1-D dynamical system suing some canonical examples. 10

   b) Show that the 1-D dynamical system $\frac{dy}{dt}=ry-4y^3$ undergoes bifurcation as r is varied. Draw a qualitative bifurcation diagram for the system and identify the nature of bifurcation. 15

4. a) Classify the fixed points (using eigen value of the system) and plot the phase portrait of the following systems. 15

   (i) $\frac{dx}{dt}=3x-4y$, $\frac{dy}{dt}=x-y$ and (ii) $\frac{dx}{dt}=-3x+2y$, $\frac{dy}{dt}=x-2y$

   b) Describe the procedure of linearizing a 2-D dynamical system. Using the linearized model how can one determine the stability of the system. 10

5 a) A 2-D nonlinear system defined by; 13

$$\frac{dx}{dt} = \sin(y)$$

$$\frac{dy}{dt} = x - x^3$$

Find the fixed points, linearize the system at the vicinity of the fixed points and classify the fixed points.

b) Define gradient and hessian of a multidimensional objective function? Obtain the gradient and hessian of the 2-D function 12

$f(X) = 2x_1^3 + x_2^2 + x_1^2 x_2^2 + 4x_1 x_2 + 3$ at point $X^T = [1 \quad 1]$.

6. a) How are the stationary points of an objective function classified by examining the nature of its hessian at the stationary points? One of the points, $X_a{}^T = [0 \quad 1]$, $X_b{}^T = [1 \quad 1]$ minimizes the function $f(X) = 100(x_2 - x_1^2)^2 + (1 - x_1)^2$. Identify the minimizer. 15

b) What is the basic difference between line search methods and gradient methods of optimization? Write the algorithm of the steepest decent method of optimization. 10

7 a) To solve the problem .15

Minimize $f(X) = 2x_1^2 - 2x_1 x_2 + x_2^2 + 2x_1 - 2x_2$ with $X_0{}^T = [0 \quad 0]$,

both steepest decent algorithm and Newton algorithm can be used. Show two iterations for each method and comment on the performance of the methods.

b) What is wavelet transform? How it differs from the Fourier transform? 10
Draw the flow chart of Genetic Algorithm as applied to optimization.

8. a) For a 2-D triangular element with element potential $V_e = a + bx + cy$; express a, b and c in terms of the element node potentials V_{e1}, V_{e2} and V_{e3} and the corresponding element shape functions. 12

b) For the triangular element shown in Fig. 8(b), determine the coefficient matrix for FEM. 13

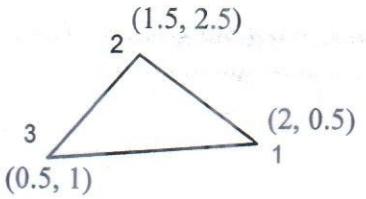

Fig. 8(b)

B.Sc. Engg.(EE)/ HDEE, 6th Sem. 138 Date: October 29, 2018 (Morning)
BScTE (2-Yr), 2nd Sem
DTE, 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. 2017-2018
Course No.: EEE 4603 / EEE 4693 / EEE 4493 — 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. Make necessary assumptions if required.

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1. a) Show the generalized functional elements of measurement systems in a block diagram and explain them briefly. 07

   b) Briefly discuss about photodiodes and phototransistors. 08

   c) The following table gives the variation of resistance with temperature for a RTD. Find the linear and quadratic approximations of resistance between 15°C and 33°C about a mean temperature of 24°C. 10

Temperature (°C)	15	18	21	24	27	30	33
Resistance (Ω)	106.06	107.14	108.22	109.3	110.38	111.46	112.75

2. 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 10 mV, 50 mV, 100 mV, 1 V and 10 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) With neat diagrams, discuss the working principle of moving iron meter movement. 10

3. a) Discuss the construction of a single-phase induction type energy meter with a neat sketch. Explain how the driving torque is produced in this type of meter. 12

   b) What are the sources of error in an electrodynamic wattmeter? Describe how the error can be compensated. 09

   c) Write down some of the advantages and disadvantages of an electrodynamic meter. 04

4. a) Define the response parameters of a 'Sample and Hold' circuit. 06

   b) Write down some of the advantages and disadvantages of Flash A/D converter. 04

   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

5. a) Define strip chart recorders. Discuss the dynamic behaviour of PMMC galvanometer type recorders. 13

   b) 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). 12

6. a) With suitable diagrams explain the different methods of obtaining capacitive displacement transducers. 13

   b) A push-pull non-contact capacitive transducer is shown in Fig. 1. It consists of four plates separated by air. Plates *A*, *C* and *D* are fixed and plate B can be moved. Plate *B* has a thickness *t* and is at a distance *d* from plates on either side. Plates *B*, *C*, *D* are all of length *l*, while plate *A* has length *2l*. All plates have a width *w*. The gap between plates *C* and *D* can be considered negligible. Neglecting the end effects, derive expressions for capacitances C_{AC} and C_{AD} for movement of the midpoint of plate *B* between $x = \pm l/2$. $x = 0$ is the position of symmetry. 12

7. a) Draw the circuit diagram of Carey-Foster slide wire bridge and derive the expression for determining unknown resistance. What is the advantage of using this type of bridge? 15

   b) An AC bridge is driven by 2 kHz sinusoidal source. In Fig. 2; $Z_1 = 10\ k\Omega$, $Z_2 = 50\ k\Omega$, Z_3 = series combination of a resistor of value 100 kΩ and a capacitor of value 100 μF, Z_4 = series combination of an unknown resistor and an unknown reactive element. Find the value of unknown resistor and the type and value of the unknown reactive element. 10

8. a) Draw a block diagram showing the basic functional components of a Programmable Logic Controller (PLC). 05

   b) What are the different types of timers that can be found in a PLC? Using the ON delay timers illustrate a ladder program for automatic sequencing of traffic lights. 10

   c) Develop a ladder diagram program to implement a burglar alarm system for a house using PLC. The user should have the option to activate or deactivate the whole system. The presence of an unauthorized person may be detected by a motion sensor or a window sensor. Once the presence of an unauthorized person is detected, the alarm should keep ringing until the user manually stops the alarm. 10

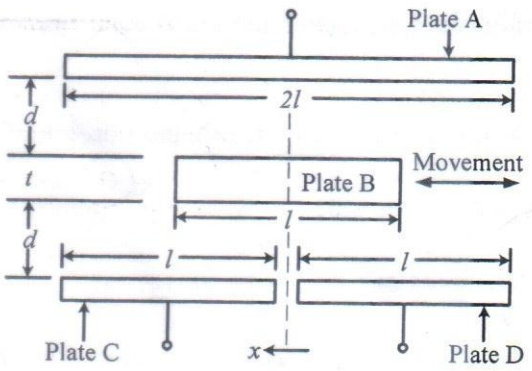

Fig. 1

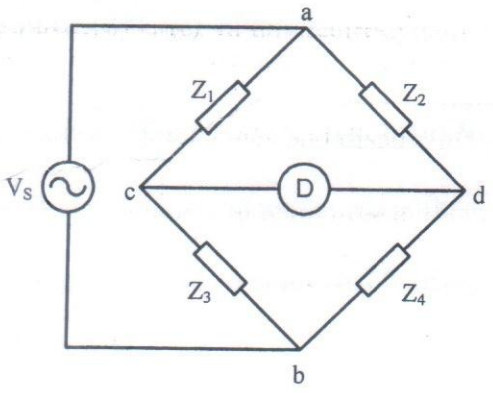

Fig. 2

B.Sc. Engg. / HD CSE 4th Semester 140 29 October 2018

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
Department of Computer Science and Engineering (CSE)

SEMESTER FINAL EXAMINATION **SUMMER SEMESTER, 2017-2018**

DURATION: 3 HOURS **FULL MARKS: 200**

CSE 4405: Data and Telecommunications

Programmable calculators are not allowed. Do not write anything on the question paper.

