Khulna University of Engineering & Technology

B. Sc. Engineering 2nd year 2nd Term (Regular) Examination, 2016

Department of Electrical and Electronic Engineering

EE 2209

Electronics-II

Time: 3 hours   Full Marks: 210

N.B.: (i) Answer **ANY THREE** questions from each section in separate scripts.

   (ii) Figures in the right margin indicate full marks.

   (iii) Graph paper may be supplied on request.

Section A

Q1. (a) What do you mean by transistor modelling? Clearly differentiate between low-frequency (12) and high-frequency transistor models with suitable example. Draw different transistor configurations and their corresponding hybrid models.

(b) Draw the hybrid π- model at LF and find $r_{bb'}$, r_{ce} and $r_{b'e}$ in terms of h-parameters. (09)

(c) What are f$_T$, f$_B$ and f$_H$ in the analysis of transistor at HF? Show that f$_T$ is actually gain-bandwidth product of an amplifier. (14)

Q2. (a) Deduce the expression of $A_f = \frac{A}{1+AB}$ for negative feed-back amplifier. The symbols have (10) their usual meanings.

(b) Describe the general characteristics of negative feed-back amplifiers. (10)

(c) For the following feedback pair calculate A_{vf}, R'_{of} and R_{if}. (Use typical values of h-parameters) (15)
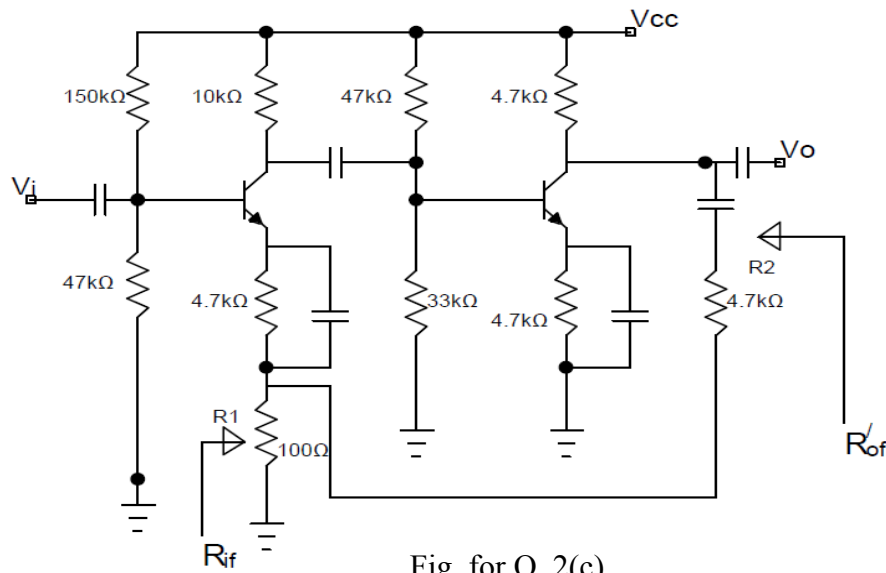

Fig. for Q. 2(c)

Q3. (a) Mention the differences between voltage amplifier and power amplifier. (06)

(b) Classify power amplifiers. Show that the maximum efficiency of class B power amplifier is (11) 78.5%.

(c) Briefly explain the necessity of cascade connection in amplifier design. (08)

(d) For the following PA calculate the circuit efficiency for an input of 12V rms. (10)
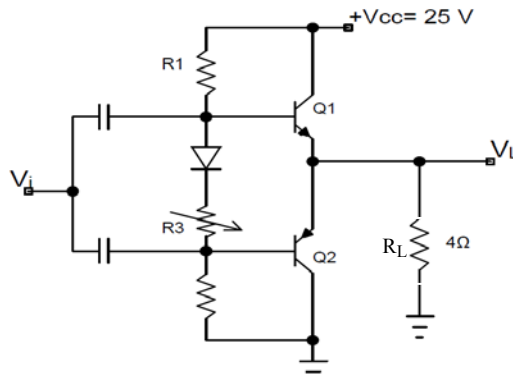

Fig. for Q. 3(d)

Q4. (a) Draw and explain the working principle of a push-pull amplifier. (10)

(b) For the amplifier shown below calculate R_i, R_i', A_v, A_{vs} and $A_1' = -I_2/I_1$. (Use typical h-parameters) (15)
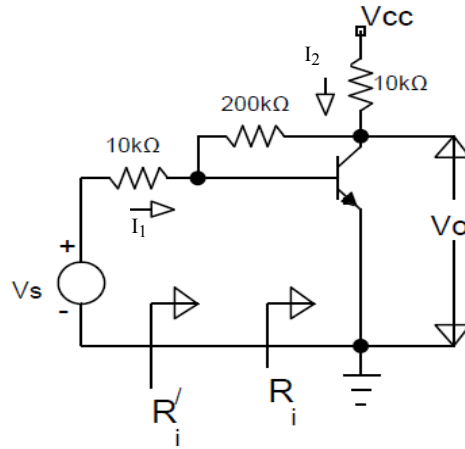

Fig. for Q. 4(b)

(c) Draw a standard R-C couple two stage amplifier having connected load R_L in the second (10)
stage. Draw its hybrid model and mention its effective collector load of Q_1 and Q_2,
respectively.

Section B

Q5. (a) What do you mean by FET? What are the important differences between (10)
    (i) FET and BJT,   (ii) JFET and MOSFET
    (iii) D-MOSFET and E-MOSFET

(b) Explain the construction and operation of a n-channel D-type MOSFET. (10)

(c) Draw and explain a CMOS inverter circuit. (10)

(d) Explain a constant current source circuit constructed using JFET. (05)

Q6. (a) Why FET biasing is essential? Draw different FET biasing circuits and their corresponding (08)
ac equivalent circuit.

(b) "FET is a voltage controlled device." - Explain. (12)

(c) Derive the expression of voltage gain for a source follower configuration. (08)

(d) Show that $g_m = g_{mo}\left[1 - \frac{V_{GS}}{V_p}\right]$, where the symbols have their usual meanings. (07)

Q7. (a) Describe the channel formation mechanism of p-channel E-MOS. (12)

(b) Draw and explain op-amp based integrator and differentiator circuits. (08)

(c) Draw a network using minimum numbers of op-amp that will provide the output of the (15)
equation, $v_0 = 8 \iint v_1 dt^2 + 4\frac{d^2 v_2}{dt^2} - 3\frac{dv_2}{dt} - 9 \int v_1 dt + 2v_1 + 5v_2$

Q8. (a) Define slew rate. Why this rating is important for an op-amp? Derive the expression of (08)
maximum frequency to operate an op-amp.

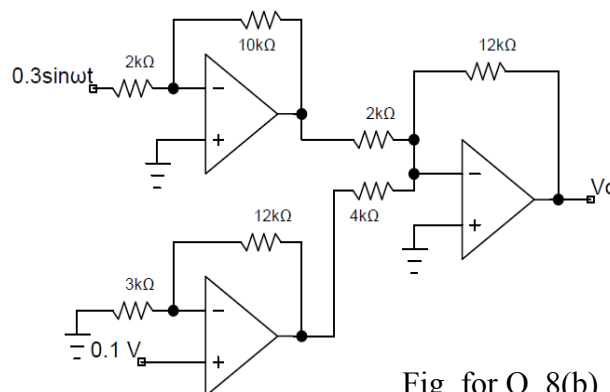(b) Calculate the output voltage for the following circuit: (08)

Fig. for Q. 8(b)

(c) Define active filter. What are the advantages of active filters over passive filters? Design a (14)
band pass filter having cutoff frequencies of 3 MHz and 9 MHz with gain of 5.

(d) Explain a comparator circuit. (05)

Khulna University of Engineering & Technology
B. Sc. Engineering 2nd year 2nd Term (Regular) Examination, 2016
Department of Electrical and Electronic Engineering
EE 2211
Electromagnetic Fields

Time: 3 hours   Full Marks: 210

N.B.: (i) Answer **ANY THREE** questions from each section in separate scripts.
　　　(ii) Figures in the right margin indicate full marks.

Section A

Q1. (a) State and explain Coulomb's law. From the law, define electric field intensity. (08)

(b) Write Gauss's law and prove the law for an arbitrary closed surface. Define (12) homogeneous, isotropic, linear and time invariant materials.

(c) Define electrostatic potential. Deduce the equation for potential at any point in (15) a system of charges. Find potentials around a line charge and between coaxial cylinders.

Q2. (a) Write Gauss's law in vector form showing surface and volume integrals. Prove (10) the law for a round beam of uniform charge density.

(b) Show that if a charge is taken around any closed path, no net work is done. (10) Demonstrate the conservative property with necessary diagrams.

(c) Deduce the equation for potential of a uniform distribution of charge having (08) spherical symmetry.

(d) Define equipotential surface. Prove that the electric field intensity, $\bar{E} = -\nabla\varphi$; (07) where the symbols have their usual meanings.

Q3. (a) Derive boundary conditions in electrostatics. (08)

(b) From Laplace's equation, find potential distributions between co-axial (15) cylinders with two dielectrics.

(c) State Stoke's theorem and demonstrate it. (12)

Q4. (a) What is electric dipole? Define dipole moment and show that the dipole (09) potential decreases with $1/_{r^2}$ rate with increasing distance.

(b) Derive Laplace's and Poisson's Equations. (06)

(c) Deduce the equation for energy of an electrostatic system and using the (10) equation, find the energy stored in a capacitor.

(d) Define vector magnetic potential and find its value using necessary derivations. (10)

Section-B

Q5. (a) State and explain Faraday's law. Show that $\nabla \times \bar{E} = -\frac{\partial \bar{B}}{\partial t}$, where the symbols have their usual meanings. (09)

(b) Determine the displacement current in between two parallel plates of a capacitor energized by an alternating current source. (10)

(c) State Maxwell's equations in differential, integral and time domain form. (06)

(d) How velocity of light can be determined using Maxwell's equations considering light as a wave? Explain mathematically. (10)

Q6. (a) What is time harmonic field? Find the velocity of a uniform plane wave in free space? (12)

(b) Prove that maximum amplitude of magnetic field intensity occurs one-eighth of a cycle later than the maximum amplitude of electric field intensity for a good conductor. (12)

(c) A current $I = 80t$ A be present in the $\overline{a_z}$ direction on the z-axis in free space within interval $-0.1 < z < 0.1$ m. Find $\overline{A_z}$ at P(0,3,0). (11)

Q7. (a) What is linear and circular polarization? Prove that a linear polarized wave can be represented by two circular polarized waves. (13)

(b) Derive the condition for complete reflection and zero reflection for three mediums having different intrinsic impedances. How these conditions can help to design the coating on a camera lens. (12)

(c) A steel pipe is constructed of a material for which $\mu_r = 180$ and $\sigma = 4 \times 10^6$ s/m. The two radii are 5 and 7 mm, and the length is 75 m. If the total current I(t) carried by the pipe is $1.7 \sin \omega t$, where $\omega = 1500\pi$ rad/s, find (i) the skin depth; (ii) the effective resistance and dc resistance. (10)

Q8. (a) Derive the equation of reflection co-efficient and transmission co-efficient for obliquely incident p-polarized uniform plane wave. (15)

(b) Briefly describe the terms i) Maximum Usable Frequency ii) Skip distance iii) Virtual Height. (10)

(c) A uniform plane wave is incident from air onto glass at an angle from the normal of 30^0. Determine the fraction of incident power that is reflected and transmitted for i) p-polarization and ii) s-polarization. Glass has refractive index $n_2 = 1.45$. (10)

Khulna University of Engineering & Technology
B. Sc. Engineering 2nd year 2nd Term (Regular) Examination, 2016
Department of Electrical and Electronic Engineering
EE 2235
Signal and Systems

Time: 3 hours   Full Marks: 210

N.B.: (i) Answer **ANY THREE** questions from each section in separate scripts.
   (ii) Figures in the right margin indicate full marks.

Section A

Q1. (a) Define signal and system with examples.   (08)

(b) Draw the "time shifting", "time scaling", and "time reversal" operations on   (09)
signal.

(c) Determine the impulse response of the following electrical system. Where x(t)   (11)
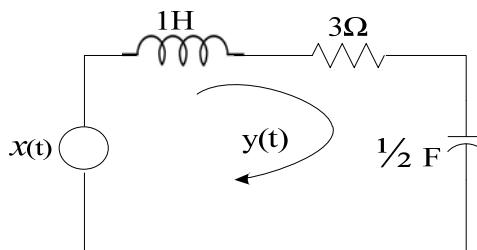and y(t) are input and output, respectively.

Fig. for Q. 1(c)

(d) Show that the system described by the following equation: (07)
$\frac{dy(t)}{dt} + 3y(t) = x(t)$ is linear, where the symbol have their usual meaning.

Q2. (a) Draw a typical instantaneous and dynamic system.   (06)

(b) Determine the derivative of unit step function.   (08)

(c) Determine the zero-input response of the following system: (08)
$\frac{d^2y(t)}{dt^2} + 4\frac{dy(t)}{dt} + 40y = \frac{dx(t)}{dt} + 2$, where, y(t) and x(t) are output and input,
respectively.

(d) What is resonance phenomenon? Show that resonance phenomenon is observed   (13)
when the input signal is identical or very close to characteristic mode of the
system.

Q3. (a) State and explain D'Alembert's principle. State the rules for drawing f-v   (10)
analogous electrical circuits from mechanical system.

(b) Obtain the state-space representation of the following system. Also find the   (10)
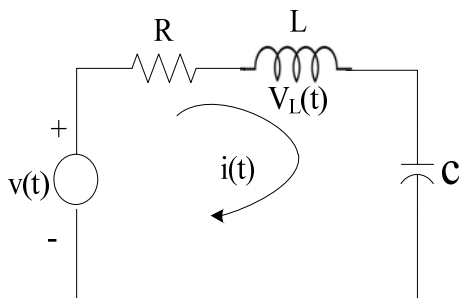transfer function assuming that output is taken from $v_L(t)$.
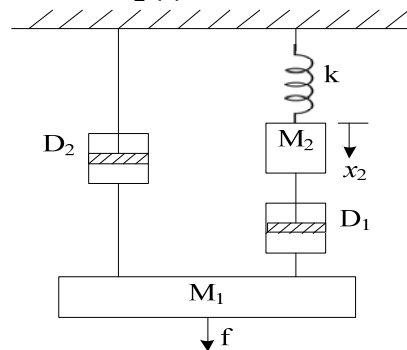

Fig. for Q. 3(b)   Fig. for Q. 3(c)

(c) Draw the f-v and f-i analogous electrical circuits for the mechanical system   (15)
shown in Fig. 3(c) and write down the governing equations in electrical domain.

Q4. (a) Derive the expression of Fourier coefficients for a periodic signal.   (15)

(b) The Fourier coefficients of a periodic signal, x(t) are $a_0=\frac{1}{2}$, $a_n = \frac{2}{n\pi}\sin\left(\frac{n\pi}{2}\right)$, (08) $b_n = 0$. The signal is applied to a R-L-C series circuit. Determine the current of the system.

(c) Find the Fourier transform of a single sinusoidal pulse of amplitude A and (12) duration T. Sketch its relative frequency distribution.

Section B

Q5. (a) Plot the following exponential signals approximately to scale and also find the (20) Laplace transform of each of them. (i) $e^{-2t}v(t)$ (ii) $e^{-2t}v(t-1)$ (iii) $e^{-2(t-1)}v(t)$ (iv) $e^{-2(t-1)}v(t-1)$.

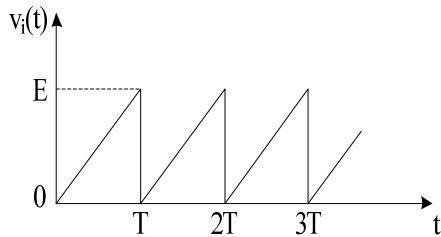(b) Find the Laplace transform of the periodic sawtooth wave shown in Fig. 5(b) (15)
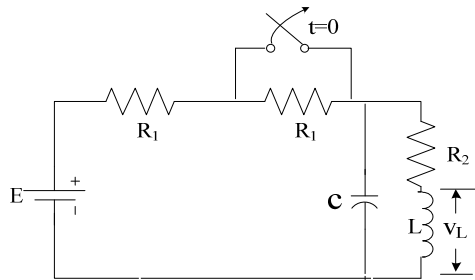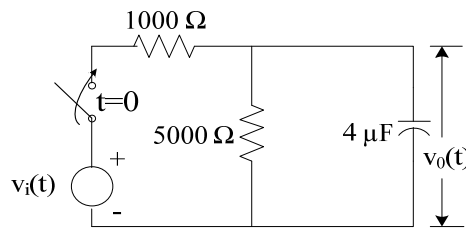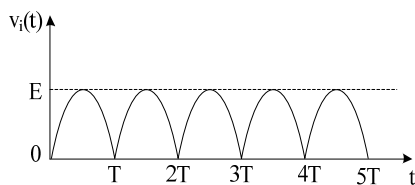

Fig. for Q. 5(b)

Fig. for Q. 6(b)

Q6. (a) Find $L^{-1}[(1 - e^{-Ts})/s(Rcs + 1)]$. (10)

(b) The circuit in Fig. 6(b) is initially under steady-state conditions. The switch is (25) opened at t=0. Find the voltage across the inductance L as a function of t.

Q7. (a) A full-wave rectified voltage is applied to a RC filter as shown in Fig. 7(a). Find (20) the voltage $V_0(t)$. Also determine the steady-state expression for $V_0(t)$.

Figs. for Q. 7(a)

(b) Two capacitors and a resistor are arranged in a circuit as shown in Fig 7(b). C_1 is (15) initially charged to a voltage E volts with polarity as given. The switch is closed at $t = 0$. Determine the current in c_1 as a function of time.

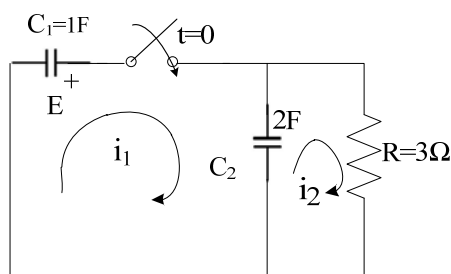Fig. for Q. 7(b)

Q8. (a) Prove that, if $Z[f(t)] = F(z)$, then $Z[f(t - nT)u(t - nT)] = Z^{-n}F(z)$, (07)

(b) Find $Z^{-1}\left[\frac{5Tz}{(z+2)(z-1)^2} - \frac{z}{z+2}\right]$. (10)

(c) Twenty-one 1-Ω resistors are connected to a d-c voltage source of 10 volts in a (18) ladder arrangement, as shown in Fig. 8(c). Determine the current in the last resistor, R_{21}.
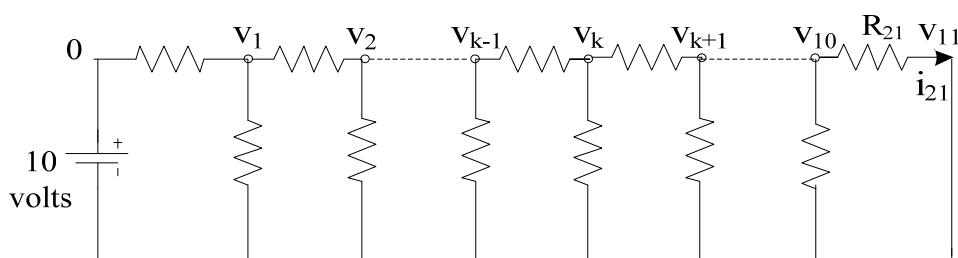

Fig. for Q. 8(c)

Khulna University of Engineering & Technology

B. Sc. Engineering 2nd Year 2nd Term (Regular) Examination, 2016

Department of Electrical and Electronic Engineering

Hum 2217

Professional Ethics and Moral Thoughts

Time: 3 hours   Full Marks: 210

N.B.:   (i) Answer **ANY THREE** questions from each section in separate scripts.

(ii) Figures in the right margin indicate full marks.

Section A

Q1. (a)   What is Ethics? Find out the relationship between 'Ethics' and 'Morality'.   (10)

(b)   Is ethics depends on Psychology? Explain their relationship.   (10)

(c)   Explain the following comment "The highest good is beyond good and evil".   (15)

Q2. (a)   Explain how the nature of will, character and conduct are interrelated?   (10)

(b)   What is egoism? Find out the differences between psychological egoism and ethical egoism.   (15)

(c)   Explain that Ethics is indispensable to religion.   (10)

Q3. (a)   Discuss moral standard in the light of relativism.   (10)

(b)   What is utilitarianism? Critically examine the moral ideal of the 'greatest happiness of the greatest number'.   (15)

(c)   Give your own opinion on the following: (10)

Can one and the same action be both right and wrong either at the same time or at different times?

Q4. (a)   What is professional Ethics? What are the roles of code of Ethics?   (15)

(b)   What are the core ethical values of engineering? Discuss the IEEE code of ethics.   (15)

(c)   Discuss the problem of freedom of will.   (05)

Q5. (a) Define morality. Discuss the principles of morality. What kind of morality (15) is important? Why?

(b) How important is socialization to develop moral thoughts. (20)

Q6. (a) What are the bases of human behavior? (10)

(b) Explain religion as a social institution. (10)

(c) What are the cultural elements that express our Ethical and Moral thoughts? (15)

Q7. (a) What is meant by occupational stress? (10)

(b) What do you mean by moral responsibility and blame? (10)

(c) What do you mean by job satisfaction? (15)

Q8. (a) Explain and justify the statement "This is one's attitude that determines (10) one's altitude".

(b) What is organizational commitment and what are the types of commitment? (15)

(c) Explain Morality in international context. Explain what plays major role in (10) restructuring Japan from world war II to present phase.

Time: 3 hours   Full Marks: 210

N.B.:   (i) Answer **ANY THREE** questions from each section in separate scripts.

(ii) Figures in the right margin indicate full marks.

Section A

Q1. (a)   Determine the set of points in the complex plane which satisfy $1 < |z + i| \le 2$ and represent   (10)
graphically.

(b)   Test the continuity, C–R equations and differentiability of the following function at $z = 0$,   (20)
$f(z) = u + iv = \{(x^3 - 3xy^2) + i(y^3 - 3x^2 y)\}/(x^2 + y^2)$ when $z \ne 0$ and $f(z) = 0$ when
$z = 0$.

(c)   Define analytic function and singular point with example.   (05)

Q2. (a)
Evaluate $\dfrac{1}{2\pi i} \oint_C \dfrac{e^z}{z - 2} dz$ if C is (i) a circle $|z| = 3$, (ii) a circle $|z| = 1$.   (12)

(b)   Define harmonic function and its conjugate. Find the harmonic conjugate v of   (11)
$u = \ln \sqrt{x^2 + y^2}$ so that $u + iv$ is analytic.

(c)
Find the Laurent expansion of the function $f(z) = \dfrac{z^2 + 1}{(z + 1)(z - 2)}$ in each of the regions (i)   (12)
$1 < |z| < 2$ and (ii) $0 < |z| < 1$.

Q3.   Evaluate any two by contour integration: (35)

(a) $\displaystyle\int_0^{2\pi} \dfrac{\cos 2\theta}{5 - 3\cos\theta} d\theta$ (b) $\displaystyle\int_0^{\infty} \dfrac{dx}{x^4 + 1}$

(c) $\displaystyle\int_0^{\infty} \dfrac{\ln(1 + x^2)}{1 + x^2} dx$ (d) $\displaystyle\int_0^{\infty} \dfrac{x^{m-1}}{1 + x} dx, \quad 0 < m < 1.$

Q4. (a)
Find the singular points of the function $\dfrac{z^2}{(z + 1)^2} \sin\left(\dfrac{1}{z - 1}\right)$ and determine their nature.   (12)

(b)
Find the residues of the function $f(z) = \dfrac{z^2 - 2z}{(z + 1)^2 (z^2 + 4)}$.   (11)

(c)   Find a bilinear transformation which transforms points $z = 0, -i, -1$ into $\omega = i, 1, 0,$ (12)
respectively.

Q5. (a) Explain function of exponential order. Are the functions (i) e^{t^2} and (ii) $\cos e^{t^2}$ of (05) exponential order? Why or why not?

(b) Define one-sided Laplace transform and unit step function. Write the following function (10) using unit step function and hence find its Laplace transform:

$$f(t) = \begin{cases} 2 & \text{if} \quad 0 < t < 1 \\ \dfrac{t^2}{2} & \text{if} \quad 1 < t < \dfrac{\pi}{2} \\ \cos t & \text{if} \quad t > \dfrac{\pi}{2} \end{cases}$$

(c) Find the Laplace transform of (12)

(i) $te^{-2t} \sin 2t$ (ii) $\dfrac{e^{-t} \sin t}{t}$.

(d) Evaluate $I = \displaystyle\int_0^\infty \dfrac{e^{-t} \sin^2 t}{t} dt$. (08)

Q6. (a) Solve $y'' + 6y' + 9y = \sin t$; $(t \geq 0)$ subject to $y(0) = y'(0) = 0$ using Laplace (12) transformations.

(b) Find the inverse Laplace transform of $\left\{ \dfrac{s}{\left(s^2 + a^2\right)^2} \right\}$ by using convolution theorem. (08)

(c) Given that $I = Q = 0$ at $t = 0$, find I in the RL circuit (following figure) for $t > 0$. (15)
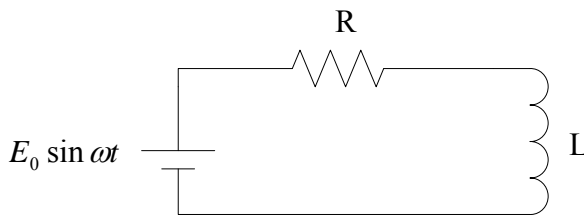
R

$E_0 \sin \omega t$ L

Fig. for Q6(c)

Q7. (a) Find the Fourier series of the function $f(x) = \begin{cases} 0 & \text{when} \quad -2 < x < 0 \\ 1 & \text{when} \quad 0 < x < 2 \end{cases}$ (10)

(b) Determine a Fourier sine series of $\cos t$ on the interval $(0, \pi)$. (10)

(c) Find and graph the amplitude spectrum of the function $f(t) = \begin{cases} \pi ; & -\pi \leq t < 0 \\ \pi - t ; & 0 < t \leq \pi \end{cases}$ (15)

Q8. (a) Find the Fourier transform of $f(t) = \begin{cases} 1 - t^2, & |t| \leq 1 \\ 0, & |t| > 1 \end{cases}$ (15)

(b) Find the Fourier cosine transform of e^{-t^2}. (10)

(c) If $F(t) = \begin{cases} e^{-xt} \varphi(t), & t > 0 \\ 0, & t < 0 \end{cases}$ then establish the relationship between Fourier transform and (10) Laplace transform.