Khulna University of Engineering & Technology
B. Sc. Engineering 2nd Year 1st Term Examination, 2017
Department of Biomedical Engineering

BME 2101
Human Anatomy

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

(Answer **ANY THREE** questions from this section in Script A)

1. a) Define neuron? Draw and label different types of neuron. (10)

   b) Enumerate different lobes of the cerebrum and explain their functions. (10)

   c) Write down 12 cranial nerves. Mention their types and functions. (15)

2. a) Draw and label the parts of a tooth. (05)

   b) Write down the muscles of the tongue. Explain the nerve supply of the tongue. (10)

   c) Give the boundary and contents of orbit. (10)

   d) Write short notes on: (10)
   (i) Parotid gland
   (ii) Function of the thymus

3. a) Draw and label the brachial plexus. (12)

   b) What is dermatome? Draw and label the dermatome of the upper limb. (11)

   c) Give the origin, insertion, nerve supply and action of the following muscles: (12)
   (i) Deltoid
   (ii) Biceps Brachii
   (iii) Trapezius
   (iv) Pronator teres

4. a) What is bone? Write down the composition and functions of the bone. (10)

   b) Write down the difference between the bones and cartilages. (05)

   c) Mention the major organ systems of the body. Describe the functions of the major organ systems. (12)

   d) Explain the given terminology: (08)
   (i) Flexion
   (ii) Extension
   (iii) Supination
   (iv) Pronation

Section B

(Answer **ANY THREE** questions from this section in Script B)

5. a) What are the parts of stomach? Name the structures forming stomach bed. (10)

   b) Write down the parts of the uterus. Mention the support of the uterus. (07)

   c) Write down the anterior relation of the right kidney. Mention the mode of blood supply of the kidney. (10)

   d) Draw and label the structure of a hepatic lobule. Write down the functions of the liver. (08)

6. a) Describe the oesophagus with constrictors, blood supply and nerve supply. (10)

   b) What is bronchopulmonary system? Draw and label the bronchopulmonary segment of the right lung. (12)

   c) Write short note on Gall bladder. (05)

   d) Write down the contents of the root of the lungs. (08)

7. a) Give the origin, nerve supply and function of the diaphragm. (10)

   b) Give the artery supply of the heart. (10)

   c) What is nephron? What are the parts of a nephron. Draw and label the different parts of a nephron. (10)

   d) Write short note on pericardium. (05)

8. a) Illustrate with diagram the boundary and content of femoral triangle. (10)

   b) Write down the classification of Arches of foot. Describe the medial and lateral longitudinal arch of the foot. (10)

   c) Give the origin, insertion, nerve supply and function of the following muscles: (15)
      (i) Sartorius
      (ii) Rectus femoris
      (iii) Gluteus maximus

Khulna University of Engineering & Technology
B. Sc. Engineering 2nd Year 1st Term Examination, 2017
Department of Biomedical Engineering

Math 2115
Transforms Analysis

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

(Answer **ANY THREE** questions from this section in Script A)

1. a) Find the Fourier series of the periodic function $f(x)$ of period 2π defined by (20)

$$f(x) = \begin{cases} \pi - x & for\ 0 \le x \le \pi \\ 0 & for\ -\pi \le x \le 0 \end{cases}$$

Also represent the function graphically for a single period.

b) Write down the complex form of Fourier series of $f(x)$ where $f(x)$ is a periodic function of period 2L defined in the interval (-L , L). Obtain the complex form of Fourier series for the function $f(x) = e^{ax}$, $-2 \le x \le 2$. (15)

2. a) A full wave rectified output is given by $I(t) = I_0 sint$, $0 \le t \le \pi$ as shown in the Fig.2(a). Find it's Fourier series expansion. (15)

