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 **Answer Script A**)

1. a) Convert the following numbers from the given base to the bases indicated: (12)
    (i)   Decimal number to 249.6 to base-3, base-4, base-7.
    (ii)   Hexadecimal 2AC5.D to decimal, octal and binary.

  b) Perform the following subtractions using 2's complement method and 1's complement method (13) and check the answer by straight subtraction: (i) $(25 - 18)_{10}$ and (ii) $(11010 - 1101)_2$.

  c) Simplify the following Boolean functions to a minimum number of literals: (10)
    (i) $y(wz' + wz) + xy$
    (ii) $[(CD)' + A]' + A + CD + AB$ to three literals.

2. a) Express the following functions in a sum of Minterms and a product of Maxterms: (12)
    (i) $F(A, B, C) = (A' + B)(B' + C)$
    (ii) $F(x, y, z) = (xy + z)(y + xz)$

  b) The Boolean expression: $BE + B'DE$ is a simplified version of the following expression (12) $A'BE + BCDE + BC'D'E + A'B'DE + B'C'DE'$. Are there any don't care condition? If so, what are they?

  c) Describe De Morgan's theorem. Using this theorem, calculate the complement of function F, (11) where $F = A(B'C' + BC)$.

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

  b) Define combinational logic. Design the combinational circuit that detects errors during (12) transmission of binary information.

  c) Design a combinational circuit that accepts a bit BCD number and generates output binary (13) number same as the excess-3 code of corresponding BCD number.

4. a) Define multiplexer. Implement the following function with a multiplexer: (08)
$$F(A, B, C, D) = \Sigma(0,2,3,4,8,10,14)$$

  b) What is meant by ROM. Implement the following the following Boolean functions using ROM (12)
$$F_1(A_1, A_0) = \sum(1,2,3)$$
$$F_2(A_1, A_0) = \sum(0,2)$$

  c) A combinational circuit is defined by the functions: (15)
$$F_1(A, B, C) = \sum(3,5,6,7)$$
$$F_2(A, B, C) = \sum(0,2,4,7)$$
Implement the circuit with a PLA having three inputs, four product terms and two outputs.

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

5. a) Write down the differences between digital and analog signal. (06)

  b) What is flip flops? Draw the diagrams of RS, JK, D and T flip flop. From these diagram write (16) their characteristics table and derive characteristics equation.

  c) What is edge triggering? Design and show the operation of a D-type negative edge triggered (13) flip flops.

6. a) Define state diagram. A sequential circuit has one input and one output. The state diagram is (13) shown in figure Q6a. Design the sequential circuits with T flip flops.
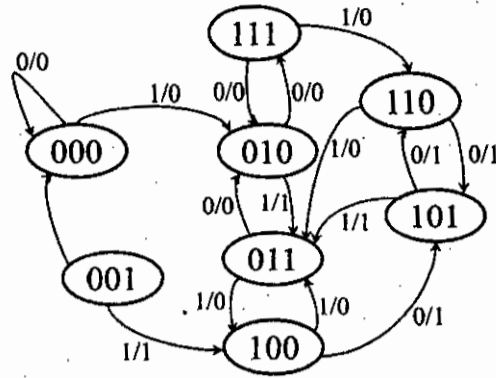

Fig.Q6a

b) Reduce the number of states shown in figure Q6a, tabulate the reduced table and draw the state (12) diagram for reduced table. Starting from state '000' of the reduced table, find the output sequence generated with an input sequence of 01110010011.

c) Design a synchronous counter that counts the decimal digits 8,4,2,1 and repeat using D flip (10) flop.