There are **8 (eight)** questions. Answer any **6 (six)** of them.

Figures in the right margin indicate marks.

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1. a) What are the layers in **TCP/IP** protocol suite? Explain the followings in terms of **OSI** model. 2+9
   i. Process to process delivery
   ii. Host to host delivery
   iii. Node to node delivery

   b) What is the difference between a port address, a logical address, and a physical address? Observe Figure 1 carefully where the packet header format is given. Each device is attached with a specific logical address and physical addresses. Complete each of the packet headers with appropriate logical and physical addresses. 3+6

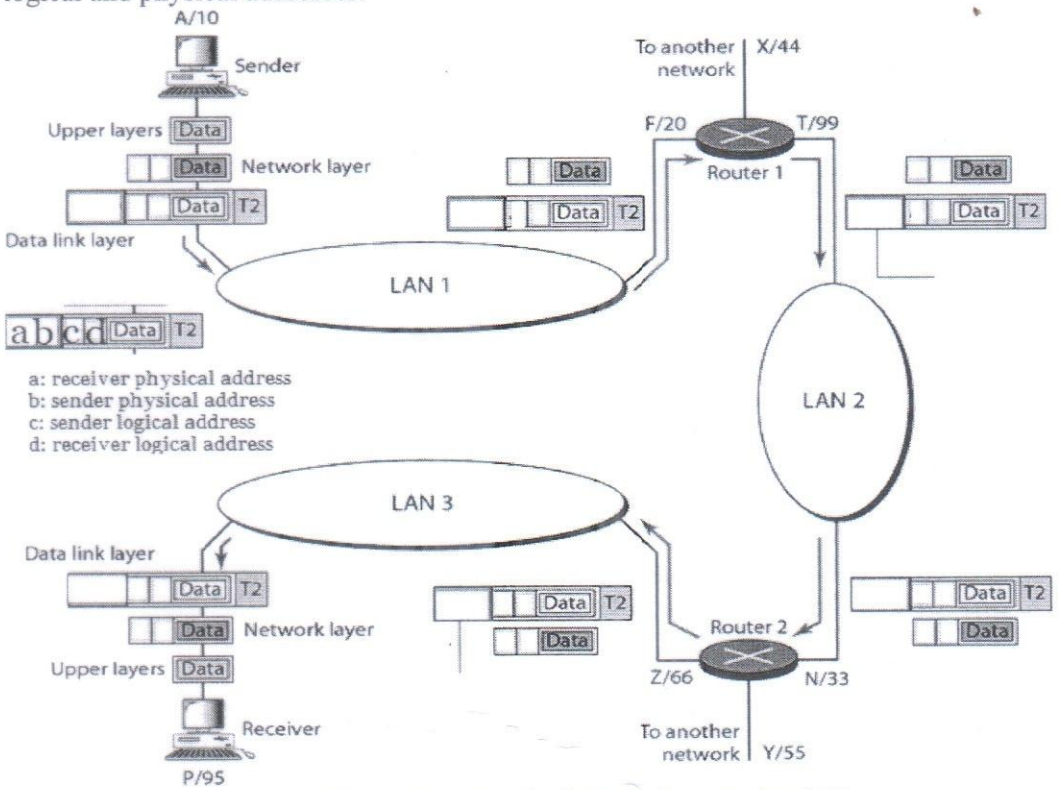

Figure 1: Network diagram for question 1.b)

   c) What do you mean by switching? Compare and contrast a circuit-switched network with a packet-switched network. 13.33

2. a) Define the followings with example: 10
   i. Jitter ii. Attenuation iii. Throughput v. Bandwidth-Delay Product

   b) What do you mean by 'data element' and 'signal element'? A signal is carrying data in which one data element is encoded as two signal elements. If the bit rate is 200 kbps, find the signal rate where c=1/2. 4+3

   c) Compare and contrast pulse code modulation (PCM) with delta modulation (DM); discuss using their module diagram. 12.33

   d) A composite periodic signal is decomposed into six sine waves with frequencies of 150, 250, 350, 450, 550 and 650 kHz, what is its bandwidth? Draw the spectrum, assuming all components have amplitude of 20 V. 2+2

3. a) Write short notes on any **three** of the following modulation technique: 3x4
   i. *MLT-3* ii. *AMI* iii. *On-off keying* (OOK) iv. *Phase Modulation*
   v. *Manchester*
   b) What do you mean by scrambling? Consider a bit stream: 11000010000000000. Draw corresponding digital signal for the following line coding schemes. 3+6
   i. *B8ZS* ii. *HDB3*
   c) With necessary diagrams explain the working principal of a fiber optic cable. Name different propagation modes of optical channels. 12.33

4. a) What do you mean by multiplexing? Distinguish between synchronous and statistical time division multiplexing (TDM). 3+6
   b) Briefly explain frequency hopping spread spectrum (FHSS). What is the main motivation of using FHSS that outweighs its bandwidth efficiency? 7+3.33
   c) Draw the send and receive window for '*Selective Repeat ARQ*' protocol. Using 5-bit sequence numbers, what is the maximum size of send and receive windows for '*Go-Back-N ARQ*' protocol? 5+3
   d) A sender sends a series of packets to the same destination using '*Go-Back-N ARQ*'. If the header of the frame allows 5 bit sequence number that starts with 0, what is the sequence number after sending 100 packets? If the sender uses '*Stop-and-Wait ARQ*' protocol for flow control then what should be the sequence number after sending 100 packets. 3+3

5. a) What do you mean by a linear block code and a cyclic code? Distinguish between forward error correction and error correction by retransmission. 4+3
   b) What do you mean by the Hamming distance and the minimum Hamming distance? With the aid of block diagrams illustrate the structure of the encoder and decoder for a Hamming code C(7, 4). 4+6
   c) Using CRC error detection scheme do the following. (Use 1011 and 0000 as the divisors) 8
      i. Generate the codeword of 1001 using CRC encoder.
      ii. A codeword 1000110 has been received. Determine whether the dataword should be accepted or rejected using CRC decoder.
   d) Mention the limitations of simple parity check codes. How is the simple parity check related to the two-dimensional parity check? 8.33

6. a) Explain the frequency reuse concept in cellular communication with appropriate figure and equation. 11.33
   b) Write short notes on any **two** of the followings- 4x2
   i. Grade of Service ii. Sectoring iii. Multipath Fading
   c) A 30 MHz spectrum is allocated to a wireless system which uses two 25 KHz simplex channels to provide full duplex voice and control channels. Compute the number of channels available per cell if that system uses 7-cell reuse pattern. If 1 MHz of the allocated spectrum is dedicated to control channels, determine an equitable distribution of control channels and voice channels in each cell of that system. 6
   d) A system has 1000 cells with 25 traffic channels available where a minimum SIR of 15dB must be maintained. Consider that there are 6 channels in the first tier. Find the minimum cluster size with path loss exponent 3. What will happen if path loss exponent n becomes 4? Will the cluster size increase or decrease? 8

7. a) Neatly sketch the GSM system architecture. How does HLR and VLR work for a roaming user? 10.33
   b) Give the taxonomy of all logical channels available in GSM. 5
   c) Write short notes on any two of the followings- 5x2
   i) Cell dragging ii) Umbrella Cell Concept iii) MAHO
   d) Suppose a new mobile communication standard is specified as an alternative to GSM with the following frequency specifications 8

   Uplink: 1400-1550 MHz Downlink: 1600-1750 MHz

   The new standard also specifies that two carrier frequencies would be working at 400 KHz distance for better voice quality. As a telecommunication engineer, calculate the following specification of the new standard.