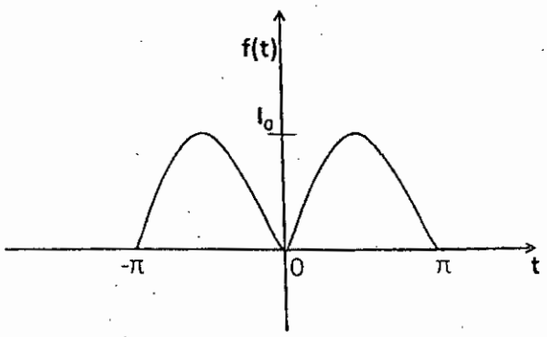

Fig. 2 (a)

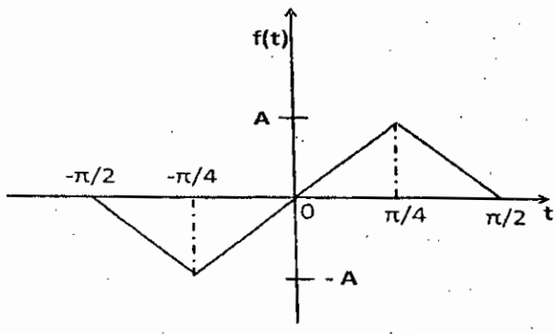

Fig. 2 (b)

b) Obtain the trigonometric Fourier series of wave form as shown by the Fig. 2 (b) (20)

3. a) Write Parseval's identity corresponding the Fourier series of the function (13)

$$f(x) = \begin{cases} x & , \quad 0 < x < 2 \\ -x & , \quad -2 < x < 0 \end{cases}$$

b) Find the Fourier transform of $f(x) = \begin{cases} 1 & for\ |x| < a \\ 0 & for\ |x| > a \end{cases}$ (12)

And hence using the inverse Fourier transform evaluate $\int_{-\infty}^{\infty} \frac{sinas\ cossx}{s} ds.$

c) Find the Fourier cosine transform of (10)

$$f(x) = \begin{cases} x & ; \ 0 \le x < 1 \\ 1 - x & ; \ 1 \le x \le 2 \\ 0 & ; \quad x > 2 \end{cases}$$

4. a) Using suitable properties find $L\{t(sin3t + te^{-2t})\}$. (10)

b) If $f(t)$ is a periodic function of period 2π, defined by (15)

$$f(t) = \begin{cases} sint & for\ 0 < t < \pi \\ 0 & for\ \pi < t < 2\pi \end{cases}$$, find $L\{f(t)\}$.

What do we mean by functions of exponential order?

c) Find the inverse Laplace transform of the following using convolution property: (10)

$$\frac{1}{(s+1)(s+2)^2}$$

Section B

(Answer **ANY THREE** questions from this section in Script B)

5. a) Define integral transform and kernel of the transform. (05)

   b) Define causal and non-causal system. Identify which of the following discrete time sequences given by the figures are causal and non-causal and find the Z-transform and the region of convergence (ROC) for each: (20)