7. a) Describe the operation and truth table of the following resistor-transistor logic gates of the (10) figure Q7c. The inputs of this truth table are A, B, C. Show the binary state of X,Y,Z and each transistor on/off state for all possible inputs.
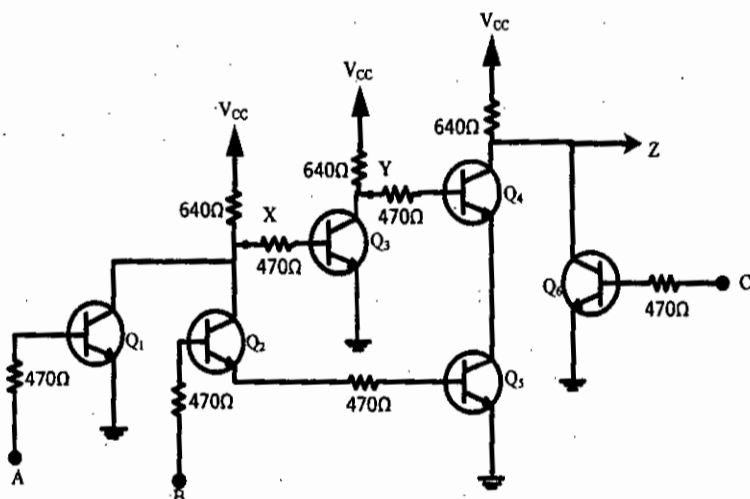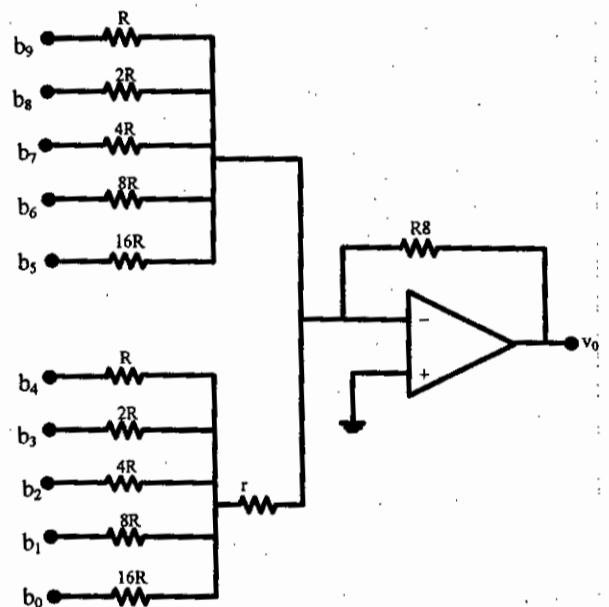

Figure Q7c

Figure Q8c

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

c) Design a synchronous counter that will count 15-10-9-8-7-6 and repeat by using JK flip-flops. (10)

d) Describe briefly the Moore's law. (05)

8. a) Describe the logic diagram and operation of a memory unit with appropriate diagram. What (10) are the contents of a $64K \times 16$ memory and how many bytes of memory can it accommodate?

b) Design a combinational circuit using ROM that accepts a three-bit numbers and outputs a (12) binary number equal to $(1 - x)^{-2}$; where x is the decimal input binary and where higher order terms are neglected.

c) Show that the above circuit in above figure Q8c is the modified version of the weighted resistor (13) D/A convertor and also find the value of 'r' for which circuit can be tuned.

Khulna University of Engineering & Technology
B. Sc. Engineering 2nd Year 1st Term Examination, 2019
Department of Biomedical Engineering
Math 2115
Transform 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)   Define integral transform and hence find the kernel of the transform. Also find the kernel of   (08)
Fourier sine transform.

b)   Define causal and non-causal system with example. Test whether the following system are   (15)
causal or not.
(i) $y(t) = tx(t)$,   (ii) $y(n) = x(n) - x(n-1)$,   (iii) $y(t) = x(t^2)$.

c)   What do you mean by Region of convergence (ROC) of z-transform. Write down the   (12)
important properties of z-transform.

2.   a)   Find z-transform of $x(n) = (\frac{1}{5})^n [u(n) - u(n-5)]$ and plot its region of convergence.   (12)

b)   By applying differentiation property, find the z-transform of $n^2 u(n)$.   (09)

c)   Find the inverse z-transform of $X(z) = \dfrac{z}{(z-1)(z-2)(z-3)}$ using partial fraction method for   (14)
ROC $3 > |z| > 2$.

