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B.Sc. Engg.(EE), 1st Sem. Date: May 23, 2018 (Morning)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination — Winter Semester, A. Y. 2017-2018
Course No.: EEE 4101 — Time: 3 Hours
Course Title: Electrical Circuit I — Full Marks150

There are **8 (eight)** questions. Answer **any 6(six)** questions. Marks in the margin indicate full marks. Do not write on this question paper. Symbols bear their usual meanings. Assume reasonable value for missing data, if any.

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1. a) Is it possible to maintain a constant voltage across a load of a practical voltage source? Justify your answer by drawing its V-I characteristics and hence define voltage regulation. 5

b) The current flowing through a wire is plotted in Fig. 1(b) below. Determine and sketch the corresponding charge. 10

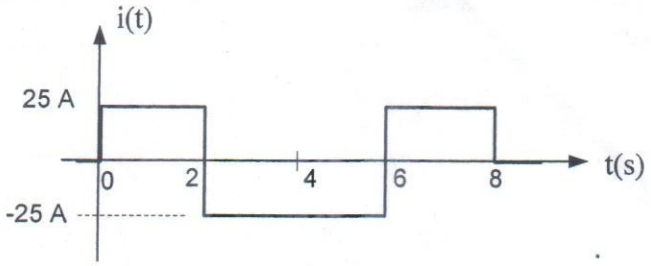

Fig. 1(b).

c) The charge entering the upper terminal of the BOX in Fig. 1(c) is shown below. How much energy is absorbed by the BOX between 0 and 9 seconds. 10

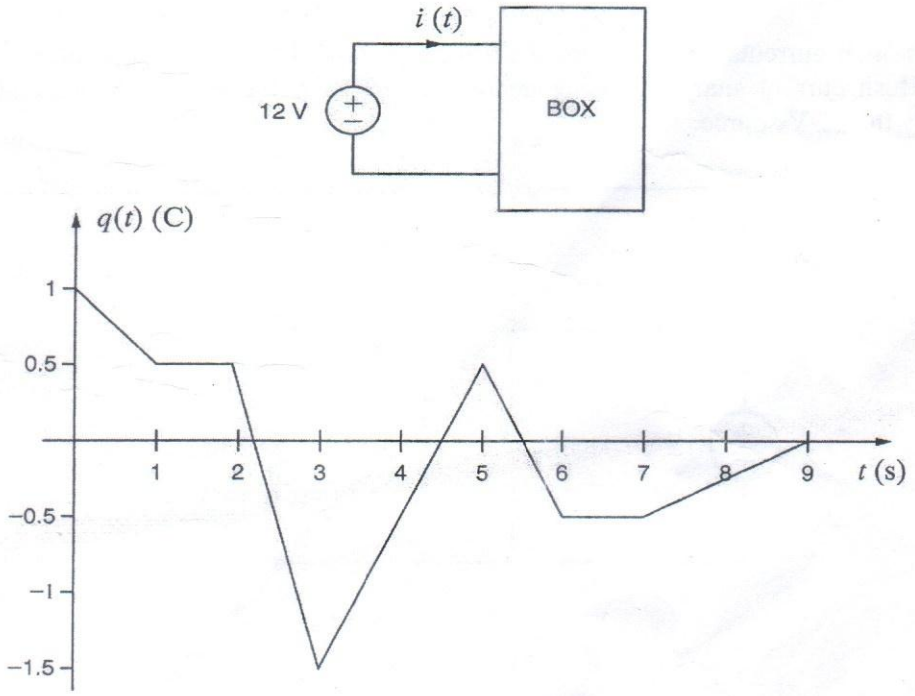

Fig. 1(c).

2. a) Derive the equation for the generalized current divide rule for N-numbers of resistor connected in parallel between a pair of nodes. 5

b) Find V_x,V_y and V_0 in the network shown in Fig. 2(b). 10

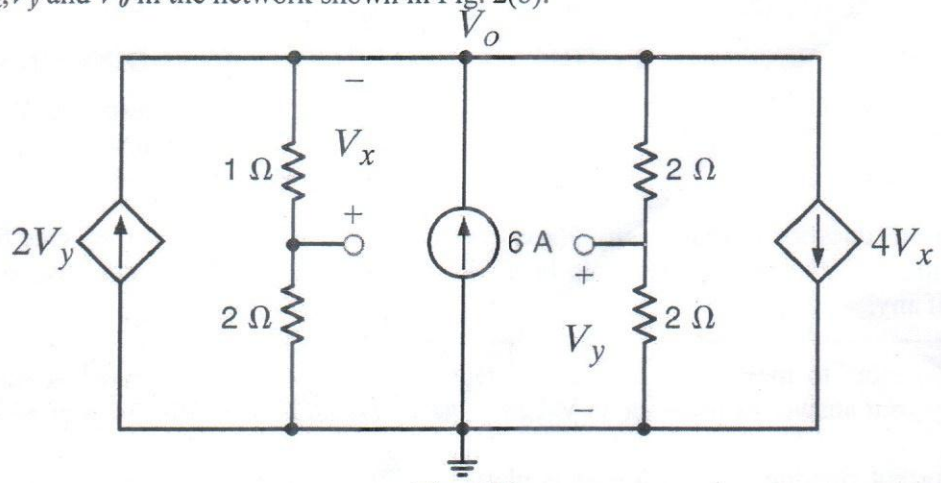

Fig. 2(b).

c) Find R_T and if a 24 V source is connected between terminals A and B, find I and I_1 as indicated in Fig. 2(c). 10

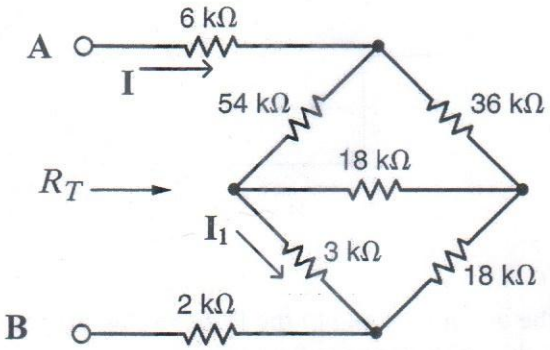

Fig. 2(c).

3. a) How are branch currents of an electrical circuit determined by (i) Nodal analysis and (ii) Loop or Mesh current analysis? Using nodal analysis, find the node voltages and power supplied by the 12 V source. 13

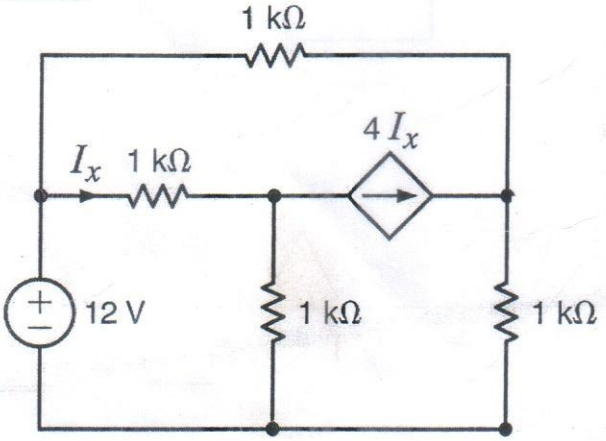

Fig. 3(a).

b) Find the mesh currents and V_0 in the circuit shown in Fig. 3(b). 12

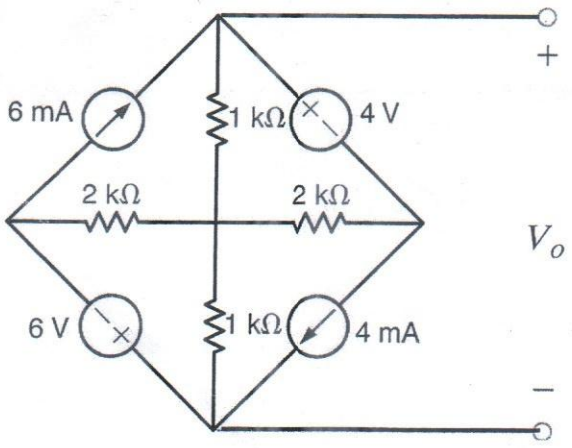

Fig. 3(b).

4. a) When is an electrical circuit called linear? Find the output V_0 in the circuit shown in Fig. 4(a) using linearity and the assumption that V_0=1 V. 13

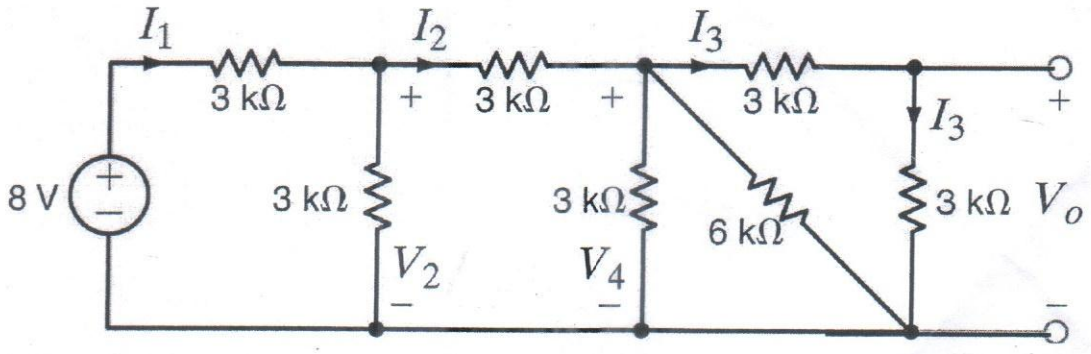

Fig. 4(a).

b) Find I_x and V_0 in the circuit shown in Fig. 4(b) using Thevenin's theorem. 12

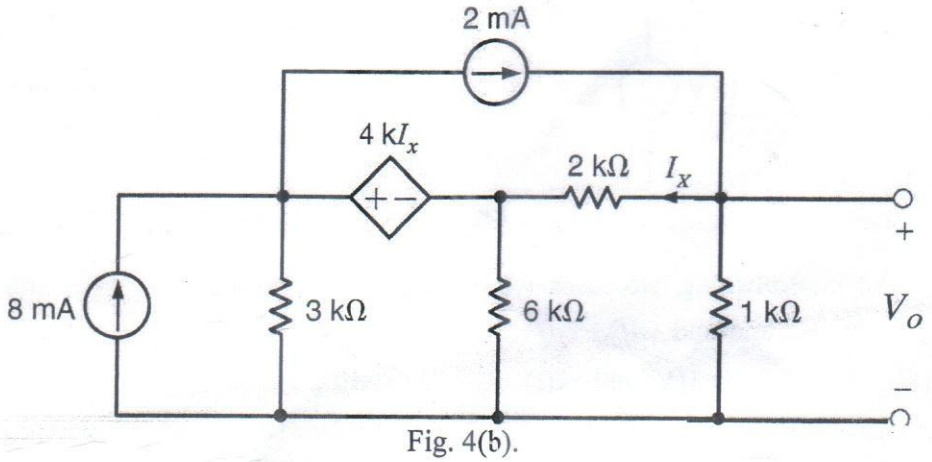

Fig. 4(b).

5. a) When does a resistive load connected to a DC network receive maximum power? Verify your statement mathematically. 5

Refer to the circuit shown below in Fig. 5(a), find the value of R_L so that it will receive maximum power and find the maximum power.

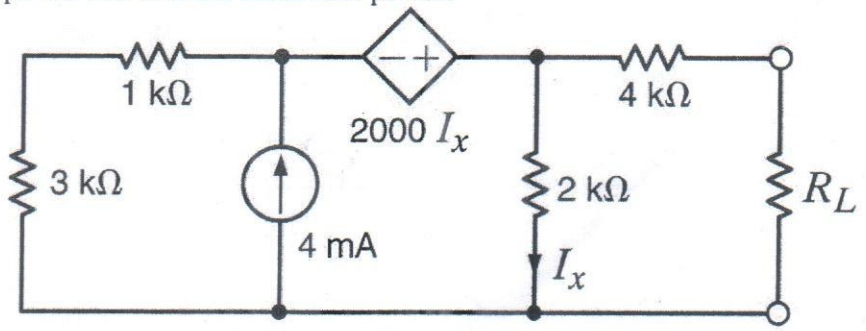

Fig. 5(a).

b) The waveform of current in a 50 μF initially uncharged capacitor is shown below in Fig. 5(b). Determine v(t) and sketch it. 10

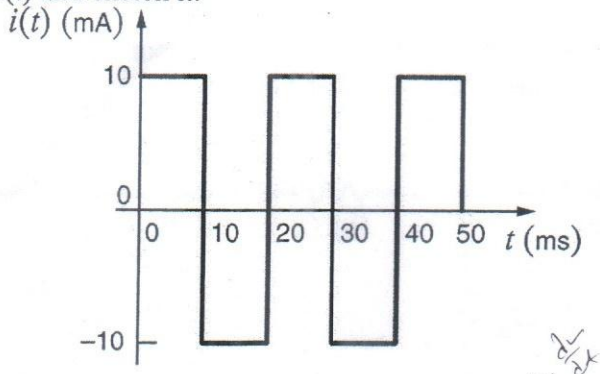

Fig. 5(b).

c) Find the value of C if the energy stored in the capacitor in Fig. 5(c) equals the energy stores in the inductor. 10

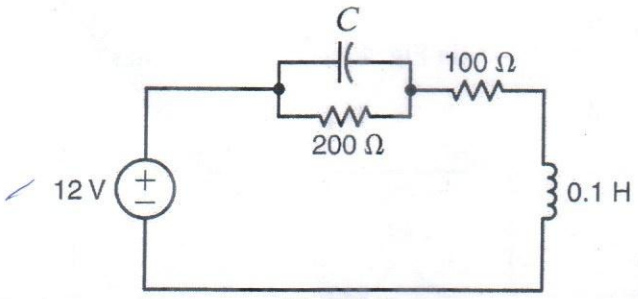

Fig. 5(c).

6. a) For which of the follwoing two cases $v_1(t)+v_2(t)$ can be calculated using phasor method? Justify your answer and find $v_1(t)+v_2(t)$. 5

(i) $v_1(t)=10\sin(10^3t-30^\circ)$ (V) and $v_2(t)=10\sin(2\pi\times10^3t+30^\circ)$ (V)

(ii) $v_1(t)=10\cos(2\pi\times10^3t-30^\circ)$ (V) and $v_2(t)=10\sin(2\pi\times10^3t+50^\circ)$ (V).

b) Define impedance. Show that the range of the impedance angle for a passive inductive branch is $0\le\varphi_L\le90^\circ$ and that for a passive capacitive branch is $-90^\circ\le\varphi_C\le0$. 10

c) In the diagram of Fig. 6(c) when $v(t) = 5\cos(10^3 t)$ V, $i(t) = 0.4\cos(10^3 t + 30°)$ A. Calculate i(t) when $v(t) = 5\cos(2\times10^3 t)$ V. 10

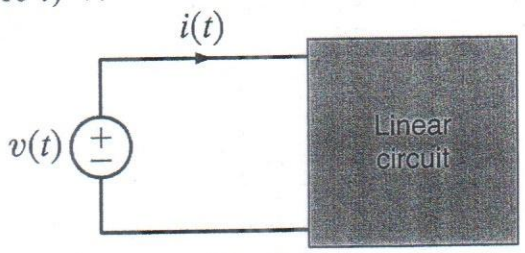

Fig. 6(c).

7. a) Calculate $v_x(t)$ in the circuit in Fig. 7(a) if $v(t) = 100\cos(10t - 30°)$ V. 12

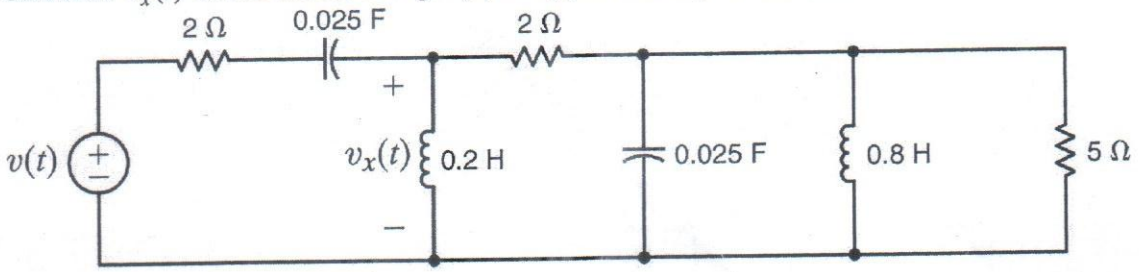

Fig. 7(a).

b) Find $v_0(t)$ in circuit in Fig. 7(b) if frequency of the source is 50 Hz. 13

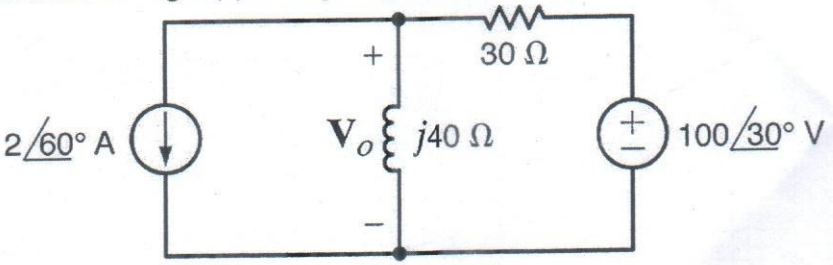

Fig. 7(b).

8. a) Define reluctance of a magnetic path. Why is B-H curve needed to calculate the reluctance of a magnetic path that contains ferromagnetic materials? A circular magnetic circuit with necessary information is shown in Fig. 8(a). A DC source establised a flux $\varphi = 3\times10^{-4}$ wb in the airgap of the magnetic circuit. Calulate the reluctance of each section of the magnetic ciruit and the mmf needed to establish that flux. 12

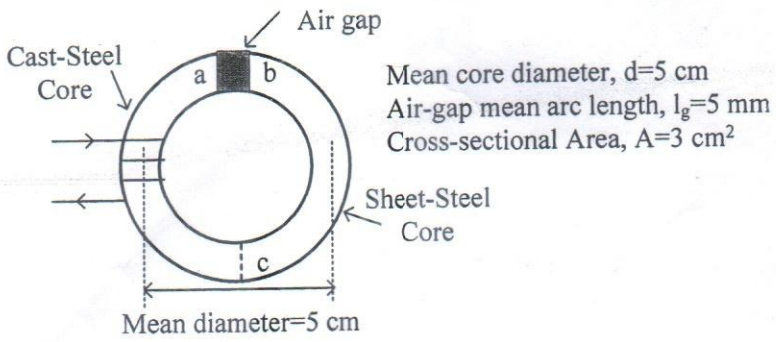

Fig. 8(a).

b) In the magnetic circuit shown in Fig. 8(b), calculate the current in the coil that will produce a magnetic flux of 8×10^{-4} wb in the air gap. The cast iron core has rectangular cross-section area of $A=16\times10^{-4}$ m^2. Take necessary value from Fig. 8(c). 13

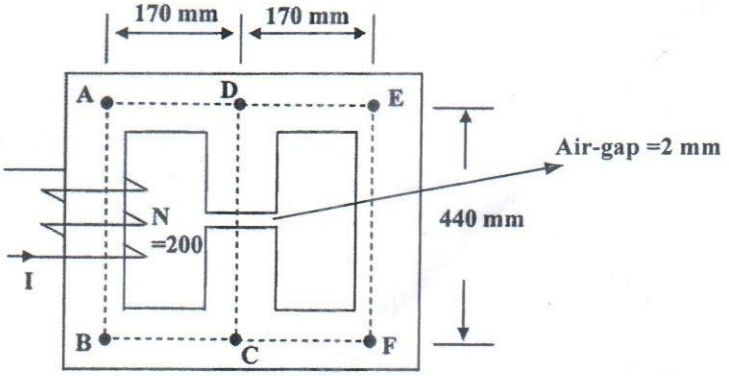

Fig. 8(b).

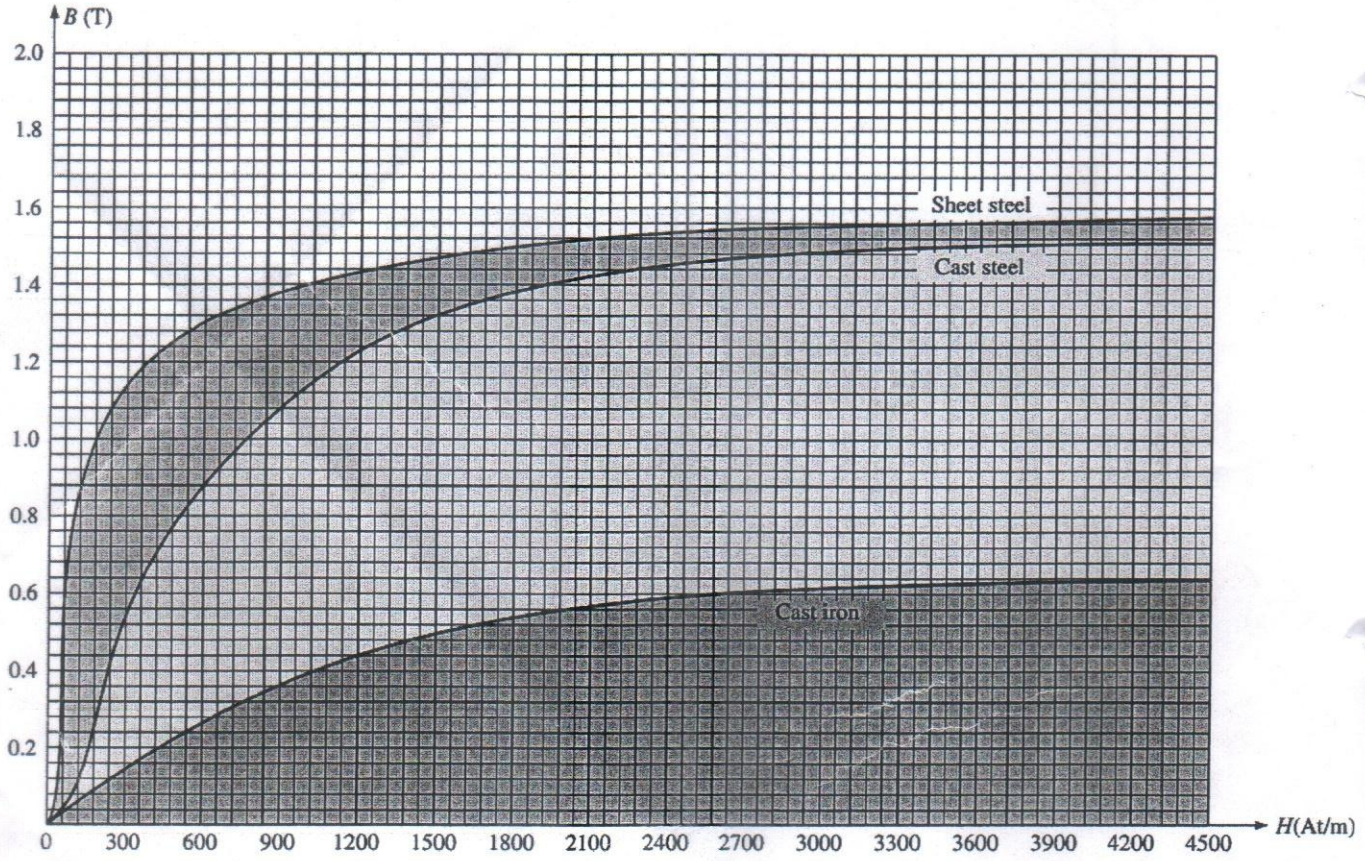

Fig. 8(c)

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B.Sc. Engg.(EE), 1st Sem. Date: June 8, 2018 (Morning)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination — Winter Semester, A.Y. 2017-2018
Course No.: Math 4121 — Time: 3 Hours
Course Title: Mathematics I — Full Marks: 150

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

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1. a) Find the angle of intersection of the curves $x^3 - 3xy^2 = -2$ and $3x^2y - y^3 = 2$.

   b) Explain (i) first derivative test, (ii) second derivative test and (iii) point of inflection with figures.

2. a) If $u = \ln(x^2 + y^2 + z^2)$, prove that $x\frac{\partial^2 u}{\partial y \partial z} = y\frac{\partial^2 u}{\partial z \partial x} = z\frac{\partial^2 u}{\partial x \partial y}$.

   b) Find the formula for the radius of curvature of the curve whose parametric equations are x=x(t) , y=y(t). Also find the radius of curvature of the curve $x = a\cos^3\theta,\ y = a\sin^3\theta$ at $\theta = \frac{\pi}{4}$.

3. Workout the following:

   i) $\int \frac{7x+3}{\sqrt{3x^2+4x+5}}dx$ ii) $\int \frac{\sin^{\frac{5}{7}} x}{\cos^{\frac{33}{7}} x}dx$ iii) $\int \frac{dx}{\sec x(\sec x + 1)}$.

4. a) Find the reduction formula for $U_n = \int_0^{\frac{\pi}{2}} \theta \sin^n \theta d\theta$ hence find $\int_0^{\frac{\pi}{2}} \theta \sin^6 \theta d\theta$.

   b) Evaluate $\int_a^b \cos x dx$ using summation.

5. a) Evaluate $\underset{n\to\infty}{Lt}\left[\left(1+\frac{1}{n}\right)\left(1+\frac{2}{n}\right)\ldots\ldots\ldots\left(1+\frac{n}{n}\right)\right]^{\frac{1}{n}}$.

b) Prove that $\int_0^{2a} f(x)dx = \begin{cases} 2\int_0^a f(x)dx & \text{if } f(2a-x)=f(x) \\ 0 & \text{if } f(2a-x)=-f(x) \end{cases}$

Hence evaluate $\int_0^{\pi} \sin^4 x\cos^7 x dx$ and $\int_0^{\pi} \sin^7 x\cos^4 x dx$.

6. a) Evaluate the following:

i) $\int_0^1 \frac{\ln(1+x)}{1+x^2}dx$, ii) $\int_0^{\frac{\pi}{2}} \frac{dx}{(a^2\sin^2 x + b^2\cos^2 x)^2}$.

b) Derive Simpson's formula and hence evaluate $\int_0^2 \frac{\sqrt{x+2}\, e^x dx}{\sqrt{1+x^2}}$ taking 10 subintervals.

7. a) Show that $\int_0^1 \frac{xdx}{\sqrt{1-x^5}} = \frac{1}{5}B(\frac{2}{5},\frac{1}{2})$

b) If s is the length of the arc of $3ay^2 = x(x-a)^2$ measured from the origin to the point(x,y) show that $3s^2 = 4x^2 + 3y^2$.

8. a) Find the area of all the loops of the curve $r = a\cos 8\theta$

b) The arc of the asteroid $x = a\cos^3\theta$ $y = a\sin^3\theta$ from $\theta = 0$ to $\theta = \frac{\pi}{2}$ revolves about the x-axis. Find the volume and surface area of the solid generated.

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B. Sc. Engg.(EE), 1st Sem. Date: 29 May, 2018 (Morning)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination — Winter Semester A. Y. 2017-2018
Course No. Phy 4121 — Time: 3 Hours
Course Title: Engineering Physics I — Full Marks: 150

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

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1. (a) Define the terms permeability (μ), susceptibility, magnetic induction (B), magnetic field (H), and magnetization (M) with reference to magnetism. Obtain a relation between magnetic susceptibility, magnetization and magnetic field. 10
   (b) Explain the classification of magnetic materials on the basis of electron spin. Show how the magnetic induction of these magnetic materials changes with respect to the applied magnetic field. 10
   (c) Explain hysteresis of a ferromagnetic material. 5

2. (a) Explain the classification of metals, semiconductors and insulators based on band theory. 7
   (b) Distinguish between intrinsic and extrinsic semiconductors. Explain the conductivity of intrinsic and extrinsic semiconductors. Why the conductivity of semiconductors increases with increasing temperature? 12
   (c) Discuss the origin of electrical resistance in metals. 6

3. (a) Explain the terms: (i) photoelectric effect, (ii) threshold frequency, (iii) work function, and (iv) stopping potential. 10
   (b) State and explain the characteristics of photoelectric emission. Establish Einstein's photoelectric equation and show how it explains the above characteristics. 10
   (c) If the wavelength of the incident radiation changes from λ_1 to other value λ_2, the corresponding kinetic energy emitted by the photo-electrons also changes from E_1 to E_2. What is the work function (φ) of the metal surface? 5

4. (a) Distinguish between classical and quantum free electron theory of metals. 6

   (b) Describe the salient features of Kronig–Penney model. Briefly explain the formation of energy bands based on this model. 19

5. (a) What is superconductivity? Describe the effect of: (i) magnetic field (ii) frequency and (iii) isotopes on superconductors. 10

   (b) Discuss the formation of Cooper pairs and energy gap in superconductors on the basis of BCS theory. 10

   (c) Briefly explain the term 'Meissner effect'. 5

6. (a) What is meant by the term polarization of light? Explain the terms plane of polarization and plane of vibration. Briefly explain the phenomenon of double refraction. 10

   (b) State and explain Brewster's law. Show that at the polarizing angle of incidence, the reflected and refracted rays are mutually perpendicular to each other. 10

   (c) The refractive index for plastics is *1.25*. Calculate the angle of refraction for a ray of light incident at polarizing angle. 5

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

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

   (c) Green light of wavelength *510 nm* from a narrow slit is incident on a double slit. If the overall separation of *10* fringes on a screen of *2 m* away is *0.02 m*, find the slit separation. 5

8. (a) What is diffraction of light? Explain various types of diffraction of light. 5

   (b) Show that in case of diffraction through single slit, the minimum intensity occurs when $b \sin\theta = m\lambda$ (m = 1, 2, ...), where b is the slit width. Show graphically the intensity of the diffracted beam through a single slit as a function of β, where $\beta = \frac{\pi b \sin\theta}{\lambda}$ and b is the width of the slit. 15

   (c) The distance between the first and fifth minima of a single slit diffraction pattern is *0.35 mm* with the screen *40 cm* away from the slit, when the light of wavelength *550 nm* is used. (i) Find the slit width. (ii) Calculate the angle θ of the first diffraction minimum. 5

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B.Sc. Engg. (EE), 1st Sem. Date: June 04, 2018 (Morning)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination — Winter Semester, A. Y. 2017-2018
Course No.: Math 4123 — Time: 3 Hours
Course Title: Matrix and Differential Equation — 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 meaning.

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1. a) Reduce the quadratic form $q = x_1^2 + 2x_2^2 - 2x_3^2 + 4x_1x_2 + 6x_1x_3$ to the canonical form and find rank, index and signature of the form. 13

   b) State Cayley-Hamilton theorem and verify for the matrix and hence find the inverse of A. 12

$$A = \begin{bmatrix} 1 & 2 & 3 \\ 1 & 3 & 6 \\ 2 & 6 & 13 \end{bmatrix}$$

2. a) Find the eigen values and eigen vectors of the matrix, 12

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

   b) The system of linear differential equations for the currents $i_1(t)$ and $i_2(t)$ in a electrical networks is: 13

$$\frac{di_1}{dt} = -11i_1 + 3i_2 + 100sint$$

$$\frac{di_2}{dt} = 3i_1 - 3i_2$$

   subject to the initial conditions: $i_1(0) = i_2(0) = 0$. Find $i_1(t)$ and $i_2(t)$ using matrix method.