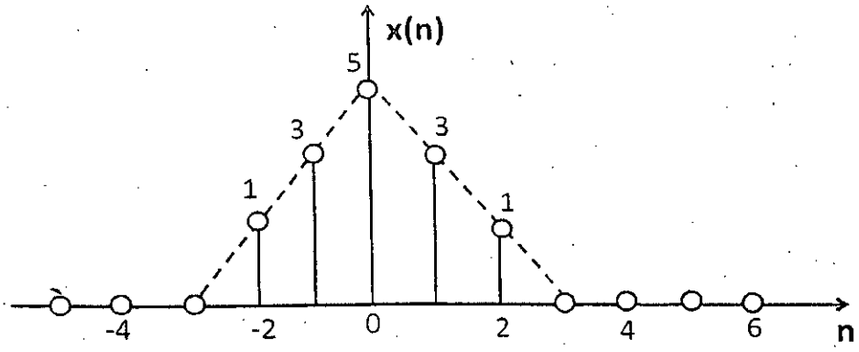

Fig. 5 (b)-1

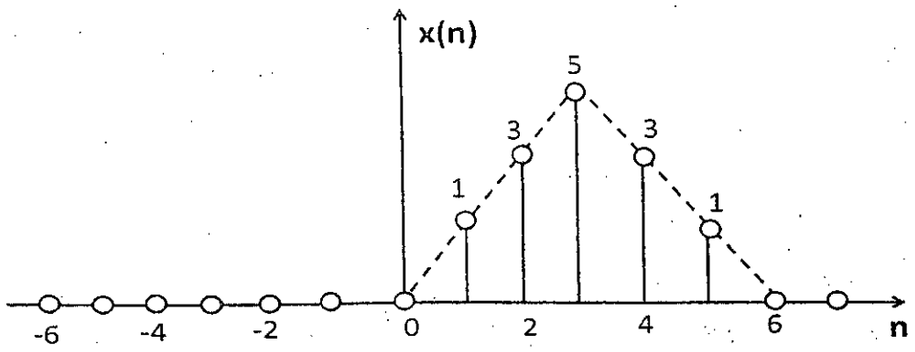

Fig. 5 (b)-2

   c) Write down the important properties of the ROC for Z-transform. (10)

6. a) Define Z-transform. Determine the Z-transform of the signal $x(n) = -a^n u(-n-1)$ and plot the ROC. (11)

   b) Define left hand and right hand finite sequence. Find the Z-transform of the signal $x(n) = u(-n-1) - u(-n-5)$. (11)

   c) Find the inverse Z-transform of (13)

$$X(z) = \frac{1+z^{-1}+2z^{-2}}{\left(1-\frac{1}{2}z^{-1}\right)\left(1-\frac{1}{3}z^{-1}\right)\left(1-\frac{1}{4}z^{-1}\right)}, \quad |z| > \frac{1}{2}$$ using partial fraction method.

7. a) Define discrete time Fourier transform (DTFT). (20)

   (i) Find the DTFT of the following finite duration sequence of length L

$$x(n) = \begin{cases} A, & for\ 0 \le n \le L-1 \\ 0, & otherwise \end{cases}$$

   (ii) Also find the inverse DTFT to verify $x(n)$ for $L = 3$ and $A = 1v$.

   b) Define Discrete Fourier transform (DFT). Determine the DFT of the sample data sequence $x(n) = \{1, 1, 2, 2, 3, 3\}$ and compute the corresponding amplitude and phase spectrum. (15)

8. a) Given $x(n) = \{0, 1, 2, 3\}$, find *X(k)* using DITFFT algorithm. (17)

   b) Given (18)

$X(k) = \{20, -5.828 - j2.414, 0, -0.172 - j0.414, 0, -0.172 + j0.414, 0, -5.828 + j2.414\}$.

   Find $x(n)$ using IDFT algorithm.

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B. Sc. Engineering 2nd Year 1st Term Examination, 2017
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ME 2115
Basic Mechanics and Thermodynamics

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
(Answer **ANY THREE** questions from this section in Script A)

1. a) Knowing that the tension in cable AB is 1425N, determine the components and direction cosines of the force exerted on the plate at B as shown in figure 1(a). (17)

Figure 1(a)

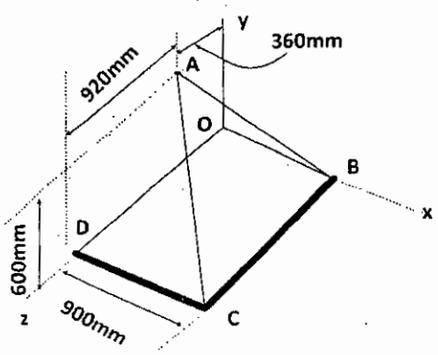
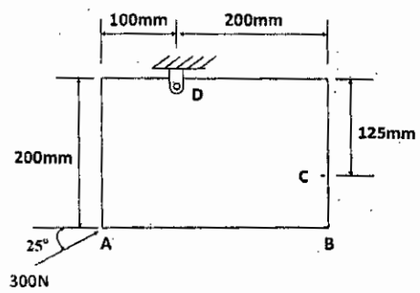


Figure 1(b)



b) A 300N force is applied at A as shown in above figure 1(b). Determine (18)
(i) The moment of the 300N force about D.
(ii) The smallest force applied at B that creates the same moment about D.