3.   a)   Find the 4-point inverse DFT of the discrete signal F[k] with period 4 given by F[0]=1,   (10)
F[1]=0, F[2]=0, F[3]=1.

b)   Given a sequence $x(n)$ for $0 \leq n \leq 3$, where $x(0) = 1, x(1) = 2, x(2) = 3$ and $x(3) = 4$,   (12)
evaluate its DFT $X(k)$.

c)   Define discrete time Fourier transform (DTFT) and find DTFT of the following finite   (13)
duration sequence of length L.
$$x(n) = \begin{cases} A, & for\ 0 \leq n \leq L-1 \\ 0, & otherwise. \end{cases}$$

4.   a)   Find the DFT of a sequence $x(n) = \{1, 2, 3, 4, 4, 3, 2, 1\}$ using DITFFT algorithm.   (17)

b)   Given,   (18)
$X(k) = \{36, -4 + j9.656, -4 + j4, -4 + j1.656, -4, -4 - j1.656, -4 - j4, -4 - j9.656\}$
find $x(n)$.

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

5.   a)   Write down the assumption for the validity of Fourier series expansion of a function. Find a   (20)
series of sines and cosines multiple of x which represents $x + x^2$ in the interval $-\pi < x < \pi$
and hence deduce that,
$$\frac{\pi^2}{6} = \sum_{n=1}^{\infty} \frac{1}{n^2}.$$

b)   Define odd and even function. Find half-range Fourier cosine series of   (15)
$$f(x) = \begin{cases} x & ; & 0 < x < \frac{L}{2} \\ L - x & ; & \frac{L}{2} < x < L \end{cases}$$

6. a) Define Parseval's identity. Use this identity to the function $f(x) = x \sin x$, $0 < x < \pi$ and (18) show that, $\dfrac{1}{1^2 \cdot 3^2} + \dfrac{1}{3^2 \cdot 5^2} + \dfrac{1}{5^2 \cdot 7^2} + \cdots = \dfrac{\pi^2 - 8}{16}$.

b) Find the Fourier cosine transform of $f(x) = \dfrac{1}{1+x^2}$ and hence derive Fourier sine transform (17) of $\varphi(x) = \dfrac{x}{1+x^2}$.

7. a) Define Laplace transform. Determine the Laplace transform of $t^2 e^{-t} \sin 4t$. (10)

b) Find Laplace transform of $f(t)$ which is shown graphically below in Fig.Q7b: (10)
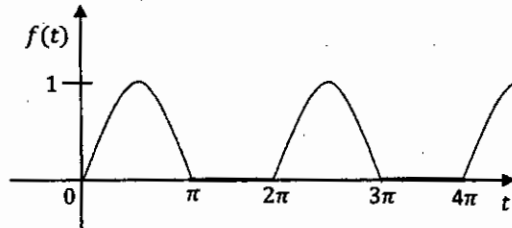

Fig.Q7b

c) Using Laplace Transform solve the IVP $y'' - y' = e^t \cos t$; $y(0) = y'(0) = 0$. (15)

8. a) Find the Fourier integral representation of $f(x) = \begin{cases} e^{-x} & ; \quad x > 0 \\ 0 & ; \quad x < 0 \end{cases}$ (13)
And find the value of the resulting integral when (i) $x < 0$ (ii) $x = 0$, and (iii) $x > 0$.

b) Sketch and Find Laplace transform of $\cos t \, u(t - \pi)$. (08)

c) State convolution theorem. Use it to obtain the inverse Laplace transform of: (14)
$$\frac{s - 2}{(s^2 - 4s + 8)^2}.$$

Khulna University of Engineering & Technology
B. Sc. Engineering 2nd Year 1st Term Examination, 2019
Department of Biomedical Engineering
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 **Answer Script A**)