141

B.Sc. Engg SWE 2nd Semester — 14 August 2018 (Morning)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
Department of Computer Science and Engineering (CSE)

MID SEMESTER EXAMINATION — **SUMMER SEMESTER, 2017-2018**
DURATION: 1 Hour 30 Minutes — **FULL MARKS: 75**

CSE 4203: Discrete Mathematics

Programmable calculators are not allowed. Do not write anything on the question paper.
There are **4 (four)** questions. Answer any **3 (three)** of them.
Figures in the right margin indicate marks.

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1. a) Describe the worst-case time complexity of the odd-even sort algorithm in terms of the number of comparisons used. Express the complexity in Big-O notation. 10

The algorithm for odd-even sort algorithm is given in Figure 1.

```
procedure oddEvenSort(a1, …, an : real numbers with n ≥ 2)
 isSorted := False
 while isSorted = False do
     isSorted := True
     i := 1
     while i < n do
         if ai > ai+1 then
             interchange ai and ai+1
             isSorted := False
         i:=i+2
     i := 2
     while i < n do
         if ai > ai+1 then
             interchange ai and ai+1
             isSorted := False
         i:=i+2
 return
```

Figure 1: Code listing for Question 1(a).

b) Express the negation of the following propositions using quantifiers, and then express them in English. 15

i. Some drivers do not obey the speed limit.
ii. All Swedish movies are serious.
iii. No one can keep a secret.
iv. There is someone in this class who does not have a good attitude.
v. Every bird can fly.

2. a) Give big-O estimates (with the values of C and n_0) for the following functions: 12

i. $(n^2 + 5)(n - 1)$
ii. $(nlgn + 1)^2 + (lgn + 1)(n^2 + 1)$
iii. $3nlg(n!) + (n^2 + 4)lg\ (n)$

b) Draw Venn Diagrams showing the followings: (Identify all parts of the diagram with proper notations) 8

i. $A \cup B \subset A \cup C, but\ B \cap C = \{\}$

ii. $A \cap B \subset A \cap C, but\ B \cap C = \{\}$

c) Write the following complexities in ascending order : 5

$\theta(n^2), \theta(b^n), \theta(nlogn), \theta(n!)\ and\ \theta(1)$

3 a) Use logical equivalence to show that following propositions are contradiction: 6

i. $\neg(p \vee \neg(p \wedge q))$

ii. $\neg(((p \vee q) \wedge (\neg p \vee r)) \rightarrow (q \vee r))$

b) Use truth table to show that:

i. $(p \wedge (p \rightarrow q) \rightarrow \neg q)$ is a contingency. 6

ii. $((p \rightarrow q) \wedge (q \rightarrow r) \rightarrow (p \rightarrow r))$ is a tautology.

c) There are two restaurants next to each other. One has a sign says "Good food is not cheap" and other has a sign that says "Cheap food is not good". Are the signs saying the same thing? Justify your answer using predicates, quantification etc. 7

d) Given that $h(x) = 3x$ and $g(t) = -2t - 2 - h(t)$ and $f(n) = -5n^2 + h(n)$, calculate $h(g(8) + f(2))$. 6

4 a) Show that if n is an integer and $n^2 + 5$ is odd, then n is even using 12

i. A proof by contraposition.

ii. A proof by contradiction

b) Given premises : 8

"Students who pass the course either do the homework or attend lecture;"

"Mahid did not attend every lecture;"

"Mahid passed the course."

Using rules of inference prove the conclusion that "Mahid have done the homework".

c) Theorem: If n^2 is positive, then n is positive. 5

Proof: Suppose that n^2 is positive. Because the conditional statement "If n is positive, then n^2 is positive" is true, we can conclude that n is positive.

Is there any problem with the proof of this theorem? Give proper arguments to support your answer.

i. Wavelength ii. Bandwidth iii. Duplex Distance iv. No of Radio Channels

8. a) With the aid of necessary diagram explain how a call to a mobile user initiated by a PSTN subscriber is established. Mention the name of different logical channels used in different stages of call establishment. 12.33

b) Draw the normal burst used in GSM. What is the significance of using Training sequence (T) Guard Period (GP) and Stealing bits (SF) in a GSM burst? 2+6

c) Mention different stages of the GSM transmission process in appropriate order. Demonstrate how four GSM bursts (each of 156.25 bits) are constructed from a 20 milliseconds voice signal following the steps of the GSM transmission process. 3+10

B.Sc. Engg. (EE), 8th Sem. 193 Date : October 29, 2018 (Morning)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination
Course No.: EEE 4849
Course Title: VLSI Circuits

Summer Semester, A.Y. 2017-2018
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. Symbols carry their usual meanings. Do not write on this question paper.

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1. a) With diagram(s), derive the expressions of drain currents of an nMOSFET in linear and saturation regions of operation. With figure, explain the body effect in a pMOSFET. [9+4]

   b) With neat diagrams, describe nMOS fabrication process steps in detail. [12]

2. a) Consider an nMOS inverter with depletion load. Supply voltage V_D = 3.5 V. Threshold voltages of load and driver are V_{td} = −2.7 V and V_{te} = 0.8 V, respectively. Required low level output voltage is $0.2V_{te}$. $\frac{\varepsilon\mu}{D}$ for load and driver are 25 $\mu A/V^2$ and 30 $\mu A/V^2$, respectively. [3+6+2+2]
      i) Calculate the high level output voltage.
      ii) Calculate the inverter ratio ignoring body effect of the load.
      iii) Choose suitable values of aspect ratios of load and driver network.
      iv) Explain what will happen if inverter ratio lower than the calculated value is chosen.

   b) Write four disadvantages of nMOS logic family compared to CMOS logic family. Derive the expression of inversion voltage of a CMOS inverter. Show how inversion voltage varies with β_n/β_p ratio. [4+4+4]

3. a) Using suitable figures and equations discuss how a buffer circuit can be implemented. No numerical example is necessary. With suitable diagram, explain how an inverting super buffer achieves smaller rise time than a regular nMOS inverter. [8+5]

   b) A CMOS inverter operates with V_D = 3.5 V, V_{tn} = 0.71 V and V_{tp} = − 0.70 V. Driver transistor has W/L = 3/2 and $\frac{\varepsilon\mu}{D}$ = 30 $\mu A/V^2$. The rise time is equal to the fall time. Assume $\mu_n = 2.5\mu_p$. Calculate: [6+6]
      i) the inversion voltage, V_{inv} and
      ii) short circuit current from source node V_D to ground when input voltage is V_{inv} .