2. a) The force P has a magnitude of 250N and is applied at the end C of a 500 mm rod AC attached to a bracket at A and B as shown in figure 2(a). Assuming $\alpha = 30^\circ$ and $\beta = 60^\circ$, replace P with (18)
(i) An equivalent force-couple system at B.
(ii) An equivalent system formed by two parallel forces applied at A and B.

Figure 2(a)

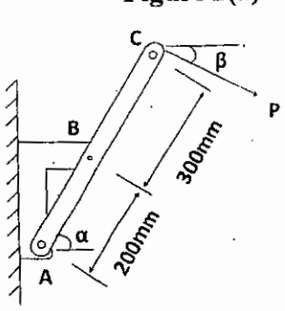
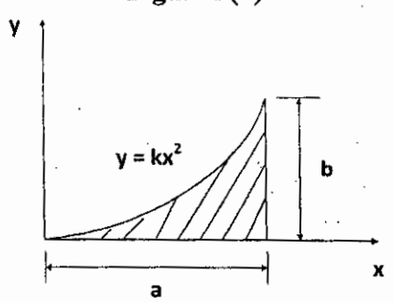


Figure 2(b)



b) Determine the location of the centroid of the shaded area shown in above figure 2(b). (17)

3. a) State and explain zeroth law of thermodynamics. Why this law is called the basis for temperature measurement? (08)

b) What are the different forms of energy encountered in thermodynamics? Using the 1st law of thermodynamics deduce the expression for non-flow energy equation. (12)

c) A closed system executes a reversible process wherein the pressure and volume vary in accordance with $pV^n = constant$, $Q = 16.25$ kJ, $\Delta U = 47.48$ kJ. If $p_1 = 101$ kPa, $V_1 = 141.6$ litre and $p_2 = 827.4$ kPa, find n and V_2. (15)

4. a) What are limitations of 1st law of thermodynamics? Write the two statements for 2nd law of thermodynamics. (08)

4. b) What is perpetual motion machine? Explain why a steam power plant without a condenser is a perpetual motion machine of second kind? Why this plant won't work? (12)

c) A piston-cylinder device contains 0.05 m^3 of gas initially at 200 kPa. At this state, a linear spring that has a spring constant of 150 kN/m is touching the piston but exerting no force on it. Now heat is transferred to the gas, causing the piston to rise and to compress the spring until the volume inside the cylin doubles. If the cross-sectional area of the piston is 0.25 m^2, determine- (15)
(i) The final pressure inside the cylinder.
(ii) The total work done by the gas.
(iii) The fraction of this work done against the spring to compress it.

Section B

(Answer **ANY THREE** questions from this section in Script B)

5. a) State and prove Newton's law of viscosity. Why viscosity of any fluid decreases with increase of temperature? (12)

b) What is total pressure and center of pressure? Deduce the expression for total pressure on an inclined plane surface. (12)

c) Pressure gage B is to measure the pressure at point A in a water flow as shown in figure 5 (c). If the pressure at B is 87 kPa, estimate the pressure at A. (11)

Figure 5 (c)

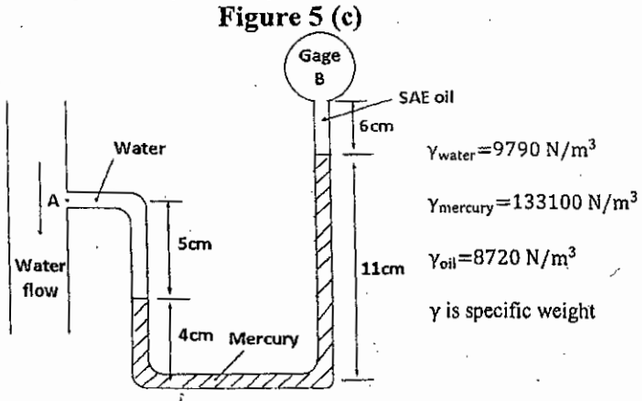
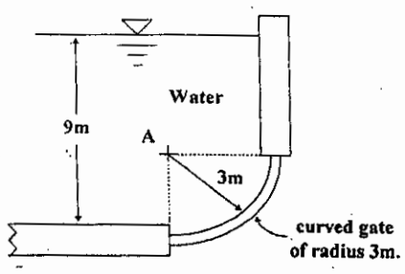