1.   a)   The tension in cable BC as shown in figure Q1a below is 725 N. Determine the resultant of   (15) the three forces exerted at point B of the beam AB.
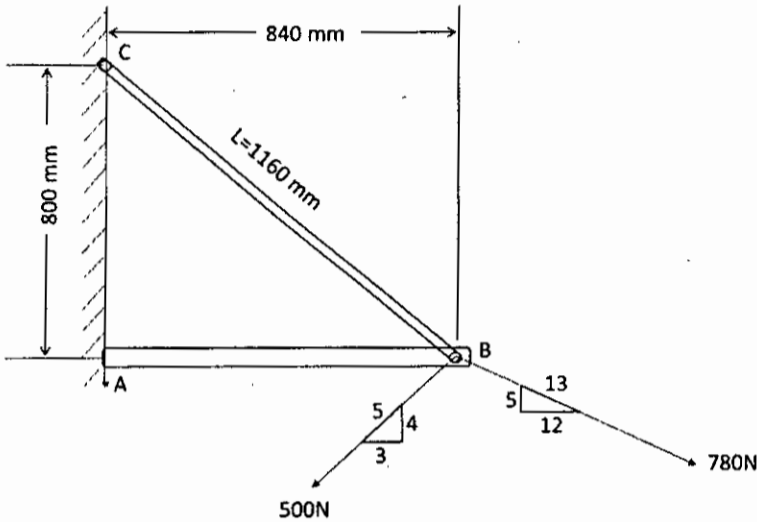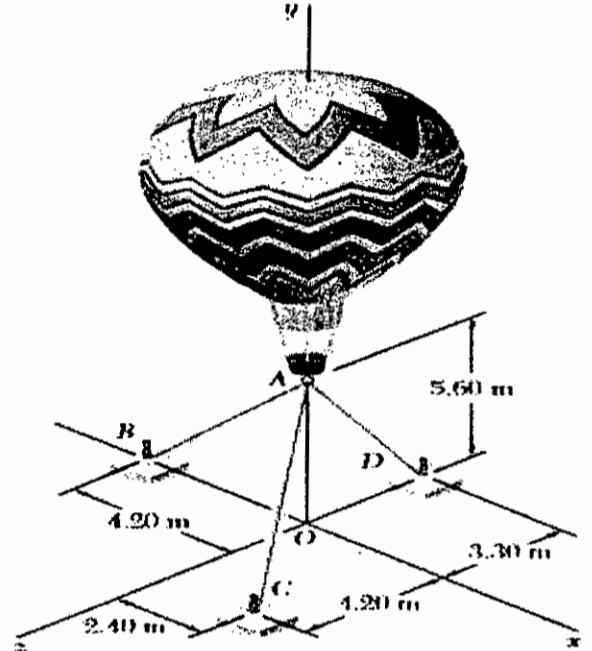

Fig.Q1a

Fig.Q1b

  b)   Three cables are used to tether a balloon as shown in above figure Q1b. Knowing that the   (20) balloon exerts an 800 N vertical force at A, determine the tension in each cables.

2.   a)   The wire AE is stretched between the corner A and E of a bent plate as shown in figure Q.2a   (15) below. Knowing that the tension in the wire is 435 N, Determine the moment about O of the force exerted by the wire (a) on corner A, (b) On corner E.
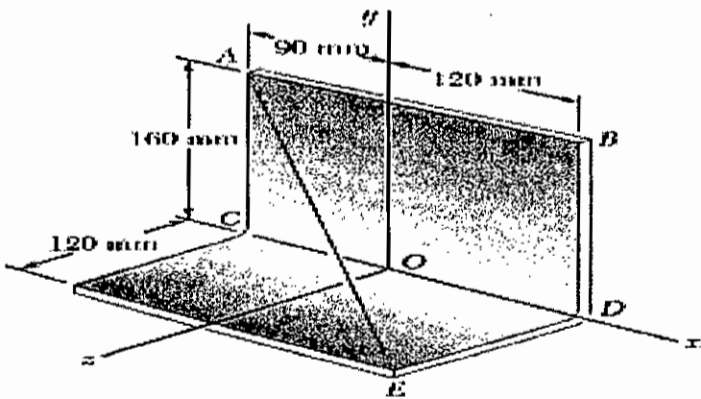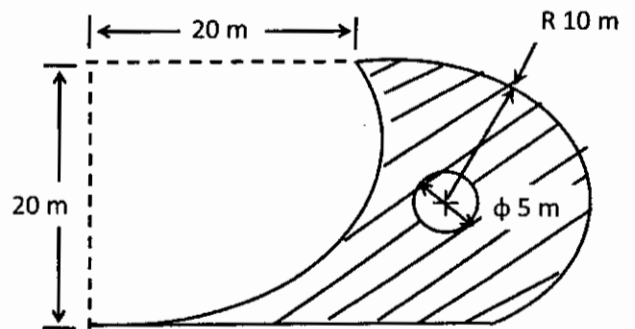

Fig.Q2a

Fig. Q2b

  b)   Find the centroid of the shaded area with reference to x and y axes as shown in above figure   (20) Q2b.