4. a) With neat diagram, show the different capacitances present in a MOSFET structure. Also, describe the behavior of gate capacitance in different modes of operation. Using general scaling model, show how saturation current density of MOSFETs scale with technology scaling. [4+6+3]

   b) Draw the circuit and stick diagrams of a 4-to-1 multiplexer implemented using CMOS pass gates. Use appropriate colored lines for the stick diagram. Monochrome encoding is not acceptable. [12]

5. a) Classify, define and describe different components of power dissipation in CMOS circuits with suitable figures and equations. [13]

   b) Describe CMOS layout design styles. Draw the circuit diagrams of 2-input NOR gate using pseudo-nMOS and dynamic CMOS logic. [6+6]

6. a) Draw the circuit diagram of a CMOS 1-bit static memory cell. Describe in detail how WRITE and READ operations are performed to and from the cell, respectively. [5+8]

   b) Design bus arbitration logic for n-line bus. Make the design modular so that it can be implemented for arbitrary number of input bits, n. Draw the circuit and stick diagram of a 1 bit cell using pass transistor logic. [12]

7. a) Make detailed comparison between MOSFET-based CMOS logic and BJT-based logic circuits. Draw the circuit diagrams of 2-input BiCMOS NAND and NOR gates. [9+4]

   b) How BiCMOS fabrication can be incorporated in CMOS n-well process? What general guidelines are followed when constructing BiCMOS circuits and why? Draw the circuit diagram of a BiCMOS inverter and explain its operation. [3+3+6]

8. a) With neat diagram, show the arrangement of atoms in intrinsic GaAs semiconductor. Explain, with figures, how both types of doping are performed in GaAs. Name different GaAs based devices. [3+6+4]

   b) With suitable diagrams, describe all the relative advantages of GaAs based devices over Si based devices. [12]

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M.Sc.TE, 2nd Sem. Date: October 27, 2018 (Morning)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid-Semester Examination
Course No.: EEE 6295
Course Title: Advanced Electronics

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

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

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1. a) Mention few linear and nonlinear applications of operational amplifier (OP-AMP). 7

   b) Mathematically explain the operation of a differential amplifier (or subtractor). 13

   c) Design a inverting amplifier with a gain of -25. 5

2. a) Determine the weight of each input voltage for the scaling adder in Figure 2(a) and find the output voltage. 10

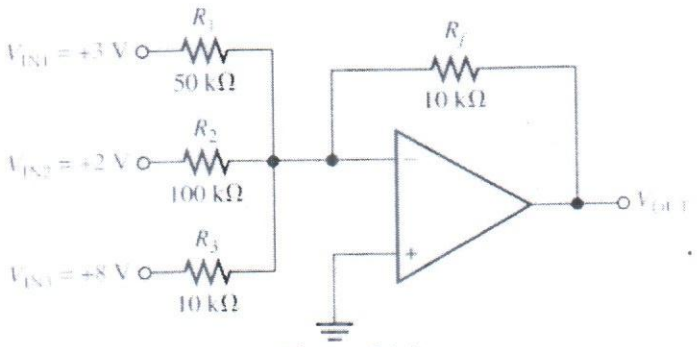

Figure 2(a)

   b) Explain operation of an integrator and diffentiator using OP-AMP. 15

3. a) Describe the operation of a full wave rectifier. 13

   b) Describe logarithmic amplifier using fundamental circuit and its logarithmic characteristic. 12

4. a) Implement the following function using CMOS. $\mathbf{Z = \overline{A(B} + C)}$ 12

   b) Implement full adder circuit using CMOS. 13

5. a) Explain the operating principle of a TTL. Decsribe its advantage over DTL. 12

   b) Describe advanced of TTL Designs. 13

6. a) Write various types of FET. Draw an n-channel JFET and explain its operation. 12

   b) Name different types of MOSFET. Explain basic operation of depletion type MOSFET. 13

7. a) How transistors worke as switches. Explain CMOS inverter. 10

   b) Draw pMOS and nMOS in series and parallel combinations. Implement universal logic gates using CMOS. 15

8. Explain the followings: 25
   i) MOSFET,
   ii) Multiplexers,
   iii) Square wave generator and
   iv) Instrumentation amplifier.

M.Sc. TE (2 Yr), 2nd Sem. 153 Date: October 23, 2018 (Morning)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination — Summer Semester, A. Y. 2017-2018
Course No.: EEE 6299 — Time: 3 Hours
Course Title: Microwave Theory and 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) The incident voltage and the reflected voltage at a point z 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. Explain how the phase of reflection coefficient varies on the line as compared to the phase of incident voltage and the reflected voltage. 12

   b) The load $Z_L = 40 - j30\ \Omega$ is connected to a transmission line with characteristic impedance $Z_0 = 50\ \Omega$ as shown in Figure 1. The reflected voltage is $V_- = 10\angle 0^0$ V at the point A, which is 12 cm away from the load. The operating frequency is 6 GHz. Determine incident voltage, incident current and reflected current at the point A. 13

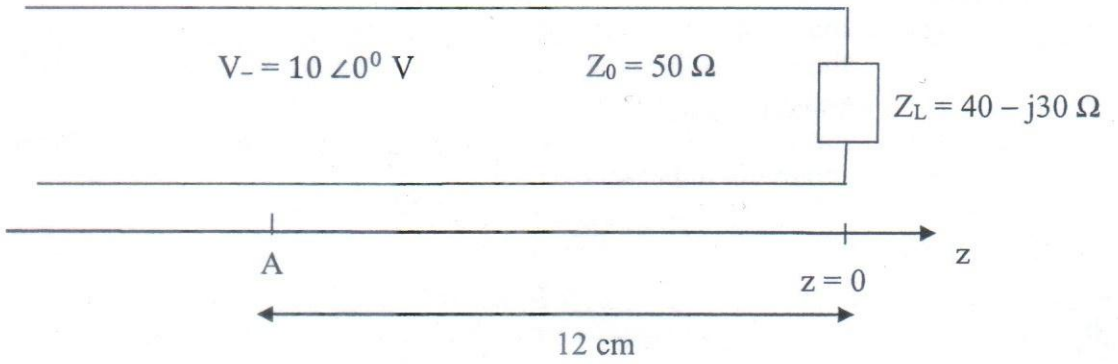


Figure 1

2. a) Prove that the same Smith chart can be alternately used as either impedance Smith chart or admittance Smith chart by simply rotating halfway (180^0) on SWR circle. 10

   b) The maximum voltage amplitude on a transmission line is 18V and the first maximum voltage point is 0.5 cm away from the load. The minimum voltage amplitude on the line is 5 V and the first minimum voltage point is 3 cm away from the load. The characteristic impedance of the line is 50 Ω. Determine: 15

   i) the load impedance,
   ii) transmission coefficient at the point of load,
   iii) input impedance, Z_i at a point 4 cm away from the load.

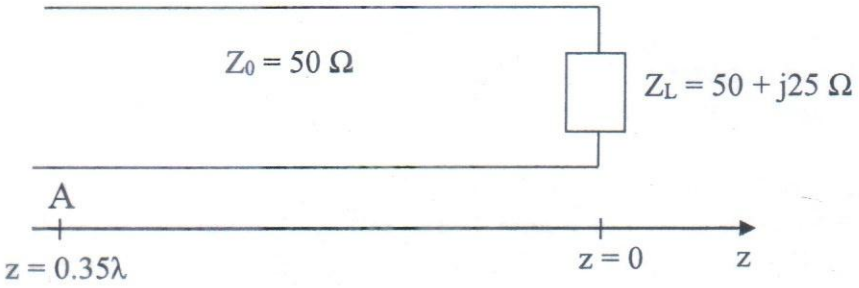
3. a) Prove the following relationship for a transmission line. 12

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

b) A load Z_L is connected to an ideal transmission line with characteristic impedance, $Z_0 = 50\ \Omega$. The incident voltage is $V_+ = 10 \angle 0^0$ V at the point of load. The reflected current is $I_- = 0.1 \angle 0^0$ A at the point A which is 11 cm away from the load. The operating frequency is 5 GHz. Determine the value of Z_L. 13

4. a) Explain why operation in the waveguide is preferred in a single mode. 7

b) A transmission line is connected to the load $Z_L = 50 + j25\ \Omega$. The line has characteristic impedance $Z_0 = 50\ \Omega$. The operating frequency is 3 GHz. Point A on the line is 0.35λ away from load. 18



Determine,

i) input admittance at the point A.
ii) the shortest distance from the load in cm for which the impedance is purely resistive.
iii) distance to the first minimum voltage amplitude point from the load in cm.
iv) minimum impedance on the line.

5. a) Define TEM, TE and TM waves. Why is TEM wave preferred when it is available? 15

b) An air filled rectangular waveguide has cutoff frequency 6 GHz for both TE_{30} and TE_{02} modes. Calculate its cutoff frequency for TE_{32} mode. Determine characteristic wave impedance for TE_{32} mode at 12 GHz. ($\mu_0 = 4\pi \times 10^{-7}$ H/m, $\varepsilon_0 = 8.854 \times 10^{-12}$ F/m) 10

6. a) A transmission line is terminated with a load $-j50\ \Omega$. The first voltage minimum is located at $\lambda/8$ distance from the load. Determine VSWR and the characteristic impedance of the transmission line. 15

b) Explain briefly why two-wire lines must be used in order to support TEM wave. What is characteristic wave impedance? 10

7. a) The circuit solution can use either voltage-current combination or electric field-magnetic field combination. Discuss which solution is better for transmission line and which solution is better for waveguide. 5

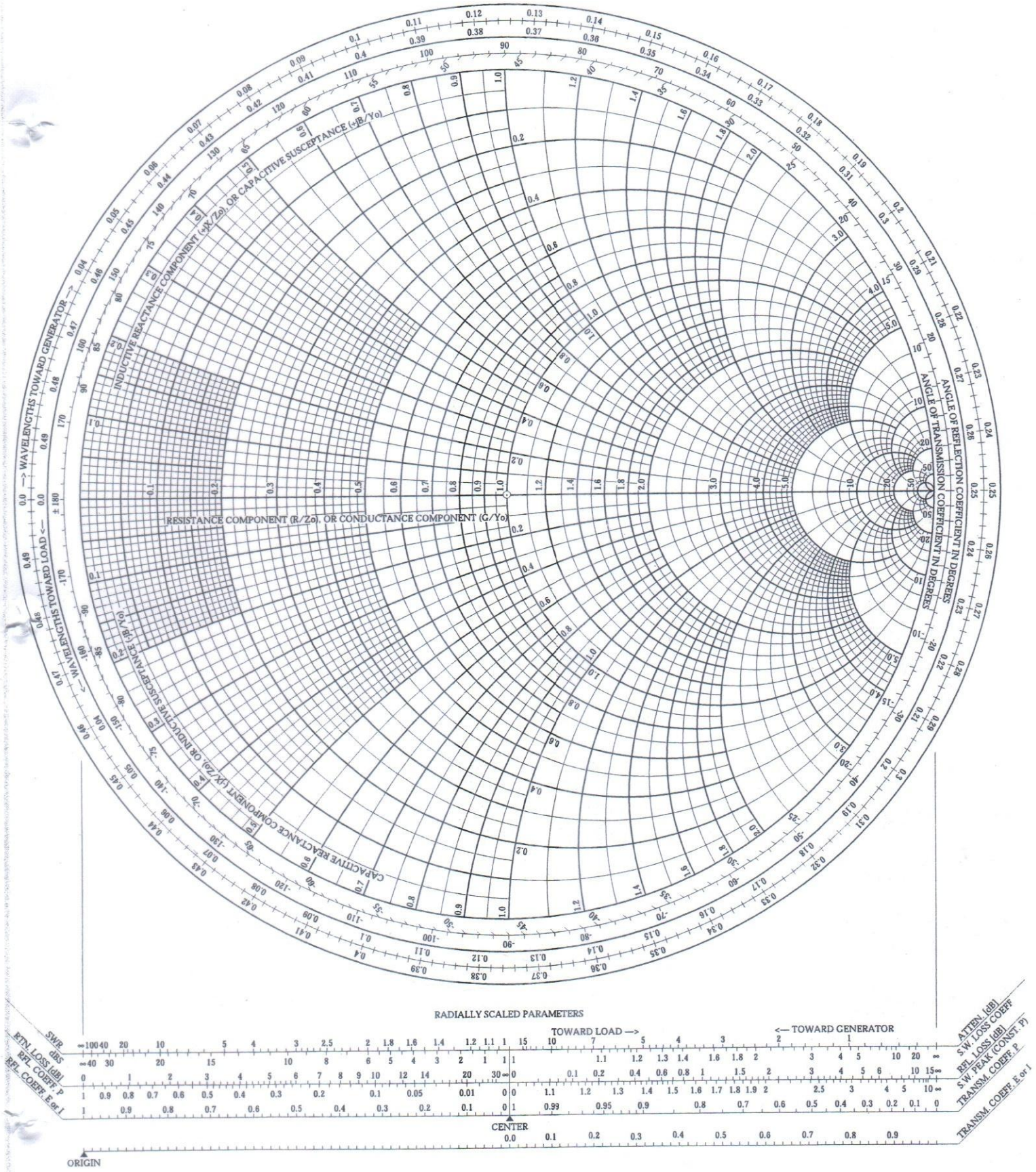
b) A transmission line with characteristic impedance 50 Ω is connected to a resistive load R ohms. $|V_+| = 5\ V$ and $|V_-| = 3\ V$. Determine all possible values of R. 10

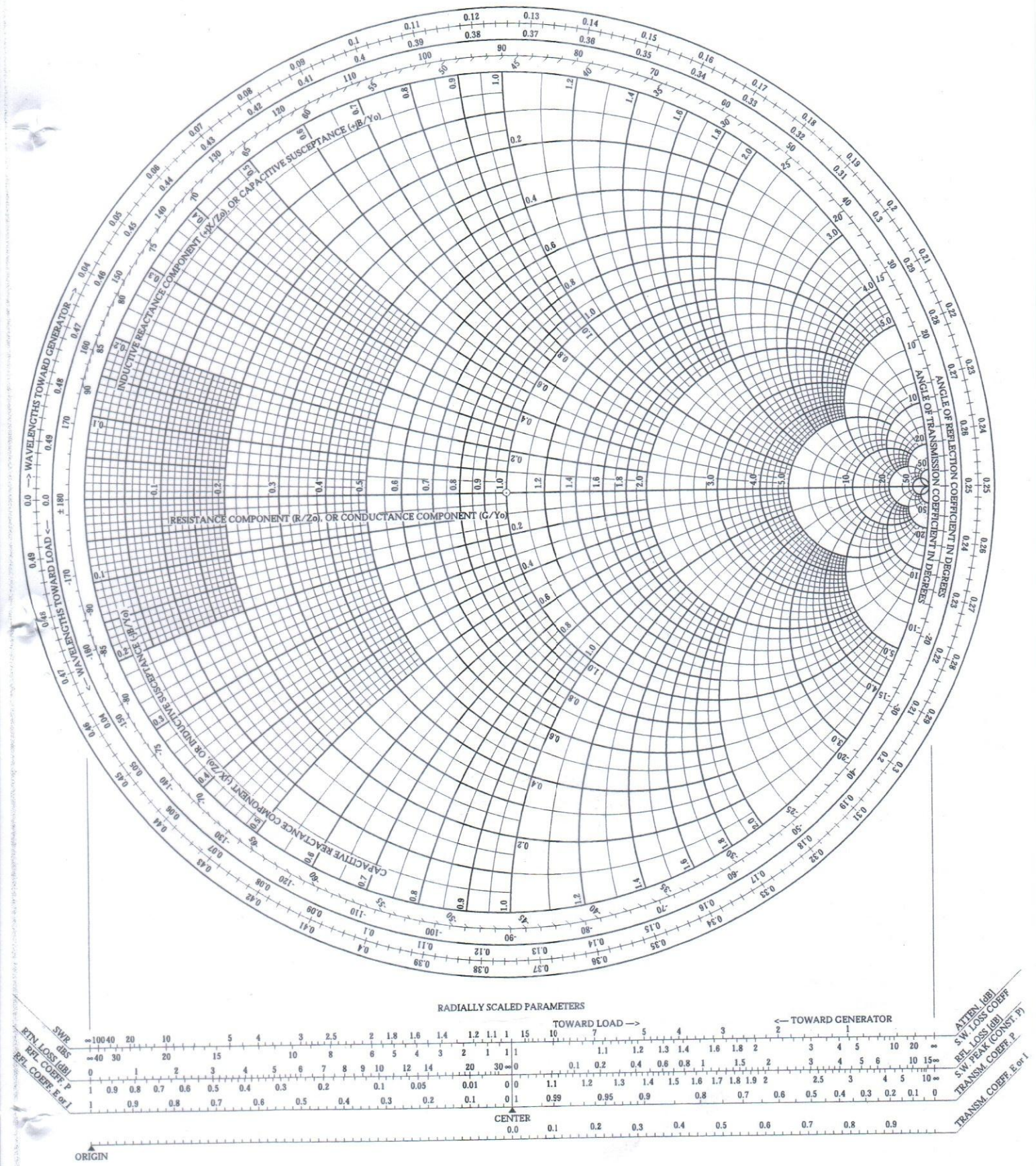
c) Which one, between E plane tee and H plane tee, is used as shunt branch? Show different possible combinations of input power and output power at different ports for magic tee. 10

8. a) A coaxial line has characteristic impedance 50 Ω. Its outer radius is 1.5 cm. Determine its maximum frequency of operation. 10

b) Differentiate between hybrid MIC and MMIC. 5

c) Compare between solid state and microwave tube solutions in terms of their advantages and disadvantages. Write down advantages and disadvantages of klystron and magnetron. 10


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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RADIALLY SCALED PARAMETERS
TOWARD LOAD —>
<— TOWARD GENERATOR
SWR
RTN. LOSS [dB]
REFL. COEFF. P
REFL. COEFF. E or I
ATTEN. [dB]
S.W. LOSS COEFF
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S.W. PEAK (CONST. P)
TRANSM. COEFF. P
TRANSM. COEFF. E or I
CENTER
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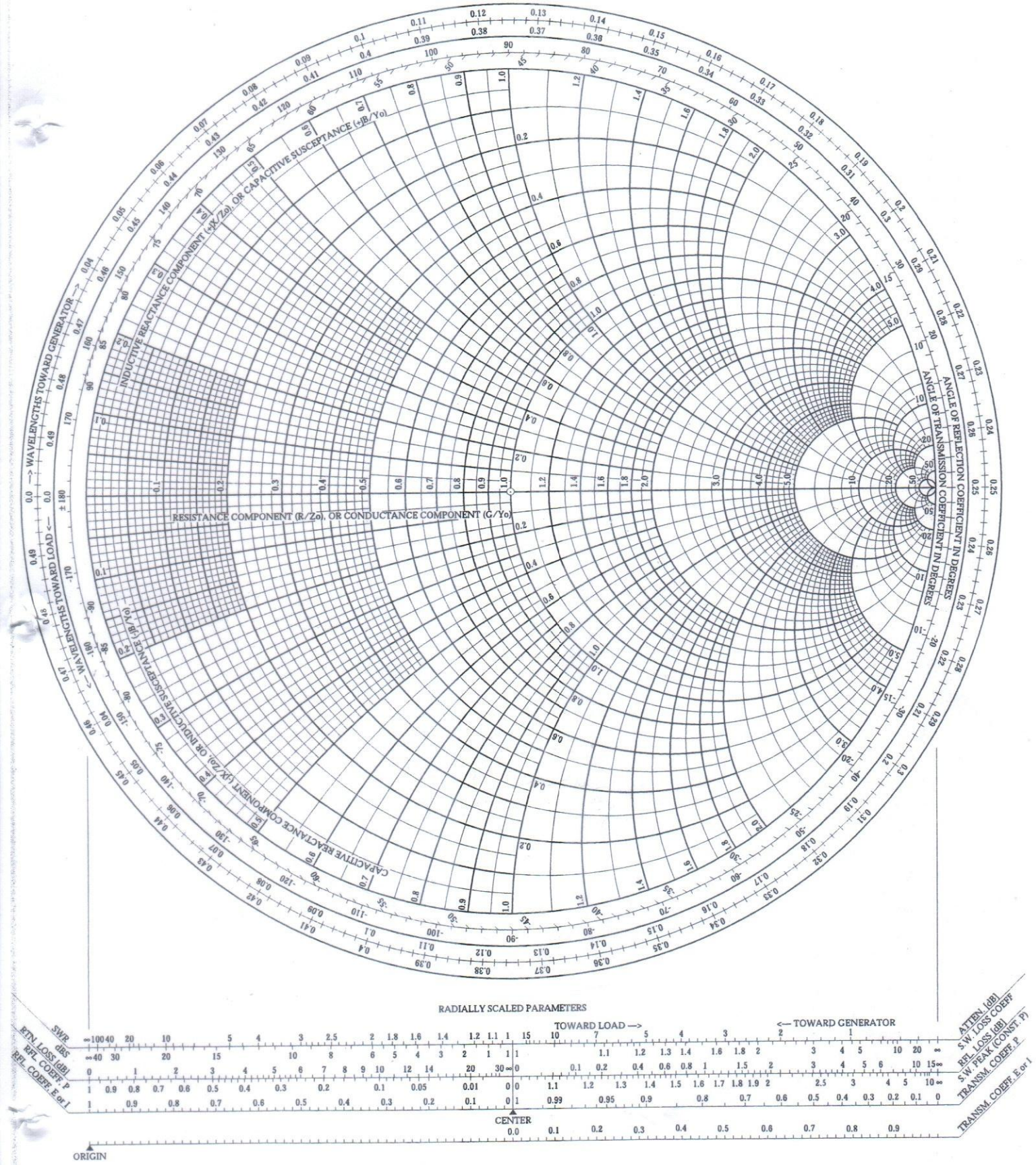
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ANGLE OF REFLECTION COEFFICIENT IN DEGREES
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RADIALLY SCALED PARAMETERS
TOWARD LOAD —>
<— TOWARD GENERATOR
SWR
RTN. LOSS [dB]
RFL. COEFF. P
RFL. COEFF. E or I
ATTEN. [dB]
S.W. LOSS COEFF
RFL. LOSS [dB]
S.W. PEAK (CONST. P)
TRANSM. COEFF. P
TRANSM. COEFF. E or I
CENTER
ORIGIN

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M.Sc. Engg. (EE) / PhD (EE) Date: October 22, 2018 (Morning)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination
Course No.: EEE 6407
Course Title: Digital Communication

Summer Semester, A. Y. 2017-2018
Time: 3 Hours
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. Classify the following signals as energy signals or power signals. Find the normalized energy or normalized power of each. 15

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

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

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

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

b) Given the spectrum 10

$$G_x(f) = 10^{-4}\left\{\frac{\sin[\pi(f-10^6)10^{-4}]}{\pi(f-10^6)10^{-4}}\right\}^2$$

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.

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

b) What is Aliasing? How can you eliminate aliasing? Explain in detail. 12

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

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

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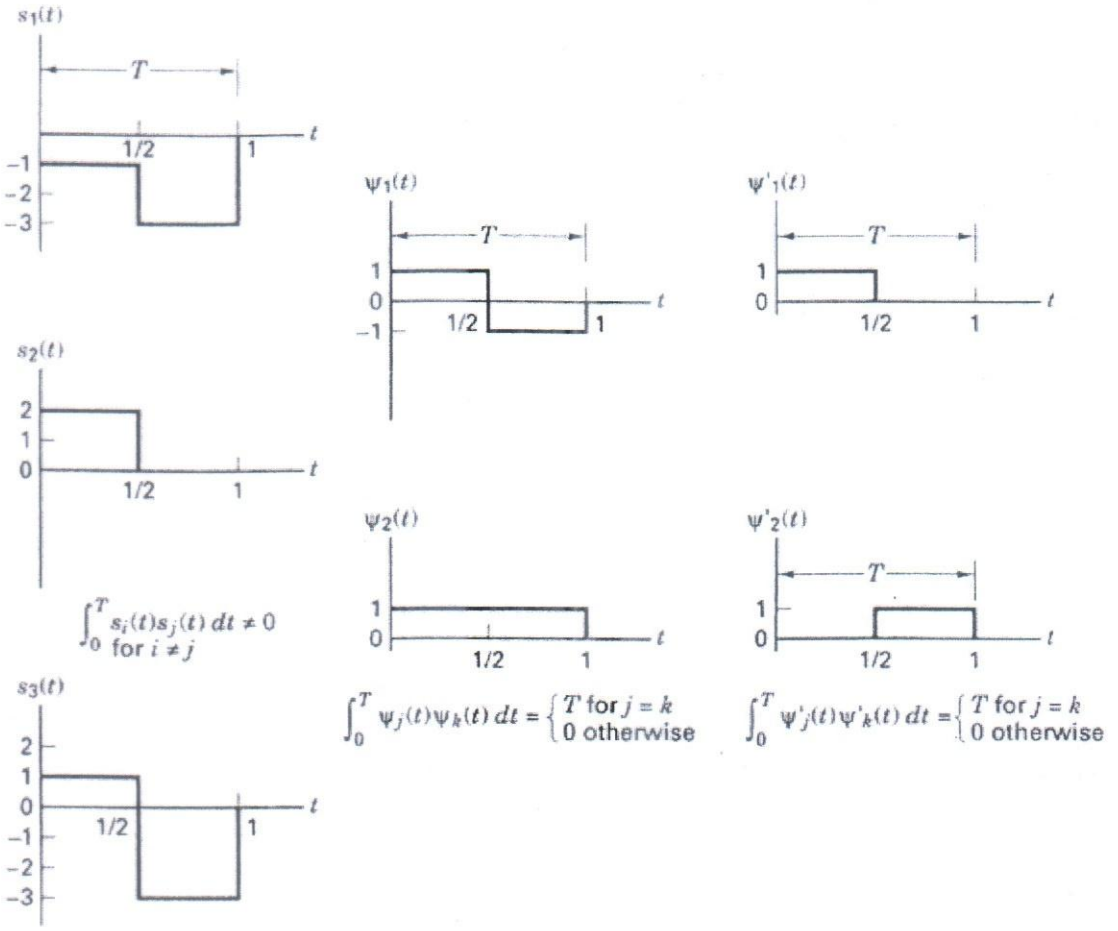

c) Consider an audio signal with spectral components limited to the frequency band 300 to 3300 Hz. Assume that a sampling rate of 8000 samples/s will be used to generate a PCM signal. Assume that the ratio of peak signal power to average quantization noise power at the output needs to be 30 dB. 05

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

ii) Calculate the system bandwidth (as specified by the main spectral lobe of the signal) required for the detection of such a PCM signal. (iii) What is the data rate in bits/s?

4. 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?

5. a) 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. 15

b) Bipolar pulse signals, $s_i(t)$ $(i = 1, 2)$, of amplitude $\pm 1V$ are received in the presence of AWGN that has a variance of $0.1\ V^2$. Determine the optimum (minimum probability of error) detection threshold, γ_0, for matched filter detection if the a priori probabilities are: $(i)\ P(s_1) = 0.5$; $(ii)\ P(s_1) = 0.7$; $(iii)\ P(s_1) = 0.2$. (iv) Explain the effect of the a priori probabilities on the value of γ_0. 10

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

b) Determine whether or not $s_1(t)$ and $s_2(t)$ are orthogonal over the interval $-1.5T_2 < t < 1.5T_2$, where $s_1(t) = \cos(2\pi f_1 t + \varphi_1)$, $s_2(t) = \cos(2\pi f_2 t + \varphi_2)$, and $f_2 = 1/T_2$ for the following cases 10

i) $f_1 = f_2$ and $\varphi_1 = \varphi_2$
ii) $f_1 = f_2$ and $\varphi_1 = \varphi_2 + \frac{\pi}{2}$

7. a) Describe the basic steps in the demodulation/detection of digital signals. Also draw the block diagram of a noncoherent detection of 2FSK signal. 15

b) Find the probability of bit error, P_B, for the coherent matched filter detection of the equally likely binary FSK signals 10

$$s_1(t) = 0.5 \cos 2000\pi\ t \quad \text{and}$$
$$s_2(t) = 0.5 \cos 2020\pi t,$$

where the two-sided AWGN power spectral density is $\frac{N_0}{2} = 0.0001$. Assume that the symbol duration is $T = 0.01\ s$.

8. a) Why do BPSK and QPSK manifest the same bit error probability relationship? Explain the demodulator for coherent detection of 16 PSK. 15

b) Explain bit error probability versus symbol error probability for multiple phase signaling and orthogonal signaling. 10

Appendix : Table for The standard normal CDF

z	Φ(z)	z	Φ(z)	z	Φ(z)	z	Φ(z)	z	Φ(z)	z	Φ(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

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M.Sc. Engg.(EE) / Ph.D. (EE) Date: 26 October, 2018 (Morning)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination — Summer Semester, A. Y. 2017-2018
Course No.: EEE 6411 — Time: 3 Hours
Course Title: Wireless Ad Hoc and Sensor Networks — 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 do you understand by Ad-hoc networking? Why is such networking required when there are standard networks? What is self-organize characteristics in Ad-hoc networks? Explain Ad-hoc networking properties. 10

   b) What is vehicular Ad-hoc networking (VANET)? Suppose there are two sink nodes located at Dhaka and Chittagong. How can you create networks to exchange data between these two sink nodes with the help of vehicular Ad-hoc networking (VANET) and wireless connectivity enabled devices? Explain and justify your techniques. 15

2. a) What is Delay Tolerant Networks (DTN)? What are the limitations associated with the Internet caused by current TCP/IP model? How does DTN overcome those problems? Explain the followings characteristics of DTN. 13
      i) Store-carry-forward,
      ii) Custody transfer, and
      iii) Bundle layer.

   b) How DTN helps to build networks in following scenarios. 12
      i) Inter-planetary communication,
      ii) Underwater communication.

3. a) A network designer designs the network depending on the coverage area and transmission range. 10
   What are the design goals and different design choices for Wireless LAN (WLAN)?
   How does a network designer define and differentiate among Wireless PAN (WPAN), Wireless LAN (WLAN), Wireless MAN (WMAN) and Wireless WAN (WWAN)?

   b) For data communication in internet using layering protocols, packet switching is more efficient than circuit switching. Define packet switching and circuit switching. 15
   For an effective packet switching, justify your design mechanism for the following issues when multiple data are transferring:
      i. The mechanism for identifying each destination.
      ii. Proper synchronization of each sender and corresponding destination.
      iii. Suitable size and rate of the packet so that it can effectively control data loss, packet delay and throughput requirement.
      iv. Proper mechanism to handle collision of packets and recognize beginning and ending of each packet.
      v. Proper coordination among the shared network so that each network can ensure equal opportunity to transfer the data.

4. a) What is Wireless Sensor Networks (WSN)? Explain three major roles of sensor nodes in WSN those act as Sources, Sinks and Actuators? How WSN helps to build networks in following scenarios. 18
   i) Disaster relief operations,
   ii) Biodiversity mapping,
   iii) Intelligent buildings (or bridges),
   iv) Facility management,
   v) Machine surveillance and preventive maintenance,
   vi) Precision agriculture,
   vii) Medicine and health care,
   viii) Logistics,
   ix) Telematics (vehicular technologies for road transportation, road safety).

   b) What is Mobile Ad Hoc Networks (MANET)? What are the main differences between MANET and WSN. Briefly explain the differences with proper justification. 7

5. a) Explain the features, topology, MAC frame format, scanning, association, time synchronization, authentication, energy conservation and power management of IEEE 802.11 wireless standards. 12

   b) As a wireless network designer, how do you consider the following performance metrics for the efficient wireless connectivity? Justify your answer by briefly explaining each of them. 13
   i) Throughput,
   ii) Delay,
   iii) Fairness,
   iv) Stability,
   v) Channel fading,
   vi) Energy consumption, and
   vii) Power management.

6. a) For personal area networking (PAN), both IR and Bluetooth technologies have their advantages and disadvantages. Justify your choice of technology between IR and Bluetooth technologies by mentioning appropriate applications. 4

   b) How does Bluetooth operate during data transferring? Briefly explain the operation state with suitable flow chart. Briefly discuss Bluetooth Piconets. 6

   c) Briefly explain the following performance metrics for the characteristics requirements of Wireless Sensor Networks (WSN): 15
   i) Type of service,
   ii) Quality of service,
   iii) Fault tolerance,
   iv) Lifetime,
   v) Scalability,
   vi) Wide range of densities,
   vii) Programmability and
   viii) Maintainability.

7. a) 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). 15

   b) What is hierarchical routing in Ad-hoc network? Explain ClusterHead Gateway Switch Routing (CGSR). 10

8. a) As a network designer, why do you need protocol suite? What do happen among network components if there is no protocol suite? 5

   b) Networks are complex, with many "pieces" such as hosts, routers, links of various media, applications, hardware, software, etc. To deal with these complex systems a layering based protocol standard called Open Systems Interconnection (OSI) model is widely used. Write the name of layers of OSI model. Explain the responsible job done by each layer and how do they contribute to the whole network. 12

   c) TCP/IP model is a modified version of OSI model. Explain TCP/IP model by comparing the layers with the OSI model. 8

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M.Sc.TE.(2 Yr), 4th Sem. Date: October 22, 2018 (Morning)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination — Summer Semester, A. Y. 2017-2018
Course No.: EEE 6499 — Time: 3 Hours
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. All symbols bear their usual meaning. Assume reasonable values for missing data.

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1. a) How is optical gain achieved in stimulated emission? Explain optical feedback and threshold current in semiconductor laser. Show the basic structure of a semiconductor laser and Fabry-Perot cavity associated with it. 3+4+4

   b) What are the deficiencies from which broad area semiconductor lasers suffer? How does gain guided semiconductor laser solve this problem? 6

   c) What will be the refractive index of the gain medium for 28% facet reflectivity in a laser? What is the use of gold stud in surface emitting LED and why is epoxy added in the etched well? 3+5

2. a) Explain the carrier confinement problem of homojunction. How does double heterostructure geometry solve this problem? 3+6

   b) Explain radiative and non-radiative recombination of semiconductor materials. Make a comparison of direct and indirect-bandgap semiconductors in terms of internal quantum efficiency through their respective recombination times. 4+6

   c) Define and explain external and total quantum efficiency using power-current characteristics of LED. 6

3. a) State the main difference between DFB and DBR laser and show their respective structures. 7

   b) What makes optical amplifier a better solution for WDM lightwave systems? Explain three possible applications of optical amplifiers in lightwave system. 2+6

   c) Compare between the main features and working principle of Raman and EDFA amplification. 5+5

4. a) Which are the suitable dopants of core and cladding for silica based optical fibers? Explain depressed and raised cladding fibers with different index profile. Mention the two stages for fabrication of telecommunication-grade silica fibers. 2+5+3

   b) Mention some applications of graded index fibers. Explain four wave mixing (FWM) in optical fiber. 3+7

   c) Compare between TDM based digital hierarchies used in North America-Japan and Europe. 5

5. a) Explain mean time to failure (MTTF) of an optical transmitter. Why should t_F exceed 10^5 hours for the optical source? 5

   b) Describe the operating principles of two types of external modulators. 9

   c) Why is external optical modulator necessary for higher bit rates? What makes packaging an important issue in the design of reliable optical transmitters? 6

   d) Define optoelectronic integration. What is the functionality of photonic integrated circuit? 5

6. a) How is p-i-n diode advantageous over p-n diode as a photodetector? Briefly mention the basic principle behind avalanche photodiode. 6+4

   b) Draw the diagram of a digital optical receiver showing various components. Define receiver sensitivity and extinction ratio of an optical receiver. 4+4

   c) Show typical point to point fiber links with periodic loss compensation. Compare between the operation of an optoelectronic repeater and optical amplifier in point to point fiber links. 3+4

7. a) Briefly discuss ring and star topologies in optical local area network (LAN). 3+5

   b) How does dispersion induced pulse broadening affect the receiver performance? What are the sources of power penalty? What is the purpose of system margin in power budget? 3+3+2

   c) Find out the bit-rate of a loss-limited light-wave system at 1.3 μm wavelength for which transmission power is taken to be 1 mW, net loss is 0.4 dB/km and average number of photons/bit is found as 450. Consider maximum transmission distance as 15 km. 9

8. a) What is burn-in or accelerated aging? Briefly explain the issue of coupling stability in the design of relaible optical transmitters. 5

   b) Derive the expression of quantum efficiency of a photodetector in terms of absorption coefficient and slab width. Define cut-off wavelength from the wavelength dependence of the absorption coefficient. 6+3

   c) Explain trade-off between bandwidth and responsivity of a photodetector. 5

   d) What will be the bandwidth of the photodetector while both transit time and RC time constant being 10 ps? If the bit rate suddenly drops to 10 Gb/s for a drift velocity of 10^5 m/s, find out the depletion region width. 2+4