Figure 6 (c)



6. a) Define and develop a relationship between the absolute pressure and gage pressure. (08)

b) Derive Bernoulli equation for steady, inviscid flow along a stream line. (12)

c) A 4m long curved gate is located in the side of a reservoir containing water in the above figure 6(c). Determine the magnitude of the horizontal and vertical components of the force of water on the gate. (15)

7. a) Why the free surface of a fluid in rigid body motion will be inclined for non-zero vertical acceleration? Explain. (15)

b) How flow velocity can be calculated from static and stagnation pressures in a pipe using pitot-static tube? (10)

c) What is meant by pressure head and velocity head? Express 65 kPa pressure in terms of pressure head of water. (10)

8. a) What is metabolism and basal metabolic rate? Explain how does the biological system of human body can be compared with thermodynamic heat engine? (10)

b) How thermodynamics and heat transfer are related? Explain the mechanisms of conduction, convection and radiation heat transfer. (10)

c) Consider a person standing in a breezy room at 20°C. Determine the total rate of heat transfer from this person if the exposed surface area and the average outer surface temperature of the person are 1.6m^2 and 29°C respectively. The convective heat transfer coefficient is 6 W/m^2 °C. (15)

Khulna University of Engineering & Technology
B. Sc. Engineering 2nd Year 1st Term Examination, 2017
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BME 2151
Numerical Methods and Statistics

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) Chi-square (χ^2) distribution chart will be provided on request.

Section A

(Answer **ANY THREE** questions from this section in Script A)

1. a) What is subtractive cancellation? Estimate the relative error in $z = x - y$ when $x = 0.3456 \times 10^4$ and $y = 0.3454 \times 10^4$ as stored in a system with four digit mantissa. (12)

b) Use the false position method to find a root of the function $f(x) = x^2 - x - 2 = 0$, in the range $1 < x < 3$. (upto 4th iteration) (11)

c) Find the root of the equation $x^2 - 3x + 2 = 0$, in the vicinity of $x = 0$ using Newton-Raphson method. (12)

2. a) Determine the square root of 2.5 by using second order Lagrange interpolation polynomial (11)

b) Given below is a table 2(b) of data for $logx$. Estimate $log2.5$ using second order Newton interpolation polynomial. (12)

Table: 2(b)

i	0	1	2	3
x_i	1	2	3	4
$logx_i$	0	0.3010	0.4771	0.6021

Table: 2(c)

i	0	1	2	
x_i	1	1.5	2.5	
$f(x_i)$	3.2	3.5	4.5	

c) Find the divided differences $f[x_0, x_1]$; $f[x_1, x_2]$ and $f[x_0, x_1, x_2]$ for the data given in the above table 2(c). (12)

3. a) Solve the following system of equations using basic Gauss elimination method. (10)

$$2x_1 + 2x_2 + x_3 = 6$$
$$4x_1 + 2x_2 + 3x_3 = 4$$
$$x_1 - x_2 + x_3 = 0$$

b) Use Simpson's 3/8 rule to evaluate (10)
(i) $\int_1^2 (x^3 + 1)dx$ (ii) $\int_0^{\pi/2} \sqrt{sinx}dx$

c) Compute Romberg estimate R_{22} for $\int_1^2 \frac{1}{x}dx$. (15)

4. a) Given the equation $y'(x) = \frac{2y}{x}$ with $y(1) = 2$. Estimate $y(2)$ using Heun's method with $h = 0.5$. (10)

b) Use the classical RK method to estimate $y(0.5)$ when $y'(x) = \frac{x}{y}$ with $y(0) = 1$ and $h = 0.25$. (14)

c) Consider a steel plate of size $15cm \times 15cm$. If two of the sides are held at 100^0C and the other two sides are held at 0^0C, What are the steady-state temperature at interior points assuming a grid size of $5cm \times 5cm$. (11)

Section B

(Answer **ANY THREE** questions from this section in Script B)

5. a) A box contains 3 red, 3 white and 9 blue balls. If 3 balls are drawn at random without replacement, determine the probability that (10)
(i) All are red (ii) At least one white
(iii) One of each color (iv) Balls are drawn in order red, white, blue

5. b) A certain stage of criminal investigation, the inspection in-charge is 60% convinced of the guilt of a certain suspect. Suppose that now a new piece of evidence that shows that the criminal has a certain characteristics (such as brown hair, baldness etc) is uncovered. If 20% of the population possesses this, how certain of the guilt of the suspect should the inspector now be if it turns out that the suspect is among this group? (13)

c) Define random variable. If X is a continuous random variable whose probability density function is given by (12)

$$f(x) = \begin{cases} c(4x - 2x^2), & 0 < x < 2 \\ 0, & otherwise \end{cases}$$

Find (i) The value of constant c.
(ii) Probability that X^2 lies between 1/4 and 1.
(iii) cdf of X.

6. a) Briefly discuss about continuous and discrete random variables. (05)

b) If the height of a population has normal distribution with mean 62 inches and standard deviation 8 inches. Find the height above which the tallest 5% of the people lie. (06)

c) Table 6(c) shows a frequency distribution of the weekly wages of 65 employees at the PQR company. Determine the followings: (18)
(i) Construct a relative frequency histogram.
(ii) Mean weekly wages of 65 employees using coding method.
(iii) Find mean deviation of the weekly wages.

Table: 6(c)

Wages ($)	No. of employees
250 - 259.99	8
260 - 269.99	10
270 - 279.99	16
280 - 289.99	14
290 - 299.99	10
300 - 309.99	5
310 - 319.99	2
Total	65

d) A car travels 25 miles at 25 mph, 25 miles at 50 mph and 25 miles at 75 mph. Find the harmonic mean and geometric mean of the three velocities. (06)

7. a) Fit a least square line to the data given in the table 7(a) using X as independent variable. Also find Y, when X = 6. (12)

Table: 7(a)

X	3	5	4	8	9
Y	2	3	6	6	5

Table: 7(c)

Physics	40	23	45	45	47	15	10	35	50	6
Mathematics	30	25	50	35	8	25	31	31	37	12

b) For an independent variable X, show that the equation of least square line can be written as (10)
$y = \left(\frac{\sum xy}{\sum x^2}\right)x$ or $y = \left(\frac{\sum xY}{\sum x^2}\right)x$, where $x = X - \bar{X}$ and $y = Y - \bar{Y}$.

c) The above table 7(c) shows the respective marks for ten students in physics and mathematics. Compute the coefficient of rank correlation. (13)

8. a) State and prove product moment formulae for linear correlation coefficient. (10)

b) Define level of significance. The standard deviation of a normal population is 3. If a random sample of size 36 drawn from the population yields a sample mean 13, then test the hypothesis that (12)
(i) Mean increased (ii) Mean decreased (iii) Mean changed
using p-value at 0.05 level of significance.

c) Mention some method of hypothesis test. Table 8(c) shows the observed and expected frequencies in tossing a die 36 times. Test the hypothesis that the die is fair using a significance level of (i) 0.05, (ii) 0.01 using chi-square test. (13)

Table: 8(c)

Event	1	2	3	4	5	6
Observed frequencies	2	4	8	9	3	10
Expected frequencies	6	6	6	6	6	6

Khulna University of Engineering & Technology
B. Sc. Engineering 2nd Year 1st Term Examination, 2017
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ECE 2115
Digital Electronics and Logic Design

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

(Answer **ANY THREE** questions from this section in Script A)

1. a) Convert the following numbers from the given base to the bases indicated: (12)
(i) Hexadecimal D2763 to decimal, octal and binary.
(ii) Decimal 25.6875 to binary, octal and hexadecimal.

b) Perform the following operations using 2's complement method: (09)
(i) $(23)_{10} - (17)_{10}$ (ii) $(111)_2 - (1101)_2$ (iii) $(8)_{10} - (-7)_{10}$

c) Express the following numbers in BCD, 2421, 5211 and $84\bar{2}\bar{1}$ (08)
(i) 527 (ii) 493

d) Convert the following numbers from Binary to Gray: (06)
(i) $(110100)_2$ (ii) $(1111)_2$ (iii) $(1101110)_2$

2. a) Describe De Morgan's theorem. Using this theorem, calculate the complement of function F, where $F = A(B'C' + BC)$. (09)

b) A seven bit Hamming code with even parity is received as (12)
(i) 1100110 (ii) 0011101 (iii) 1000010
Locate the error position if any and find the correct message.

c) What is meant by self complementary code and weighted code. Justify the statement "2421 and 5211 code are both self complementary and weighted". (08)

d) Distinguish between the canonical form and standard form of a Boolean function. (06)

3. a) What do you mean by universal gate? Why some gates are called universal and some are not ? (10)

b) Obtain the NAND logic diagram of a full-adder from the Boolean functions: (10)
$$c = xy + xz + yz$$
$$s = c'(x + y + z) + xyz\ .$$

c) Simplify the following Boolean functions to a minimum number of literals: (10)
(i) $\bar{Y}\bar{Z} + \bar{W}\bar{X}\bar{Z} + \bar{W}XY\bar{Z} + WY\bar{Z}$
(ii) $AB + A\bar{B}C(\bar{B}\bar{C} + C) + \overline{AC}$

d) Implement the following Boolean function using NOR gates: (05)
$$F = A(B + CD') + BC'$$

4. a) Draw the logic diagram of 2-line to 4-line decoder/demultiplexer using NOR gates only. (10)

b) Specify the truth table of an octal-to-binary priority encoder. Provide an output to indicate if at least one of the inputs is a 1. The table can be listed with 9 rows and some of the inputs will have don't care values. (10)

c) Implement the following function with a multiplexer: (07)
$$F(A, B, C, D) = \sum(0, 1, 3, 4, 8, 9, 15)\ .$$

d) Explain the operations of a decoder and encoder. (08)

Section B

(Answer **ANY THREE** questions from this section in Script B)

5. a) Describe the operation of RTL, DTL, and TTL NAND gate. (18)

   b) What is flip-flop? Why is flip-flop called one bit memory cell? (10)

   c) What is Moore's law? What are the general characteristics of basic logic families? (07)

6. a) Design a synchronous counter that will count 14 - 11 - 9 - 4 - 7 - 1 and repeat using JK flip-flops. (12)

   b) Design a CMOS digital circuit that realizes the following Boolean functions: (10)

   (i) $y = A'BC + A(B + C')$ (ii) $y = xy' + z(x' + y')$ (iii) $y = abc + d$

   c) The content of a 4-bit shift register is initially 1101. The register is shifted six times to right with the serial input being 101101. What is the content of the register after each shift? (13)

7. a) What is PLD? How many types of PLD in modern digital electronics? What are the applications of it? (10)

   b) Draw the circuit diagram using Pseudo-NMOS for the following Boolean functions: (12)

   (i) $y = \overline{a + bc}$ (ii) $y = \overline{a + bc + ca}$

   c) Design a PLA circuit using Pseudo-NMOS NOR-NOR to realize the following sum of product functions: (13)

   $F_0 = A'B' + AC'$ $F_1 = AB + AC'$

   $F_2 = A'B' + BC'$ $F_3 = AC + B$

8. a) Find out the characteristics table, excitation table, state diagram and equation of JK flip-flop. (15)

   b) Construct a Johnson counter with ten timing signals. (10)

   c) What is register? Describe the operation of a memory unit in CPU. (10)