3. a) Solve: $\left[(3x+2)^2D^2 + 3(3x+2)D - 36\right]y = 81x^2 + \frac{9}{3x+2}$. 13

   b) Solve: $\left[(x+2)D^2 - (2x+5)D + 2\right]y = (x+1)e^x$ by the method of factorization of the operator. 12

4. a) Solve the system of linear differential equations 12

$$\frac{dx}{dt} + 2x - 3y = t, \quad \frac{dy}{dt} - 3x + 2y = e^t.$$

   b) Find the currents $i_1(t)$ and $i_2(t)$ in a electrical networks containing a resistance 50 ohms, an inductor 1 henry and capacitor 10^{-4} f. The currents $i_1(t)$ and $i_2(t)$ are initially zero and E(t)=60 volts. 13

5. a) Determine whether $x=2$ is an ordinary point or a regular singular point of the differential equation $x^2(x-2)^2 y_2 + 2(x-2)y_1 + (x+3)y = 0$. 5

b) Solve in series the differential equation $x\frac{d^2y}{dx^2} + (1+x)\frac{dy}{dx} + 2y = 0$ by the method of Frobenious. 20

6. a) Find the partial differential equation by eliminating the arbitrary functions from the equation $\phi(x-y+z,\ x^2+2y^2-3z^2)=0$. 8

b) Solve: $(xz^3 + x^2yz)p - (yz^3 + xy^2z)q = x^4$. 8

c) Solve: $x(y-z)p + y(z-x)q = z(x-y)$. 9

7. a) Find complete integral and singular integral of: $px^2 + 2qxy = 2zx + pq$. 8

b) Solve: $(D_x^2 - D_xD_y - 2D_y^2)z = 12x^2 + 2y$. 9

c) Solve: $(D_x^2 - 4D_xD_y + 4D_y^2)z = e^{2x+y}$ 8

8. a) Derive the Laplace equation in polar co-ordinate from Cartesian co-ordinate. 12

b) Solve the wave equation, 13

$$\frac{\partial^2 v}{\partial t^2} = a^2 \frac{\partial^2 v}{\partial x^2}$$

under the boundary and initial conditions respective as:

$v(0,t) = v(\pi,t) = 0$ and $\left(\frac{\partial v}{\partial t}\right)_{t=0} = 0,\ v(x,0) = 2(\sin x + \sin 3x)$

B.Sc. SWE, 1st Sem. 138 Date: June 05, 2018 (Morning)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination
Course No.: Phy 4143
Course Title: Physics II

Winter 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) Find current, I in the circuit of Fig. 1 (a). Assume, all resistors are of equal valued (assume any value) and E = 20V. 10

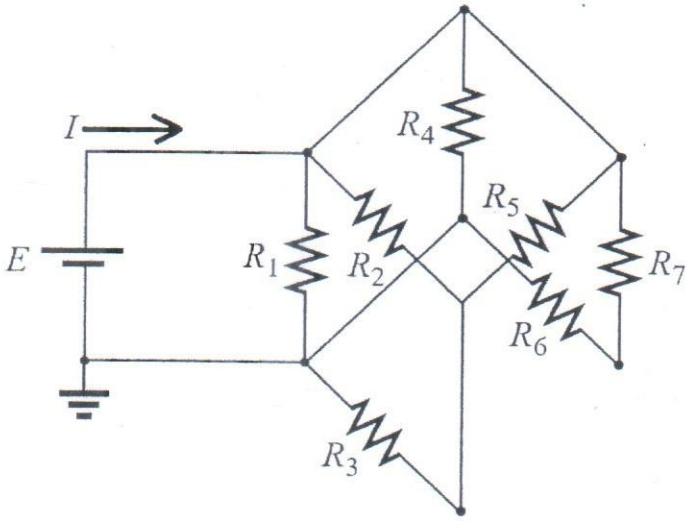

Fig. 1 (a)

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.

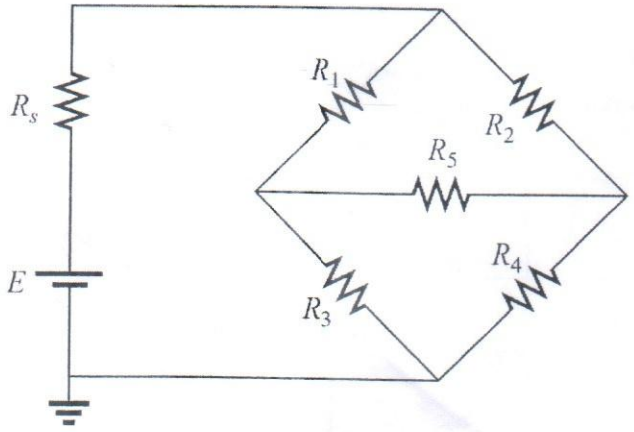

Fig. 1 (b)

2. a) Find voltage, v_s (t) in the circuit of Fig. 2 (a), if the current i_x through the 1 Ω resistor is 0.5 sin 200t A and draw the qualitative phasor diagram. 15

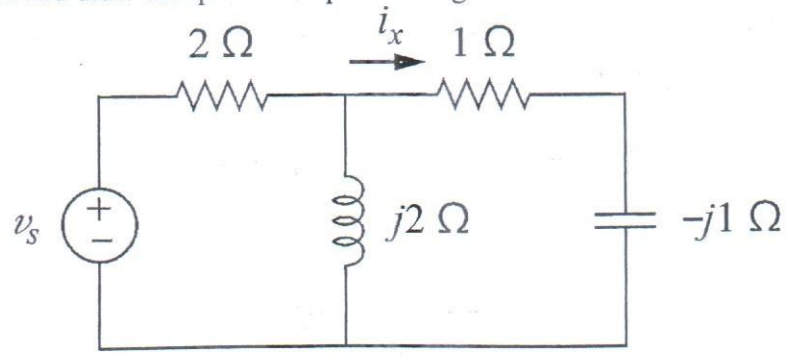

Fig. 2 (a)

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

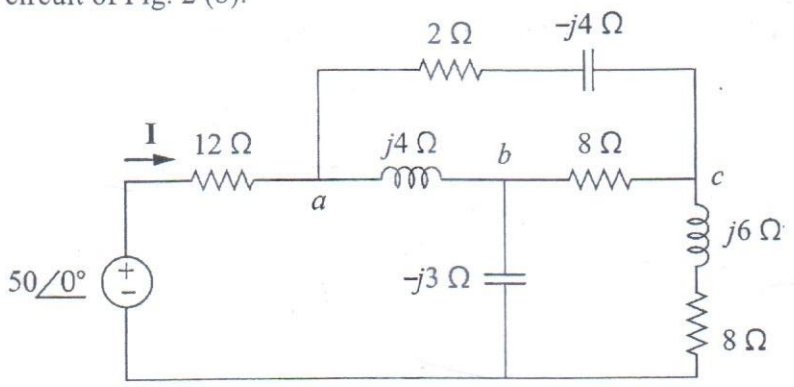

Fig. 2 (b)

3. a) Find I in the following circuit of Fig. 3 (a) using Nodal Analysis. 12

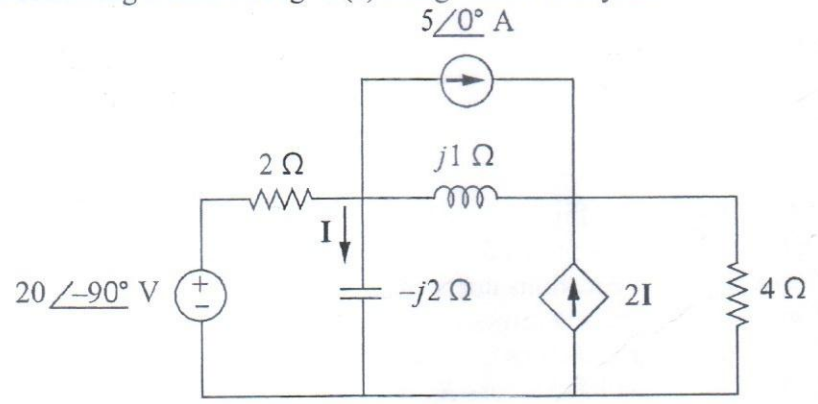

Fig. 3 (a)

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_o. 13

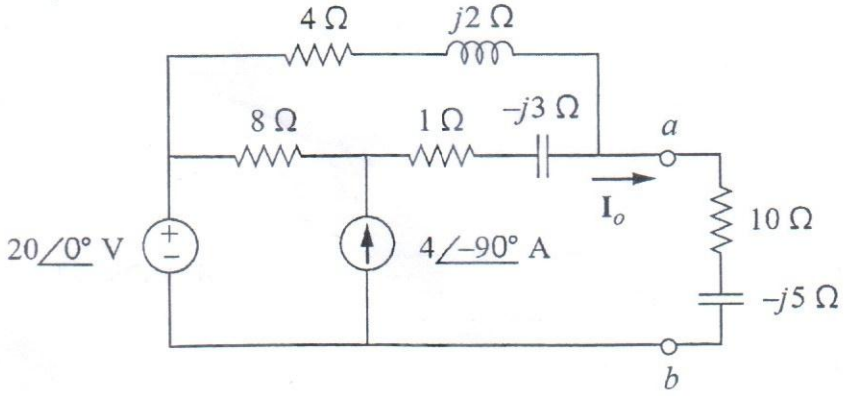

Fig. 3 (b)

140

4. a) Determine the rms value of the periodic current shown in the Fig. 4 (a). If the current flows through a 10 Ω resistor, find the average power absorbed by the resistor. 10

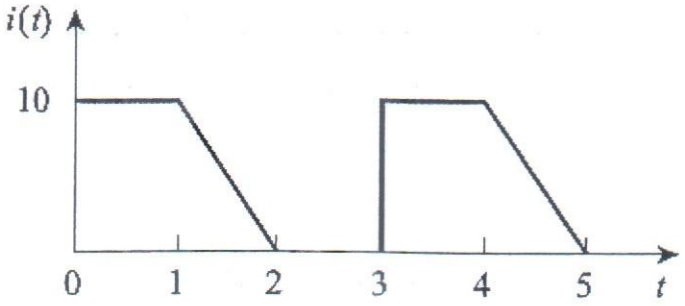

Fig. 4 (a)

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

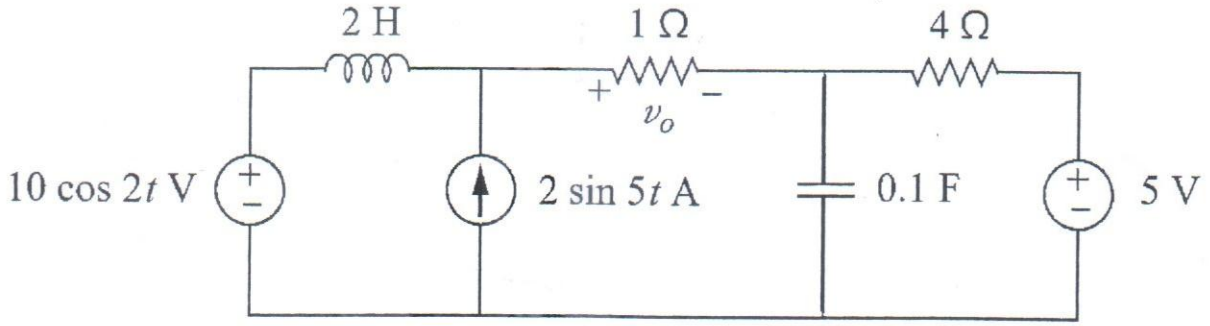

Fig. 4 (b)

5. a) For a balanced wye-delta 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. 5 (b) and the real power absorbed by the load. 10

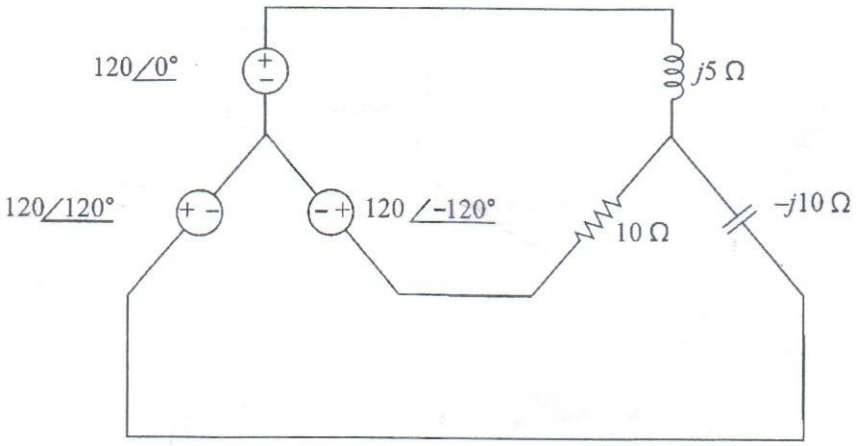

Fig. 5 (b)

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

b) Find the value of parallel capacitance required to correct a load of 240 kVAR at 0.85 lagging pf to unity pf. Assume that the load is supplied by a 210 V (rms), 50 Hz line. 8

c) In Fig. 6 (c), 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

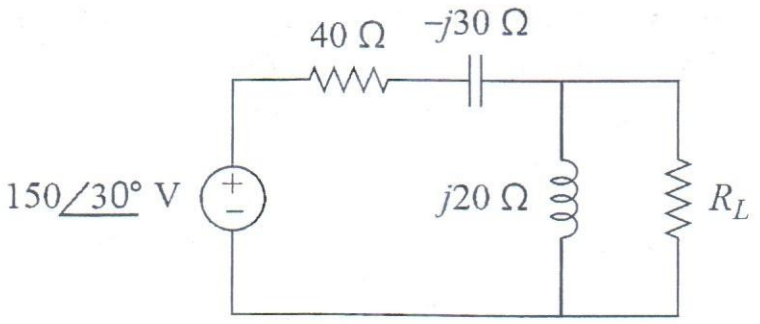

Fig. 6 (c)

7. a) Mention the advantages of three-phase system comapred to single-phase system in terms of power loss. Justify your answers with necessary diagrams and equations. 9

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). 16

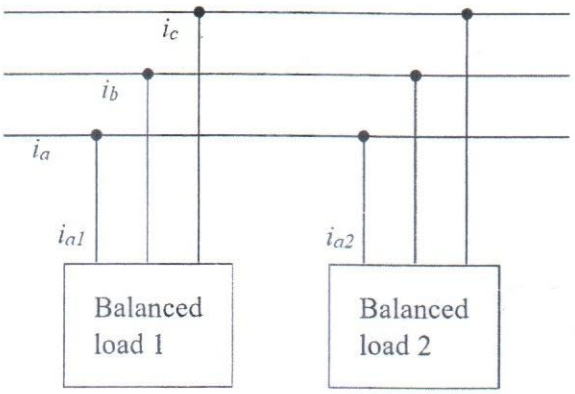

Fig. 7 (b)

8. a) In the parallel RLC circuit in Fig. 8 (a), R= 5 Ω, L= 0.2 mH, and C= 10 μF. (a) Calculate ω_0, Q, and B. (b) Find ω_1 and ω_2. 10

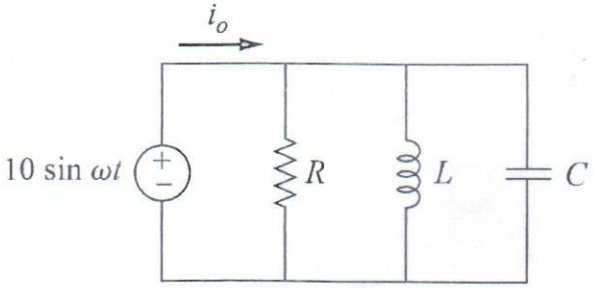

Fig. 8 (a)

b) 15

i. What do you mean by passive filter and active filter?

ii. How many types of filter are found generally? Draw their ideal and practical frequency response.

iii. What is cut-off frequency of a filter? Define it by voltage gain.

iv. Draw the circuits of High Pass Filter and Band Stop Filter. Find their transfer functions. Draw the frequency responses from their transfer functions. Also find their cut-off frequency.

BBA in TM, 1st Sem. 142 Date: June 04, 2018 (Morning)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination — Winter Semester, A. Y. 2017-2018
Course No.: EEE 4161 — Time: 3 Hours
Course Title: Electrical and Electronic Technology I — Full Marks: 150

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

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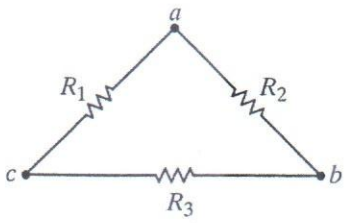
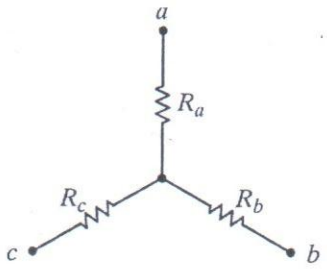
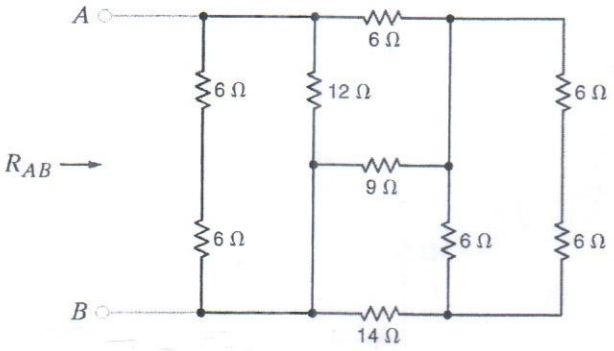
1. a) State and explain Ohm's law, KCL and KVL. 06

   b) What is Wye to Delta and Delta to Wye transformation? Derive the equations for R_1, R_2 and R_3 in terms of R_a, R_b and R_c and vice versa from the following figure. 12

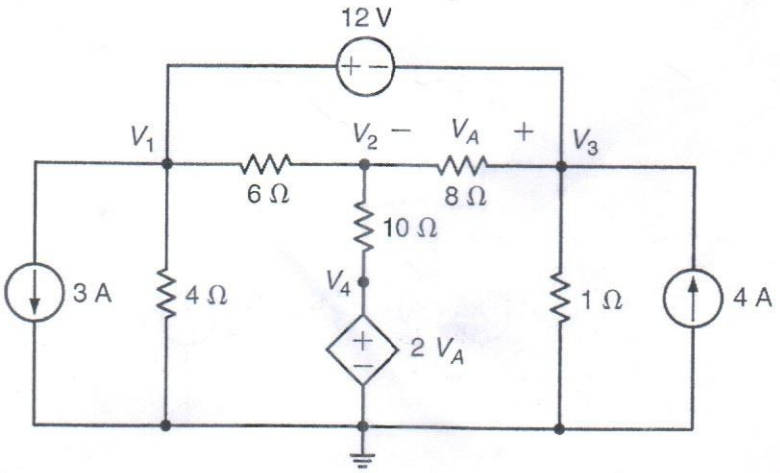




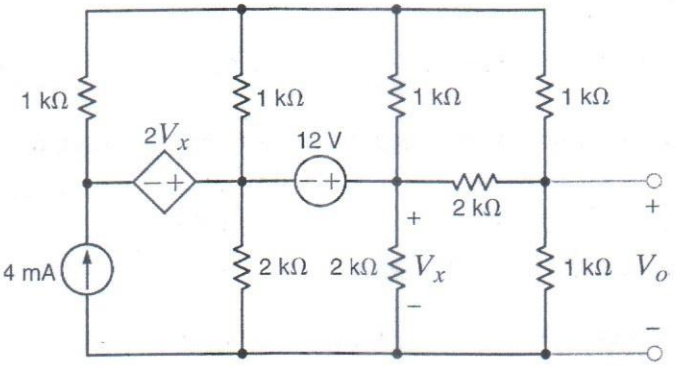
   c) Find the equivalent resistance R_{AB} in the following figure. 07



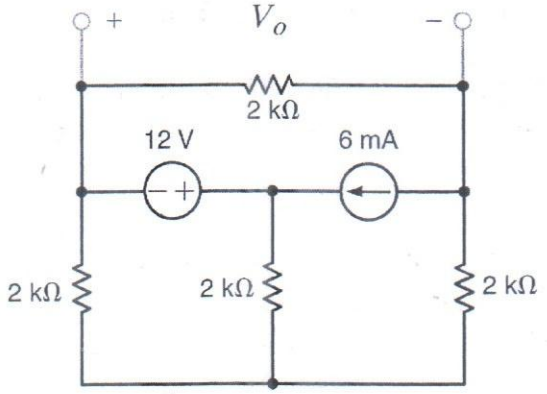
2. a) Use nodal analysis to find V_1, V_2, V_3 and V_4 in the following figure. 13



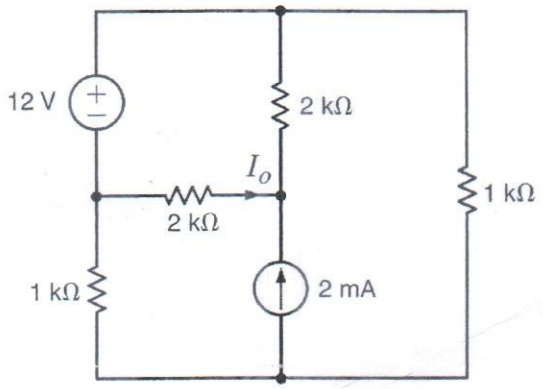
b) Use loop analysis to find Vo in the circuit in figure below. 12



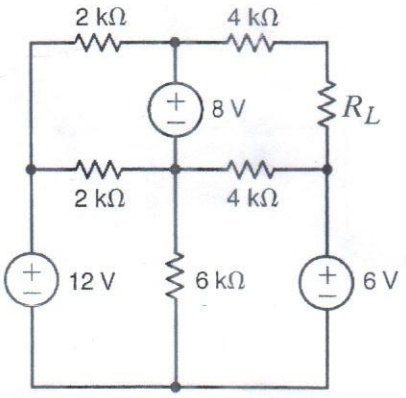
3. a) Find V_0 in the circuit in figure below using superposition theorem. 13



b) Find I_0 in the circuit in figure below using Thevenin's theorem. 12



4. a) Find the value of R_L in the following figure for maximum power transfer and the maximum power that can be dissipated in R_L. 12



b) Find the equation for power in R branch and draw the voltage, current and power in thesame plot. 05

c) A voltage $v = 150 \cos 314t$ volts is applied to a purely resistive branch of $R = 30$ ohms, 08

i) Write the expression for i as a function of time, employing numerical coefficients.
ii) What is the frequency of the voltage and current variations?
iii) Write the expression for p as a function of time, employing numerical coefficients.
iv) What is the frequency of the power variation?

5. a) Considering voltage $v = V_m \sin\omega t$ volts, derive the current, impedance and power expression for a RL branch. Draw the voltage, current and power in the same plot. 12

b) R = 10 Ω and L = 0.05 H are connected in series and energized by a 25-cycle sinusoidal voltage, the maximum value of which is 150 volts. 13

i) Find the complete impedance expression for the RL branch.
ii) Write the expression for the supply voltage as a function of time, making v = 75 (di/dt positive) at t = 0.
iii) Write the expression for current as a function of time, assuming that the voltage in (ii) is applied to the branch. Employ numerical coefficients.
iv) Write the expression for the instantaneous power delivered to the branch as a function of time. Express the result in three terms: a number, one cosine, and one sine term. What is the average power delivered?

6. a) Explain different types of generators. 08

b) What is the voltage equation of a motor? Find the condition for maximum power transfer. 07

c) In a long-shunt compound generator, the terminal voltage is 230 V when generator delivers 150 A. Determine i) induced e.m.f. ii) total power generated and iii) distribution of this power. Given that shunt field, series field, divertor and armature resistance are 92Ω, 0.015Ω, 0.03Ω and 0.032Ω respectively. 10

7. a) What are the advantages and disadvantages of an induction motor? 08

b) Explain the production of rotating field in the case of a two-phase supply induction motor. 10

c) A 12-pole, 3-phase alternator driven at a speed of 500 r.p.m. supplies power to an 8-pole, 3-phase induction motor. If the slip of the motor at full load is 3%, calculate the full load speed of the motor. 07

8. a) Derive the e.m.f. equation of a transformer. What is voltage transformation ratio? 10

b) The core of a three phase, 50 Hz, 11000/550 V delta/star, 300 kVA, core-type transformer operates with a flux of 0.05 Wb. Find 10

i) number of H.V. and L.V. turns per phase,
ii) e.m.f. per turn,
iii) full load H.V. and L.V. phase-currents.

c) How to find the energy in an L circuit? Consider voltage $v = V_m \sin\omega t$. 05

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B.Sc. Engg. (EE)/ HDEE, 3rd Sem. Date: May 30, 2018 (Morning)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination — Winter Semester, A. Y. 2017-2018
Course No.: EEE 4301 — Time: 3 Hours
Course Title: Power System I — Full Marks: 150

There are **8 (eight)** questions. Answer **any 6 (six)** questions. Marks in the margin indicate full marks. Programmable calculators are not allowed. Do not write on this question paper. Symbol(s) preserve their usual meanings. Assume reasonable value if necessary.

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1. a) Discuss briefly mutual GMD and GMR of transmission line conductors. 6

   b) Derive the expression of inductance of each wire for a single phase two wire line. 9

   c) Find the inductance per phase per km of double circuit 3-phase line shown in Fig. 1(c). The conductors are transposed and are of radius 0·75 cm each. 10

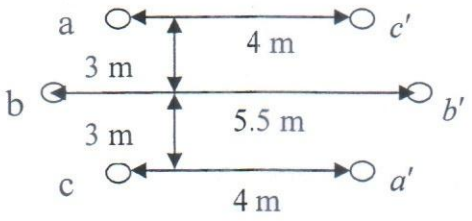

Fig. 1(c)

2. a) With neat diagram describe the operation of differential protective relays of power system. 8

   b) Derive the expression for the insulation resistance of a single core cable. 6+
   Resistance of the insulation thickness of a single core cable is 495×10^6 Ω per km. The core diameter is 2.5 cm and resistivity of insulation is 4.5×10^{12} Ω-m. Find the insulation thickness. 6

   c) Find the line loss due to charging current of an unloaded transmission line. 5

3. a) For transmission line of medium length using nominal T model, derive the generalized parameters A, B, C and D for the same. 11

   b) A three phase line of length 81 km and resistance 0.87 Ω/km delivers 5 MW at 0.9 p.f. lagging. The receiving end voltage is 60 kV. Radius and spacing between lines are 2.61 mm and 2 m, respectively with 50 Hz system. Using nominal T method, find: 14
      i. Percentage voltage regulation and
      ii. Power factor at sending end.

4. a) Prove that g_{max}/g_{min} in a single-core cable is equal to D/d. 7+
Maximum and minimum stresses in the dielectric of a single core cable are 40 kV/cm (r.m.s.) and 10 kV/cm (r.m.s.), respectively. If the conductor diameter is 2 cm, find : 6
(i) Thickness of insulation material and (ii) operating voltage.

b) For a two wire line, show that the capacitance between conductor and neutral is given by 12

$$C_{an} = \frac{6.283k}{\ln\frac{D}{r}}$$, where symbols bear their usual meaning.

5. a) Single phase a.c. distributor AB is fed from end A and has a total impedance of (0.2+j0.3) Ω. 14
At the far end, the voltage V_B = 240 V and the current is 100 A at a p.f. of 0.8 lagging. At the mid point M, a current of 100 A is tapped at a p.f. of 0.6 lagging with reference to the voltage at the mid point, V_M. Calculate:
i. Supply voltage at A, V_A.
ii. Phase angle between V_A and V_B.

b) What is a sag in overhead lines? Deduce an approximate expression for sag in overhead lines when supports are at unequal levels. 11

6. a) What is corona? Describe the various methods for reducing corona effect in an overhead transmission lines. Explain the following terms with reference to corona: 13
(i) Visual critical voltage and (ii) critical disruptive voltage.

b) 3-phase, 220 kV, 50 Hz transmission line consists of 1·5 cm radius conductor spaced 2 m apart in equilateral triangular formation. If the temperature is 40 °C and atmospheric pressure is 76 cm, calculate the corona loss per km of the line. Take m_o = 0·85 and g_o = 21·2 kV/cm (r.m.s.). 12

7. a) Derive the expression for string efficiency of a 3-disc suspension insulator string. Discuss various methods used for increasing the string efficiency of suspension type insulators in the overhead lines. 9

b) Each of the three insulators forming a string has a self-capacitance of C farad. The shunt capacitance of each insulator is 0.2 C to earth and 0.1 C to line. A guard ring increases the capacitance of line of the metal work of the lowest insulator to 0.3 C. Calculate the string efficiency of the arrangement: (i) with the guard ring, (ii) without guard ring. 8+8

8. a) Write short note on Interconnected system. 10

b) A two wire d.c. distributor AB, 600 meters long is loaded as under: 15

Distance from A (meters):	150	300	350	450
Load in Amperes:	100	200	250	300

The feeding point A is maintained at 440V and that of B at 430V, if each conductor has a resistance of 0.01 Ω per 100 m, calculate:
i. Currents supplied from A and B,
ii. Minimum potential and the point at which it occurs and
iii. Power dissipated in the distributor.

B.Sc. Engg.(EE)/HDEE, 3rd Sem. 147 Date: June 01, 2018 (Morning)

DTE 1st Sem.

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

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

Winter 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 negative feedback? What are the advantages and disadvantages of the negative feedback? 8

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

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

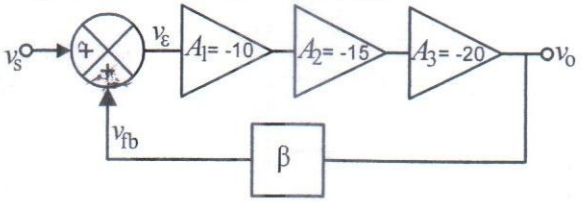

Fig. 1(c)

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

   b) What are the major limitations of passive filters? What are the types of active filters? Draw their corresponding circuit diagrams and transfer functions. 10

   c) Consider the circuit shown in Fig. 2(c), derive the expressions for the magnitude and phase of the voltage transfer function. 10

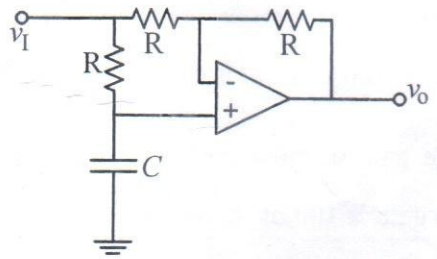

Fig. 2(c)

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

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

c) Determine the closed-loop voltage gain $A_v = \frac{v_0}{v_i}$ for the ideal op-amp circuit in Fig. 3(c). Let $R = 30$ kΩ, determine the current in the resistor R in the T-network for $v_i = -0.15$ V. 10

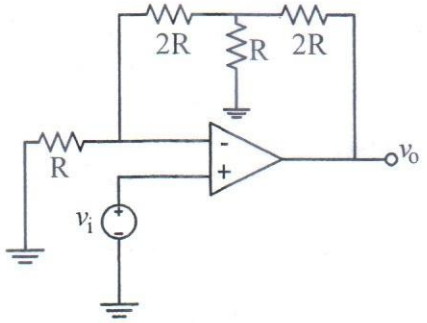

Fig. 3(c)

4. a) Consider the case of a voltage source with a 100 kΩ output impedance driving a 1 kΩ load impedance. If a voltage follower inserted between the source and the load then show that it will prevent loading effect. 5

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

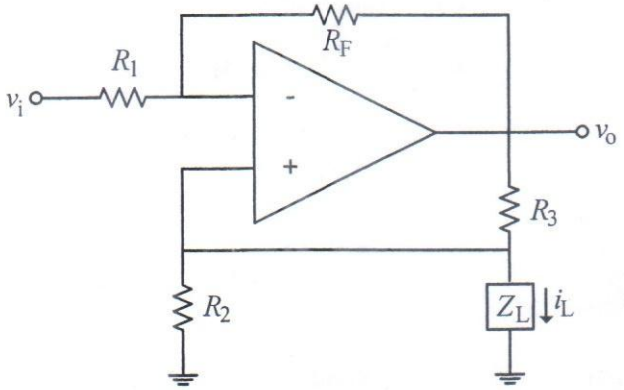

Fig. 4(b)

c) Consider the voltage-to-current converter shown in Fig. 4(b). The load impedance is $Z_L = 200$ Ω and the input voltage is $v_i = -3$ V. Determine the load current i_L and the output voltage v_o if $R_1 = 10$ kΩ, $R_2 = 1.5$ kΩ, $R_3 = 3$ kΩ and $R_F = 20$ kΩ. 10

5. a) Define phase margin and gain margin. What is meant by frequency compensation? 05

b) The open-loop voltage gain of an amplifier is given by $A_v = \frac{10^5}{\left(1+j\frac{f}{10^3}\right)\left(1+j\frac{f}{10^5}\right)}$, if the low-frequency closed-loop gain is 100, is this amplifier stable? If so, determine the phase margin. 10

c) An open-loop amplifier can be described by $A_v = \frac{10^4}{\left(1+j\frac{f}{10^5}\right)}$, a dominant pole is to be inserted such that a closed-loop amplifier with a low-frequency gain of 50 has a phase margin of 45 degrees. Determine β and the required dominant pole frequency. 10

6. a) Briefly explain the bandwidth extension and show that the gain-bandwidth product of a feedback amplifier is a constant. 05

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

c) Given the Bode plot in Fig. 6(c), obtain the transfer function $H(\omega)$. 10

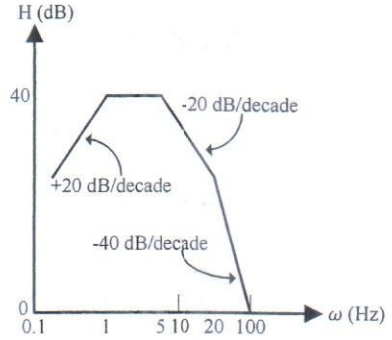

Fig. 6(c)

7. a) Analyze the phase-shift oscillator in Fig. 7(a). Show that the frequency of oscillation is given by $\omega_0 = \frac{1}{\sqrt{6}RC}$ and that the condition for oscillation is given by $\frac{R_2}{R} = 29$. 10

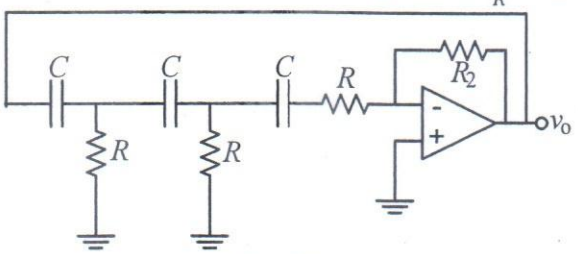

Fig. 7(a)

b) Describe and explain the operation of a Wien-bridge oscillator. 10

c) Design a Wien-bridge oscillator to oscillate at $f_0 = 20$ kHz. 05

8. a) Discuss crossover distortion in class-B operation of an amplifier. 10

b) Describe the operation of a class-AB complementary BJT push–pull output stage. 10

c) Calculate maximum ac output power and efficiency of the amplifier shown in Fig. 8(c). V_{BE} may be assumed negligibly small with $V_{CC} = +10$ V and $V_{EE} = -10$ V. 05

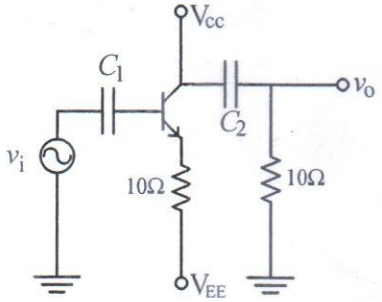

Fig. 8(c)

150

B.Sc. Engg.(EE)/ HDEE, 3rd Sem. Date: June 07, 2018 (Morning)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination
Course No.: EEE 4305
Course Title: Energy Conversion I

Winter 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 and acronyms bear their usual meaning.