3.   a)   Consider the volley ball net as shown in figure Q3a. Determine the angle formed by guy   (10) wires AB and AC.
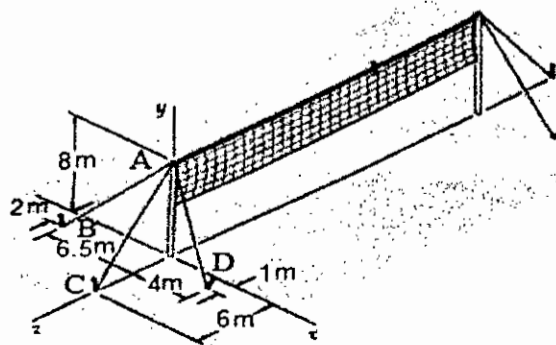

Fig.Q3a

b) State Newton's law of cooling. Derive an expression for the temperature distribution of a (15) hallow sphere whose inside radius is r_1 and outside radius is r_2 having thermal conductivity. K.

c) What is metabolism? How biological system of human body can be compared with (10) thermodynamic heat engine?

4. a) Explain the relationship among process, path and cycle. Discuss the types of process. How (11) a process can be described completely?

b) Explain the zeroth law of thermodynamics. Formulate how temperature can be measured (12) based on the zeroth law.

c) A gas in a piston-cylinder assembly undergoes an expansion process for which the (12) relationship between pressure and velocity is given by $Pv^n = constant$
The initial pressure is 3.0 bar, the initial and final volume are $0.1 m^3$ and $0.2 m3$, respectively. Determine the work for the process, if (i) n = 1.5 (ii) n = 0 and (iii) n = 1.0

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

5. a) Distinguish between the path function and the point function with examples. (06)

b) Prove that energy is a point function and property of the system, however, energy transfer (09) from the system are path function.

c) What is flow work? Drive the energy red balance equation applying the first law of (12) thermodynamics for a control volume.

d) A fan consumes 20W of electric power when operating and discharges air at a rate of 1kg/s. (08) Determine the air velocity of discharged air.

6. a) State the two statements of the second law of thermodynamics. Explain how these statements (10) are related with refrigerator and heat engine?

b) What are the observation that can be made about the two statements of the second law of (15) thermodynamics? Prove that the two statements are equivalent.

c) What is entropy? How entropy concept can be used to identify a process that prohibited in (10) nature? Explain with example.

7. a) What is fluid? Why do we need to assume fluid as a continuous smooth medium in classical (10) fluid mechanics?

b) Why a liquid droplet takes spherical shape. Why the droplet breaks down if more liquid is (12) added to it?

c) A hydro-electric power plant as shown in the figure Q.7c takes in $30m^3/s$ of water through (13) its turbine and discharges it to the atmosphere at 2m/s velocity. The head loss in the turbine and penstock system is 20 m. Assuming turbulent flow, α= 1.06, estimate power extracted by the turbine. If the generator in the plant has loss of about 15%, how much power is generated from the plant?
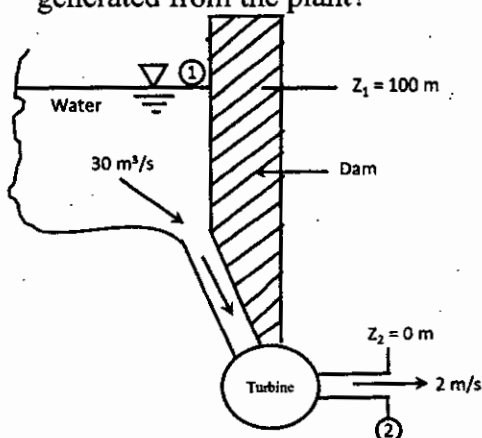
Fig. Q7c
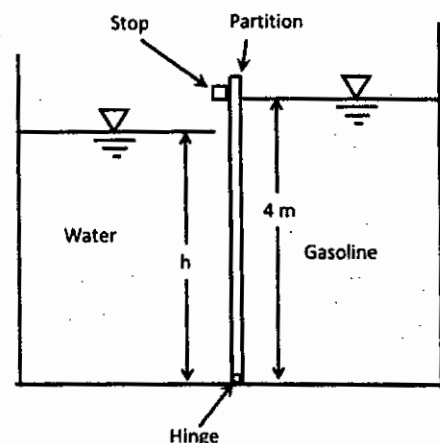
Fig. Q8c

8. a) How pressure varies point to point in incompressible fluid at rest? Make appropriate (10) derivation.

b) What is meant by stability? Illustrate with appropriate diagram, the stability criteria for (12) floating object.

c) An open tank as show in above figure Q.8c has a vertical partition and on one side contains (13) gasoline ($\rho = 700kg/m^3$) at a depth of 4 m. A rectangular gate that is 4m high and 2 m wide and hinged at one end is located in the partition. Water is slowly added to the empty side of the take. At what depth, h will the gate start to open?

Khulna University of Engineering & Technology
B. Sc. Engineering 2nd Year 1st Term Examination, 2019
Department of Biomedical Engineering
BME 2151
Numerical Methods & 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) Necessary probability distribution charts will be provided on request.

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

1. a) What is Numerical analysis? Draw the block diagram of a numerical computing process.   (06)

   b) What is numerical error? Find the roundoff error in storing the number 642.6745 using a four (07) digit mantissa.

   c) Use the bisection method to find a root of the function $f(x) = x^2 - x - 2 = 0$ in the range (11) $1 < x < 3$. (up to 4th iteration)

   d) Use the Secant method to compute a root of the equation $x^2 - 5x + 6 = 0$. (11) (up to 5th iteration)

2. a) Solve the following systems of equation by Gauss-Jordan method   (10)
$$x_1 + 2x_2 - 3x_3 = 4$$
$$2x_1 + 4x_2 - 6x_3 = 8$$
$$x_1 - 2x_2 + 5x_3 = 4$$

   b) Find the Lagrange interpolation polynomial which agrees with the following data: (15)

x	1.0	1.1	1.2	1.3
$\cos x$	0.5403	0.4536	0.3624	0.2675

Use it to estimate $\cos 1.15$.

   c) Find the divided differences $f[x_0, x_1], f[x_0, x_2], f[x_1, x_2]$ and $f[x_0, x_1, x_2]$ for given data: (10)

i	0	1	2
x_i	1.0	1.5	2.5
$f(x_i)$	3.2	3.5	4.5

3. a) Given the data: (10)

x	1.2	1.3	1.4	1.5
$f(x)$	1.063	1.091	1.119	1.145

Calculate $f(1.35)$ using Newton's interpolation polynomial of 2nd order.

   b) Evaluate the following integrals using trapezoidal rule: (10)
(i) $\int_0^2 (3x^3 + 2x^2 - 1)dx$;
(ii) $\int_0^\pi (3\cos x + 5)\, dx$.

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

4. a) Approximate the derivative of $f(x) = x^2 + 2x$ at $x = 4$ using Forward, Backward and (10) Central difference method with step size 1.

   b) Given the equation $y'(x) = \frac{2y}{x}$ with $y(1) = 2$. Estimate $y(2)$ using Heun's method with (13) $h = 0.25$.

   c) Solve for the steady state temperatures in a rectangular plate 6 cm × 8 cm, if one 8 cm side is (12) held at 50°C and the other 8 cm side is held at 30°C and the other two sides are held at 10°C. Assume square grids of size 2 cm × 2 cm.

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

5. a) Write short notes on: (10)
   (i) Mutually exclusive events; (iii) Frequency approach of probability assignment;
   (ii) Expected value; (iv) Probability density function.

   b) Of three cards one is painted red on both sides; one is painted black on both sides and one is (08) painted red on one side and black on the other. A card is randomly chosen and placed on a table. If the side facing up is red, what is the probability that the other side is also red?

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

   d) Random variable X has the density function, $f(x) = c(9x - 5x^2)$ where $-3 < x < 2$. (12)
   (i) Find the probability that X^2 lies between $\frac{1}{4}$ and 1.
   (ii) Find the corresponding distribution function.

6. a) Height of a 25 year old man is normally distributed with mean 70 inches. If (09) $P(X < 79) = 0.0055$, what is the standard deviation of this distribution?

   b) The table Q6b shows a frequency distribution. Determine the followings: (18)
   (i) Draw boxplot (show calculation of each component);
   (ii) Standard deviation of the distribution;
   (iii) Cumulative frequency polygon.

   Table: Q6b

Height (inches)	Number of People
60-65	6
66-71	18
72-77	43
78-83	27
84-89	10
Total	104

   c) A car travels 25 miles at 25 mph, 25 miles at 50 mph and 25 miles at 75 mph. Find harmonic (08) mean and geometric mean of the three velocities.

7. a) Define coefficient of determination. Find Pearson correlation coefficient for the following (12) data set as shown in table Q7a.

   Table: Q7a

Blood Pressure (units)	30	50	46	25	33
Weight (units)	65	80	75	49	58

   Table: Q7b

X	70	63	60	70	62	65
Y	155	150	135	168	132	139

   b) Fit a least square line to the data given in above table Q7b. Using X as independent variable. (11)

   c) Write short notes on: (12)
   (i) Rank correlation
   (ii) Free hand method of curve fitting.

8. a) Define null hypothesis and level of significance. (05)

   b) p value of a hypothesis test is $p \leq 0.01$; what does this mean? (05)

   c) Table Q8c shows duration efficacy of a certain drug for northern and southern people. At 5% (12) significance level, do the data provide sufficient evidence to conclude that, on average, northern people have higher duration of efficacy than the southern people?

   Table: Q8c

Duration of Efficacy (unit time)	
Northern people	Southern people
09, 12, 13, 13, 18	20, 12, 07, 14, 28

   d) Last years violent crime distribution is given in the table Q8d(i). This years observation in (13) the violent crime distribution is given in table Q8d(ii). Do the data provide sufficient evidence to conclude that, this year, the distribution of violent crime have changed from the last year. (α=5%).

   Table: Q8d(i)

Types of Violent Crime	Relative frequency
Murder	0.011
Abduction	0.063
Robbery	0.286
Assault	0.640
Total	1.00

   Table: Q8d(ii)

Types of Violent Crime	Frequency
Murder	3
Abduction	37
Robbery	154
Assault	306
Total	500

Khulna University of Engineering & Technology
B. Sc. Engineering 2nd Year 1st Term Examination, 2019
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 **Answer Script A**)

1. a) Write down the components of hepatobiliary system with proper diagram.   (10)

    b) Describe oesophagus with constrictors, blood supply and nerve supply.   (10)

    c) Draw and label the different parts of kidney. Give the anterior relation of right kidney.   (10)

    d) Enumerate the blood supply and function of liver.   (05)

2. a) Write short notes on: (09)
        (i) Thyroid gland,
        (ii) Thymus,
        (iii)Spleen.

    b) Describe the anatomical structure of larynx with diagram.   (10)

    c) Explain the given terminology: (10)
        (i) Proximal,
        (ii) Superficial,
        (iii)Flexion,
        (iv)Supination,
        (v) Sagital plane.

    d) List the male and female reproductive organs. Draw the different parts of uterus.   (06)

3. a) Draw and label the important nuclei of thalamus. Write down the major function of thalamus. (12)

    b) Draw and label middle ear. Enumerate the functions of middle and inner ear.   (10)

    c) Draw and label the anatomical structure of eyeball.   (08)

    d) Write short notes on spinal cord.   (05)

4. a) Write down the difference between sympathetic and parasympathetic nervous system. Draw   (10)
        and label unipolar and bipolar neuron.

    b) Write down the boundary and contents of anterior triangle of the neck.   (10)

    c) Write short notes on: (10)
        (i) Para Nasal Sinuses,
        (ii) Basal Ganglia.

    d) Enumerate different parts of the cerebrum.   (05)

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

5. a) What is thoracic cage? How it is formed? Discuss about the 12 pairs of ribs.   (08)

    b) Define thoracic aperture. Write down the boundary and contents of the thoracic inlet.   (10)

    c) Which structure separates the thorax from abdomen? Write down the nerve supply of those   (10)
        structure. List the structure passing through the esophageal opening of the diaphragm.

    d) What is pleural cavity and pleural recesses?   (07)

6. a) Draw and label the structure of lungs. (05)

    b) Describe the root of the both lungs. List the difference of right and left lungs. (10)

    c) What are the chamber, valve, structure and border of the heart? Mention the arterial supply (10)
        of the heart.

    d) Write short notes on: (10)
        (i) Transverse sinus,
        (ii) