Khulna University of Engineering & Technology
B. Sc. Engineering 2nd year 2nd Term (New/Old) Examination, 2017
Department of Electrical and Electronic Engineering
Math 2203
Mathematics IV

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 modulus and argument of a complex number. Prove that $|z_1 z_2| = |z_1||z_2|$ for any two complex numbers z_1 and z_2. (07)

(b) Determine the region in the z plane represented by $|z-1| + |z+1| \leq 3$ by expressing in rectangular form. (08)

(c) If $|z| - z = 2 + i$, find z and hence find the modulus and amplitude of z. (08)

(d) If $u(x,y) = 3x^2y - y^3 - 2x^3 + 6xy^2$, is $u(x,y)$ harmonic? If so, find its harmonic conjugate and the corresponding analytic function $f(z)$. (12)

Q2. (a) If $f(z) = \frac{z}{2}$, then by use of definition show that $\lim_{z \to -\frac{i}{2}} f(z) = -\frac{i}{4}$. (06)

Is the function continuous at $z = -\frac{i}{2}$? Explain.

(b) Locate and name the singularities in the finite z-plane of the following functions: (09)

(i) $f(z) = \ln(z+2)$,

(ii) $f(z) = \frac{(z+3i)^5}{(z^2-2z+5)^2}$

(iii) $f(z) = \left(\frac{\sin z}{z}\right)^{1/z^2}$.

(c) Find the Laurent's series expansion of $\frac{z-1}{z^2+5z+6}$ in the region $2 < |z| < 3$. (08)

(d) Evaluate $\int_C (\bar{z} - 2z)dz$ along the curve C where (12)
(i) C is the straight line from z = 1 + i to z = 3 + i and they from z = 3 + i to z = 3 + 3i.
(ii) C is the straight line directly from z = 1 + i to z = 3 + 3i.

Q3. (a) Expand $f(z) = \sin z$ in a Taylor series about $z = \frac{\pi}{4}$. (08)

(b) Evaluate $\oint_C \frac{3z^2+2}{(z-1)^2(z^2+9)} dz$ where C: $|z-2| = 2$. (12)

(c) Show that $\int_0^{2\pi} \frac{\cos 3\theta}{5-4\cos\theta} d\theta = \frac{\pi}{12}$ by the method of contour integration. (15)

Q4. (a) If $\alpha + i\beta = \frac{1}{a-ib}$, then show that $(\alpha^2+\beta^2)(a^2+b^2) = 1$. What do we understand by simply and multiply –connected region? (07)

(b) Answer any one of the following integrals by the method of contour integration: (16)

(i) $\int_{-\infty}^{\infty} \frac{\cos 2\pi x}{x^2+x+1} dx$

(ii) $\int_{-\infty}^{\infty} \frac{x^2-x+2}{x^4+10x^2+9} dx$

(c) State Cauchy's residue theorem. Find the value of $\oint_C \frac{\sin^6 z}{(z-\frac{\pi}{6})^2} dz$ if C is the circle $|z| = 1$. (12)

Section B

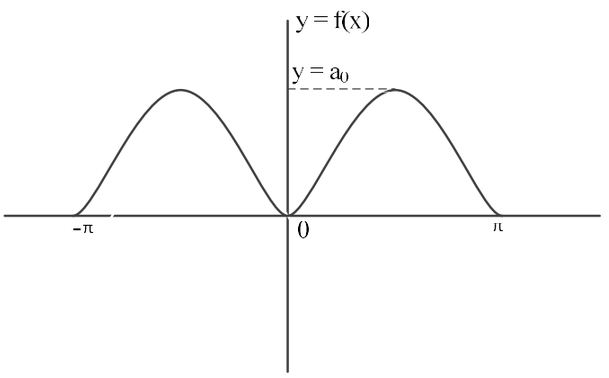
Q5. (a) Obtain the Fourier series of the periodic function *f(x)* of period 6 defined by (22)

$$f(x) = \begin{cases} -1 & \text{for } -3 < x < 0 \\ 1 & \text{for } 0 < x < 3 \end{cases}$$

and verify the result by finding the complex form of Fourier series of *f(x)*.

(b) Find the Fourier series expansion of the periodic function *f(x)* defined by the interval $(-\pi, \pi)$ with period 2π given by $f(x) = \cos \alpha x,\ -\pi < x < \pi$, where $\alpha \neq 0, \pm 1, \pm 2, \cdots$. (13)

Q6. (a) A full wave rectifier is an expansion of the function *f(x)* represented graphically- (13)



Find its Fourier series expansion.

(b) If $f(x) = \begin{cases} -x & \text{for } -0 \leq x \leq \frac{\pi}{2} \\ \pi - x & \text{for } \frac{\pi}{2} \leq x \leq \pi, \end{cases}$ (12)

Obtain a half range sine series for *f(x)*.

(c) Define Fourier integral. Show that $\int_0^\infty \frac{\cos ux}{u^2+1} du = \frac{\pi}{2} e^{-x}\ x > 0$. Also find the value of $\int_0^\infty \frac{du}{1+u^2}$. (10)

Q7. (a) Find the Laplace transform of $f(t) = \begin{cases} 3t;\ 0 < t < 2 \\ 6;\ 2 < t < 4 \end{cases}$ with $f(t+4) = f(t)$ (08)

(b) Evaluate $L^{-1}\left\{\frac{1}{s^2(s^2+9)}\right\}$ by use of the convolution theorem. (09)

(c) Define Harmonics function. Solve the Laplace equation in two dimensions $u_{xx} + u_{yy} = 0$ under the boundary conditions, (18)

$$u(0,y) = u(1,y) = u(x,0) = 0$$
$$u(x,1) = u_1 \text{ and } u(x,y) < u.$$

Q8. (a) Using finite Fourier transforms to solve $\frac{\partial U}{\partial t} = \frac{\partial^2 U}{\partial x^2}$; $U(0,t) = 0$, $U(4,t) = 0,\ U(x,0) = 2x$ where $0 < x < 4,\ t > 0$. (18)

(b) An inductor of 2 henrys, a resistor of 10 ohms and a capacitor of 0.02 farads are connected in series with an e.m.f. of 200 Volts. At t = 0 the charge on the capacitor and current in the circuit are zero. Draw this circuit and write down the ordinary differential equation for it. Also find the charge on the capacitor at any time, $t > 0$ by using the Laplace transform. (17)

Khulna University of Engineering & Technology
B. Sc. Engineering 2nd year 2nd Term (Regular) Examination, 2017
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.

Section A

Q1. (a) Using Miller's theorem simplify the following circuit. Draw its hybrid model. Calculate its A_{VS} and $A_I' = -\frac{I_2}{I_1}$. Given, R_c = 10 KΩ, R_f = 200 KΩ, and R_s = 10 KΩ. (17)

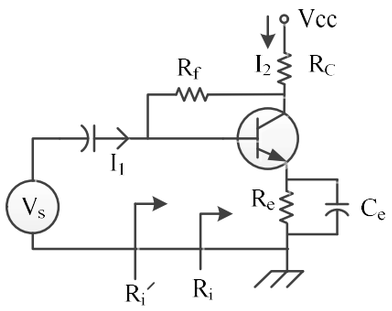


Fig. Q1(a)

(b) Draw the Darlington emitter follower circuit and hence derive the expression of its input resistance. If you compare it with a single stage emitter follower what is your observation? (18)

Q2. (a) Describe the general characteristics of negative feedback amplifiers. (13)
(b) Calculate the voltage gain with feedback for the following circuit. (22)

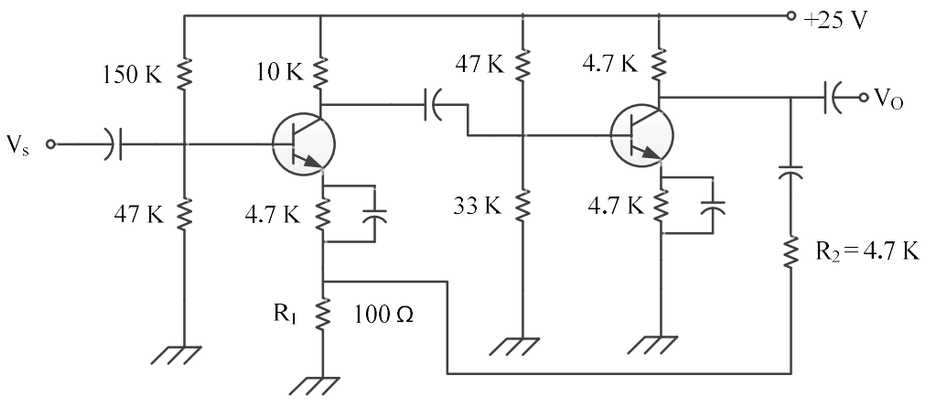


Fig. Q2(b)

Q3. (a) Show that the low 3dB frequency of a R-C coupled amplifier can be expressed as $f_1 = \frac{1}{2\pi(R_0' + R_i')C_b}$; where the symbols have their usual meanings. (10)
(b) Discuss the effect of bypass capacitor on low-frequency response. (10)
(c) What are f_B and f_T in the analysis of a transistor at high frequencies? Draw the approximate equivalent circuit of a transistor at high frequencies with resistive load; simplify it and show the expression of its voltage gain. (15)

Q4. (a) Show that the maximum efficiency of a transformer coupled class A power amplifier is 50%. (10)
(b) For a class B amplifier using a supply of V_{cc} = 30 V and driving a load of 16 Ω, determine its maximum values of (i) input power (ii) output power, and (iii) efficiency. Show that the maximum heat dissipation does not take place corresponding to maximum efficiency. (13)
(c) Define Bode plot, dominant plot and corner frequency. (06)
(d) Define and explain the total harmonic distortion of power amplifier. (06)

Section B

Q5. (a) Explain the term "field effect" in FET. Draw the transfer curve from drain characteristics curve. Show that FET is a voltage-controlled device. (07)

(b) Draw the construction of n-channel depletion type MOSFET and explain the operation of it. With the help of transfer curve and characteristics curve, prove that this MOSFET can be used as both depletion and enhancement-type MOSFET. (13)

(c) Mention the type of bias of the following network shown in Fig. Q5(c). The configuration has an operating point defined by V_{GSQ} = -2.6 V and I_{DQ} = 6.2 mA, with I_{DSS} = 16 mA and V_p = -6 V. If g_{os} = 20 μs, calculate the value of (i) g_m, (ii) Z_o, and (iii) A_v if r_d is open-circuited. Draw the ac equivalent circuit. (15)

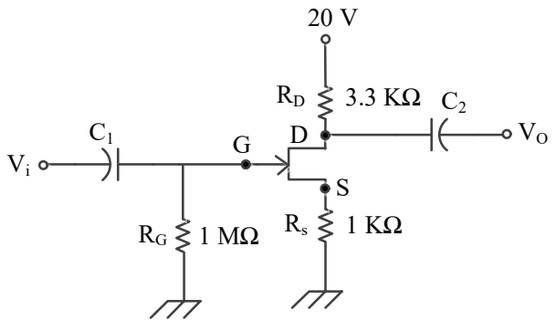


Fig. Q5(c)

Q6. (a) What is meant by FET biasing and 1why is it necessary? Draw fixed-bias, voltage-devider, and common-gate biasing configurations. Draw the ac equivalent circuits of all these configurations. (08)

(b) For the configuration shown in Fig.Q6 (b), determine the value of (i) I_{DQ} and V_{GSQ}, and (ii) V_{DS} by drawing the transfer curve and indicating Q-point. (15)

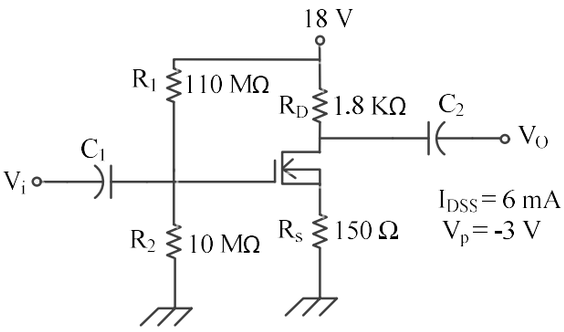


Fig. Q6(b)

(c) Define transconductance and obtain the expression of it from which graphically show the effect of transconductance on V_{GS} and $I_{D,}$ where the symbols have usual meanings. (12)

Q7. (a) What do you mean by active filter? Draw the circuit diagrams of first order (i) LPF and (ii) HPF. Draw the circuit diagram of a BPF also. In all cases use OP-Amp. Mention the equations of cut-off frequencies for BPF. (13)

(b) For the following OP-Amp, deduce the expression of output voltage $V_{o.}$ (09)

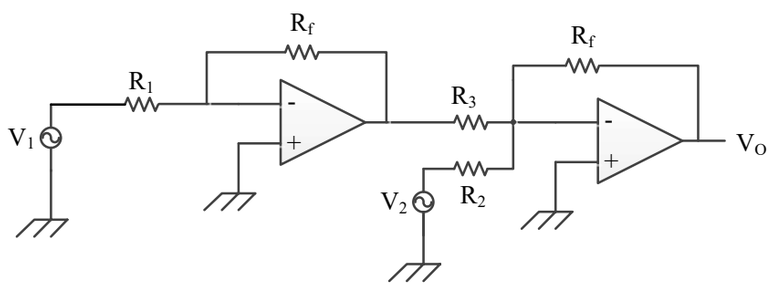


Fig. Q7(b)

(c) Explain the circuit operation of a n-channel JFET amplifier. Explain the term "pinch-off voltage" in the operation of JFET. (13)

Q8. (a) Design a band-pass filter to pass frequencies between 300 Hz and 3KHz having a dc gain of 10. (07)

(b) Design an analog computer circuit to solve the differential equation (13)

$5\frac{d^2v_0}{dt^2} + 2\frac{dv_o}{dt} + v_o = 10\sin 4t,\ t > 0$

subject to $v_o(0) = -4,\ v_o'(0) = 1$, where the prime refers to the time derivative.

(c) Show that a C-MOS can be used as an inverter. (15)

Khulna University of Engineering & Technology
B. Sc. Engineering 2nd year 2nd Term (Regular) Examination, 2017
Department of Electrical and Electronic Engineering
EE 2211
Electromagnetic Field

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 electric field intensity. Find the expression for field of *n* point charges. (11)
(b) Show that the work done on a system is only a function of final positions and not of the path of the charge. (10)
(c) Define electrostatic potential. Deduce the equation for potential at any point in the system of charges. Find potentials around a line charge and between co-axial cylinders. (14)

Q2. (a) State and explain Gauss's law. Using the law, find fields between concentric spherical electrodes with two dielectrics and find fields of a spherical region of uniform charge density. (09)
(b) Prove Gauss's law for regular and arbitrary closed surface. Define homogeneous, isotrophic, linear and time invariant materials. (10)
(c) What is electric dipole? Define dipole moment and show dipole potential decreases as $1/r^2$ with increasing distance from the origin. (09)
(d) Define equipotential surface. Prove that the electric field intensity $\bar{E} = -\nabla\phi$, symbols have their usual meanings. (07)

Q3. (a) Derive boundary conditions in electrostatics. (08)
(b) From the Laplace's equation, find potential distributions between coaxial cylinders with two dielectrics. (12)
(c) Derive the equation for energy of an electrostatic system and from the equation find energy stored in a capacitor. (15)

Q4. (a) Write Ampere's circuital law for magnetic field. Using Ampere's circuit law, determine the magnetic field intensity, $\bar{H}$ at different cross-sectional positions of a co-axial cable. (13)
(b) Prove that $\nabla \times \bar{H} = \bar{J}$, where the symbols have their usual meanings. (11)
(c) What is vector magnetic potential? Show vector magnetic potential $\bar{A}(r) = \int \frac{\mu I'(r')\overline{dl}}{4\pi R}$, where the symbols have their usual meanings. (11)

Section B

Q5. (a) State Faraday's law. Compose the conditions for having a non-zero $d\phi/dt$. Within a cylindrical region $\rho < b$, the magnetic field is given by $\bar{B} = B_o e^{kt}\bar{a}_z$. Find electric field intensity at any point due to this magnetic field. (13)
(b) What is displacement current? "A non time varying field can not create current through a capacitor"-Justify the statement. (10)
(c) Let μ=10^{-5} H/m, $\epsilon = 4 \times 10^{-9}$ F/m, $\sigma = 0$ and $\rho_v = 0$. Assume the value of k so that each of the following pair of fields satisfies Maxwell's equation: (12)
(i) $\bar{D} = 6\hat{a}_x - 2y\hat{a}_y + 2z\hat{a}_z$ nC/m^2, $\bar{H} = kx\hat{a}_x + 10y\hat{a}_y - 25z\hat{a}_z$ A/m.
(ii) $\bar{E} = (20y - kt)\hat{a}_x$ V/m, $\bar{H} = (y + 2 \times 10^6 t)\hat{a}_z$ A/m.

Q6. (a) What is meant by intrinsic impedance of a medium? Determine the intrinsic impedance of free space. (13)

(b) Solve Helmholtz equation for lossy dielectric and compose the equation for electric and magnetic field . Explain working principle of microwave oven. (14)

(c) Let the current I = 80t A be present in the $\hat{a}_z$ direction on the z-axis in free space within the interval -0.1<z<0.1 m. Find A_z at P(0,3,0). (08)

Q7. (a) Explain linear polarization and circular polarization. "Circular polarized light can be generated using an anisotropic medium"-Justify the statement. (13)

(b) Prove that a linearly polarized wave is sum of two circularly polarized wave of opposite handedness. (10)

(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 carried by the pipe $I(t) = 8\cos\omega t$ A, where $\omega = 120\,\pi$ rad/s, find (i) the skin depth; (ii) the effective resistance; (iii) the dc resistance; and (iv) the time average power loss. (12)

Q8. (a) State Poynting theorem and explain its each term. (11)

(b) Derive the conditions for total reflection and total transmission of obliquely incident waves. (15)

(c) Write short notes on (i) LOS, (ii) MUF and (iii) Skip distance. (09)

Khulna University of Engineering & Technology
B. Sc. Engineering 2nd year 2nd Term (Regular) Examination, 2017
Department of Electrical and Electronic Engineering
EE 2235
Signals 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) Draw a typical instantaneous and dynamic system. (06)

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

(c) Determine and draw the even and odd components of the signal, $x(t) = e^{-at}u(t)$; where the symbols have their usual meanings. (09)

(d) Determine zero-input response of the following system: (12)
$\frac{d^2y(t)}{dt^2} + 4\frac{dy(t)}{dt} + 40y(t) = \frac{dx(t)}{dt} + 2$;
where $y(t)$ and $x(t)$ are output and input, respectively. The expression may contain arbitrary constants.

Q2. (a) Show that the output of a system, $y(t) = x(t) \otimes h(t)$, where $\otimes$, $x(t)$, and $h(t)$ are convolution operator, input signal and impulse response, respectively. (09)

(b) Determine the transfer function of the following system: (08)
$(D^2 + 5D + 6)y(t) = Dx(t)$, where the symbols have their usual meanings.

(c) Determine the "forced response" of a system having transfer function, $H(j\omega)$ and the input, $x(t) = \cos \omega t$; where the symbols have their usual meanings. (08)

(d) Show that the impulse response of a BIBO stable system must satisfy the condition: $\int_{-\infty}^{\infty} |h(Y)|dY < \infty$, where the symbols have their usual meanings. (10)

Q3. (a) Define "time constant" or "rise time" of a system. Describe graphically the effect of "time constant" on the filtering properties of a system. (10)

(b) Draw the $f - v$ and $f - i$ analogous electrical circuit of the following mechanical system shown in Fig. Q3(b) and write down the equation of performance. (13)

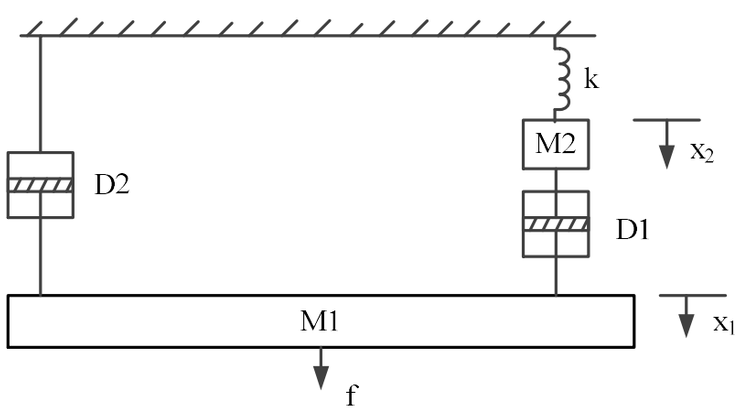


Fig. Q3(b)

(c) The electromagnetic system shown in Fig. Q3(c) may represent a loudspeaker or an electromagnetic relay. The moving coil in the uniform magnetic field, "B" has "n" turns of circumstances "C" and its inductance and resistance are L and R, respectively. A voltage $e(t)$ is applied to the coil. Draw the equivalent electrical circuit of the system. (12)

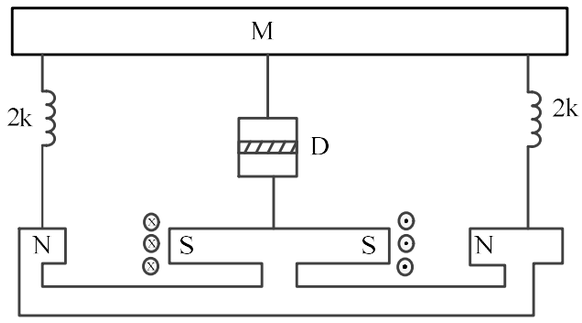


Fig. Q3(c)

Q4. (a) Find the Fourier series expansion for the periodic waveform shown in Fig. Q4(a): (15)

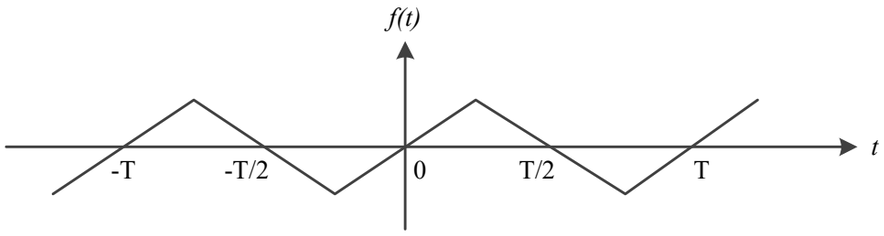


Fig. Q4(a)

(b) Determine the voltage $(e_0(t))$ across the parallel branch of the circuit shown in Fig. 4(b). The excitation source of the circuit is a single rectangular pulse. (20)

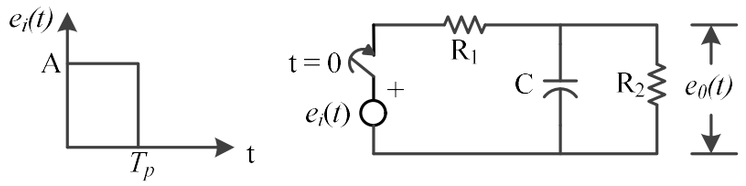


Fig. Q4(b)

Section B

Q5. (a) Plot the following signals approximately to scale and also find the Laplace transform of each of them: (20)

(i) $\cos \omega t\, u(t)$ (ii) $\cos \omega t\, u(t-1)$

(iii) $\cos \omega\, (t-1)u(t)$ (iv) $\cos \omega(t-1)u(t-1)$

(b) Find the Laplace transform of the full-wave rectified voltage wave shown in Fig. Q5(b). (15)

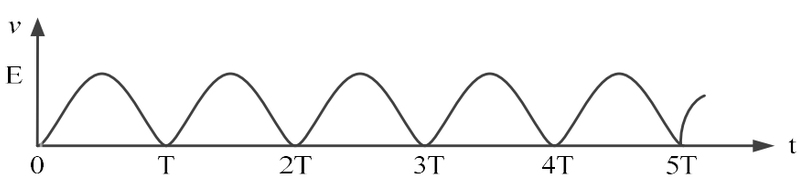


Fig. Q5(b)

Q6. (a) Find $L^{-1}[\frac{s+2}{s(s+1)^2(s+3)}]$ (10)

(b) Find the voltage $v_R(t)$ appearing across the resistance R in the following circuit when the input voltage $v_i(t)$ is a periodic sawtooth wave as shown in Fig. Q6(b), and there is an initial voltage $v_C(0^+) = E/2$ on the capacitor. Determine also the steady-state expression for v_R. (25)

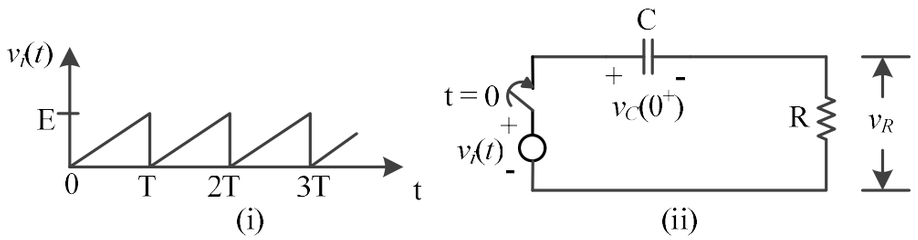


Fig. Q6(b)

Q7. (a) State and prove convolution theorem. Find the inverse Laplace transform of the following function by using convolution theorem (15)

$$\frac{s}{(s^2+\omega_1^2)(s^2+\omega_2^2)}$$

(b) The switch in the circuit of Fig. Q7(b) is closed at $t = 0$. The desired response is the voltage v_L across the inductance. Find the (i) the step response $\omega_n(t)$; (ii) $v_L(t)$ from $\omega_n(t)$ by using the superposition integral and (iii) its transfer function H(s). (20)

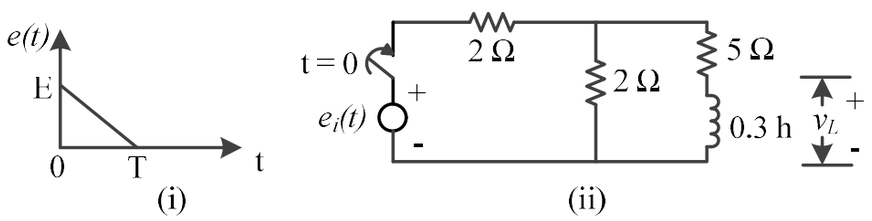


Fig. Q7(b)

Q8. (a) The periodic rectangular current wave shown in Fig. Q8(a) is applied to the parallel R-C circuit shown in Fig. Q8(a). Determine the steady-state expression for the voltage $v(t)$. (15)

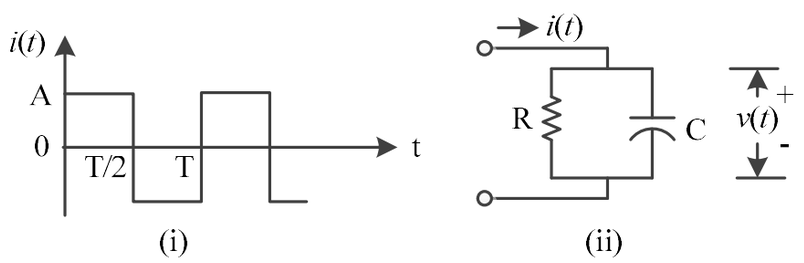


Fig. Q8(a)

(b) Prove that if $Z[f(t)] = F(z)$, then $Z[tf(t)] = -Tz\frac{d}{dz}F(z)$ (10)

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

Khulna University of Engineering & Technology

B. Sc. Engineering 2nd year 2nd Term (Regular) Examination, 2017

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? Explain the principles of Ethics for the Engineers.	(15)
	(b)	Is Ethics dependent on Religion? Explain their relationship.	(10)
	(c)	"All moral values are relative"-Comment on it.	(10)
Q2.	(a)	What is Egoism? Find out the distinctions between Psychological Egoism and Ethical Egoism.	(15)
	(b)	"There are absolute moral truth"-discuss the statement in the light of relativism.	(10)
	(c)	What is relativism? What are the advantages and disadvantages of relativism in our society?	(10)
Q3.	(a)	What do you mean by Utilitarianism? Discuss the theory of utilitarianism by Bentham.	(15)
	(b)	Discuss the relation between desire and will.	(20)
Q4.	(a)	Explain the nature of will, character and conduct. Show how are they inter-related?	(15)
	(b)	"Character is a completely fashioned will"-explain the statement.	(10)
	(c)	Discuss the problem of freedom of will.	(10)

Section B

Q5.	(a)	What is morality? Explain it as a philosophy.	(15)
	(b)	What are the principles of morality? Explain the moral functions of religion.	(20)
Q6.	(a)	What is culture? Explain the relationship between culture and morality.	(10)
	(b)	Explain the stages of socialization and the role of socialization on our professional life.	(15)
	(c)	What is Ethnocentrism? How is it related to morality?	(10)
Q7.	(a)	What is occupational stress? When job stressor lead to job strain.	(15)
	(b)	What is Burnout? How is it related to low work motivation?	(20)
Q8.	(a)	What is meant by Moral Responsibility and Blame? What conditions completely eliminate a person's moral responsibility?	(10)
	(b)	Explain organizational commitment as an attitudinal variable of professional life.	(10)
	(c)	What is motivation? Narrate Need Hierarchy theory to explain motivation.	(15)