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1. a) Discuss pole pitch, coil pitch and commutator pitch of a dc machine with neat diagram. How do you identify the front-end and back-end of a coil in a dc machine? 10

   b) Calculate the front pitch (Y_F) and back pitch (Y_B) of simplex wave winding (progressive) for the armature of a dc generator having 4-poles and 26 conductors arranged in double-layers. Using the calculated Y_F and Y_B, show the overall connection scheme in a tabular form (winding diagram not required). How many parallel paths will be present in this winding? 10

   c) The pole pitch of a 6-pole dc machine is measured as 180° (mechanical). Find out the corresponding pole pitch in electrical degrees. What would happen to the pole pitch (both mechanical and electrical) value if the number of poles gets doubled? 05

2 a) What are the consequences of practical commutation in a dc machine? How is it different than the ideal commutation? Comment on the magnitude of reactance voltage in case of ideal commutation. 07

   b) What is the process of determining the polarity of inter-poles in a dc machine? Which current is flown through the inter-pole winding and why? Discuss in brief with neat diagram. 06

   c) A 4-pole lap-connected armature of a dc shunt generator is required to supply 250 V across the loads connected in parallel: i) 5 kW Geyser, ii) 7.5 kW lighting load. The generator has an armature resistance of 0.25 ohm and a field resistance of 225 ohm. The armature has total 240 conductors and runs at 1500 rpm. Neglecting brush contact drop and friction loss, determine: i) flux per pole, ii) armature current per parallel path, and iii) armature current, output power and prime mover speed if the lighting load is turned off. 12

3. a) What is the critical speed of a shunt generator? How is it related to the voltage build-up process of the shunt generator? Mention other factors (if any) responsible for proper voltage build-up of a shunt generator. 07

   b) When does the energy storage in the field poles of a self-excited dc generator change? What are the differences between the OCCs of a shunt generator and a compound (long shunt) generator? Draw the OCC for a series generator. 08

   c) A 220 V compound generator is supplying a load of 110 A at 220 V. The resistances of its armature, shunt and series windings are 0.1 ohm, 50 ohm and 0.06 ohm, respectively. Find the induced emf, armature current, electrical power output and copper losses when the machine is connected as i) long shunt and ii) short shunt. 10

4. a) Why are the shaft torque and armature torque not identical for dc motors? Which loss would become negligible if these torques could be assumed equal? 02

b) Consider a 2-pole dc machine being initially run as a generator by the prime-mover in the anti-clockwise direction as shown in figure 4 (b). Find out the direction of current through the armature conductors in loaded condition. In which direction the magnetic neutral axis (MNA) will get shifted due to armature reaction? 08
If, however, the machine is run as a motor, considering the same direction of current flowing through the armature (as found earlier in case of generator), determine the direction of motion for the motor and the direction of MNA shift due to armature reaction.

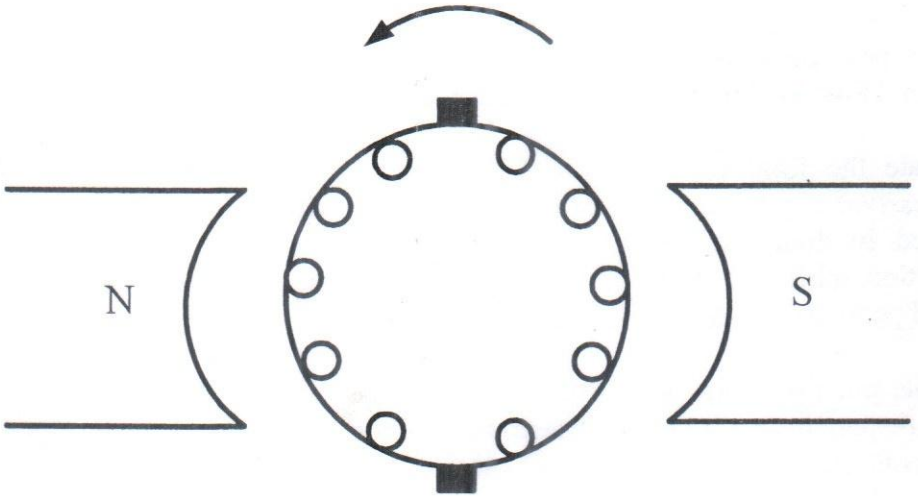

Figure: 4 (b)

c) A 4-pole, 250 V, wave connected shunt motor gives 11.25 kW when running at 1100 rpm and drawing armature and field current of 50 A and 1.0 A, respectively. It has 540 conductors. Its armature resistance is 0.1 ohm. Neglecting brush voltage drop, find i) armature torque, ii) shaft torque, iii) flux per pole, iv) rotational losses and v) efficiency. 15

5. a) The load coupled to the shaft of a dc motor has torque vs time characteristics as shown in figure 5 (a). With appropriate equations, explain the kind of motor that should not be used. 05

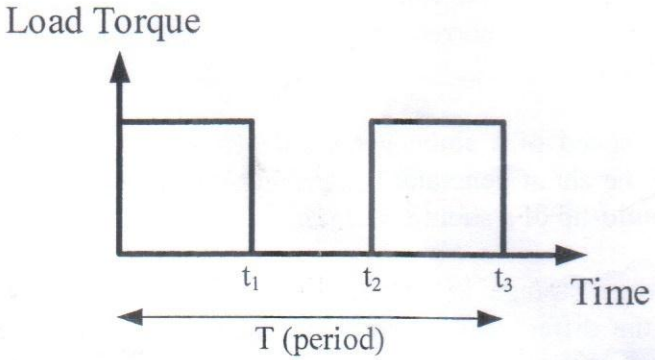

Figure: 5 (a)

b) Considering a dc shunt motor is running at constant load, explain the effect of increase in flux on motor's speed, armature current and torque with relevant equations. 08

c) A 6-pole 300 V lap-connected series motor has 800 conductors and 20 mWb flux/pole. The armature and field resistance are 0.5 ohm and 0.01 ohm respectively. What will be the speed and torque developed by the motor when it draws 20 A from the supply mains? Neglect armature reaction. If magnetic and mechanical losses amount to 500 W, find i) shaft torque, ii) output in kW and iii) efficiency at this load. 12

6. a) A dc shunt motor along with its starter circuit is shown in figure 6 (a). Identify the major flaws of the given configuration and discuss their respective impact on the operation. Rectify the flaws (wherever applicable) and redraw the corrected configuration. 20

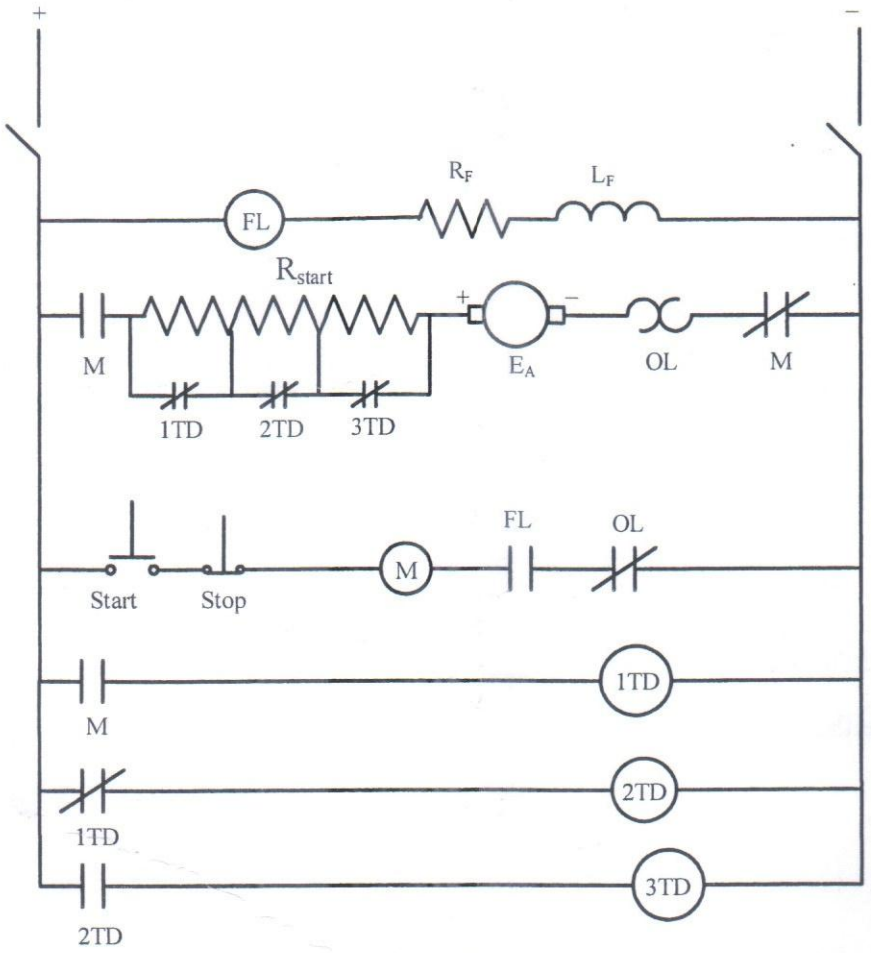

Figure 6 (a)

b) The nameplate data of a dc machine reads as follows: 05
Voltage: 220 V, Power: 1 kW, Speed: 1800 rpm. $R_{field,\ min}$ = 110 ohm. Consider a reasonable value for armature resistance. Calculate the rated armature current and the starting current for this machine when used as a shunt motor.

7. a) Are the winding thicknesses of a transformer's low-voltage and high-voltage sides same? Justify your answer. 05

b) A 100 kVA, 33000/3300 V, 50 Hz, step down transformer has the following resistance and leakage reactance values: R_1 = 4 ohm, R_2 = 0.04 ohm, X_1 = 12 ohm, X_2 = 0.12 ohm. The transformer is operating at rated load. If the power factor of the load is 0.866 lagging, determine the efficiency of the transformer. 15

c) Define turns ratio of a transformer. Explain the way of determining the direction of current flow in the primary and secondary sides of the transformer shown in figure 7 (c). Consider the instantaneous polarity of the primary side voltage as depicted in the figure. 05

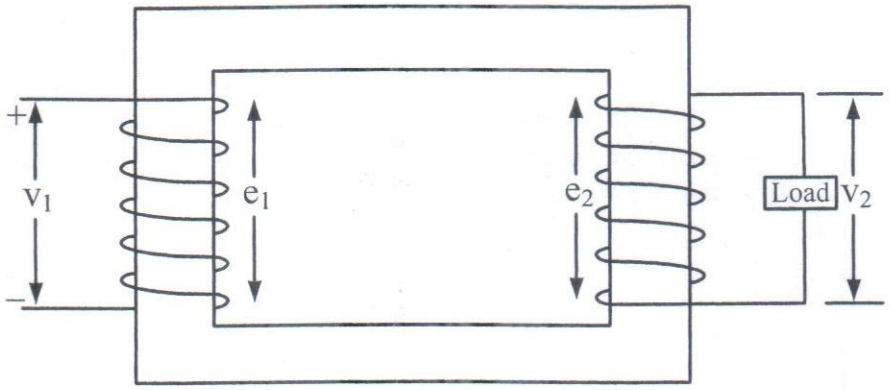

Figure 7 (c)

8. a) What are the purposes of using oil in a transformer tank? How does the breather work? 05

b) How much mechanical loss is present in a transformer? Derive the condition of maximum efficiency for a transformer. 05

c) The following data were obtained from testing a 50 kVA 5000/250 V, step down transformer: 15

	Voltage (V)	Current (A)	Power (W)
Open-circuit test	250	2	100
Short-circuit test	150	10	500

Determine the equivalent circuit of the transformer as viewed from the high-voltage side.

B.Sc. Engg. (EE)/HDEE, 3rd Sem. 153 Date: May 24, 2018 (Morning)
DTE. 1st Sem.

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination — Winter Semester, A. Y. 2017-2018
Course No.: EEE 4307 / EEE 4397 — Time: 3 Hours
Course Title: Digital Electronics — 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) Using r's complement, ('r' represents the base) perform the subtraction operations: 3
   (i) $(46894)_{10} - (1883)_{10}$, (ii) $(01100101)_2 - (11101000)_2$.

   b) Add the following BCD numbers: 3
   (i) 1000 + 0110,
   (ii) 00100101 + 00100111 and
   (iii) 010101100001 + 011100001000.

   c) Prove the identity of each of the following Boolean equations, using algebraic manipulation:
   (i) $A\bar{B}\bar{C} + B\bar{C}\bar{D} + BC + \bar{C}D = B + \bar{C}D$ 7
   (ii) $\bar{A}(A+B) + (B+A)(A+\bar{B}) = A + B$ 7

   d) Simplify the following Boolean function using Karnaugh-Map in SOP form: 5
   $F = (B + C + D).(A + B + \bar{C} + D).(\bar{A} + B + C + \bar{D}).(A + \bar{B} + C + D).(\bar{A} + \bar{B} + C + D)$.

2. a) A NAND gate with eight inputs is required. For each of the following cases, minimize the number of gates used in the multiple-level result: 15
   (i) Design the 8-input NAND gate using 2-input NAND gates and NOT gates only.
   (ii) Design the 8-input NAND gate using 2-input NAND gates, 2-input NOR gates and NOT gates only if needed.
   (iii) Compare the number of gates used in (i) and (ii).

   b) Design a Full-Adder using MUX and NOT gates only. 10

3. a) Show the operation of a basic Latch circuit. 6

   b) Construct a *D* flip-flop using: 8
   (a) NAND gates,
   (b) NOR gates.

   c) Convert a *D* flip-flop to a *J-K* flip-flop by including input gates to the *D* flip-flop. The gates needed for the input of the D flip-flop can be determined by means of sequential-circuit design procedures. The sequential circuit to be considered will have one *D* flip-flop and two inputs, *J* and *K*. 11

4. a) Construct a state table for the circuit shown in Figure 4.a and identify the stable states of the circuit. Derive a Boolean expression for the next value of the output Q in terms of Q, A and B. 15

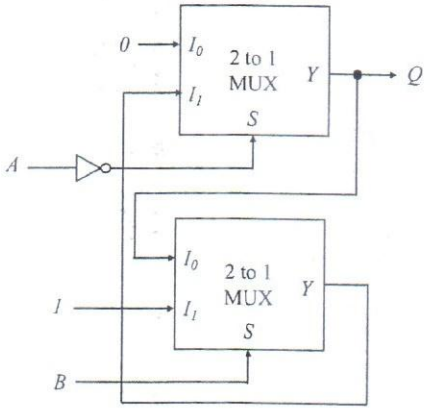

Figure 4.a

b) Reduce the following Boolean expression using the Quine-McCluskey method: 10
$F = \bar{A}\bar{B}\bar{C}D + \bar{A}\bar{B}CD + \bar{A}B\bar{C}\bar{D} + \bar{A}B\bar{C}D + A\bar{B}CD + AB\bar{C}\bar{D} + AB\bar{C}D + ABCD$.

5. a) Fibonacci sequence is characterized by the fact that every number after the first two is the sum of the two preceding ones. Design a **synchronous** counter that will produce binary equivalent of Fibonacci sequence up to the binary value of 13 as shown in the following table. 20

Steps	Step 0	Step 1	Step 2	Step 3	Step 4	Step 5	Step 6	Step 7
Fibonacci Sequence	0	1	1	2	3	5	8	13

b) Design a 4 bit BCD **asynchronous** counter. 5

6. a) Design a sequence detector using *R-S* flip-flop that has a form shown in Figure 6.a. The output Z should be 1 if the input sequence ends in either 101 or 0110 and Z should be 0 otherwise. For example: 17

X 0 1 0 1 0 1 1 0 1 1 0 1 1 0 0 1
Z 0 0 0 1 0 1 0 1 1 0 0 0 1 0 1 0 0

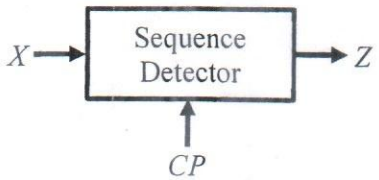

Figure 6.a

b) The state diagram for a sequential circuit appears in Figure 6.b. Find the state table of the circuit. How many flip-flops are required to design the circuit? 8

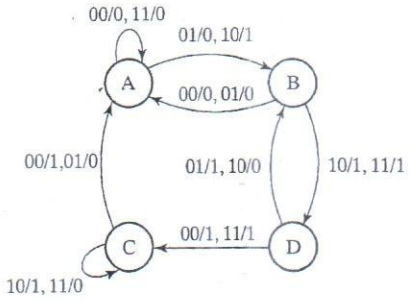

Figure 6.b

7. a) Design a (128K × 16) bit RAM. You must show the logic diagram, address lines, read/write input, data inputs and data outputs. 6

b) (i) How many 128K × 16 RAM chips are needed to provide a memory capacity of 2MB? 9

(ii) How many address lines are required to access 2 MB? How many of these lines are connected to the address inputs of all chips?

(iii) How many lines must be decoded to produce the chip select inputs? Specify the size of the decoder.

c) Draw the logic diagram of a 4-bit register with four D flip-flops and four 4×1 MUX with mode selection inputs S_1 and S_0. The register operates according to the following function table: 10

S_1	S_0	Register Operation
0	0	No Change
0	1	Complement the four outputs
1	0	Clear register to 0
1	1	Load Parallel data

8. a) Implement the following logic circuit in CMOS. 7

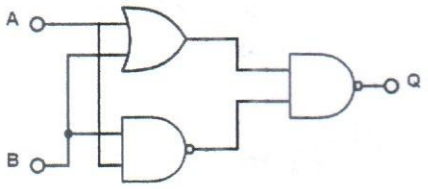

Figure 8.a

b) What are the benefits of digital signal over analog signal? 3

c) An ADC produces the following sequence of binary numbers when an analog signal is applied to its input: 0000, 0010, 0011, 0100, 0101, 0110, 0111, 0110, 0101, 0100, 0011, 0010, 0001, 0000. 15

(i) Design a circuit that will produce the input digitally from the digital signal applied.

(ii) Reconstruct the input signal digitally.

B.Sc. Engg.(ME)/ HDME, 3rd Sem. Date: June 04, 2018 (Morning)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination — Winter Semester, A. Y. 2017-2018
Course No.: Phy 4313 — Time: 3 Hours
Course Title: Basic Electronics and Semiconductor Physics — 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) For the zener diode network of Fig. 1(b), (i) determine V_L, V_R, I_Z and P_Z considering $V_Z = 10$ V and $P_{ZM} = 30$ mW. (ii) Repeat part (i) with $R_L = 3$ kΩ. 12

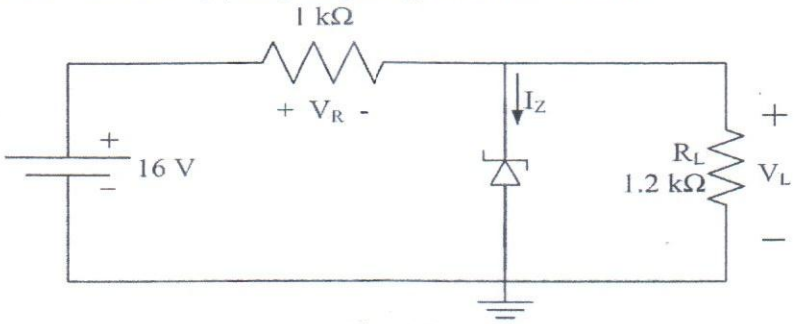

Fig. 1(b)

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

2. a) Draw the input and output voltage wave shapes for the circuits in Fig. 2(a), Fig. 2(b), Fig. 2(c) and Fig. 2(d). Consider $V_{in} = 10V_{p\text{-}p}$, R = 1 kΩ, V = 2 V. 12

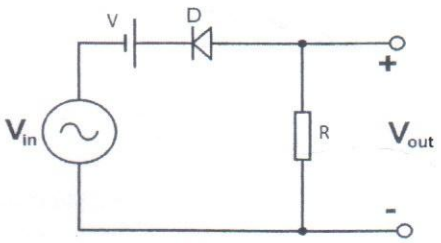

Fig: 2(a)

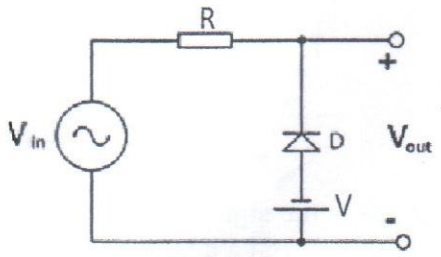

Fig: 2(b)

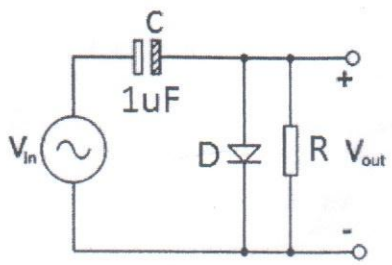

Fig: 2(c)

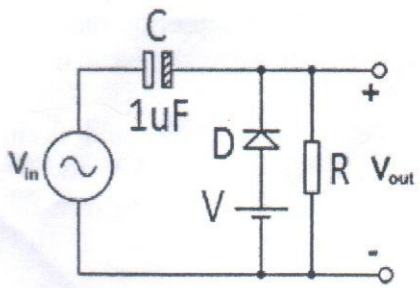

Fig: 2(d)

b) A full wave bridge rectifier with a 120 V_{peak} sinusoidal input has a load resistor of 1 kΩ. 13
   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.

3. a) What is the major difference between a bipolar and unipolar device? Mention what kind of device a BJT is and why? 5

b) Sketch the output or collector characteristics of a common base transistor amplifier. Using the characteristics curve, 10
   i. Determine the resulting collector current if $I_E = 4.5$ mA and $V_{CB} = 4$ V.
   ii. Repeat part (i) if $I_E = 4.5$ mA and $V_{CB} = 16$ V.
   iii. How have the change in V_{CB} affected the resulting level of I_C?

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

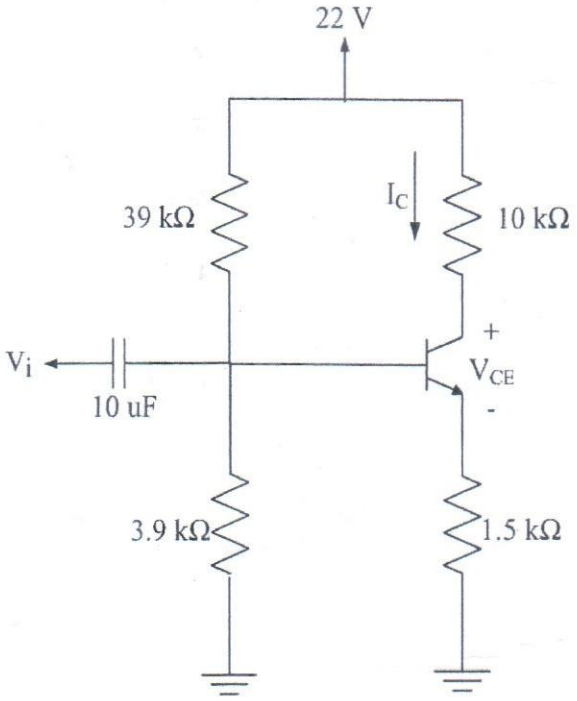

Fig. 3(c)

4. a) i. What is the significant difference between the construction of an enhancement-type MOSFET and a depletion-type MOSFET? 15
   ii. Sketch a *p*-channel enhancement-type MOSFET with the proper biasing applied ($V_{DS} > 0$ V, $V_{GS} > V_T$) and indicate the channel, the direction of electron flow, and the resulting depletion region.
   iii. Briefly describe the basic operation of an enhancement-type MOSFET.

b) i. Sketch the transfer and drain characteristics of an *n*-channel enhancement-type MOSFET if $V_T = 3.5$ V and $k = 0.4\times10^{-3}$ A/V^2. 10
   ii. Repeat part (i) for the transfer characteristics if V_T is maintained at 3.5 V but k is increased by 100% to 0.8×10^{-3} A/V^2.

5. a) What are the major differences between the collector characteristics of a BJT transistor and the drain characteristics of a JFET transistor? Compare the units of each axis and the controlling variable. 6

b) 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. 8

c) Given, $I_{DSS} = 6$ mA and $V_P = -4.5$ V: 5
   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.

d) Sketch the transfer curve for an n-channel JFET with $I_{DSS} = 10$ mA and $V_P = -5$ V using shorthand method. 6

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

b) Implement the equation using op-amps: 12

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

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 are 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

7. a) Draw the block diagram of an Uninterruptible Power Supply (UPS) and briefly explain the function of each block. 12

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

8. a) Convert the numbers: 6
   i. $(7865034)_{10} = (\ ?\ )_{16}$
   ii. $(1010110)_{10} = (\ ?\ )_{8}$
   iii. $(976A8F)_{16} = (\ ?\ )_{8}$
   iv. $(10110001)_{8} = (\ ?\ )_{10}$

b) Implement the function using digital logic gates: 8

$$F(A, B, C, D) = \sum (0, 4, 7, A, D, F)$$

c) Design a 3 to 8 bit decoder using digital logic gates. Use the designed decoder to design a 4 to 16 bit decoder. 11

BScTE(2-Yr), 1st Sem.
B.Sc.Engg. (EE)/HDEE, 3rd Sem. Date: June 05, 2018 (Morning)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination — Winter Semester, A.Y. 2017-2018
Course No.: Math 4321/Math 4529 — Time: 3 Hours
Course Title: Transform Technique and Linear Algebra — 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 Fourier series in the interval [–3, 3] and write its coefficients. Obtain the Fourier series for periodic function $f(x) = \begin{cases} 0, & -2 \le x \le 0 \\ 1, & < x \le 2 \end{cases}$. Sketch the graph of f($x$) for $-6 \le x \le 6$. 13

   b) If f(x) is given by $f(x) = \begin{cases} -x, -\pi \le x \le 0 \\ x, 0 < x \le \pi \end{cases}$, expand the function in Fourier series. Also evaluate $\sum_{n=1}^{\infty} \frac{1}{(2n-1)^2}$. 12

2. a) Find the Laplace transforms for the following functions: 15
   i) $f(x) = \cos(5x)$, ii) $f(x) = x^n$, iii) $f(x) = \sinh(ax)$.

   b) Prove that the Laplace transformation obeys the rules of linear property. 10

3. a) Define periodic function with example. Prove that for periodic function F(t), the Laplace transform $L\{F(t)\} = \frac{1}{1-e^{-ST}} \int_0^T e^{-ST} F(t)dt$. 15

   b) Find the Laplace transform of $f(x) = \begin{cases} cost, & 0 < t < \pi \\ 0, & \pi < t < 2\pi \end{cases}$. 10

4. a) State the convolution theorem and using it evaluate $L^{-1}\{\frac{3}{s^2(s+2)}\}$. 10

   b) Find the solution of $y''(t) - 9y(t) = e^t$ with the boundary conditions $y(0) = 1$ and $y'(0) = 0$ and then verify it. 15

5. a) Define Beta and Gamma function. With the help of Laplace transform, show that $B(m,n) = \frac{\Gamma m \, \Gamma n}{\Gamma(m+n)}$. 15

   b) Evaluate $\int_0^{\infty} e^{-x^2} dx$ by using Laplace transform. 10

6. a) Define Euclidean n-space. Let x = (6, 3, –2, –4, –1) and y = (3, –1, 0, –7, –2) be the two vectors in $\mathbb{R}^5$. Find i) the unit vectors of x and y, and ii) the distance between them. 15

   b) Determine the constant k, so that the vectors x = (k, 1, 2) and y = (1+k, 4, –3) are orthogonal to each other. 10

7. a) Define vector space over a scalar field K in $\mathbb{R}^n$. For what values of λ, the vectors $(1, \lambda, 5)$ in $\mathbb{R}^3$ is a linear combination of the vector $(1, -3, 2)$ and $(2, -1, 1)$? 10

   b) Determine whether the vector $(0, 5, 6, -3)$ is a linear combination the vector set $\{(-1, 3, 2, 0), (2, 0, 4, -1), (7, 1, 1, 4), (6, 3, 1, 2)\}$ or not. If yes, write its linear combination form and if not, explain why? 08

   c) Show that the vectors $(1, 1/2, 1/4)$, $(-2, -2, -8)$ and $(3, 9, 27)$ generate $\mathbb{R}^3$ and then verify your result. 07

8 a) Define linear dependence and independence of a vector space. Determine whether the matrices $A=\begin{bmatrix}1 & 2\\ 3 & 1\end{bmatrix}$, $B=\begin{bmatrix}3 & -1\\ 2 & 2\end{bmatrix}$ and $C=\begin{bmatrix}1 & 1\\ 0 & 0\end{bmatrix}$ are linearly dependent or independent. 10

   b) What is linear transformation? Test whether the following transformations are linear or not: 15

   i) $T: \mathbb{R}^3 \to \mathbb{R}$ define by $T(x, y, z) = 2x - y + 4z$,

   ii) $T: \mathbb{R}^3 \to \mathbb{R}^3$ define by $T(x, y, z) = (x + y, -x - y, z)$.

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B.Sc. Engg. (EE), 1st Sem. Date: June 04, 2018 (Morning)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination — Winter Semester, A. Y. 2017-2018
Course No.: Math 4123 — Time: 3 Hours
Course Title: Matrix and Differential Equation — 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 meaning.

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1. a) Reduce the quadratic form $q = x_1^2 + 2x_2^2 - 2x_3^2 + 4x_1x_2 + 6x_1x_3$ to the canonical form and find rank, index and signature of the form. 13

   b) State Cayley-Hamilton theorem and verify for the matrix and hence find the inverse of A. 12

$$A = \begin{bmatrix} 1 & 2 & 3 \\ 1 & 3 & 6 \\ 2 & 6 & 13 \end{bmatrix}$$

2. a) Find the eigen values and eigen vectors of the matrix, 12

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

   b) The system of linear differential equations for the currents $i_1(t)$ and $i_2(t)$ in a electrical networks is: 13

$$\frac{di_1}{dt} = -11i_1 + 3i_2 + 100sint$$

$$\frac{di_2}{dt} = 3i_1 - 3i_2$$

   subject to the initial conditions: $i_1(0) = i_2(0) = 0$. Find $i_1(t)$ and $i_2(t)$ using matrix method.

3. a) Solve: $\left[(3x+2)^2 D^2 + 3(3x+2)D - 36\right]y = 81x^2 + \frac{9}{3x+2}$. 13

   b) Solve: $\left[(x+2)D^2 - (2x+5)D + 2\right]y = (x+1)e^x$ by the method of factorization of the operator. 12

4. a) Solve the system of linear differential equations 12

$$\frac{dx}{dt} + 2x - 3y = t, \quad \frac{dy}{dt} - 3x + 2y = e^t.$$

   b) Find the currents $i_1(t)$ and $i_2(t)$ in a electrical networks containing a resistance 50 ohms, an inductor 1 henry and capacitor 10^{-4} f. The currents $i_1(t)$ and $i_2(t)$ are initially zero and E(t)=60 volts. 13

5. a) Determine whether $x=2$ is an ordinary point or a regular singular point of the differential equation $x^2(x-2)^2 y_2 + 2(x-2)y_1 + (x+3)y = 0$. 5

b) Solve in series the differential equation $x\frac{d^2y}{dx^2} + (1+x)\frac{dy}{dx} + 2y = 0$ by the method of Frobenious. 20

6. a) Find the partial differential equation by eliminating the arbitrary functions from the equation $\phi(x-y+z,\ x^2+2y^2-3z^2)=0$. 8

b) Solve: $(xz^3 + x^2yz)p - (yz^3 + xy^2z)q = x^4$. 8

c) Solve: $x(y-z)p + y(z-x)q = z(x-y)$. 9

7. a) Find complete integral and singular integral of: $px^2 + 2qxy = 2zx + pq$. 8

b) Solve: $(D_x^2 - D_xD_y - 2D_y^2)z = 12x^2 + 2y$. 9

c) Solve: $(D_x^2 - 4D_xD_y + 4D_y^2)z = e^{2x+y}$ 8

8. a) Derive the Laplace equation in polar co-ordinate from Cartesian co-ordinate. 12

b) Solve the wave equation, 13

$$\frac{\partial^2 v}{\partial t^2} = a^2 \frac{\partial^2 v}{\partial x^2}$$

under the boundary and initial conditions respective as:

$v(0,t) = v(\pi,t) = 0$ and $\left(\frac{\partial v}{\partial t}\right)_{t=0} = 0,\ v(x,0) = 2(\sin x + \sin 3x)$

B.Sc. Engg. (CSE)/ HDCSE, 3rd Sem. 163 Date: June 08, 2018 (Morning)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination — Winter Semester, A.Y. 2017-2018
Course No.: EEE 4383 — Time: 3 Hours
Course Title: Electronic Devices and Circuits — 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 value for any missing data.

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1. a) What is the pinch-off voltage for a JFET? Explain this phenomenon for an n-channel JFET with appropriate diagrams. What is the condition for obtaining pinch-off voltage for this kind of set-up? 10

   b) How can we materialize a differentiator and an integrator? Design the circuits with proper waveshapes and justification. 09

   c) Draw the circuit diagrams of an n-channel JFET with appropriate limiting values of the drain voltage, gate voltage, drain current and gate current for the following states: 06
      i) Saturation
      ii) Pinch-off
      iii) Normal operation

2. a) What is Shockley's equation? Draw the transfer characteristics and drain characteristics of a p-channel JFET using the shorthand method. 10

   b) What is an oscillator? Design the relaxation oscillator with proper circuit diagrams and waveshapes at different terminals of the oscillator. 09

   c) What are the methods for turning off an SCR? Explain them with appropriate circuit diagrams and equations. 06

3. a) What is an active filter? What is the cut-off frequency for a low pass filter? Design a fifth-order band-pass active filter and derive its cut-off frequencies. 10

   b) What is pulsating DC? Design a capacitor filter and explain its operation with appropriate circuit diagrams and wave-shapes. What is the significance of a capacitor filter? 09

   c) What is voltage regulation? Design a series voltage regulator with separate control and comparator units and describe its operation. 06

4. a) What is a difference amplifier? Why do we not use an isolated op-amp as the difference amplifier? Design a circuit to counter the difficulties of a single op-amp difference amplifier with proper justification. 10

   b) What are the functions of stabilizers and UPS? Sketch the basic block diagram for a UPS and explain its operation. 09

c) Derive the equations and draw the circuit diagram to represent the source signals of an ideal op-amp in terms of their differential and common mode components. 06

5. a) What is a PJT? Sketch and explain the transfer characteristics curve of a UJT with equivalent circuit diagram and equations. How does a UJT differ from an SCR? 10

b) Determine the regulated voltage and all the circuit currents for the shunt regulator of Fig. 5(b). 09

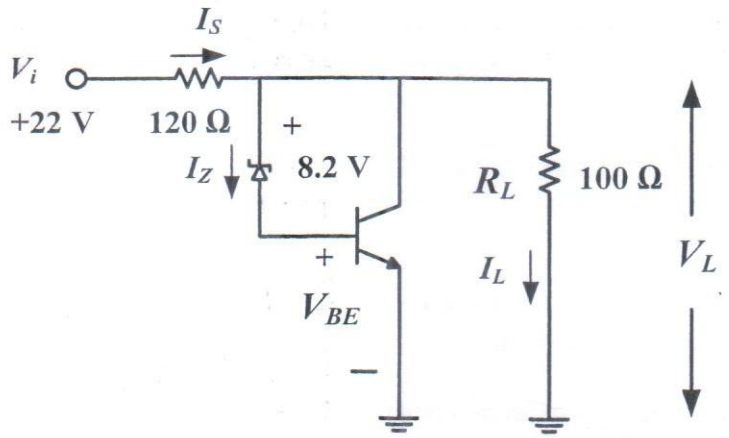

Fig. 5(b)

c) Design an AND-gate using ideal diodes and explain its operation. 06

6. a) Prove that for every decade change in current for a pn junction diode, the corresponding voltage change is $2.3 \times V_T$, where V_T = Thermal voltage at room temperature. 07

b) Draw the circuit diagram for a CMOS inverter and explain the process of inversion of logic levels. 06

c) What are α and β for a BJT. Derive the expression by which α and β are related to each other. 06

d) Design the circuit in Fig. 6(d) assuming $V_{BE} = 0.7$ V at $I_C = 1$ mA and $\beta = 100$. 06

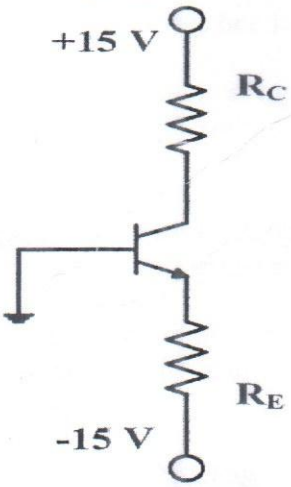

Fig. 6(d)

7. a) Sketch the direction of current flow in a pnp transistor biased to operate in active mode along with their causes of origin. 07

   b) Derive the expression for trans-conductance of an npn transistor in common-emitter configuration. 06

   c) What is the purpose of DC biasing in BJT? Justify the statement "BJT is a voltage-controlled current source". 06

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

8. a) For the circuit in Fig. 8(a), I_{DSS} = 8 mA and $V_P = -8V$, calculate the values of I_{DQ}, V_{GSQ}, V_D and V_S. Also draw the graph for Q-point. 16

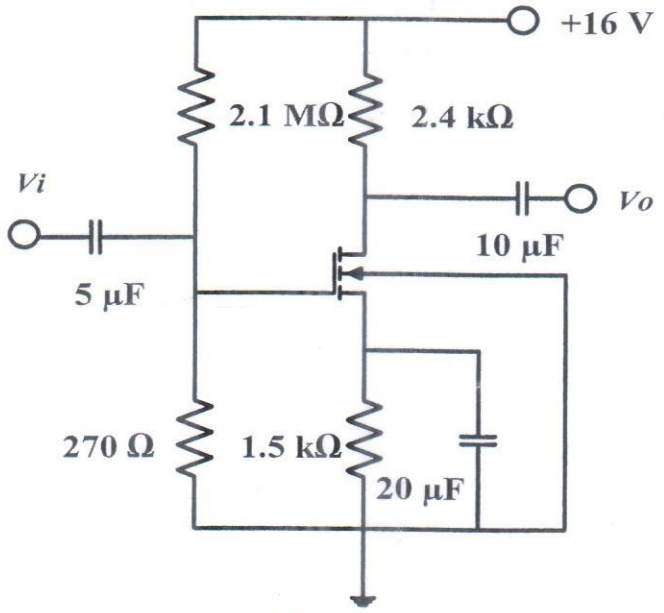

Fig. 8(a)

   b) Explain the differences between DIAC and TRIAC along with their transfer curves and equivalent circuit diagrams. Sketch the SCR transfer characteristics curve and explain different regions and points of the curve. 09

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B.Sc. Engg.(CEE), 3rd Sem. Date: June 04, 2018

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination — Winter Semester, A.Y. 2017-2018
Course No.: EEE 4385 — Time: 3 Hours
Course Title: Electrical and Electronic Technology — 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 Ohm's law? Define KVL and KCL. For the circuit shown in Fig. 1(a), determine the voltage, V. 7

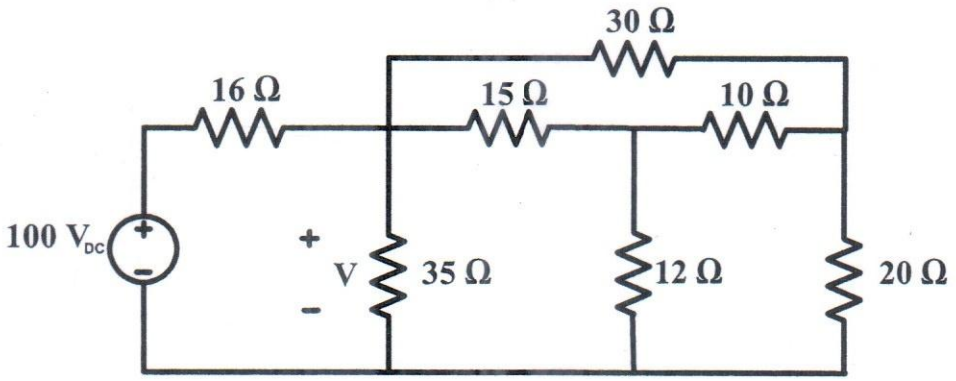

Fig. 1(a)

b) Define maximum power transfer theorem. For the circuit shown in Fig. 1(b), find the Thevenin equivalent circuit at terminal *a-b*. 10

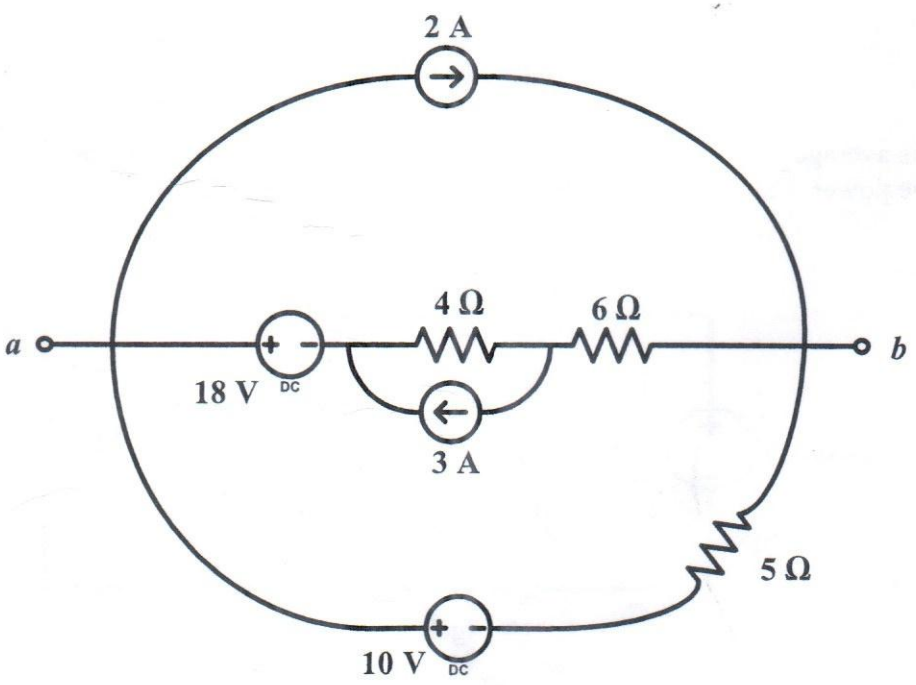

Fig. 1(b)

c) What is superposition principle? Using mesh analysis, find i_1, i_2 and i_3 in circuit shown in Fig. 1(c). 8

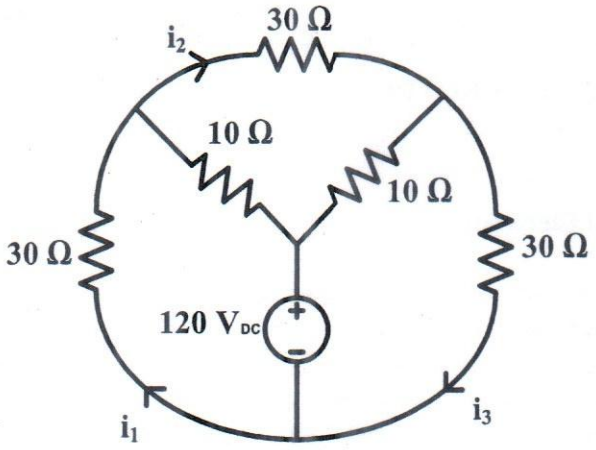

Fig. 1(c)

2. a) Determine current I_0 in Fig. 2(a) using Norton's theorem. 12

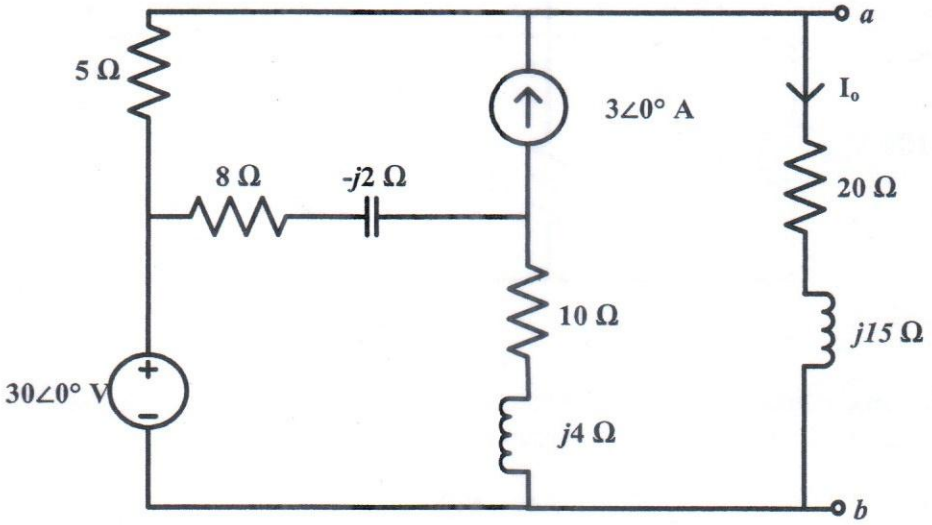

Fig. 2(a)

b) What is average power? In Fig. 2(b), the resistor R_L is adjusted until it absorbs maximum average power. Calculate R_L and the maximum average power absorbed by it. 8

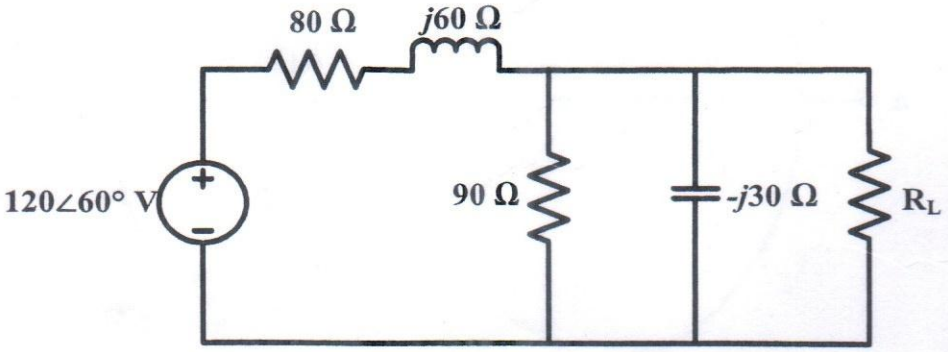

Fig. 2(b)

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

3. a) Use nodal analysis to find v_0 in the circuit of Fig. 3(a). Let $\omega = 2$ krad/s. 13

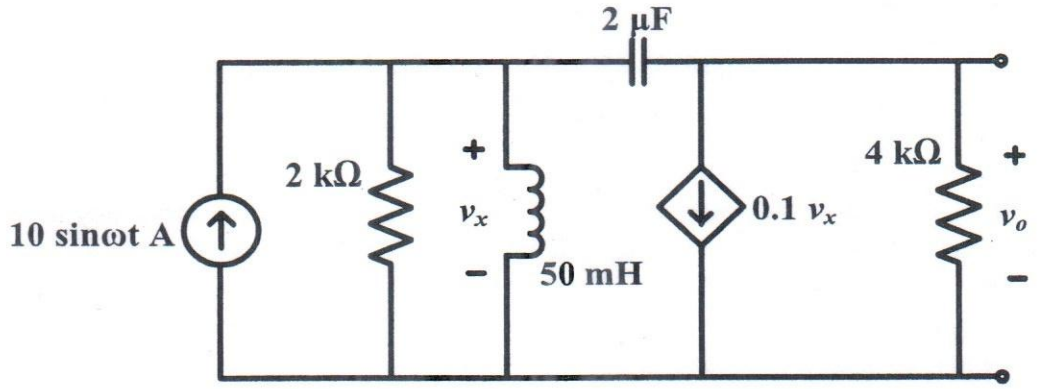

Fig. 3(a)

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b) What is admittance? Find I in the circuit of Fig. 3(b).

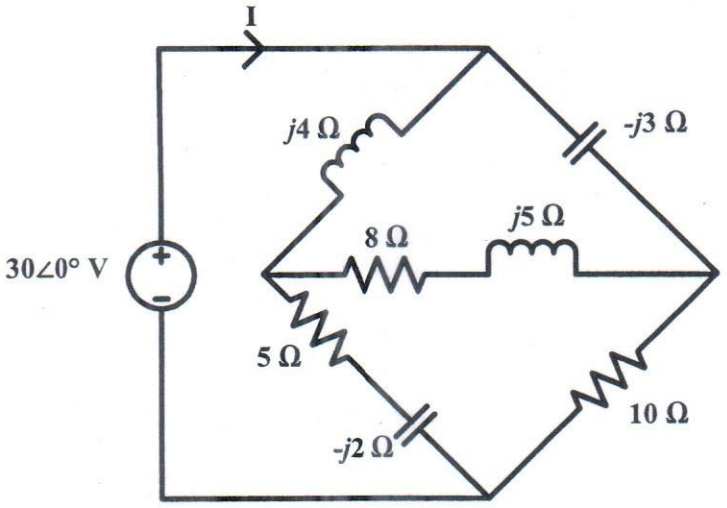

Fig. 3(b)

4. a) A 4-pole, long-shunt lap-wound generator supplies 25 kW at a terminal voltage of 500 V. The armature resistance is 0.03 Ω, series field resistance is 0.04 Ω and shunt field resistance is 200 Ω. The brush drop may be taken as 1.0 V. Determine the e.m.f. generated. Also calculate the number of conductors if the speed is 1200 r.p.m. and flux per pole is 0.02 weber. Neglect the armature reaction. 8

b) The magnetization characteristic for a 4-pole, 110-V, 1500 r.p.m. shunt generator is as follows : 8

Field current (A)	0	0.5	1	1.5	2	2.5	3
O.C. voltage (V)	5	50	85	102	112	116	120

Armature is lap-connected with 144 conductors. Field resistance is 45 ohms. Determine

i. voltage that the machine will build up at no-load,
ii. the critical resistance,
iii. the speed at which the machine just fails to excite,
iv. residual flux per pole.

c) For a d.c. generator, derive the condition for maximum efficiency. 5

d) Draw the power stage diagram of a d.c. generator. 4

5. a) What is torque? For a d.c. shunt motor, prove that the armature torque is 9

$$T_a = 9.55 \frac{E_b I_a}{N} N - m$$

b) A 500-V, 37.3 kW, 1000 r.p.m. d.c. shunt motor has on full load an efficiency of 90%. The armature circuit resistance is 0.24 Ω and there is total voltage drop of 2 V at the brushes. The field current is 1.8 A. Determine 8

i. full load line current,
ii. full load shaft torque in N-m,
iii. total resistance in motor starter to limit the starting current to 1.5 times the full load current.

c) The armature winding of a 200-V, 4-pole, series motor is lap-connected. There are 280 slots and each slot has 4 conductors. The current is 45 A and the flux per pole is 18 mWb. The field resistance is 0.03 Ω, the armature resistance is 0.05 Ω and the iron and friction losses total 800 W. The pulley diameter is 0.41 m. Find the pull in newton at the rim of the pulley. 8

6. a) Write down the name of different methods of speed control of d.c. shunt motor. What do you mean by electric braking? What are the different types of electric braking? Write down their names. 10

b) What is a transformer? Why the transformer rating is in kVA? 5

c) A 200/400-V, 50 Hz transformer gave the following test results: 10

Short-circuit test: with low voltage winding short circuited: 15 V, 10 A, 85 W and
Open circuit test: 200 V, 0.7 A, 85 W on high voltage side.

Compute the equivalent circuit parameters of the transformer and show them in figure.

7. a) Classify a.c. motors based on their principle of operation and structural features. 5

b) Why does the rotor rotate? Derive the condition for maximum starting torque of a three-phase induction motor. 9

c) A 3-phase, slip-ring, induction motor with star connected rotor has an induced e.m.f. of 120 volts between the slip-rings at stand still with normal voltage applied to the stator. The rotor winding has a resistance per phase of 0.03 Ω and standstill leakage reactance per phase is 1.5 Ω. Calculate 6

i. rotor current/phase when running short-circuited with 4% slip,
ii. the slip and current per phase when the rotor is developing maximum torque.

d) Briefly explain the parallel operation of alternators. 5

8. a) Determine V_L, I_L, I_Z, and I_R for the network of Fig. 8(a) 9

i. if $R_L = 180\ \Omega$

ii. if $R_L = 470\ \Omega$

iii. Determine the value of R_L that will establish maximum power conditions for the Zener diode.

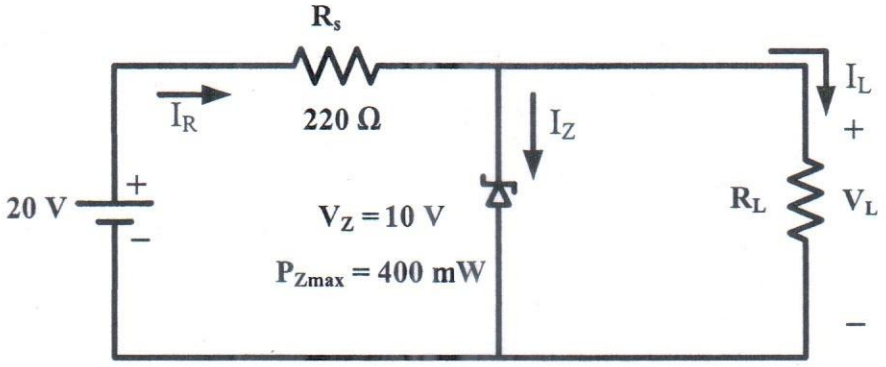

Fig. 8(a)

b) Sketch i_R and v_o for the network of Fig. 8(b) for the input shown. 8

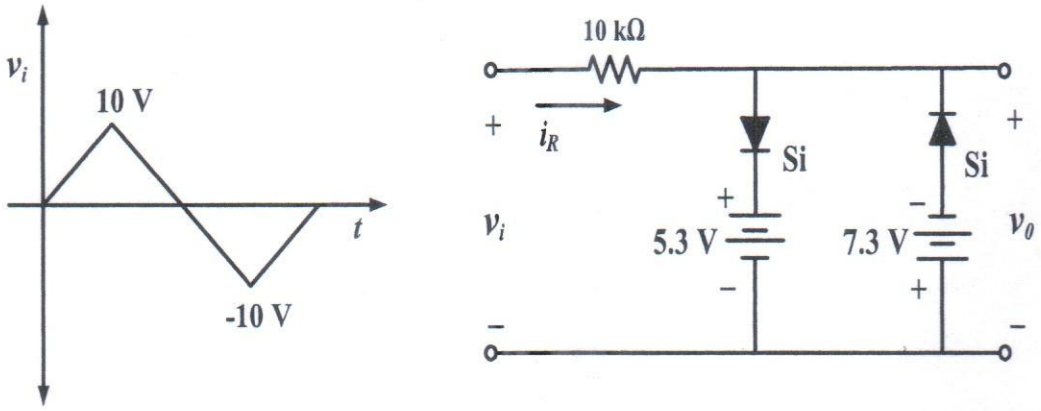

Fig. 8(b)

c) Sketch v_o for the network of Fig. 8(c) and determine the d.c. voltage available. 8

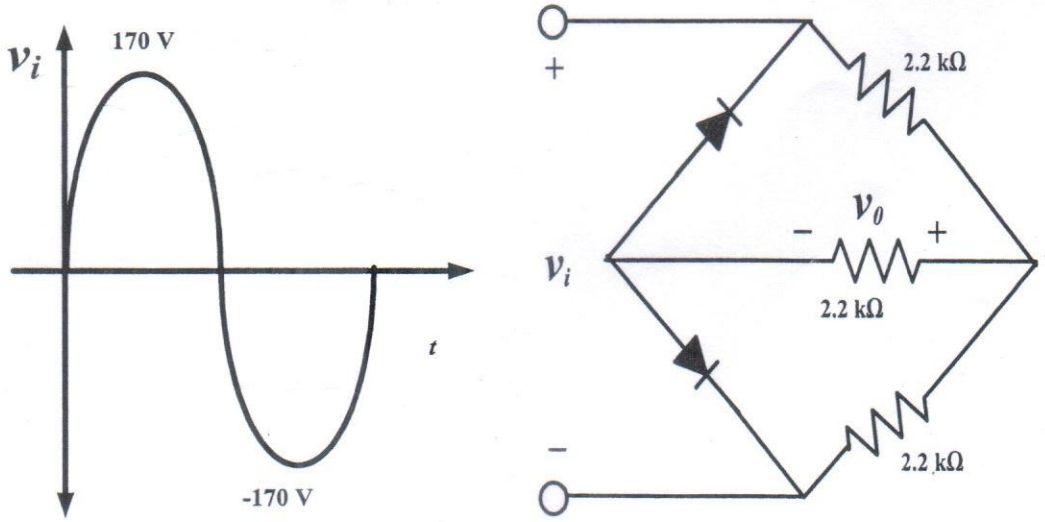

Fig. 8(c)

B.Sc. Engg.(EE)/HDEE, 5th Sem. Date: June 08, 2018 (Morning)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination — Winter Semester, A. Y. 2017-2018
Course No.: EEE 4501 — Time: 3 Hours
Course Title: Electromagnetic Fields and Waves — Full Marks: 150

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

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1. a) What is electric potential difference (V)? If the general expression of potential difference is $V = -\int \vec{E}.d\vec{L}$, derive and prove that "electric field intensity is the gradient of potential V". Also, show that it satisfies the equation $\vec{\nabla} \times \vec{E} = 0$. 8

   b) Given that Gauss's law in point form is $\vec{\nabla}.\vec{D} = \rho_v$ and flux density is $\vec{D} = \varepsilon\vec{E}$, then with the help of them derive the Poisson's Equation, $\vec{\nabla}^2 V$. When does Poisson's equation reduce to Laplace's equation. Why is Laplace's equation useful for electromagnetic engineering experts? 12

   c) Find the potential difference, $V_{AB} = -\int_B^A \vec{E}.d\vec{L}$ between two conducting cylindrical shells where two cylindrical shells carrying charge density $\rho_L = 2\times10^{-12}$ C/m on the inner shell and having radii $a = 5.7$ cm and $b = 6.3$ cm as shown in Fig. 1 (c). (Given that $\vec{E} = \frac{\rho_L}{2\pi\varepsilon_0\rho}\hat{a}_\rho$ for line charge, where, ε_o = 8.85 x 10^{-12} C/Vm). 5

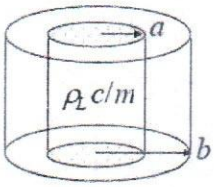


Fig. 1 (c)

2. a) State Gauss's law. Consider a cloud of point charges surrounded by a closed surface of any arbitrary shape as shown in Fig. 2(a), where $\vec{D}_s$ is electric flux density and $d\vec{S}$ is small surface area. If Q is total charge and ψ is total electric flux, derive integral form of Gauss's law. 8

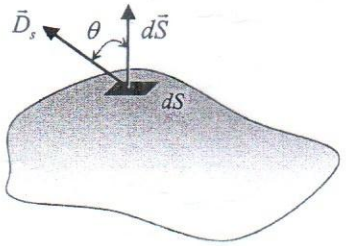


Fig. 2(a)

   b) How do you obtain differential form of Gauss's law from integral form of Gauss's law? State first Maxwell's equation from differential form of Gauss's law. 4

   Applying Gauss's law solve the following problems, [where, εo=8.85 x 10-12 C/Vm],

$$\oint_s \vec{E} \bullet \hat{n}da = \frac{q_{enclosed}}{\varepsilon_0}$$

i) Seven point charges in Fig. 2(i) are enclosed in a cylindrical surface ***S***. If the values of the charges are Q_1= -60 nC, Q_2= -40 nC, Q_3= +50 nC, Q_4= 82 nC, Q_5= -140 nC, Q_6= +100 nC and Q_7=-15 nC, find the total flux through ***S***. 4

Fig. 2 (i)

ii) Line charge in Fig. 2 (ii) with linear charge density $\rho = 8 \times 10^{-12}$ C/m passes through the center of a sphere. If the flux through the surface of the sphere is 3.5×10^{-3} Vm, what is the radius ***R*** of the sphere? 4

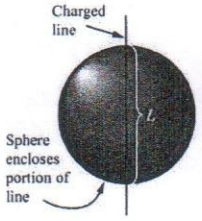


Fig. 2 (ii)

iii) Find the electric flux through a cylinder of radius $r = 4.5 \times 10^{-3}$ m and height $h = 45 \times 10^{-3}$ m surrounding a portion of an infinite line charge with charge density $\rho = 4 \times 10^{-12}$ C/m as shown in Fig. 2 (iii). Also use Gauss's law to verify that the enclosed charge is ρh. Given that the electric field at distance r from an infinite line charge with linear charge density ρ is given by $\vec{E} = \frac{1}{2\pi\varepsilon_o}\frac{\rho}{r}\hat{r}$. 5

Fig. 2 (iii)

3. a) Assume that charges +Q and –Q are uniformly distributed in parallel plate capacitor as shown in Fig. 3 (a). By applying Gauss's law and with the help of electrical potential, show that capacitance, $C = \frac{\varepsilon A}{d}$. 8

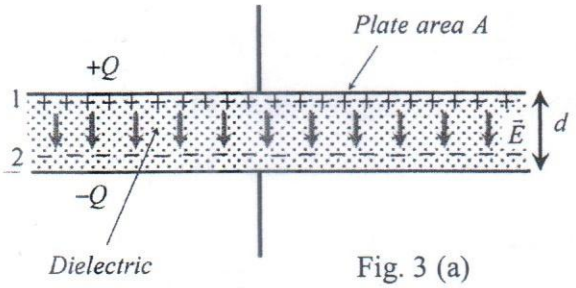


Fig. 3 (a)

b) In Fig. 3(b), assume that the infinite line charge is aligned along the Z axis symmetrically with respect to the origin. The charge associated with each element length dz is $dQ = \rho_L dz$ and can be treated as point charge. By defining all other terms, show that electric flux density, $\vec{D}$, at point P becomes $\vec{D} = \frac{\rho_L}{2\pi\rho}\hat{a}_\rho$. 10

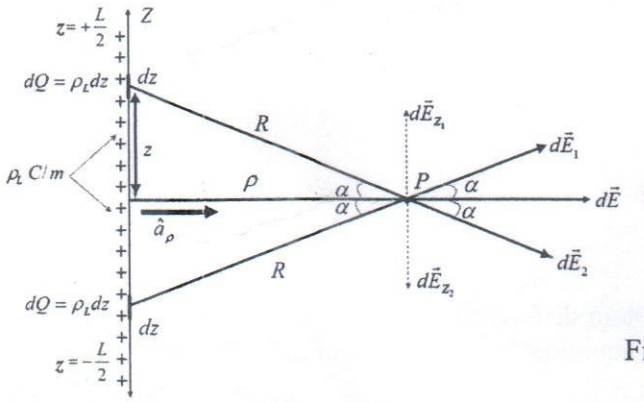


Fig. 3 (b)

c) In Fig. 3(c), find electric field intensity, $\vec{E}$, and electric flux density, $\vec{D}$ at *(0,0,3)* m due to $Q_1 = 0.67\mu C$ at *(0,8,0)* m and $Q_2 = -0.23\mu C$ at *(5,0,0)* m. [ε_o=*8.85* x 10^{-12} C/Vm]. 7

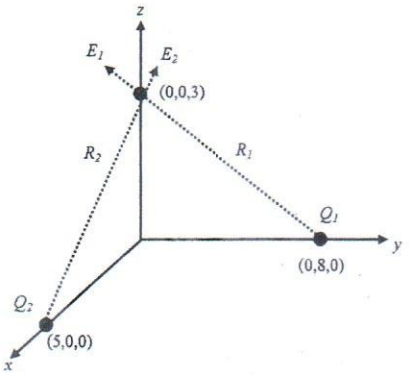


Fig. 3(c)

4. a) As an electrical engineer, your one of the main tasks is to produce electric current. According to Faraday's law, the variation of magnetic flux with time produces current. Give examples of different ways to vary magnetic fields to produce current from magnetic fields. 20

For the following three figures, explain the working principle to produce induced current due to variation of magnetic fields.

Fig. 4 (i)

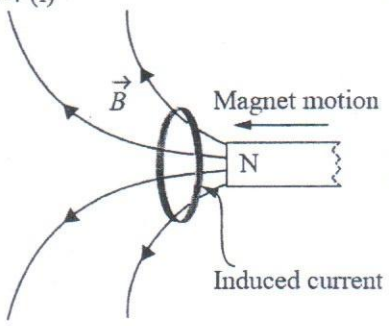


Fig. 4 (ii)

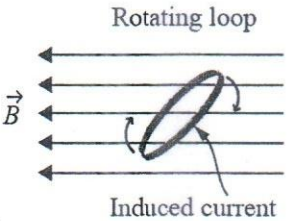
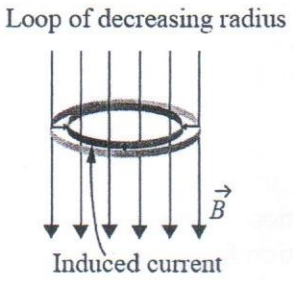


Fig. 4 (iii)



b) Write down three rules of thumb that will help you visualize and sketch the electric fields produced by changing magnetic fields. 5

5. a) Maxwell's equations describe how electric and magnetic fields are generated and altered by each other and by charges and currents. Write down Maxwell's equations in final form (for Time Varying Fields) and Maxwell's equations for static Electromagnetic (EM). 8

b) What is electric flux? From the concept of electric field intensity and electric flux, determine electric flux density $\vec{D}$. Why definition of $\vec{D}$ is important from the permittivity, ε_o, point of view? 6

c) Determine electric flux density $\vec{D} = D_Q + D_L$, at *(10,1,25)* if there is a point charge *-15π mC* at *(1, 0, 0)* and a line charge *20π mC/m* along the y-axis. [$\varepsilon_0 = \frac{10^{-9}}{36\pi} = 8.85x10^{-12}$ C/Vm]. 5

d) Find the potential difference, $V_{AB} = -\int_B^A \vec{E}.d\vec{L}$ between two points A and B in the field of a point charge, Q and having radii r_A = *15.3* cm and r_B = *20.8* cm as shown in Fig. 5 (d). (Given that $\vec{E} = \frac{Q}{4\pi\varepsilon_0 r^2}\hat{a}_r$ for point charge and $\vec{E} = \frac{\rho_L}{2\pi\varepsilon_0\rho}\hat{a}_\rho$ for line charge, where, ε_o = 8.85 x 10^{-12} C/Vm). 6

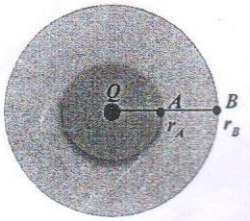


Fig. 5 (d)

6. a) According to Faraday's experiments, write down magnetic field characteristics in static case and in time varying case. Write down similarities and dissimilarities between electrostatic field and induced electric field. 8

b) According to Faraday's law of electromagnetic, induced emf (electromotive force) for a single turn becomes $V_{emf} = -\frac{d\psi}{dt}$. With the help of this relationship, derive Maxwell's equation for stationary loop in time varying magnetic field in terms of curl of electric field intensity, E and time varying magnetic flux density, B. 10

c) To analysis magnetic circuits, write down the analogy between magnetic and electric circuits. The toroidal core of a coil has $a = 10$ cm and a circular cross section with $b = 1$ cm as shown in Fig. 6 (c). If the core is made of steel ($\mu_r = 1000$) and has a coil with 200 turns, calculate the amount of current that will produce a flux of 0.5 mWb in the core. ($\mu_0 = 4\pi \times 10^{-7}$ N / A^2). 7

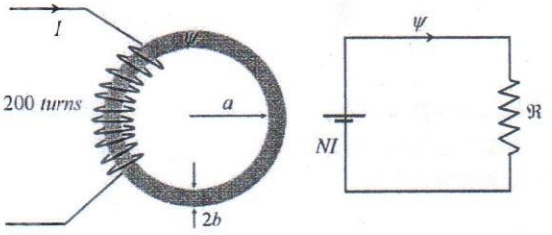


Fig. 6 (c)

7. a) What do you mean by continuity of current equation, $\nabla.\vec{J}$? Derive the continuity of current equation from the principle of conservation of charge. As an electrical engineer, why this equation is important to you? How Kirchhoff's current law follows continuity of current equation? 6

b) Why does Maxwell's equation for magnetic fields derived from Ampere's circuital law not compatible with time varying case? What modification do you need to improve Maxwell's equation in such case? With the modification technique, derive improved version of Maxwell's equation for magnetic fields which can be applicable in both static and time varying case. 9

c) What is displacement current? Write down three characteristics of displacement current. 4

d) What is the difference between conductors and dielectrics? If conduction current density is $\overrightarrow{J_c}$ and displacement current density is $\overrightarrow{J_D}$, how do you determine the nature of material. Write down the conditions for good dielectics, semi-conductor and good conductor in relation with ω, ε and σ. 6

8. a) What do you mean by lossless or non-conducting medium? Write down Maxwell's equations for lossless or *non-conducting medium* and for *conducting medium*. 5

b) What do you mean by *wave* in electromagnetic wave propagation? By using Maxwell's equations for lossless or *non-conducting medium*, derive the wave equation in term of magnetic fields intensity, H. 6

c) Using Maxwell's equations for *conducting medium*, derive the wave equation in term of magnetic fields intensity, H. 6

d) Write down both General forms and Sinusoidal Time Varying forms of w*ave* equations for both lossless or *non-conducting medium* and *conducting medium*, in terms of electric fields intensity, E, magnetic fields intensity, H, electric flux density, D, and magnetic flux density, B. 8

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

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Date: May 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 4503 /EEE 4591
Course Title: Power Electronics

Winter 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. Assume reasonable value for any missing data.

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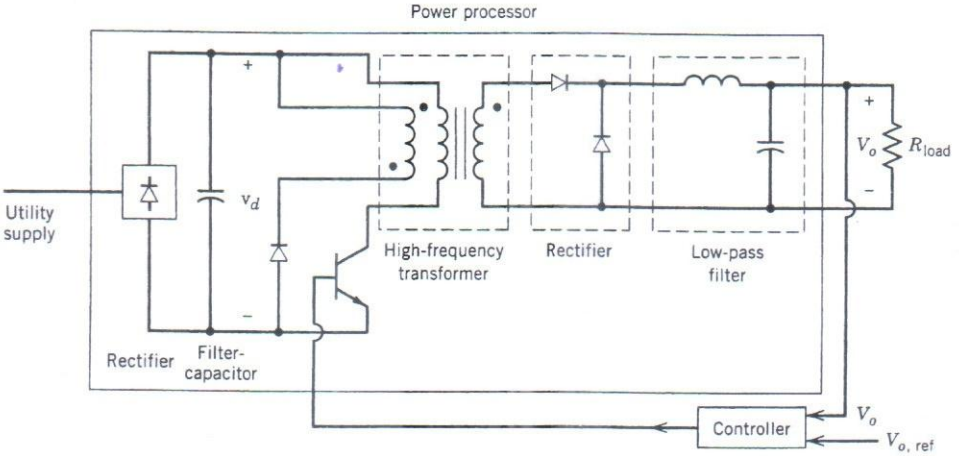
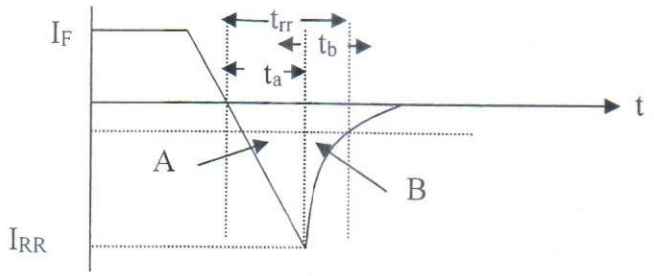
1. a) What are probable sources of renewable energy available in the universe? In order to convert any form of renewable energy to electrical energy, propose a clear schematic using power electronic systems. Mention why linear electronics is not suitable for the above energy conversion. 08

b) The following figure demonstrates the use of power electronic system for SMPS. Clearly explain the roles of the transistor switch and high frequency transformer of the circuit. 08

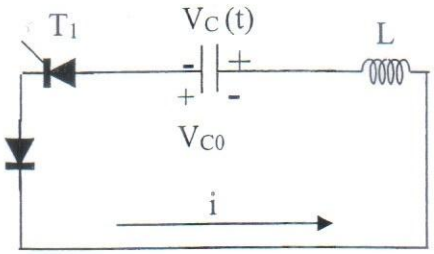


c) Why is reverse recovery characteristic of a semiconductor device considered so important? Following is the reverse recovery characteristic of a semiconductor device whose data are as follows: I_{RR} = 90 amp, area A = 90 amp-μs, area B = 45 amp-μs. Find (i) the rate of fall current (ii) the storage charge and (iii) the reverse recovery time. 09



2. a) A diode circuit with an LC load is shown in the figure 2 (a) with capacitor having an initial voltage $V_S\ (t = 0) = -V_{C0} = -220\ V$, capacitance, C = 20 μF, and inductance, L = 80 μH. If the thyristor T_1 is fired at $t = 0$, determine (i) the peak current through the diode, (ii) the conduction time of the diode and (iii) the steady-state value of the capacitor voltage. 08

Figure 2 (a)



b) Draw the circuit diagram of a single phase full bridge diode rectifier with resistive load. If a sinusoidal voltage is applied as the input, draw the wave-shapes of input current and output voltage. If the load is replaced by a highly inductive load, then also draw the wave-shape of input current. Explain which load introduces harmonics in the input-side. 08

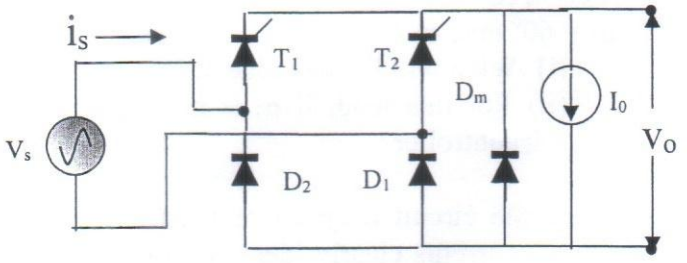
c) Draw the circuit diagram of full bridge rectifier with a source inductance of 10 mH. If the rectifier is supplying a load of a highly inductive that carries 10 A current when a sinusoidal voltage of rms value=230V and frequency 50Hz is applied,. (i) draw the wave-shapes of input current, output voltage and (ii) find the value of commutation angle and output dc voltage. 09

3. a) Draw the circuit diagram of a three phase full bridge diode rectifier with a resistive load. 10
   (i) Find the expression of dc output voltage and rms value of diode current.
   (ii) Find the rectifier efficiency, Form Factor (FF), Transformer Utilization Factor (TUF).

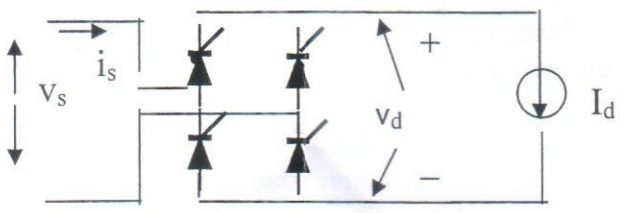
b) Mathematically establish the effect of source inductance on the output voltage of a three phase full bridge diode rectifier. 10

c) If a sinusoidal three phase voltage is applied to a three phase full bridge diode rectifier where line to line voltage 430 V, frequency is 50 Hz, source inductance of each phase is 5 mH and constant load current is 10 A, then calculate the dc output voltage of rectifier. 05

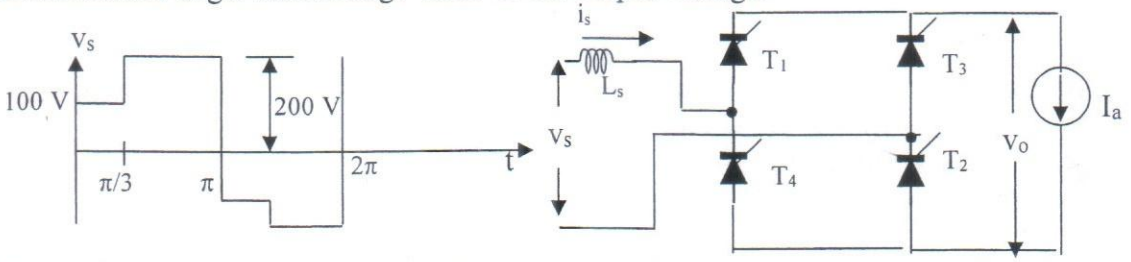
4. a) The input voltage of the following converter is 230 V (rms), 50 Hz sinusoidal. The load current is 10 A continuous. If the power supplied to the load is 1.5 kW, (i) determine the firing angles for T_1 and T_2., (ii) draw the waveshapes of i_s, and v_o. (iii) If D_m is removed what will be waveshape of V_o? 08



b) For the following converter, the input voltage has a square waveforms with amplitude of 200 V at a frequency of 60 Hz. Assume I_d = 10 A. Obtain an analytical expression for V_d in terms of V_s, I_O and α. If $\alpha = 45^o$, find V_d. 08



c) Following is a full converter with a finite source inductance L_S=5mH. The load is highly inductive of 10 A current. The **input is not sinusoidal** and its waveshape is shown below whose frequency is 50 Hz. The thyristors T_1&T_2 are fired at $\alpha = 30^0$ and T_3&T_4 are fired at $\omega t = \pi + \alpha$, respectively. Draw the wave-shapes of the output voltage, input current and find the commutation angle and average value of the output voltage. 09



5. a) Draw the circuit diagram of a three-phase half-wave controlled rectifier for a highly inductive load. Draw the wave-shapes of output voltage and current through the thyristor connected to phase 'a'. Derive the expression of average value of the output voltage. 12

b) For three phase converter as mentioned in Q. 5. a), an Y-connected resistive load is connected and load resistance of each phase is 10 ohm. If the supply is also Y-connected and phase voltage is 208 Volt and frequency is 60 Hz. If it is required to obtain average output voltage of 50% of the maximum possible output voltage, calculate (i) the delay angle α, (ii) the average and rms output currents (iii) the average and rms thyristor currents, and (iv) the input power factor. 13

6. a) An ac controller has a resistive load of R = 10 Ω and the input is 220 V, 50 Hz. The thyristors switch is on for n = 25 cycles and for m = 75 cycles. Determine: 09
   (i) the rms value of the output voltage,
   (ii) the input power factor,
   (iii) the average and rms current through thyristors.

b) For an ac controller with R-L load, draw the waveshapes of the output voltage and also derive the expression of the rms value of the output voltage. If the firing angle is equal to the load angle then what will be waveshape of the output voltage? 08

c) A single-phase full-wave ac controller with an R-L load is supplied with an rms voltage V_S = 120 V, f = 60 Hz. The load inductance is L = 6.5 mH. The thyristors are fired at $\alpha_1 = 60^0$ and $\alpha_2 = \Pi + 60^o$, respectively. The thyristor 1 ceases conduction at $\beta = 240^0$. 08
   (i) What will be the value of load resistance?
   (ii) For this load, if α_1 is made less than 60^0 what will be the output voltage of the controller?

7. a) Draw the circuit diagram of a buck-boost regulator. Drawing the waveshapes of various branch currents clearly identify which current accounts for the ripple of the output voltage. Derive the expression of the ripple voltage at the output. 10

b) A buck-boost regulator has an input voltage V_S = 12 V. The duty cycle is k = 0.6. and the switching frequency is 25 kHz. For the inductance, L = 250 μH and for filter capacitance, C = 220 μF and for average value of load current I_a = 1.5 A, determine (i) average output voltage (ii) the peak to peak output ripple voltage (iii) the peak to peak ripple inductor current and (iv) critical value of L and C. 15

8. a) Draw the circuit diagram of a single-phase bridge inverter. Draw the wave-shapes of output voltage and current for an inductive load. Show the swiching stares in a table of the above inverter to obtain an ac voltage. 12

b) For the single phase bridge inverter as mentioned in Q. 8. a) the load is resistive of R=2.4 ohm. And the dc input is V_S=48 V. Find (i) rms value of the output voltage at the fundamental frequency, (ii) the output power, P_O, (iii) the average and peak current of each transistor and (iv) the THD. 13

B.Sc. Engg.(EE)/ HDEE 5th Sem Date: May 31, 2018 (Morning)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination — Winter Semester, A. Y.2017-2018
Course No.: Hum 4521 — Time: 3 Hours
Course Title: Engineering Management — Full Marks: 150

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

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1. a) What is engineering management? What are the advantages of understanding the technology in top management? 08

   b) What is marketing management? Distinguish between consumer market and business market. 08

   c) What is strategic planning? Briefly explain the tools utilized by engineering managers to prepare strategic plans. 09

2. a) What is forecasting? Discuss four different types of qualitative forecasting process. 10

   b) The demand for electrical power at IUT over the years 2012-2018 is given in the table below. Find the demand at 2019 and 2020 using (i) moving average method, (ii) weighted moving average method and (ii) exponential smoothing method (α=0.40). 15

Year	Demand (kW)
2012	500
2013	530
2014	580
2015	600
2016	640
2017	690
2018	720

3. a) What is organization design? Discuss (i) task technology approach and (ii) environmental approach to design an organization. 06

   b) What are the sources of employees? Explain five basic principles of interviewing? 07

c) A defense contractor in Savar, Dhaka has six jobs arein processing. Processing time and due dates are given in the table. Set the processing sequence according to LPT/ EDD/ SPT and evaluate. 12

Job	Processing time (Days)	Due date (Days)
A	6	22
B	12	14
C	14	30
D	2	18
E	10	25
D	4	34

4. a) Discuss the work sampling process for labor standard measurement. What are the advantages and disadvantages of work sampling process? 10

b) Discuss the differences between time study and predetermined time standard techniques for work measurement. 05

c) A marker pen manufacturing operation consisting of three elements and it has been subjected to a time study. The recorded observations are shown in the following table. By labor-union contract, the allowance time for the operation is personal time 5%, delay 5% and fatigue 10%. Determine the standard time for the work operation. 10

Job Element	Observations (minutes)						Performance Rating (%)
	1	2	3	4	5	6	
A	0.1	0.3	0.2	0.9	0.2	0.1	90
B	0.8	0.6	0.8	0.5	3.2	0.7	110
C	0.5	0.5	0.4	0.5	0.6	0.5	80

5. a) What are the differences between power and authority? Briefly describe three different types of authority. 09

b) What is delegation? Discuss three common prerequisites of delegation. 08

c) What is motivation? Explain the expectancy theory of motivation. 08

6. a) What is quality? Discuss any six different aspects of quality. 09

b) Discuss (i) non-conformance and (ii) conformance cost of quality. 08

c) What is total quality management (TQM)? Explain the approaches of TQM. 08

7. a) Explain Halsey and Rowan plans for wage incentive. Compare Halsey and Rowan plans from the view point of (i) worker and (ii) Employer. 10

   b) In Walton Digi-Tech Company, a technician is assembling a Passion series laptop. The technician has taken 10 hours to complete the job while the allowed time was 12 hours. Incentive rate for the technician is 200 taka per hour. Calculate the work cost of the job under the following methods of payment of wages: (i) Flat time rate; (ii) Piece rate; (iii) Halsey plan & (iv) Rowan plan. 15
   Additional information: (i) Total parts cost 10000 Tk and (ii) Factory overhead cost 150% of wages.

8. a) Write short notes on: (i) manufacturing cost and (ii) quality cost. 10

   b) Apple has opened a sales center at Dallas downtown to sell only iPhone. The average selling price of aniPhone is $750 and the average variable expense per phone is $600. The shop rent is $1000/month, sales representative salary is $2000/month, advertisement cost is $1000/month, and utility bill is $500/month. (i) What is the break-even sale in units? (ii) If 50 units iPhone was sold in February 2018, what was the profit? (iii) What is the profit impact if the sales center cuts its selling price $20 per unit, increases its advertising budget by $5,000 per month, and increases unit sales from 50 to 80 units per month? 15

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B.Sc. Engg. (EE)/HDEE, 5th Sem. Date: June 4, 2018 (Morning)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination — Winter Semester, A. Y. 2017-2018
Course No.: Math 4521 — Time: 3 Hours
Course Title: Numerical Methods — 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. Consider appropriate approximation for any missing data.

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1. a) The function expressed below is called the error function. It is used in the field of probability and cannot be calculated exactly for finite values of x. However, one can expand the integrand as a Taylor polynomial and then perform integration. Now, calculate the approximate value of $erf(2.0)$ using the first three terms of the Taylor series around $t = 0$, and then determine the integration of this error function. 8

$$erf(x) = \frac{2}{\sqrt{\pi}} \int_0^x e^{-t^2} dt$$

b) The Taylor series for e^x at point $x = 0$ is given by 7

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

How many terms it would require to get an approximation of e^1 within a magnitude of true error of less than 10^{-6}?

c) With the help of appropriate example, explain truncation and round off error. 5

d) One common instance where subtractive cancellation occurs involves finding the roots of a parabola, $ax^2 + bx + c$, with the quadratic formula: 5

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

For cases where $b^2 \gg 4ac$, the difference in the numerator can be very small and round-off errors can occur. In such cases, an alternative formulation can be used to minimize subtractive cancellation:

$$x = \frac{-2c}{b \pm \sqrt{b^2 - 4ac}}$$

Now, use 5-digit arithmetic with chopping to determine the roots of the following equation with both versions of the quadratic formula.

$$f(x) = x^2 - 5000.002x + 10$$

2. a) Thermistors are temperature-measuring devices based on the principle that the thermistor material exhibits a change in electrical resistance with a change in temperature. By measuring the resistance of the thermistor material, one can then determine the temperature. 13

For a 10K3A Betatherm thermistor,

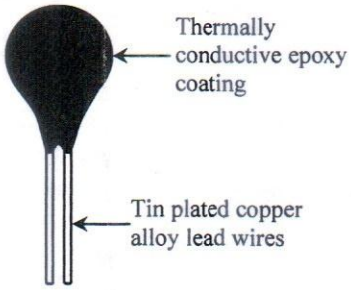

Figure 1: A typical thermistor.

the relationship between the resistance R of the thermistor and the temperature is given by

$$\frac{1}{T} = 1.129241 \times 10^{-3} + 2.341077 \times 10^{-4} \ln(R) + 8.775468 \times 10^{-8} \{\ln(R)\}^3$$

Where, T is in Kelvin and R is in ohms.

A thermistor error of no more than $\pm 0.01\,^{\circ}\mathrm{C}$ is acceptable. To find the range of the resistance that is within this acceptable limit at $19\,^{\circ}\mathrm{C}$, we need to solve

$$\frac{1}{19.01 + 273.15} = 1.129241 \times 10^{-3} + 2.341077 \times 10^{-4} \ln(R) + 8.775468 \times 10^{-8} \{\ln(R)\}^3$$

and

$$\frac{1}{18.99 + 273.15} = 1.129241 \times 10^{-3} + 2.341077 \times 10^{-4} \ln(R) + 8.775468 \times 10^{-8} \{\ln(R)\}^3$$

Use the Newton-Raphson method of finding roots of equations to find the resistance R at $18.99\,^{\circ}\mathrm{C}$. Conduct three iterations to estimate the root of the above equation. Find the absolute relative approximate error at the end of each iteration and the number of significant digits at least correct at the end of each iteration.

b) To find the inverse of a number a, one can use the equation 12

$f(c) = a - \frac{1}{c} = 0$, where c is the inverse of a.

Use the secant method of finding roots of equations to find the inverse of $a = 2.5$. Conduct three iterations to estimate the root of the above equation. Find the absolute relative approximate error at the end of each iteration and the number of significant digits at least correct at the end of each iteration.

3. a) A two-dimensional circular cylinder is placed in a high speed uniform flow. Vortices shed from the cylinder at a constant frequency, and pressure sensors on the rear surface of the cylinder detect this frequency by calculating how often the pressure oscillates. Given three data points, use müller's method to find the time where the pressure was zero. 5

Time	0.60	0.62	0.64
Pressure	20	50	60

b) Discuss the algorithm for bisection method. Also explain with example about the drawbacks of this method. 8

c) You are working for a start-up computer assembly company and have been asked to determine the minimum number of computers that the shop will have to sell to make a profit. The equation that gives the minimum number of computers n to be sold after considering the total costs and the total sales is 12

$$f(n) = 40n^{1.5} - 875n + 35000 = 0.$$

Use the false-position method of finding roots of equations to find the minimum number of computers that need to be sold to make a profit. Conduct four iterations to estimate the root of the above equation. Find the absolute relative approximate error at the end of each iteration and the number of significant digits at least correct at the end of each iteration.

4. a) There is strong evidence that the first level of processing what we see is done in the retina. It involves detecting something called edges or positions of transitions from dark to bright or bright to dark points in images. These points usually coincide with boundaries of objects. To model the edges, derivatives of functions such as 10

$$f(x) = \begin{cases} 1 - e^{-ax}, & x \geq 0 \\ e^{ax} - 1, & x \leq 0 \end{cases}$$

are needed to be found.

i. Use the central finite divided difference approximation of the first derivative of $f(x)$ to calculate the functions derivative at $x = 0.1$ for $a = 0.24$. Use a step size of $\Delta x = 0.05$. Also, calculate the absolute relative true error.

ii. Repeat the procedure from part (i) with $a = 0.12$. Does the estimate of the derivative increase or decrease? Also, calculate the absolute relative true error.

b) To simplify a model for a diode, it is approximated by a forward bias model consisting of DC voltage V_d, and resistor R_d. Table illustrated below, represents the current vs. voltage data, which are collected for a small signal diode model after six experiments. 10

Table: Current versus voltage for a small signal diode model.

V (volts)	I (amps)
0.6	0.01
0.7	0.05
0.8	0.20
0.9	0.70
1.0	2.00
1.1	4.00

The experimental data can be regressed to $I = B_1 V + B_0$. Once B_0 and B_1 are known, V_d and R_d can be computed as $V_d = -\frac{B_0}{B_1}$ and $R_d = \frac{1}{B_1}$. Find the value of V_d and R_d.

c) Explain with the help of Taylor series expansion, why central finite divided difference approximation have more accuracy than both forward and backward finite divided difference approximations. 5

5. All electrical components, especially off-the-shelf components do not match their nominal value. Variations in materials and manufacturing as well as operating conditions can affect their value. Suppose a circuit is designed such that it requires a specific component value, how confident can we be that the variation in the component value will result in acceptable circuit behavior? To solve this problem a probability density function is needed to be integrated to determine the confidence interval. For an oscillator to have its frequency within 5% of the target of 1 kHz, the likelihood of this happening can then be determined by finding the total area under the normal distribution for the range in question: 25

$$(1-\alpha)=\int_{-2.15}^{2.9}\frac{1}{\sqrt{2\pi}}e^{-\frac{x^2}{2}}dx$$

a) Use 6-segment Simpson's 1/3 rule to find the frequency.
b) Use 6-segment Trapezoidal rule to find the frequency.
c) Find the absolute relative true error, $|\epsilon_t|$, for part (a) and (b). Also comment on which method is better to approximate the frequency and why?

6. Three-phase loads are common in AC systems. When the system is balanced, the analysis can be simplified to a single equivalent circuit model. However, when it is unbalanced, the only practical solution involves the solution of simultaneous linear equations. In one model the following equations need to be solved. 25

$$\begin{bmatrix} 0.7460 & -0.4516 & 0.0100 & -0.0080 & 0.0100 & -0.0080 \\ 0.4516 & 0.7460 & 0.0080 & 0.0100 & 0.0080 & 0.0100 \\ 0.0100 & -0.0080 & 0.7787 & -0.5205 & 0.0100 & -0.0080 \\ 0.0080 & 0.0100 & 0.5205 & 0.7787 & 0.0080 & 0.0100 \\ 0.0100 & -0.0080 & 0.0100 & -0.0080 & 0.8080 & -0.6040 \\ 0.0080 & 0.0100 & 0.0080 & 0.0100 & 0.6040 & 0.8080 \end{bmatrix} \begin{bmatrix} I_{ar} \\ I_{ai} \\ I_{br} \\ I_{bi} \\ I_{cr} \\ I_{ci} \end{bmatrix} = \begin{bmatrix} 120 \\ 0.000 \\ -60.00 \\ -103.9 \\ -60.00 \\ 103.9 \end{bmatrix}$$

Find the values of I_{ar}, I_{ai}, I_{br}, I_{bi}, I_{cr}, and I_{ci} using the Gauss-Seidel method. Use the following values as initial guess and conduct three iterations.

$$\begin{bmatrix} I_{ar} \\ I_{ai} \\ I_{br} \\ I_{bi} \\ I_{cr} \\ I_{ci} \end{bmatrix} = \begin{bmatrix} 20 \\ 20 \\ 20 \\ 20 \\ 20 \\ 20 \end{bmatrix}$$

7. a) The co-efficient matrix for a set of linear algebraic equations are given as follow. 15

$$\begin{bmatrix} 0.3333 & 0.1667 & 0.6667 \\ 0 & 0.58332 & -0.00015002 \\ 1.05 & -1.00 & 0.00 \end{bmatrix}$$

Find the inverse of this co-efficient matrix using LU decomposition.

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

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

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

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

The solution for the unknowns x_1, x_2, and x_3 is given by

$$\begin{bmatrix} 4 & 2 & 1 \\ 6.25 & 2.5 & 1 \\ 9 & 3 & 1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \begin{bmatrix} 8.57 \\ 10 \\ 12 \end{bmatrix}$$

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

8. a) A rectifier-based power supply requires a capacitor to temporarily store power when the rectified waveform from the AC source drops below the target voltage. To properly size this capacitor a first-order ordinary differential equation must be solved. For a particular power supply, with a capacitor of 150 μF, the ordinary differential equation to be solved is 15

$$\frac{dv(t)}{dt} = \frac{1}{150 \times 10^{-6}} \left\{ -0.1 + \max\left(\frac{|18\cos(120\pi(t))| - 2 - v(t)}{0.04}, 0 \right) \right\}$$

$$v(0) = 0$$

Now, using the Runge-Kutta 4th order method, find out the voltage across the capacitor at $t = 0.00006\ s$. Use step size, $h = 0.00002$ s.

b) The open loop response, that is, the speed of the motor to a voltage input of 20V, assuming a system without damping is 10

$$20 = (0.02)\frac{d\omega}{dt} + (0.06)\omega$$

Where, ω is speed in rad/s. If the initial speed is zero; use the Runge-Kutta 2nd order method and a step size of $h = 0.4$ s to find the speed at $t = 1.2\ s$. Assume, $a_1 = \frac{1}{2}$.

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B.Sc.TE (2-Yr), 1st Sem.
B.Sc. Engg.(EE) / HDEE, 5th Sem. Date: May 23, 2018(Morning)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester-Final Examination — Winter Semester, A. Y. 2017-2018
Course No.: EEE 4523 / EEE 4595 — Time: 3 hours
Course Title: Switchgear and Protection Equipment I — Full Marks: 150

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

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1. a) What do you mean by protective zones and dead zones? Draw the figure of a typical power system mentioning protective zones for each component. Can dead zone be practically available in a typical power system? 8

   b) Differentiate between Current Transformer (C.T.) and Potential Transformer (P.T.). 7

   c) What do you mean by rate of rise of transient recovery voltage (TRV)? What are the significant characteristics of TRV? Derive the equation: 10

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

   Where E_m and f_n have their usual meanings.

2. a) What do you mean by resistance switching? Explain resistance switching with proper diagram. For critical damping show 10

   $$R = \frac{1}{2}\sqrt{\frac{L}{C}}$$

   where R, L, C have their usual meanings.

   b) Define transient recovery voltage (TRV). With proper diagram explain the effects of natural frequency and power factor on TRV. 7

   c) A 50Hz, 3 phase alternator has rated voltage 13500 V, is connected to a circuit breaker where inductive reactance is 4Ω / phase and capacitance C=2μF. Determine maximum R.R.R.V, peak re-striking voltage and frequency of oscillations. 8

3. a) Explain Slepian's theory of arc interruption. What were the drawbacks of this theory? State the assumptions of Cassie's theory and explain how it describes arc interruption successfully. 8

   b) Explain in details how ionization and deionization of gas occur in the circuit breakers. 7

   c) Explain the construction and working principle of air-break circuit breaker. 10

4. a) Explain the working principle of air-blast circuit breaker. With proper diagram explain axial blast type and cross blast type air blast circuit breaker. Draw the modified double arc extinction chamber of air blast circuit breaker. 15

b) Draw the compressed air system for air-blast circuit breaker with proper labeling. 10

5. a) Write the physical, chemical and dielectric properties of SF_6 circuit breaker. 11

b) Define Gas Insulated Substation (GIS). Draw the section view of a GIS and explain the general constructional features of a SF_6 GIS. 10

c) Explain the gas monitoring system of a SF_6 circuit breaker. 4

6. a) Draw the equivalent circuit of a double break oil circuit breaker. Now if C_1 = 10pF and C_2 = 40pF then find the relation between V_1 and V_2. What percentage of 10

(i) voltage appear across gap and
(ii) across the moving contact and earth ?

How can you equalize the voltage between the gaps? Show mathematically.

b) Explain the construction and working principle of minimum oil break circuit breaker. 10

c) Explain the maintenance of oil circuit breakers. 5

7. a) Explain the stator faults in an alternator. Draw and explain the schematic diagram of Merz-Price protection scheme of delta connected alternator. Explain the role of auxiliary relay in this type of protection scheme. What is the basic difference between Merz-Price protection and restricted earth fault protection of alternator. 15

b) An alternator winding protected by a percentage differential relay is shown in Figure 7(a). The relay has 0.25 A minimum pick up current and has a % slope of 10%. A high resistance ground fault has occurred near the grounded neutral end of the generator winding while generator is carrying load. Assuming that the CT's have 400/5 amps ratio and no inaccuracies. Will the relay trip the generator CB under this fault condition? 10

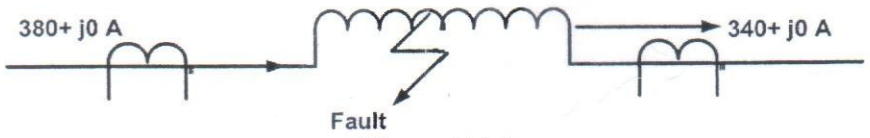

Figure 7 (a)

8. a) What type of protection is provided by Buchholz relay? Draw and explain the construction of Buchholz relay. What are the limitations of this type of relay? 11

b) A 3 phase power transformer having a line voltage ratio of 400 V to 33 kV is connected in star-delta. The C.T. on 400 V side has current ratio of 1000/5. What must be the C.T. ration on 33 kV side? Draw the arrangement. Assume current on 400 V side of transformer to be 1000 A. 10

c) Draw a table showing power transformer connections and C.T. connections on primary and secondary sides of a transformer. 4

B.Sc. Engg.(EE)/ HDEE, 5th Sem Date: May 25, 2018 (Morning)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination — Winter Semester, A.Y. 2017-2018
Course No.: EEE 4531 — Time: 3 hours
Course Title: Energy Conversion III — Full Marks: 150

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

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1. a) What is energy? Name the different types of sources of energy (conventional and nonconventional) and discuss any 2 (two) of them. 5

   b) Draw the e-q curve of a simple charged capacitor and point out energy and co-energy and write the corresponding integral equations. Show that $W_{fld} = W'_{fld} = \frac{1}{2}Ce^2$ for energy in electrostatic field. 10

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

2. a) Write the assumptions of an ideal transformer. Show that the ideal transformer transforms voltages in the direct ratio of turns, currents in the inverse ratio and impedances in the direct ratio squared. 10

   b) What is back emf? A 4 pole, 240 V, wave connected shunt motor gives 11.19 kW when running at 1000 r.p.m and drawing armature and field current of 50 A and 1 A, respectively. It has 540 conductors. Its resistance is $0.1\,\Omega$. Assuming a drop of 1 V per brush, find (a) total torque, (b) useful torque, (c) useful flux/pole, (d) rotational losses and (e) efficiency. 10

   c) Briefly explain duality between electric field and magnetic field. 5

3. a) What is solar cell? Draw the structure of a solar cell and briefly describe all the parts of it. How much power will be generated if the solar cell is 14% efficient, the size is 14 cm×14 cm and solar radiation is 800 W/m^2. 8

   b) Draw solar cell, module and array and differentiate among them. What is EVA film? Discuss all the properties of EVA film. 7

   c) Draw the solar cell I-V curve and briefly explain all of the terms. Define fill factor and efficiency of a solar cell. 10

4. a) Differentiate between average speed and schedule speed. Show that, for a trapezoidal system crest speed, $V_m = \frac{t - \sqrt{t^2 - 4kD}}{2k}$. Find out the expression for 'k' for this system. 15

b) A train runs between 2 stations which are 1500 m apart. Crest speed is 1.25 times of the average speed. Acceleration and retardation are 1.8 and 3.6 km/h/s respectively and stop time is 21 seconds. Find out schedule speed by assuming trapezoidal system. 10

5. a) Answer the following questions: 15
i) What are the indications and causes of an overloaded generator?
ii) When a generator loses its residual magnetism either due to lightning or short circuit, how can it be made to build up?
iii) Can a generator be reversed by reversing the connections between the armature and field coils?
iv) How do we conclude that connections between field coils and armature are correct?
v) What is meant by armature reaction?

b) Discuss the advantages among brushed DC, brushless DC and stepper motor. Mention several applications of series, shunt and compound motor. 10

6. a) What is MPPT? Draw the flowchart of incremental conductance method to track the maximum power point of a solar power system. 12

b) A house owner decides to use a solar PV system to run 4 CFLs (20 watt each) and 3 fans (60 watt each) for 8 hours per day. Sunshine is available 8 hours/day. Peak power rating of PV panel is 40 W, operating factor is 0.75 and the efficiency of inverter and battery are 0.8 and 0.9, respectively. Battery voltage and depth of discharge are 12 V and 0.85, respectively. 13

What is the total load? Find out the number of PV panels, batteries and inverters required for the system. What will be the total cost of the system if the unit prices of the solar modules, batteries and inverters are 10000 Tk, 8000 Tk and 6000 Tk respectively.

7. a) What is the difference between solar PV system and solar thermal system. Draw the schematic diagram of a single basin solar still and explain solar distillation system. 15

b) Design a PV system for pumping 30000 litres of water everyday from a depth of 15 meter where drawdown is 2 m, frictional loss is 5% of the total vertical lift, solar PV module's rating is 40 Wp, operating factor is 0.8, pump efficiency is 0.30 and mismatch factor is 0.81. 10

8. a) For a wind power system, define coefficient of performance, capacity factor, tip speed ratio, lift force and horizontal axis wind turbine. 15

b) An industry wants to install wind turbine to generate actual energy of 25000 kWh. Wind speed is 5 m/s at height 15 m from ground. Which turbine do you suggest? Make necessary assumptions and estimate rotor size and power rating of the turbine. 10

B.Sc.Engg. (EE)/HDEE, 5th Sem. 191 Date: May 23, 2018 (Morning)

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

Semester Final Examination — Winter Semester, A. Y. 2017-2018
Course No.: EEE 4541 — Time: 3 Hours
Course Title: Wireless Communication — Full Marks: 150

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

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1. a) Write down the advantages of the use of low frequencies in wireless communication. Why is the use of higher and higher frequencies being adopted in the course of time? 6

   b) Which one, between FDD and TDD, is more widely used for LTE? What is the baseband bandwidth (bandwidth of audio source) for FM radio broadcast? 4

   c) Mention whether modulation used in Ethernet or not and give its reasons. What is maximum packet size for Ethernet? Is the MAC address for Ethernet globally unique? 6

   d) What is the front end of a wireless communication system? Define characteristic wave impedance. 4

   e) For SINR 20 dB, determine the maximum possible spectral efficiency according to the theorem of Shannon's capacity. 5

2. a) Briefly explain polarization diversity. What is the advantage of $+45^0/-45^0$ polarization? 7

   b) When may multiple international carriers be used to set up a voice call? What is the usual approximate distance between two repeaters in the long distance terrestrial telecommunication system of BTCL? 4

   c) What is the unit of spectral efficiency? How high are the frequencies at the maximum for cellular communication so far? 4

   d) Why is the location of GPS satellites closer than GEO? What is the main advantage of GEO satellites? 6

   e) Why is the TDMA frame in uplink delayed by three timeslots compared to downlink in GSM? 4

3. a) Derive the expression for received power in the case of two-ray model for both large and small distances between the transmitter and the receiver. 10

   b) Write down the names of two error checking techniques. Which FEC techniques are nowadays widely used for cellular communication? Which FEC technique is used in WiMAX? 5

   c) There is a knife-edge blockage between a transmitter and a receiver. The blockage blocks 6 Fresnel zones fully and it does not partially block any Fresnel zone. Determine the value of Fresnel-Kirchoff diffraction parameter. 10

4. a) What type of wireless links are usually interference limited? Give reasons. 4

   b) What is done in LTE to overcome flat fading? What is the maximum user velocity supported in LTE? 4

   c) A user is traveling at 120 km/hour. He is receiving a signal at frequency 6 GHz. Determine the maximum possible symbol period to avoid fast fading assuming maximum Doppler shift. 10

   d) Write down the common Key Performance Indicators (KPIs) for communication systems. What are the typical values of CINR for acceptable, good and excellent performance of a wireless link? Write down the typical BLER values for error sensitive and error tolerant applications. 7

5. a) How can Adaptive Modulation and Coding (AMC) and Transmission Power Control (TPC) affect each other in cellular communication systems? 4

   b) With the advancement of technology, which of these parameters are gradually increasing for non-LOS communication systems: i) operating frequency, ii) modulation level and iii) number of MCS levels for AMC? Give reasons. 8

   c) Compare non-LOS and LOS communication links in terms of their i) typical bandwidth capability, ii) SINR and iii) maximum modulation level. Give reasons. 8

   d) Write down the names of different wired communication links in the order of their bandwidth capability. Write down the names of two popular types of UTP. 5

6. a) Why does the uplink impose constraint in link budget calculation? What is the edge of beam loss in the link budget for satellite? Why is the first stage amplifier of a wireless receiver made with as little noise as possible? 8

   b) Compare the capacities of 2G and 3G cellular communication systems in terms of their approximate number of voice calls using the same bandwidth. 6

   c) Assume that heavy rain has significantly attenuated the received power in satellite communication. What action may be taken then? 3

   d) Why should one check the category of a 3G/4G phone or the class of 2G phone before its purchase? 3

   e) Write down typical power values in dBm for the following cases: 5
      i. maximum transmit power of UE,
      ii. maximum received power with calls that can sustain with no difficulties,
      iii. maximum received power with calls that can sustain with some difficulties,
      iv. maximum received power at UE below which the operation may go out of service and
      v. maximum transmit power of base station for very large cell.

7. a) Describe how the requirements of a wireless system are established starting with setting up a target BER and finally using link budget calculation. Show the factors on which different target parameter values depend. 10

   b) How many times can power be adjusted in UMTS (3G) at the maximum? What is the purpose of training sequence bits of a burst transmission in GSM? 6

c) Differentiate voice, FTP transfer, SMS, video streaming, web browsing and e-mail applications in terms of delay-tolerant and error-tolerant services. 4

d) The Intermediate Frequency (IF) of a superheterodyne receiver is 455 kHz. If the incoming carrier frequency is 1150 kHz, what is the frequency of image signal? 5

8. a) For Rayleigh fading model, derive the relationship between the amplitude of the received signal and in-phase and quadrature components of Gaussian random variables. 10

b) User 'A' stays close to the base station and user 'B' stays far away from the base station for cellular communication. Mention who will suffer from more electromagnetic radiation. Give reasons. 5

c) The EIRP of a transmitter is 30 dBm. The path loss at a reference distance of 10 m is 54 dB. The path loss exponent is 3.5. Calculate the outage probability at a distance 1 km from the transmitter considering the minimum allowable received power of −100 dBm. The standard deviation in dB for Gaussian distribution is 4. Use log-normal shadowing model. 10

B.Sc. TE. (2-Yr), 1st Sem. 194 Date: May 25, 2018 (Morning)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination — Winter Semester, A. Y. 2017-2018
Course No.: EEE 4597 — Time: 3 Hours
Course Title: Telecommunication Principles — Full Marks: 150

There are **8 (eight)** questions. Answer **any 6 (six)** questions. All questions carry equal marks. Marks in the margin indicate full marks. Programmable calculators are not allowed. Do not write on this question paper. All symbols bear their usual meanings. Make reasonable approximation(s) for missing information.

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

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

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

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

   b) Explain the process of frequency mixing. What are meant by up and down conversions. 8

3. a) Name the cellular technologies for various generations of 3GPP and 3GPP2 starting from 2.75G. 6+4

   b) Mention the reasons for which operation in lower frequencies can be advantagious in wireless communication. 7

   c) Compare among isotropic antenna,omni-directional antenna and directional antenna. 8

4. a) Define beam-width and effective aperture of an antenna. 5

   b) Show an example of a hybrid topology consisting of a star backbone with four bus networks. 6

   c) Mention the advantages and disadvantages of mesh and ring topologies in a computer network. 8+6

5. a) Name the seven layers of the OSI model with their functionality. Show the interaction between layers in the OSI model. 7+8

   b) What are the layers of TCP/IP protocol suite? Show the relationship of layers and addresses in TCP/IP. 10

6. a) What is correlative coding? Demonstrate duobinary coding and decoding for the sequence $\{x_k\}$= 0 0 1 0 1 1 0 considering first bit of the digit as the startup digit not part of the data. 13

   b) Why do we need precoding? With the same $\{x_k\}$ sequence of 6(a) illustrate duobinary precoding. 12

7. a) Explain uniform and non uniform quantization. Which kind of quantization is used for speech communication? Explain in detail. What is companding? 5+7+3

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

8. a) Prove that probability of bit error $P_B = Q\ (a_1\text{-}a_2\ /2\sigma_0)$. 12

   b) Explain the basic SNR parameter for digital communication systems. 8

   c) Explain the correlation realization of a matched filter. 5

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B.Sc. Engg. (EE), 7th Sem. May 24, 2018 (Morning)
B.Sc.TE (2Yr), 3rd Sem, B.Sc.TE (1Yr), 1st Sem.

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination — Winter Semester, A. Y. 2017-2018
Course No.: EEE 4705/EEE 4791 — Time: 3 Hours
Course Title: Control System 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. Use suitable assumptions for missing information.

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1. a) Mention three primary objectives of analysis and design of control systems. 3

   b) Derive the transfer function $G(s)$ of a DC motor of constant field. The system is shown in Fig: 1(b). 12

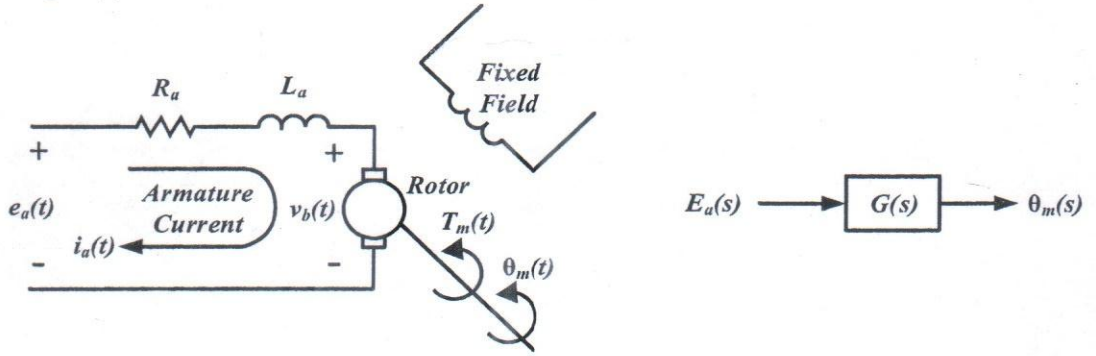

Fig: 1(b)

   c) For the rotational mechanical system shown in the Fig: 1(c), find the transfer function $G(s)=\theta_2(s)/T(s)$. 10

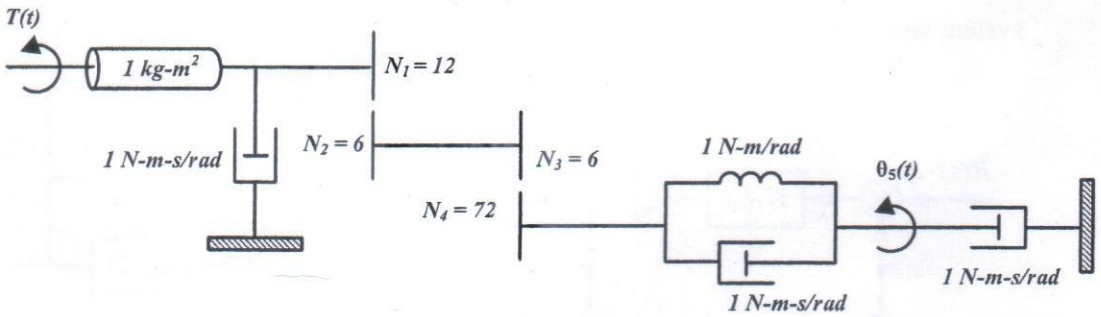

Fig: 1(c)

2. a) Define damping ratio, ζ. How 2nd order system behaves differently based on its values? 4

   b) For the system shown in Fig: 2(b), (i) Find the transfer function $G(s)=X(s)/F(s)$. (ii) Find $\zeta, \omega_n, \%OS, T_s, T_P$ and C_{final} for a unit step input. 12

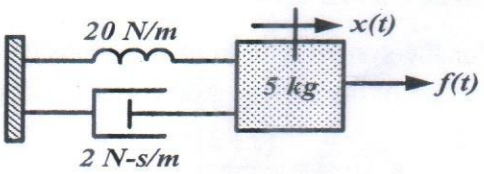

Fig: 2(b)

c) Determine the value of K and D of the close loop transfer function shown in Fig: 2(c)., so that the maximum overshoot in unit-step response is 25% and the peak time is 2 sec. Assume, $J = 1\text{kg-m}^2$. 9

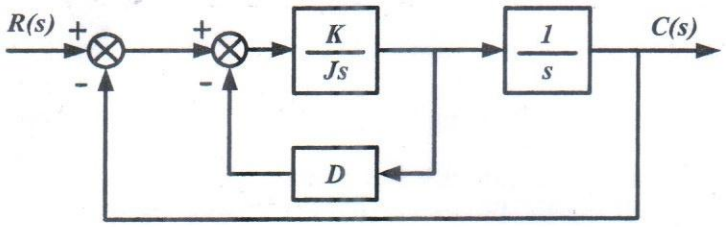

Fig: 2(c)

3. a) Using Mason's rule find the transfer function $T(s) = C(s)/R(s)$ for the system represented in Fig: 3(a). 10

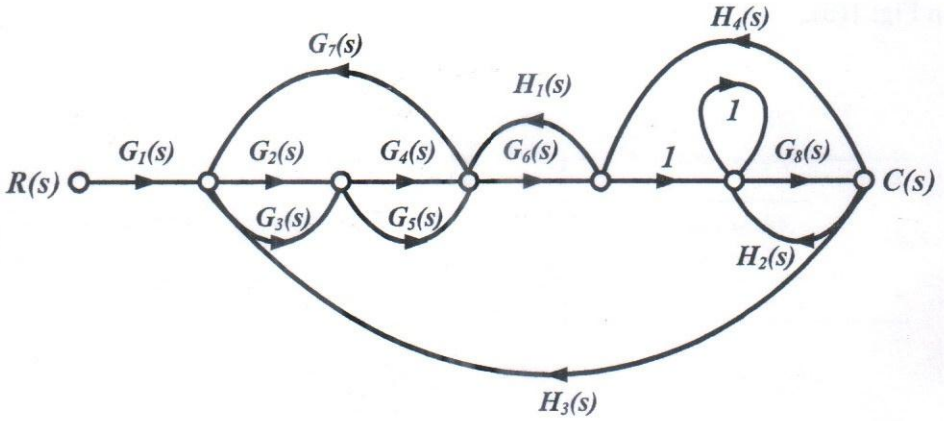

Fig: 3(a)

b) Use block diagram reduction to find the transfer function $T(s) = C(s)/R(s)$ for the system shown in Fig: 3(b). 10

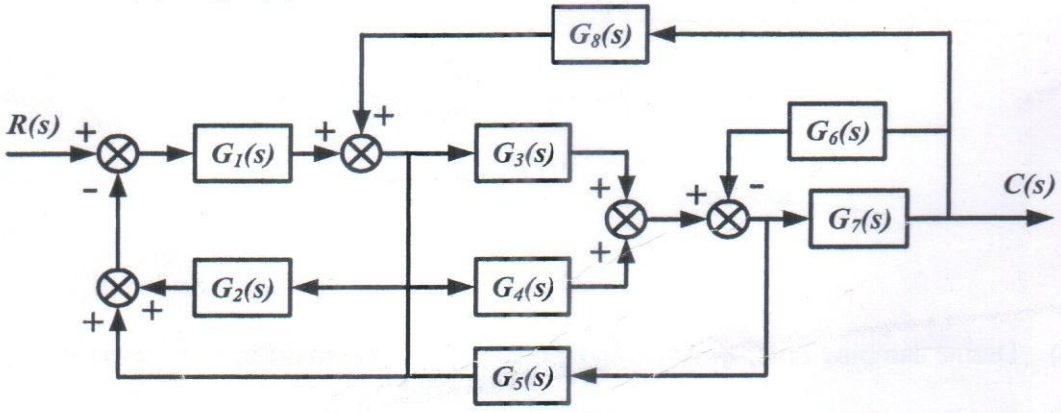

Fig: 3(b)

c) Mathematically explain how a PID controller can help to meet the system specifications. 5

4. a) Draw the Bode plot for the system with following transfer function. Also find the phase margin and the gain margin of the system. Add correction for the second order system. 10

$$G(s) = \frac{(s+2)(s^2+1.4s+9)}{(s+6)(s^2+4.5s+49)}$$

b) Draw the root locus of the unity feedback system with following forward path transfer function: 15

$$G(s)=\frac{K\left(s^2+2s+4\right)}{s(s+4)(s+6)\left(s^2+1.4s+1\right)}$$

Find the range of the gain for which the system is stable.

5. a) Explain how different System Types are related in choosing test input signal. 3

b) For the system shown in Fig: 5(b), do the following: 12

i. Derive the expression for the error, $E(s)=R(s)-C(s)$ in terms of $R(s)$ and $D(s)$.

ii. Derive the steady-state error, $e(\infty)$, if $R(s)$ and $D(s)$ are unit step functions.

iii. Determine the attributes of $G_1(s)$, $G_2(s)$ and $H(s)$ necessary for the steady-state error to become zero.

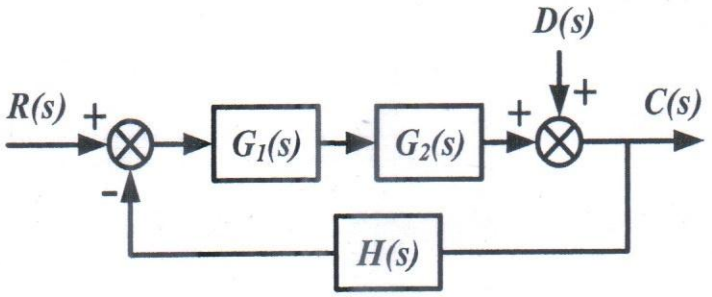

Fig: 5(b)

c) Given the unity feedback control system of Fig: 5(c) where, 10

$$G(s)=\frac{K}{s(s+a)}$$

Find the following:

i. **K** and **a** to yield $K_v=1000$ and a 20% overshoot,

ii. **K** and **a** to yield a 1% error in the steady state and a 10% overshoot.

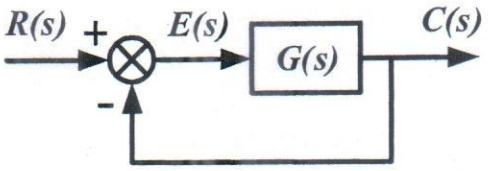

Fig: 5(c)

6. a) Explain how Routh-Hurwitz criterion enable us to know system's stability. 3

b) Use Routh-Hurwitz criterion to find, how many closed-loop poles of the system shown in Fig: 6(b) lies in the left half-plane, in the right half-plane, and on the $j\omega$-axis. 12

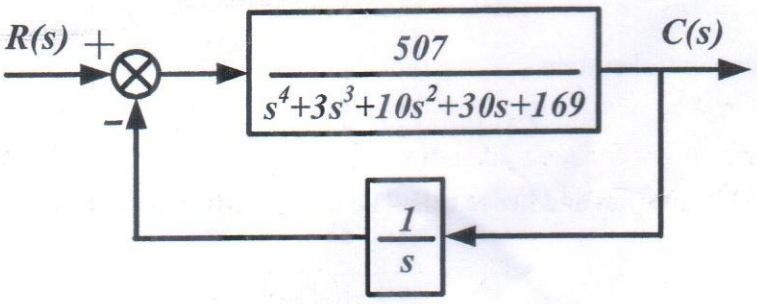

Fig: 6(b)

c) For the system shown in Fig: 6(c), find the value of gain, K, that will make the system oscillate. Also, find the frequency of oscillation. 10

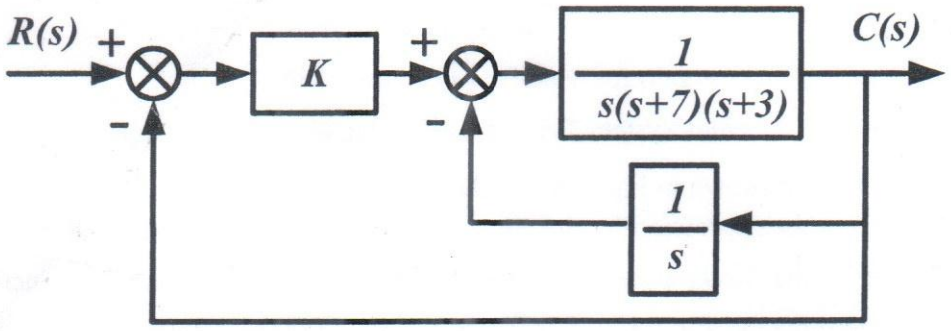

Fig: 6(c)

7. a) Plot the root locus for the system represented by the following characteristic equation. Here, H(s) =1. Find also the limiting value of gain and the frequency of pure oscillation. 13

$$1+\frac{K(s+6)}{(s+3)(s+4)(s+7)(s+9)}$$

b) Identify and realize following compensator with passive networks. 12

i. $\frac{s+0.1}{s+0.01}$

ii. $\frac{s+2}{s+5}$

iii. $\left(\frac{s+0.1}{s+0.01}\right)\left(\frac{s+1}{s+10}\right)$

8. a) Define Gain margin and Phase margin pictorially. 2

b) Design a lag compensator so that the system of Fig: 8(b) operates with 45^0 phase margin and static error constant of 100. 13

$$G(s)=\frac{K(s+4)}{(s+2)(s+6)(s+8)}$$

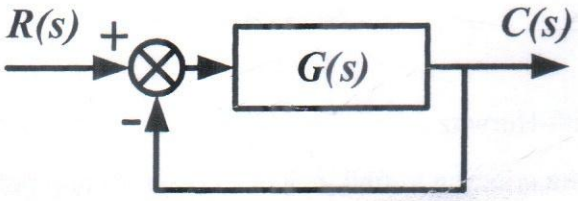

Fig: 8(b)

c) For a certain control system 10

$$G(s)=\frac{K}{s(s+2)(s+10)},\ H(s)=1$$

Sketch the Nyquist plot and hence calculate the range of the values of K for stability.

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B.Sc. Engg. (EE), 7th Sem.

Date: June 07, 2018

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination
Course No.: EEE 4715
Course Title: High Voltage Engineering

Winter 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) With a neat sketch describe briefly the working principle of Cockcroft-Walton type multiplier circuit arrangement for generation of HVDC. Find the ripple and voltage drop of this circuit. 18

   b) A Cockcroft-Walton type voltage multiplier has 8 stages with capacitances, all equal to 0.05 μF. The secondary maximum voltage of the supply transformer is 125 kV at a frequency of 150 Hz. If the load current to be supplied is 5 mA, determine 07
      i) percentage ripple,
      ii) the regulation and
      iii) the optimum number of stages for minimum regulation or voltage drop

2. a) Explain the negative corona discharge phenomena. 10

   b) What are the undesirable effects of Corona? How could you reduce these effects? 08

   c) A certain three-phase equilaterally spaced transmission line has a total corona loss of 60 kW at 110 kV and a loss of 100 kW at 111 kV. What is the disruptive critical voltage between lines? 07

3. a) Describe with a neat sketch, the working principle of an electrostatic machine, developed by Van de Graff. What are the advantages of this machine? 13

   b) Draw the circuit diagram of a Tesla coil and explain its operation. 12

4. a) What is the intrinsic breakdown strength of a solid dielectric? Derive the expression for the critical field in case of electromechanical breakdown of solid dielectric. 3+10 = 13

   b) What is internal discharge of a solid dielectric? Derive the expression of the voltage across the capacitance due to void. 12

5. a) What are the different theories of breakdown in insulating liquids? Describe the Bubble theory. 20

   b) Write down the industrial application of corona discharge. 05

6. a) What are the methods used for high voltage measurements? Explain with a neat diagram the electrostatic voltmeter used for measurement of DC and AC voltages. 12

   b) With a neat diagram, explain how a sphere-gap can be used to measure the peak value of HV. Describe in detail the parameters and factors that influence such voltage measurement. 10

   c) Write down the advantages and disadvantages of resistive potential divider method for measuring HVDC. 03

7. a) Describe the measurement of dielectric constant and dissipation factor of a liquid dielectric at higher frequencies using resonance method. Also find out the loss factor for the liquid dielectric. 20

   b) What are the quantities that can be measured by Peak-Voltmeter? Explain its operation. 05

8. a) What is streamer mechanism of breakdown of gases? Discuss the mechanism proposed by Raether. 07

   b) Derive the criterion for the breakdown of a gas under electrical stress in terms of the two coefficients, as postulated by Townsend. 18

B.Sc. Engg. (EEE), 7th Sem. 202– Date: June 7, 2018 (Morning)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination
Course No.: EEE 4725
Course Title: Optical Communication

Winter 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. All symbols bear their usual meaning. Assume reasonable values for missing data.

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1. a) Compare between guided and unguided optical communication. Describe fifth generation of fiber-optic communication system. 5+5

   b) The minimum bit rate for analog TV transmission is 66 Mbps with a signal bandwidth of 4 MHz. Find out the SNR value. 5

   c) Explain SONET, SDH and STM with their respective bit rates. 10

2. a) Explain fiber birefringence covering degree of modal birefringence, beat length, fast and slow axis. 8

   b) Calculate an estimation of bit-rate distance product for a cladded graded-index fiber with $n_1 = 1.5$, $n_2 = 1.497$. Find out the index profile α for minimum dispersion in this case. Compare this α value with that of parabolic index profile. 5+3

   c) Mention some applications of graded index fibers. Explain four wave mixing (FWM) in optical fiber. 3+6

3. a) Mention the two stages for fabrication of telecommunication-grade silica fibers. Explain depressed and raised cladding fibers with different index profile. 3+5

   b) What makes optical amplifier a better solution for WDM lightwave systems? Explain three possible applications of optical amplifiers in lightwave system. 2+5

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

4. 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. 5+5

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

5. a) Explain mean time to failure (MTTF) of an optical transmitter. Why should t_F exceed 10^5 hours for the optical source? 6

   b) How is optical gain achieved in stimulated emission? Explain optical feedback and threshold current in semiconductor laser. 3+4

   c) Why is external optical modulator necessary for higher bit rates? State the main difference between DFB and DBR laser and show their respective structures. 2+5

   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 deplection region width. 2+4

B.Sc. Engg. (EE), 7th Sem. 204 Date: June 5, 2018 (Morning)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination — Winter Semester, A. Y. 2017-2018
Course No.: EEE 4729 — Time: 3 Hours
Course Title: Discrete Mathematics and Numerical Analysis — Full Marks: 150

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

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1. a) Derive the Newton-Raphson method. 5

   b) In Secant Method, why is the derivative approximated by a backward finite difference method? 5

   c) Derive Muller's Method to obtain a root of an equation. 5

   d) Determine the highest real root of $f(x) = 2x^3 - 11.7x^2 + 17.7x - 5$, by 10
   i) graphically,
   ii) fixed point Iteration method (five iterations, $x_0 = 3$),
   iii) Newton- Raphson method (five iterations, $x_0 = 3$).

2. a) Use Muller's method with guesses of x_0, x_1 and x_2 = 4.5, 5.5, 5, respectively, to determine a root of the equation $f(x) = x^3 - 13x - 12$. The estimated error is 0.00001%. 15

   b) Write a pseudo code for Muller's method. Find the time function for the code for the machine in Figure 2(b). 10

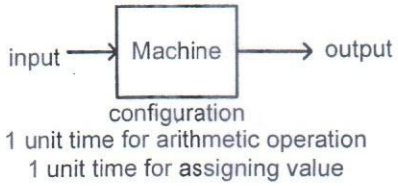

Figure 2(b)

3. a) Derive 2nd order Range-Kutta method. 5

   b) Integrate $f(x,y) = 4e^{0.8x} - 0.5y$ using 2nd, 3rd and 4th order Runge-kutta method and compare the results. 10

   c) Derive the trapezoidal rule for integration. 5

   d) Numerically integrate $f(x) = 0.2 + 25x - 200x^2 + 675x^3 - 900x^4 + 400x^5$ from $a = 0$ to $b = 0.8$ using Trapezoidal Rule. 5

4. a) Derive Simpson's 1/3 rule. 5

   b) Use Simpson's 1/3 rule and 3/8 rule to integrate $f(x) = 8 + 4\cos x$, and comment on the best process by comparison. 10

c) Find the root of $f(x) = (667.38 / x)(1 - e^{-(x / 68.1)10}) - 40$ Using Bisection method. If the desired error is 0.0625 then how many iterations do you need? 10

5. Calculate the potentials of the nodes inside the boundary of Figure 5. Use At least 5 iterations. 25

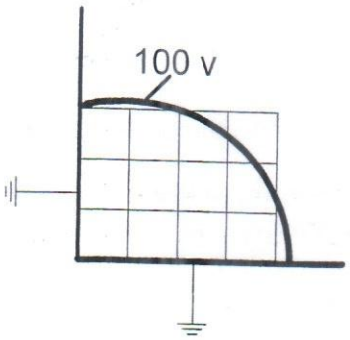

Figure 5

6. a) The potential system in Figure 6(a) is symmetric about the y-axis. Set the initial values at free nodes equal to zero and calculate the potential of nodes inside the boundary. Use at least 7 iterations. 15

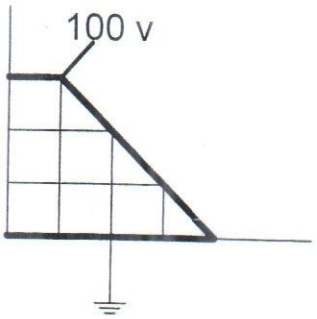

Figure 6(a)

b) Use Taylor Series expansion to approximate 3rd order derivative numerically. 5

c) Derive the numerical approximation for Hyperbolic PDEs. 5

7. a) Fill up the given data table using interpolation. 15

x	$f(x)$	x	$f(x)$	x	$f(x)$	x	$f(x)$	x	$f(x)$
0	0	6	63	12	511	19	520	25	75
1	0	7	63	13	511	20	520	26	75
2	7	8	215	14	515	21	350	26.66	-
3	7	9	215	15	515	22	350	27	30
3.33	-	9.66	-	16	-	22.165	-	28	30
4	26	10	342	17	-	23	225	29	9
5	26	11	342	18	-	24	225	30	9

b) Derive the implicit formula for Hyperbolic PDEs and find the time function for the 10

formula for the machine in Figure 7(b).

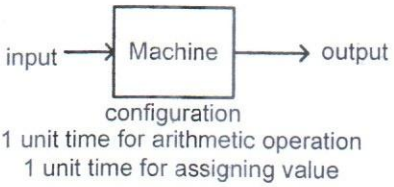

Figure 7(b)

8. Solve the wave equation $\Phi_{tt} = \Phi_{xx}$, $0 < x < 1$, subject to the boundary conditions $\Phi(0,t) = 0 = \Phi(1,t)$ and the initial conditions $\Phi(x,0) = 100*\cos \pi x$; $\Phi_t(x,0) = 0$; Choose your time step to be 0.05. 25

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

Date: June 5, 2018 (Morning)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

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

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

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

b) The load $Z_L = 40 - j30\ \Omega$ is connected to an ideal transmission line with characteristic impedance, $Z_0 = 50\ \Omega$. The reflected current is $I_- = 0.2\angle 0^0$ amp at a point on the line, which is 8 cm away from the load. The distance between the maximum current amplitude point and the minimum current amplitude point is 1.5 cm. Determine the reflected voltage and the incident current at a point, which is 10 cm away from the load. 15

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. 8

b) A transmission line is terminated with a load $j200\ \Omega$. The first voltage minimum is located at $3\lambda/8$ distance from the load. Determine VSWR and the characteristic impedance of the transmission line. 8

c) The incident voltage leads the reflected current by 45^0 on a transmission line at time instant t_1. The incident voltage is $6\angle 0^0$ V at $t_1+T/4$ on the transmission line where T represents a period. The line has characteristic impedance $Z_0 = 60\ \Omega$ and VSWR is 2. Determine reflected current at $t_1+T/4$ on the transmission line. 9

3. a) Show that the resultant voltage waveforms look identical but shifted in position for open and short circuited cases. Also, show that the input impedance is purely reactive and it can take any value of inductance or capacitance depending on the length of the line for open circuited case. Show that the open circuit point is located at the rightmost point on Smith chart. 12

b) The characteristic impedance of a transmission line is $Z_0 = 75\ \Omega$. Design a quarter-wave transformer in order to match load impedance $15 - j15\ \Omega$ for operating frequency 6 GHz. The characteristic impedance of the quarter-wave transformer needs to be resistive. Calculate any length or distance in cm. 13

4. a) The reflection coefficient is 135^0 at a particular point on a transmission line. Draw a vector diagram that shows the time relationship among incident voltage, reflected voltage, incident current and reflected current at the particular point. 4

b) What is Bode-Fano criterion? Write down the advantage of tapered lines. 6

c) A transmission line with characteristic impedance 75 Ω is connected to a load. The line is filled in with a material which has dielectric constant, $\varepsilon_r = 1.4$. The VSWR on the line is 2.4. The distance to the first minimum voltage amplitude point from the load is 0.867 cm. The operating frequency is 10 GHz. Determine, 15

i) reflection coefficient at the point of the load,
ii) the maximum impedance on the line and
iii) the distance from the load in cm where the impedance is 37.5 + j30 Ω.

5. a) Derive the following expression from Maxwell's equation. 10

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

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

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

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

b) 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. 12

7. a) Derive the expressions for E and H fields for TEM operation in coaxial line. 9

b) Explain why operation in a single mode is preferred? Why TEM wave is preferred when it is available? 6

c) The cutoff frequency for the dominant mode is 3 GHz for a circular waveguide. The waveguide will not carry any mode higher than TE_{41}. Determine the maximum bandwidth available for TM_{21} mode signal. Use Table 1. 10

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

Table 1

8. a) Compare between solid state and microwave tube solutions. Write down advantages and disadvantages of Magnetron. 8

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

c) Show how output power at different ports are available for power input to different ports for Magic Tee. 5

B.Sc. Engg.(EE), 7th Sem. 2nd 2 1 0 Date: 28 May, 2018 (Morning)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination — Winter Semester, A. Y. 2017-2018
Course No.: EEE 4741 — Time: 3 Hours
Course Title: Digital Signal Processing — 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. Consider the following analog sinusoidal signal:
$$x_a(t) = 3\sin(100\pi t).$$

   a) Sketch the signal $x_a(t)$ for $0 \leq t \leq 30$ ms. 5

   b) The signal $x_a(t)$ is sampled with a sampling rate, $F_s = 300$ samples/s. Determine the frequency of the discrete-time signal $x(n) = x_a(nT), T = 1/F_s$ and show that it is periodic. 8

   c) Compute the sample values in one period of $x(n)$. Sketch $x(n)$ on the same diagram with $x_a(t)$. What is the period of the discrete-time signal in milliseconds? 7

   d) Can you find a sampling rate F_s such that the signal $x(n)$ reaches its peak value of 3? 5

2. a) Determine the response $y(n)$, for $n \geq 0$ of the following system: 12
$y(n) + 0.5y(n-1) = (-0.5)^n u(n)$, when $y(-1) = 2$.

   b) For the following sequences: 13
$x_1(n) = \{\underset{\uparrow}{2},1,0,1\}$ and $x_2(n) = \{\underset{\uparrow}{1},2,0,1\}$
perform the linear convolution by using circular convolution and justify your answer.

3. a) A causal LTI system is described by the following difference equation 10
$$y(n) - 0.5y(n-2) = 0.75x(n-3) - 0.5x(n) + 0.2x(n-2).$$
Draw the corresponding direct-form I and II structures.

   b) Determine the FT of the following sequence: 15
$x(n) = n\alpha^n u(n+2)$, $|\alpha|<1$.

4. Design a digital notch filter to reject only the 50 Hz signal from the patient ECG signal. Let the practical ECG signal has the frequency band of 0 Hz to 2 kHz.

   a) Show the approximate magnitude response of $X(e^{j\omega})$ for 8 kHz sampling frequency where $x(n)$ is the ECG signal. 5

   b) Find both $h(n)$ and $H(z)$ of the designed filter. 10

   c) Plot the pole and zero of the filter on the Z-plane. 5

   d) Plot the approximate magnitude response of $H(e^{j\omega})$ from Z-plane. 5

5. a) For the following magnitude response of a filter in Fig. 5(a), draw the approximate pole and zero location in the Z-plane. 12

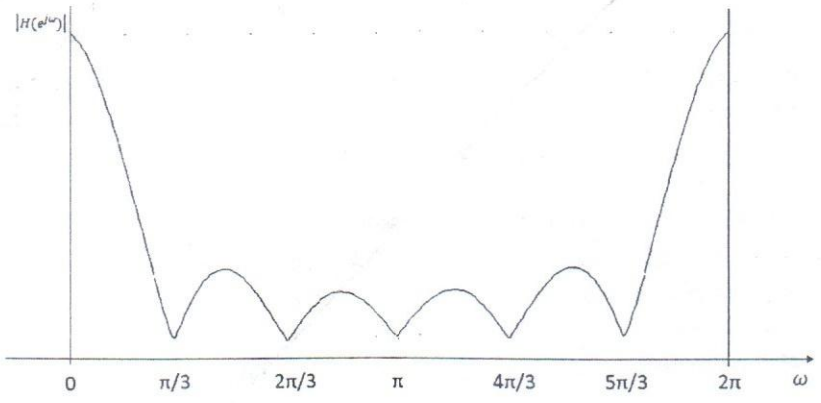

Fig. 5(a): Magnitude response of a filter

b) For 5 point moving average filter, find the Z transform and plot the poles and zeros on the Z-plane. 13

6. Determine and sketch the magnitude and phase spectra of the following periodic signals:

a) $x(n) = 4sin\frac{\pi(n-2)}{3}$ and 13

b) $x(n) = 1, -\infty < n < \infty$. 12

7. a) Why are the ideal filters not realizable? Explain your answer with example. 5

b) Design a filter which will allow to pass only $P_1(n)$ from the following input signal: 15
$x(n) = P_1(n) + P_2(n)$,
where, $P_1(n) = cos0.4n$ and $P_2(n) = cos0.9n$.

c) Show that, cascading of two same types of filters not always provide higher quality factor. 5

8. a) What are the basic differences between FIR and IIR filters? 5

b) Usually why is a low pass filter used before sampling an analog signal? 5

c) $H(z) = \frac{1}{2}(1 + z^{-1})$ is a transfer function of a low pass filter. Draw the amplitude and phase responses for both the single stage system and cascaded four single stages. Also find the cutoff frequency for the cascaded system. 15

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

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

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

There are **8 (eight)** questions. Answer **any 6 (six)**. All questions carry equal marks. Marks for each part of the questions are indicated on the right margin. Symbols have their usual meanings. Programmable calculators are not allowed. Do not write on this question paper.

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1. a) Two atoms are being brought together and the energy of one atom in the field of another is given by $W(r) = -\alpha/r^n + \beta/r^m$ where symbols carry their usual meanings. Derive the expression of the distance between two atoms so that the atoms may form a bond. Use appropriate figure. Also derive the relation between m and n. 7+6

   b) Into how many types solids can be classified on the basis of chemical bonds? Describe ionic crystal and mechanism of ionic bond formation with reference to the periodic table. 4+8

2. a) Two lattice planes cut the axes as following : 3+4
      i) x = 3, y = 2 and z = 2,
      ii) x = 1, y = 3 and parallel to z axis ($z = \infty$).
   Find out the Miller indices of the planes.

   b) With suitable diagram and proper equations explain Bragg's law. What is the application of Bragg's law? 7+2

   c) Describe cubic, tetragonal and orthorhombic crystal systems on the basis of unit cell. 3+3+3

3. a) What properties a wave function must have to represent a real body? Write down the time dependant and steady-state forms of Schrödinger wave equation in three dimensions. What is expectation value? 3+3+3 +4

   b) A particle with energy E is incident on an energy barrier of height V. Explain why the particle may tunnel through the barrier even if $E < V$ and why it may get reflected by the barrier even if $E > V$. 6+6

4. a) A copper wire has a resistivity of 1.68×10^{-8} Ohm-m at room temperature. There are 8.46×10^{28} conduction electrons per m^3; electron mass, $m = 9.1 \times 10^{-31}$ kg; electronic charge, $e = 1.6 \times 10^{-19}$ Coulomb. Compute: 9
      i) relaxation time of electrons,
      ii) the average drift velocity of electrons for an electric field of 10 V/m along the wire and
      iii) mobility of electrons.

   b) Define Debye temperature. What is Matthiessen's rule? How do impurities and imperfections modify the resistivity of a material? Explain. 2+3+3

   c) What are superconductors? Define transition temperature of a superconductor. Name three superconducting materials. 2+3+3

5. a) Write down the expression of the Fermi-Dirac distribution function f(E). Plot f(E) versus E at T = 0°K for intrinsic semiconductor using the expression. 4+9

   b) Plot the variation of majority carrier concentration with inverse of temperature (1000/T) and explain different regions on the plot. 6+6

6. a) How does carrier mobility vary with temperature? Explain using appropriate figures. 5+8

   b) Briefly describe the working principle of photodiodes. How photodiodes can be operated as solar cells? 6+6

7. a) Give definitions of electric dipole moment and polarization with equations. Derive the expression of induced dipole moment of an atom and associated electronic polarization in monoatomic gas having atomic number Z and number of atoms/m^3 N. 4+9

   b) Derive Clausius-Mosotti expression for elemental monoatomic solid dielectrics. What is piezoelectricity? What types of materials show piezoelectric effect? 8+2+2

8. a) Classify and define all materials (magnetic and non-magnetic) from magnetic dipole moment consideration. Use diagrams if necessary. 10

   b) What are ferrimagnetic materials or ferrites? Explain how the amount of spontaneous magnetization in a ferrimagnetic material can be controlled. 3+5

   c) What is ferromagnetic domain? Explain how application of external magnetic field causes domain wall motion. What factors affect the mobility of domain wall? 2+3+2

M.Sc.T.E., 3rd Sem. 214 Date: May 24, 2018 (Morning)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination — Winter Semester, A. Y. 2017-2018
Course No.: EEE 6397 — Time: 3 Hours
Course Title: Statistical Theory of Communication — Full Marks: 150

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

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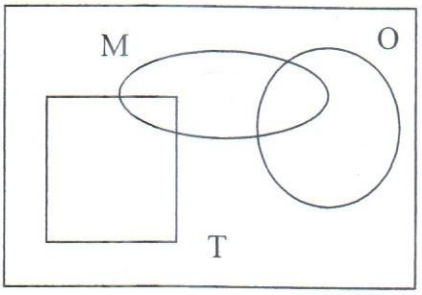
1. a) A pizza at Pizza Hut is either Regular (R) or Tuscan (T). In addition, each slice may have mushrooms (M) or onions (O) as described by the Venn diagram shown below. For the sets specified below, shade the corresponding region of the Venn diagram. 07

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



b) What are the axioms of probability? Explain the terms conditional probability, Bayes' theorem and laws of total probability. 08

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

2. a) What are PMF, PDF and CDF? Show that the expected value of Geometric random variable is $E[X] = 1/p$. 13

b) Let X have the binomial PMF 12

$$P_X(X) = \binom{5}{x} (1/2)^5.$$

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?

3. a) Explain the families of a discrete random variable X. Include PMF of X, E[X] and Var[X] in your answer. 13

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

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

4. a) What is standard normal distribution? Explain how a general Gaussian distribution is converted to a standard normal distribution. 13

b) 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 $E[e^X]$?

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

b) Determine which, if any, of the following functions have the properties of power spectral density functions. Justify your determination. 12

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

6. 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?

7. 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. 13

   b) Describe the basic steps in the demodulation/detection of digital signals. Also draw the block diagram of a noncoherent detection of 4 PSK signal. 12

8. a) Why do BPSK and QPSK manifest the same bit error probability relationship? Explain the demodulator for non-coherent detection of 3 FSK. 13

   b) Explain bit error probability versus symbol error probability for multiple phase signaling and orthogonal signaling. 12

Appendix : Table for Q(x)

x	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0000	.5000	.4960	.4920	.4880	.4840	.4801	.4761	.4721	.4681	.4641
.1000	.4602	.4562	.4522	.4483	.4443	.4404	.4364	.4325	.4286	.4247
.2000	.4207	.4168	.4129	.4090	.4052	.4013	.3974	.3936	.3897	.3859
.3000	.3821	.3783	.3745	.3707	.3669	.3632	.3594	.3557	.3520	.3483
.4000	.3446	.3409	.3372	.3336	.3300	.3264	.3228	.3192	.3156	.3121
.5000	.3085	.3050	.3015	.2981	.2946	.2912	.2877	.2843	.2810	.2776
.6000	.2743	.2709	.2676	.2643	.2611	.2578	.2546	.2514	.2483	.2451
.7000	.2420	.2389	.2358	.2327	.2296	.2266	.2236	.2206	.2177	.2148
.8000	.2119	.2090	.2061	.2033	.2005	.1977	.1949	.1922	.1894	.1867
.9000	.1841	.1814	.1788	.1762	.1736	.1711	.1685	.1660	.1635	.1611
1.000	.1587	.1562	.1539	.1515	.1492	.1469	.1446	.1423	.1401	.1379
1.100	.1357	.1335	.1314	.1292	.1271	.1251	.1230	.1210	.1190	.1170
1.200	.1151	.1131	.1112	.1093	.1075	.1056	.1038	.1020	.1003	.9853E-01
1.300	.9680E-01	.9510E-01	.9342E-01	.9176E-01	.9012E-01	.8851E-01	.8691E-01	.8534E-01	.8379E-01	.8226E-01
1.400	.8076E-01	.7927E-01	.7780E-01	.7636E-01	.7493E-01	.7353E-01	.7215E-01	.7078E-01	.6944E-01	.6811E-01
1.500	.6681E-01	.6552E-01	.6426E-01	.6301E-01	.6178E-01	.6057E-01	.5938E-01	.5821E-01	.5705E-01	.5592E-01
1.600	.5480E-01	.5370E-01	.5262E-01	.5155E-01	.5050E-01	.4947E-01	.4846E-01	.4746E-01	.4648E-01	.4551E-01
1.700	.4457E-01	.4363E-01	.4272E-01	.4182E-01	.4093E-01	.4006E-01	.3920E-01	.3836E-01	.3754E-01	.3673E-01
1.800	.3593E-01	.3515E-01	.3438E-01	.3362E-01	.3288E-01	.3216E-01	.3144E-01	.3074E-01	.3005E-01	.2938E-01
1.900	.2872E-01	.2807E-01	.2743E-01	.2680E-01	.2619E-01	.2559E-01	.2500E-01	.2442E-01	.2385E-01	.2330E-01
2.000	.2275E-01	.2222E-01	.2169E-01	.2118E-01	.2068E-01	.2018E-01	.1970E-01	.1923E-01	.1876E-01	.1831E-01
2.100	.1786E-01	.1743E-01	.1700E-01	.1659E-01	.1618E-01	.1578E-01	.1539E-01	.1500E-01	.1463E-01	.1426E-01
2.200	.1390E-01	.1355E-01	.1321E-01	.1287E-01	.1255E-01	.1222E-01	.1191E-01	.1160E-01	.1130E-01	.1101E-01
2.300	.1072E-01	.1044E-01	.1017E-01	.9903E-02	.9642E-02	.9387E-02	.9137E-02	.8894E-02	.8656E-02	.8424E-02
2.400	.8198E-02	.7976E-02	.7760E-02	.7549E-02	.7344E-02	.7143E-02	.6947E-02	.6756E-02	.6569E-02	.6387E-02
2.500	.6210E-02	.6037E-02	.5868E-02	.5703E-02	.5543E-02	.5386E-02	.5234E-02	.5085E-02	.4940E-02	.4799E-02
2.600	.4661E-02	.4527E-02	.4396E-02	.4269E-02	.4145E-02	.4025E-02	.3907E-02	.3793E-02	.3681E-02	.3573E-02
2.700	.3467E-02	.3364E-02	.3264E-02	.3167E-02	.3072E-02	.2980E-02	.2890E-02	.2803E-02	.2718E-02	.2635E-02
2.800	.2555E-02	.2477E-02	.2401E-02	.2327E-02	.2256E-02	.2186E-02	.2118E-02	.2052E-02	.1988E-02	.1926E-02
2.900	.1866E-02	.1807E-02	.1750E-02	.1695E-02	.1641E-02	.1589E-02	.1538E-02	.1489E-02	.1441E-02	.1395E-02
3.000	.1350E-02	.1306E-02	.1264E-02	.1223E-02	.1183E-02	.1144E-02	.1107E-02	.1070E-02	.1035E-02	.1001E-02
3.100	.9676E-03	.9354E-03	.9043E-03	.8740E-03	.8447E-03	.8164E-03	.7888E-03	.7622E-03	.7364E-03	.7114E-03
3.200	.6871E-03	.6637E-03	.6410E-03	.6190E-03	.5976E-03	.5770E-03	.5571E-03	.5377E-03	.5190E-03	.5009E-03
3.300	.4834E-03	.4665E-03	.4501E-03	.4342E-03	.4189E-03	.4041E-03	.3897E-03	.3758E-03	.3624E-03	.3495E-03
3.400	.3369E-03	.3248E-03	.3131E-03	.3018E-03	.2909E-03	.2802E-03	.2701E-03	.2602E-03	.2507E-03	.2415E-03
3.500	.2326E-03	.2241E-03	.2158E-03	.2078E-03	.2001E-03	.1926E-03	.1854E-03	.1785E-03	.1718E-03	.1653E-03
3.600	.1591E-03	.1531E-03	.1473E-03	.1417E-03	.1363E-03	.1311E-03	.1261E-03	.1213E-03	.1166E-03	.1121E-03
3.700	.1078E-03	.1036E-03	.9961E-04	.9574E-04	.9201E-04	.8842E-04	.8496E-04	.8162E-04	.7841E-04	.7532E-04
3.800	.7235E-04	.6948E-04	.6673E-04	.6407E-04	.6152E-04	.5906E-04	.5669E-04	.5442E-04	.5223E-04	.5012E-04
3.900	.4810E-04	.4615E-04	.4427E-04	.4247E-04	.4074E-04	.3908E-04	.3747E-04	.3594E-04	.3446E-04	.3304E-04
4.000	.3167E-04	.3036E-04	.2910E-04	.2789E-04	.2673E-04	.2561E-04	.2454E-04	.2351E-04	.2252E-04	.2157E-04
4.100	.2066E-04	.1978E-04	.1894E-04	.1814E-04	.1737E-04	.1662E-04	.1591E-04	.1523E-04	.1458E-04	.1395E-04
4.200	.1335E-04	.1277E-04	.1222E-04	.1168E-04	.1118E-04	.1069E-04	.1022E-04	.9774E-05	.9345E-05	.8934E 05
4.300	.8540E-05	.8163E-05	.7801E-05	.7455E-05	.7124E-05	.8807E-05	.6503E-05	.6212E-05	.5934E-05	.5668E-05
4.400	.5413E-05	.5169E-05	.4935E-05	.4712E-05	.4498E-05	.4294E-05	.4098E-05	.3911E-05	.3732E-05	.3561E-05
4.500	.3398E-05	.3241E-05	.3092E-05	.2949E-05	.2813E-05	.2682E-05	.2558E-05	.2439E-05	.2325E-05	.2216E-05
4.600	.2112E-05	.2013E-05	.1919E-05	.1828E-05	.1742E-05	.1660E-05	.1581E-05	.1506E-05	.1434E-05	.1366E-05
4.700	.1301E-05	.1239E-05	.1179E-05	.1123E-05	.1069E-05	.1017E-05	.9680E-06	.9211E-06	.8765E-06	.8339E-06
4.800	.7933E-06	.7547E-06	.7178E-06	.6827E-06	.6492E-06	.6173E-06	.5869E-06	.5580E-06	.5304E-06	.5042E-06
4.900	.4792E-06	.4554E-06	.4327E-06	.4111E-06	.3906E-06	.3711E-06	.3525E-06	.3448E-06	.3179E-06	.3019E-06
5.000	.2867E-06	.2722E-06	.2584E-06	.2452E-06	.2328E-06	.2209E-06	.2096E-06	.1989E-06	.1887E-06	.1790E-06
5.100	.1698E-06	.1611E-06	.1528E-06	.1449E-06	.1374E-06	.1302E-06	.1235E-06	.1170E-06	.1109E-06	.1051E-06

M.Sc. Engg. (EE) / Ph.D. (EE) 218 Date : June 01, 2018

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination — Winter Semester, A.Y. 2017-2018
Course No.: EEE 6401 — Time: 3 Hours
Course Title: Optical Fiber Communication — Full Marks: 150

There are **8 (eight)** questions. Answer **any 6 (six)** questions. All questions carry equal marks. Marks for each part of the questions are indicated on the right margin. Symbols have their usual meanings. Programmable calculators are not allowed. Do not write on this question paper.

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1. a) What are the advantages of optical fiber as a medium for information transmission compared to electrical systems based on co-axial cables? Using suitable figures show how time division multiplexing (TDM) is implemented in a digital communication system having three channels. Use non-return-to-zero (NRZ) format. 6+7

   b) Using geometrical optics, explain why graded-index fibers offer larger numerical aperture and less dispersion than step-index fibers. Explain intermodal dispersion in step/graded-index fiber in terms of mode theory. 8+4

2. a) What is fiber birefringence? Briefly describe polarization mode dispersion (PMD) in single mode fiber (SMF). What is confinement factor? 3+3+3

   b) How is it possible to obtain minimum dispersion at minimum attenuation (loss) wavelength in SMF? Explain using suitable figure. 6

   c) What is Beer's law? How does extrinsic absorption loss arise in optical fiber due to water vapour and at which wavelengths does it occur? What is Mie scattering? 2+6+2

3. a) What is Stimulated Raman Scattering (SRS)? Explain clearly how this mechanism becomes stimulated. What is four-wave mixing (FWM)? 8+5

   b) Explain self-phase modulation and cross-phase modulation. Using equations, show how cross-phase modulation is more dominant than self-phase modulation. 8+4

4. a) What are the advantages of semiconductor laser optical source over other types of sources? Describe the basic working principle of a semiconductor laser. 6+7

   b) What is the limitation of using direct optical modulation? Describe electroabsorption modulator and Mach-Zehnder (MZ) interferometer based external modulator with suitable diagrams. 2+10

5. a) What are the requirements of a good semiconductor photodetector? With appropriate mathematical equations explain why there has to be a trade-off between responsivity and bandwidth of a photodetector. 6+7

   b) Describe p-i-n photodiodes and avalanche photodiodes. What is meant by receiver sensitivity? Mention three factors that degrade receiver sensitivity. 6+3+3

6. a) Describe the point-to-point link and local area network used in fiber optic communication system. 4+9

   b) With necessary equations discuss the basic principle of optical amplifiers. What is amplifier noise figure, F_n and what are the factors that affect F_n? 8+2+2

7. a) What are the applications of optical amplifiers? Give description of Erbium doped fiber amplifier with necessary figure. 6+7

   b) What are the advantages and disadvantages of semiconductor optical amplifier (SOA)? Which nonlinear effect is used in Raman amplifier and how? 8+4

8. a) What are the advantages of coherent lightwave systems? Using appropriate figures and equations discuss the basic concept of coherent detection. Using equations of currents, show how homodyne detection is better than direct detection. 4+5+4

   b) Why is it difficult to implement homodyne detection? Explain how PSK and FSK can be implemented in optical communication systems. 4+8

M.Sc. Engg. (EE) / PhD (EE) 220 Date: May 24, 2018 (Morning)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination — Winter Semester, A. Y. 2017-2018
Course No.: EEE 6407 — Time: 3 Hours
Course Title: Digital Communication — Full Marks: 150

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

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1. a) Write the properties of autocorrelation of an energy signal and a power signal. Explain the bandwidth of different data in different perspective. 15

   b) Determine which, if any, of the following functions have the properties of power spectral density functions. Justify your determination. 10
   i) $X(f) = \delta(f) + \cos^2 2\pi f$
   ii) $X(f) = 10 + \delta(f - 10)$
   iii) $X(f) = \exp(-2\pi|f - 10|)$
   iv) $X(f) = \exp[-2\pi(f^2 - 10)]$

2. a) What is correlative coding? Explain Duobinary Coding and Decoding with a demonstration. Also explain precoding with an Illustration. 13

   b) 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. 12

3. 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) 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 $\varphi_1 = \varphi_2 + \frac{\pi}{2}$.

4. 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

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

b) A system using matched filter detection of equally likely BPSK signals, $s_1(t) = \sqrt{\frac{2E}{T}} cosw_0t$ and $s_2(t) = \sqrt{\frac{2E}{T}} cos(w_0t + \pi)$, operates in AWGN with a received E_b/N_0 of 6.8 dB. Assume that $E\{z(T)\} = \pm\sqrt{E}$. 10

i) Find the minimum probability or bit error, P_B , for this signal set and E_b/N_0.

ii) If the decision threshold is $\gamma = 0.1\sqrt{E}$, find P_B .

6. a) What are the tradeoffs using error correction coding? Explain them in detail. Also explain rectangular code. 15

b) Compare the message error probability for a communication link with and without the use of error-correction coding. Assume that the uncoded transmission characteristics are: BPSK modulation, Gaussian noise, $\frac{P_r}{N_0} = 43.776$, data rate $R = 4800$ bits/s. For the coded case, also assume the use of a (15, 11) error-correcting code that is capable of correcting any single-error pattern within a block of 15 bits. Consider that the demodulator makes hard decisions and thus feeds the demodulated code bits directly to the decoder, which in turn outputs an estimate of the original message. 10

7. a) What is a standard array? How can a vector space be represented by a standard array? Describe the process for error correction decoding using a (6, 3) code. Use the parity check matrix $H = \begin{bmatrix} 1 & 0 & 0 & 1 & 0 & 1 \\ 0 & 1 & 0 & 1 & 1 & 0 \\ 0 & 0 & 1 & 0 & 1 & 1 \end{bmatrix}$. 15

b) Draw and explain the implementation of a (6, 3) decoder using simple circuitry. 10

8. a) Explain Hamming codes, Extended Golay code and BCH codes. 15

b) Consider a hamming code with m = 3. The generator matrix of this hamming code is given below. 10

$$G = \begin{bmatrix} 1 & 1 & 1 & 1 & 0 & 0 & 0 \\ 1 & 0 & 1 & 0 & 1 & 0 & 0 \\ 0 & 1 & 1 & 0 & 0 & 1 & 0 \\ 1 & 1 & 0 & 0 & 0 & 0 & 1 \end{bmatrix}$$

i) Find all the codewords of the code.

ii) Find H, the parity-check matrix of the code.

iii) Compute the syndrome for the received vector 1 1 0 1 1 0 1. Is this a valid code vector?

iv) What is the error-correcting capability of the code?

v) What is the error-detecting capability of the code?

Appendix : Table for Q(x)

x	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0000	.5000	.4960	.4920	.4880	.4840	.4801	.4761	.4721	.4681	.4641
.1000	.4602	.4562	.4522	.4483	.4443	.4404	.4364	.4325	.4286	.4247
.2000	.4207	.4168	.4129	.4090	.4052	.4013	.3974	.3936	.3897	.3859
.3000	.3821	.3783	.3745	.3707	.3669	.3632	.3594	.3557	.3520	.3483
.4000	.3446	.3409	.3372	.3336	.3300	.3264	.3228	.3192	.3156	.3121
.5000	.3085	.3050	.3015	.2981	.2946	.2912	.2877	.2843	.2810	.2776
.6000	.2743	.2709	.2676	.2643	.2611	.2578	.2546	.2514	.2483	.2451
.7000	.2420	.2389	.2358	.2327	.2296	.2266	.2236	.2206	.2177	.2148
.8000	.2119	.2090	.2061	.2033	.2005	.1977	.1949	.1922	.1894	.1867
.9000	.1841	.1814	.1788	.1762	.1736	.1711	.1685	.1660	.1635	.1611
1.000	.1587	.1562	.1539	.1515	.1492	.1469	.1446	.1423	.1401	.1379
1.100	.1357	.1335	.1314	.1292	.1271	.1251	.1230	.1210	.1190	.1170
1.200	.1151	.1131	.1112	.1093	.1075	.1056	.1038	.1020	.1003	.9853E-01
1.300	.9680E-01	.9510E-01	.9342E-01	.9176E-01	.9012E-01	.8851E-01	.8691E-01	.8534E-01	.8379E-01	.8226E-01
1.400	.8076E-01	.7927E-01	.7780E-01	.7636E-01	.7493E-01	.7353E-01	.7215E-01	.7078E-01	.6944E-01	.6811E-01
1.500	.6681E-01	.6552E-01	.6426E-01	.6301E-01	.6178E-01	.6057E-01	.5938E-01	.5821E-01	.5705E-01	.5592E-01
1.600	.5480E-01	.5370E-01	.5262E-01	.5155E-01	.5050E-01	.4947E-01	.4846E-01	.4746E-01	.4648E-01	.4551E-01
1.700	.4457E-01	.4363E-01	.4272E-01	.4182E-01	.4093E-01	.4006E-01	.3920E-01	.3836E-01	.3754E-01	.3673E-01
1.800	.3593E-01	.3515E-01	.3438E-01	.3362E-01	.3288E-01	.3216E-01	.3144E-01	.3074E-01	.3005E-01	.2938E-01
1.900	.2872E-01	.2807E-01	.2743E-01	.2680E-01	.2619E-01	.2559E-01	.2500E-01	.2442E-01	.2385E-01	.2330E-01
2.000	.2275E-01	.2222E-01	.2169E-01	.2118E-01	.2068E-01	.2018E-01	.1970E-01	.1923E-01	.1876E-01	.1831E-01
2.100	.1786E-01	.1743E-01	.1700E-01	.1659E-01	.1618E-01	.1578E-01	.1539E-01	.1500E-01	.1463E-01	.1426E-01
2.200	.1390E-01	.1355E-01	.1321E-01	.1287E-01	.1255E-01	.1222E-01	.1191E-01	.1160E-01	.1130E-01	.1101E-01
2.300	.1072E-01	.1044E-01	.1017E-01	.9903E-02	.9642E-02	.9387E-02	.9137E-02	.8894E-02	.8656E-02	.8424E-02
2.400	.8198E-02	.7976E-02	.7760E-02	.7549E-02	.7344E-02	.7143E-02	.6947E-02	.6756E-02	.6569E-02	.6387E-02
2.500	.6210E-02	.6037E-02	.5868E-02	.5703E-02	.5543E-02	.5386E-02	.5234E-02	.5085E-02	.4940E-02	.4799E-02
2.600	.4661E-02	.4527E-02	.4396E-02	.4269E-02	.4145E-02	.4025E-02	.3907E-02	.3793E-02	.3681E-02	.3573E-02
2.700	.3467E-02	.3364E-02	.3264E-02	.3167E-02	.3072E-02	.2980E-02	.2890E-02	.2803E-02	.2718E-02	.2635E-02
2.800	.2555E-02	.2477E-02	.2401E-02	.2327E-02	.2256E-02	.2186E-02	.2118E-02	.2052E-02	.1988E-02	.1926E-02
2.900	.1866E-02	.1807E-02	.1750E-02	.1695E-02	.1641E-02	.1589E-02	.1538E-02	.1489E-02	.1441E-02	.1395E-02
3.000	.1350E-02	.1306E-02	.1264E-02	.1223E-02	.1183E-02	.1144E-02	.1107E-02	.1070E-02	.1035E-02	.1001E-02
3.100	.9676E-03	.9354E-03	.9043E-03	.8740E-03	.8447E-03	.8164E-03	.7888E-03	.7622E-03	.7364E-03	.7114E-03
3.200	.6871E-03	.6637E-03	.6410E-03	.6190E-03	.5976E-03	.5770E-03	.5571E-03	.5377E-03	.5190E-03	.5009E-03
3.300	.4834E-03	.4665E-03	.4501E-03	.4342E-03	.4189E-03	.4041E-03	.3897E-03	.3758E-03	.3624E-03	.3495E-03
3.400	.3369E-03	.3248E-03	.3131E-03	.3018E-03	.2909E-03	.2802E-03	.2701E-03	.2602E-03	.2507E-03	.2415E-03
3.500	.2326E-03	.2241E-03	.2158E-03	.2078E-03	.2001E-03	.1926E-03	.1854E-03	.1785E-03	.1718E-03	.1653E-03
3.600	.1591E-03	.1531E-03	.1473E-03	.1417E-03	.1363E-03	.1311E-03	.1261E-03	.1213E-03	.1166E-03	.1121E-03
3.700	.1078E-03	.1036E-03	.9961E-04	.9574E-04	.9201E-04	.8842E-04	.8496E-04	.8162E-04	.7841E-04	.7532E-04
3.800	.7235E-04	.6948E-04	.6673E-04	.6407E-04	.6152E-04	.5906E-04	.5669E-04	.5442E-04	.5223E-04	.5012E-04
3.900	.4810E-04	.4615E-04	.4427E-04	.4247E-04	.4074E-04	.3908E-04	.3747E-04	.3594E-04	.3446E-04	.3304E-04
4.000	.3167E-04	.3036E-04	.2910E-04	.2789E-04	.2673E-04	.2561E-04	.2454E-04	.2351E-04	.2252E-04	.2157E-04
4.100	.2066E-04	.1978E-04	.1894E-04	.1814E-04	.1737E-04	.1662E-04	.1591E-04	.1523E-04	.1458E-04	.1395E-04
4.200	.1335E-04	.1277E-04	.1222E-04	.1168E-04	.1118E-04	.1069E-04	.1022E-04	.9774E-05	.9345E-05	.8934E 05
4.300	.8540E-05	.8163E-05	.7801E-05	.7455E-05	.7124E-05	.8807E-05	.6503E-05	.6212E-05	.5934E-05	.5668E-05
4.400	.5413E-05	.5169E-05	.4935E-05	.4712E-05	.4498E-05	.4294E-05	.4098E-05	.3911E-05	.3732E-05	.3561E-05
4.500	.3398E-05	.3241E-05	.3092E-05	.2949E-05	.2813E-05	.2682E-05	.2558E-05	.2439E-05	.2325E-05	.2216E-05
4.600	.2112E-05	.2013E-05	.1919E-05	.1828E-05	.1742E-05	.1660E-05	.1581E-05	.1506E-05	.1434E-05	.1366E-05
4.700	.1301E-05	.1239E-05	.1179E-05	.1123E-05	.1069E-05	.1017E-05	.9680E-06	.9211E-06	.8765E-06	.8339E-06
4.800	.7933E-06	.7547E-06	.7178E-06	.6827E-06	.6492E-06	.6173E-06	.5869E-06	.5580E-06	.5304E-06	.5042E-06
4.900	.4792E-06	.4554E-06	.4327E-06	.4111E-06	.3906E-06	.3711E-06	.3525E-06	.3448E-06	.3179E-06	.3019E-06
5.000	.2867E-06	.2722E-06	.2584E-06	.2452E-06	.2328E-06	.2209E-06	.2096E-06	.1989E-06	.1887E-06	.1790E-06
5.100	.1698E-06	.1611E-06	.1528E-06	.1449E-06	.1374E-06	.1302E-06	.1235E-06	.1170E-06	.1109E-06	.1051E-06

M.Sc. Engg.(EE) / Ph.D. (EE) 223 Date: 28 May, 2018 (Morning)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination — Winter 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) 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.

2. 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

3. a) Write the name of layers of OSI model and briefly explain the responsible job done by each layer and how they contribute to the whole network. 9

   b) What is the basic difference between OSI model and TCP/IP model? Briefly explain by comparing the layers of both models in suitable tabular forms. 9

   c) How long does it take for a packet of length 1,000 bytes to propagate over a link of distance 2,500 km with propagation speed 2.5×10^8 m/s and transmission rate 2 Mbps? More generally, how long does it take for a packet of length L to propagate over a link of distance d, propagation speed s and transmission rate R bps? Does this delay depend on packet length? Does this delay depend on transmission rate? 7

4. a) What is Wireless Sensor Networks (WSN)? 18
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:
   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 and
   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) What is Delay Tolerant Networks (DTN)? What are the limitations associated with 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 and
   ii) Underwater communication.

6. a) What do you understand by Ad-hoc networking? 6
Why is such networking required when there are standard networks?
What is self-organize characteristics in Ad-hoc networks?

   b) What is vehicular Ad-hoc networking (VANET)? 13
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.

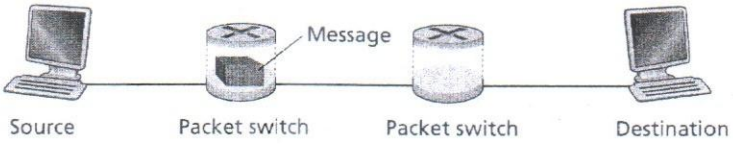
   c) Suppose Host A wants to send a large file to Host B. The path from Host A to Host B has three links of rates $R_1 = 500$ kbps, $R_2 = 2$ Mbps and $R_3 = 1$ Mbps. 6
   i) Assuming no other traffic in the network, what is the throughput for the file transfer?
   ii) Suppose the file is 4 million bytes. Dividing the file size by the throughput, roughly how long will it take to transfer the file to Host B?
   iii) Repeat (i) and (ii), but now with R_2 reduced to 100 kbps.

7. a) A network designer designs the network depending on the coverage area and transmission range. 12
What are the design goals and different design choices for Wireless LAN (WLAN)?
How does a network designer define and differentiate Wireless PAN (WPAN), Wireless LAN (WLAN), Wireless MAN (WMAN) and Wireless WAN (WWAN)?

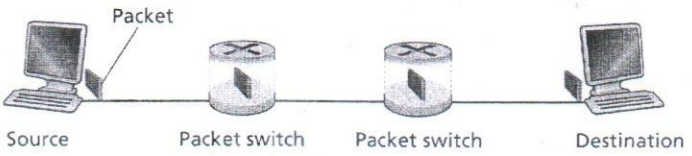
b) In modern packet-switched networks, including the Internet, following the message segmentation mechanism the source host segments long, application-layer messages (for example, an image or a music file) into smaller packets and sends the packets into the network. The receiver then reassembles the packets back into the original message. Figure 7. (b) illustrates the end-to-end transport of a message with and without message segmentation. Consider a message that is 8×10^6 bits long is to be sent from source to destination. Suppose each link in the figure is 2 Mbps. Ignore propagation, queuing, and processing delays. 13

i) Consider sending the message from source to destination *without* message segmentation. How long does it take to move the message from the source host to the first packet switch? Keeping in mind that each switch uses store-and-forward packet switching, what is the total time to move the message from source host to destination host?

ii) Now suppose that the message is segmented into 800 packets, with each packet being 10,000 bits long. How long does it take to move the first packet from source host to the first switch? When the first packet is being sent from the first switch to the second switch, the second packet is being sent from the source host to the first switch. At what time will the second packet be fully received at the first switch? How long does it take to move the file from source host to destination host when message segmentation is used? Compare this result with your answer in part (i) and comment.



End-to-end message transport: without message segmentation



End-to-end message transport: with message segmentation

Figure 7. (b)

8. 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.

M.Sc. Engg.(EE)/PhD 226 Date: May 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 6607
Course Title: Computational Electromagnetics

Winter 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) How are Electromagnetic(EM) problems classified from mathematical point of view? What are the common types of boundary conditions need to be adopted in solving EM problems both analytically and numerically? 12

   b) Illustrate the method of separation of variables in solving the scalar homogeneous wave equation defined as, 13

$$\nabla^2 E - \frac{1}{c^2}\frac{\partial^2 E}{\partial t^2} = 0 .$$

   Where $E(x, y, z, t)$ is a component of 3-D electric field propagating in free space with velocity c.

2. a) Derive the explicit type finite difference(FD) scheme for an elliptic type EM problem with Dirichlet boundary conditions. 10

   b) The potential at boundaries of a 2-D square region is shown in Fig. 2(b). Find the potentials at the interior nodes numerically. 15

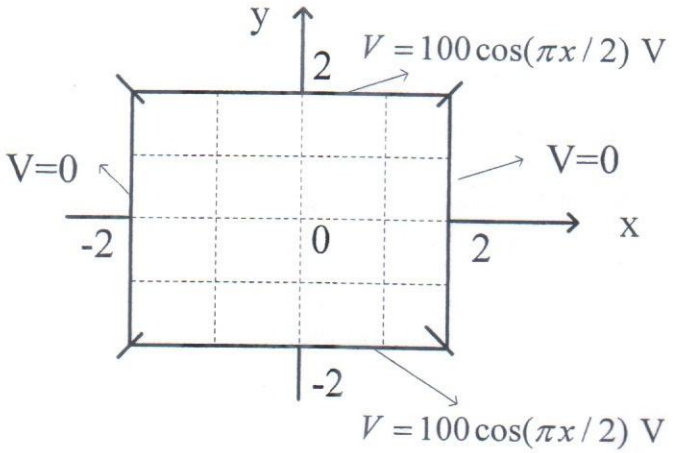

Fig. 2(b).

3. a) Discuss how does step size affect the solution of parabolic and hyperbolic type EM problems using explicit type FD algorithms. 10

b) Solve the parabolic EM problem defined by the PDE; 15

$$\frac{\partial^2 E}{\partial x^2} = \frac{\partial E}{dt}, \quad 0 \le x \le 2,$$

Using explicit FD scheme subject to the boundary condition $E(0,t) = 0 = E(2,t)$, t>0 and initial condition $E(x,0) = \sin\left(\frac{\pi}{2}x\right)$. Use $\Delta x = 0.25$ *and* $r = \frac{\Delta t}{(\Delta x)^2} = 0.5$.

4. Using forward-time centered space method the FD scheme of an EM problem- 12+13

$$\frac{\partial E}{\partial t} + v_p \frac{\partial E}{dx} = 0$$

can be written as,

$$\frac{E_i^{n+1} - E_i^n}{\Delta t} + v_p \frac{E_{i+1}^n - E_{i-1}^n}{2\Delta x} = 0$$

or equivalently

$$E_i^{n+1} = E_i^n - \left(\frac{v_p \Delta t}{2\Delta x}\right)\left[E_{i+1}^n - E_{i-1}^n\right].$$

Show by von Neumann stability analysis that the above scheme is always numerically unstable.

A minor modification of the scheme by replacing E_i^n with a spatial average;

$$E_i^n = \frac{E_{i+1}^n + E_{i-1}^n}{2}$$

suggested by Lax makes the scheme stable. Justify it.

5. a) Give a general description of the method of weighted residual as applied to EM problem. 10

b) Solve the EM boundary value problem $-\frac{d^2\phi}{dx^2} + 0.1\frac{d\phi}{dx} = 1$, $0 \le x \le 10$ with boundary conditions $\phi'(0)=0= \phi(0)$ using the trial function 15

$$\tilde{\phi}(x) = a_1 \cos\left(\frac{\pi x}{20}\right) + a_2 \cos\left(\frac{3\pi x}{20}\right) + a_3 \cos\left(\frac{5\pi x}{20}\right).$$

Determine the unknown coefficients using collocation method.

6. a) Derive the equation of numerical dispersion (ND) evolves from finite differencing a 1-D scalar wave equation. What is the effect of ND on the solution of wave equation? 10

b) A 1-D wave is propagating along the **x**-direction in free space. Quantify the ND in terms of numerical wavenumber and phase velocity of the wave for the following three cases; 15

(i) $\Delta x \to 0,\ \Delta t \to 0,$

(ii) $c\Delta t = \Delta x$ and

(iii) $\frac{c\Delta t}{\Delta x} = \frac{1}{2}$ and $\frac{\Delta x}{\lambda_0} = \frac{1}{8}$.

Where λ_0, is the free space wavelength of the EM wave and c, is the velocity of EM wave. For the case (ii) above, if the physical wave propagates over a distance of 20 λ_0, what would be the corresponding distance its numerical analog propagate?

7. a) Describe the generalized approach of Method of Moment (MoM) for solving EM problems. 10

b) A portion of a conducting wire of radius 2 mm and length 6 cm is maintained at a potential of 10 V and aligned on the y-axis as shown in Fig. 7(b) below. Using MoM, find the charge densities on the wire. Assume segment size = 2 cm. 15

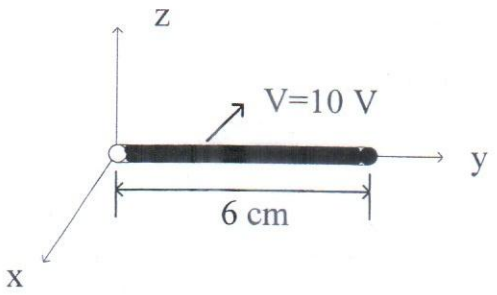

Fig. 7(b)

8. a) The vertex potential and the coordinates of a triangular element which is a part of a particular finite element mesh are tabulated below. Find the potential at (1, 2) and at the center of the element. 12

Vertex	x	y	V
1	2	-1	8
2	1	4	12
3	0	0	10

b) For the two element mesh shown in Fig. 8(b), find the global coefficient matrix. 13

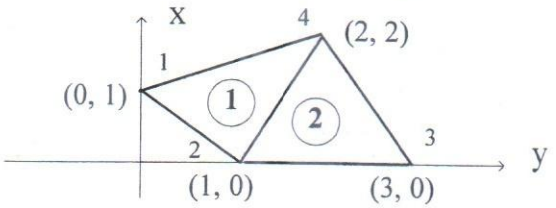

Fig. 8(b)

M.Sc. Engg. (EE) 229 Date: June 05, 2018 (Morning)

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

DEPARTEMNT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination
Course No.: EEE 6801
Course Title: Power Electronics

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

There are **8 questions**. Answer **any 6 questions**. All questions carry equal marks. Programmable calculators are not allowed. Do not write on this question paper.

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1. (a) "As the technology for the power semiconductor devices and integrated circuits develops, the potential for applications of power electronics becomes wider". Justify the statement by giving proper illustrations.

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

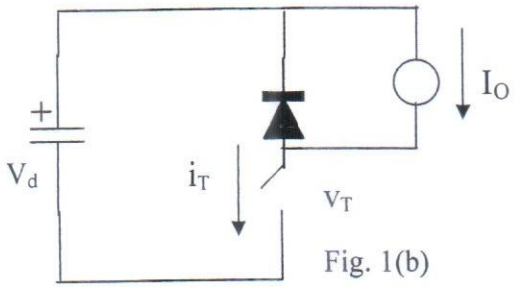

Fig. 1(b)

Considering Fig. 1(b), comment on the switching power loss of the on-state and off-state of the power electronic switch. If the switching power loss increases with the switching frequency, what trade-off do you think to take for efficient switching operation?

(c) List some of the basic characteristics of a controllable switch.

2. (a) The Fig. 2(a) is a diode rectifier with constant dc side voltage. Here the current i_d is zero during zero crossing of the input voltage that i_d is discontinuous. Derive the expression of i_d and use it to find average value of the load current.

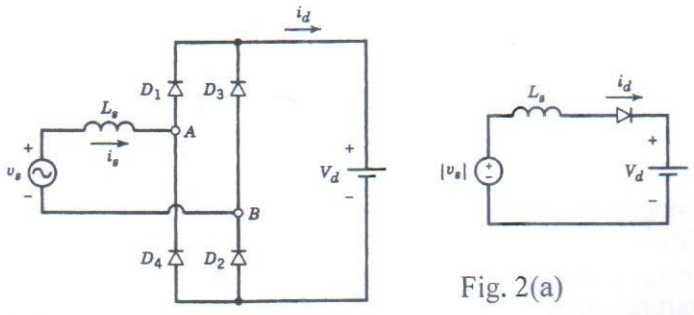

Fig. 2(a)

(b) The rectifier shown in Fig. 2(a) has V_S=120 V at 80 Hz, L_S=1 mH, and V_d= 150 V, draw the waveform of i_d and indicate θ_b, θ_f and $I_{d,\,peak}$ also calculate average value of I_d.

3. (a) (i) Draw a three-phase diode rectifier with the ac side inductance L_S=0 and an L_d is placed between the rectifier and the filter capacitor.
(ii) Derive the minimum value of L_d in terms of V_{LL}, ω and I_d that will result a continuous i_d. Assume v_d is ripple free. The equation of current has been derived using the wave-shapes of voltage and current as shown in Fig. 3(a). The equation of current is:

$$i_d(\theta) = \frac{V_{LL}}{\omega L_d}(\sqrt{2}\sin\theta - 1.35\theta + 0.0129)$$

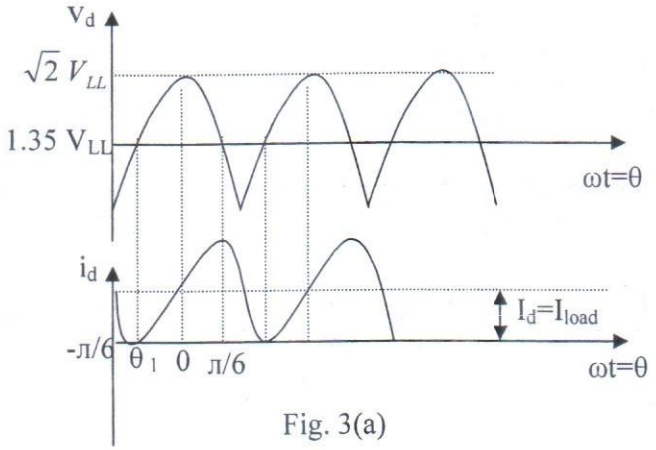

Fig. 3(a)

(b) Describe the current commutation process of a three phase uncontrolled rectifier with finite source inductance and a constant dc current. Derive the expression of the commutation angle and average value of the output voltage. If V_{LL}=208 V, 60 Hz, L_S=2 mH and I_d=5 A, find the value of the average output voltage. Compare the result with single phase bridge rectifier with source inductance and load current of the same amounts.

4. (a) Draw the output voltage and input current wave-shapes of a single phase controlled rectifier for highly inductive load with a source inductance. If the firing angle is 90^0 what will be average value of the output voltage?

(b) For the following converter shown in Fig. 4(b), L_S is 5% with rated voltage of 230 V at 50 Hz and the rated VA of 5 kVA. Calculate the commutation angle u and V_d for the power of 3 kW and $\alpha=30^0$.

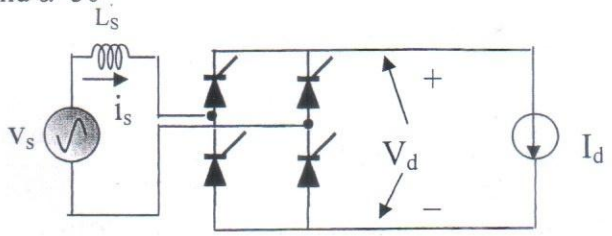

Fig. 4(b)

5. (a) Consider a three phase, half controlled converter whose devices are connected in the following fashion: thyristors T_1, T_2 T_3 are connected to the upper portion of the bridge and diodes D_1, D_2 and D_3 are connected to the lower portion of the bridge. Calculate value of the delay angle α for which $V_d=V_{do}$. Draw the wave-shape of output voltage v_d and identify the devices that conduct various intervals. Obtain DPF, PF and THD in the input current and compare results with a full-bridge coverter operating at V_d=0.5 V_d. Assume L_S=0.

(b) Describe the current commutation process of a three-phase controlled rectifier with a non-zero value of source inductance and constant load current. You can use the Fig. 5(b) for your answer. Derive the expression of commutation angle and average value of output voltage.

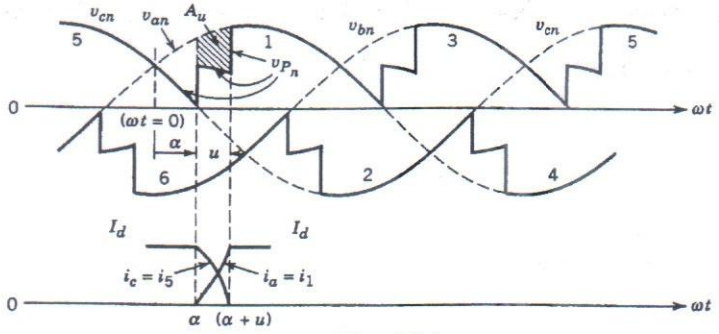

Fig. 5(b)

6. (a) For a buck converter of discontinuous conduction mode, derive the expression of V_o for constant V_d. You may use the Fig. 6(a) for the derivation.

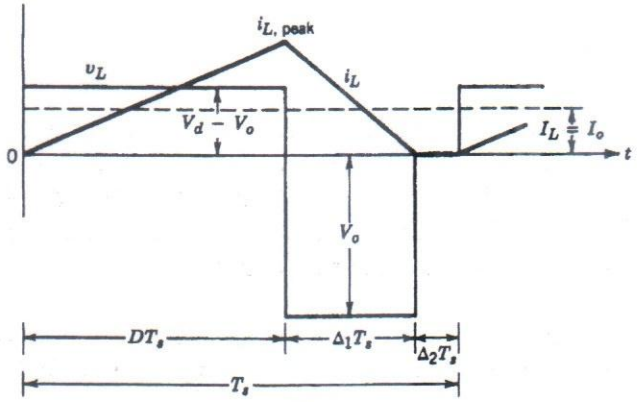

Fig. 6(a)

(b) Calculate duty cycle D for V_o=5 V, f_s=20 kHz, L=1 mH, V_d=12.6 V and I_o=200 mA for the discontinuous conduction of a buck converter with constant V_d.

7. (a) Draw the circuit diagram of a Cuk converter. Explain its operation for both on and off position of the switch.

(b) In a Cuk converter operating at 50 kHz, L_1=L_2=1 mH and C_1=5 μF. The output capacitance is sufficiently large to yield an essentially constant output voltage. Here V_d= 10 V and the output V_o is regulated to be constant at 5 V. It is supplying 5 W to a load. Assume ideal components. Calculate the percentage errors in assuming constant voltage across C_1 or in assuming constant currents i_{L1} and i_{L2}.

8. (a) For a three phase 50 Hz inverter, sketch the gating signals for 120 degree conduction and find the expressions of line to line voltage. If a Y load of R=10 ohm, and L= 10 mH per phase is connected to this inverter, calculate the line currents.

(b) Write down the various advanced modulation techniques used in inverter operations. Explain any method that can be effectively used to reduce the unwanted harmonics at the output of an inverter.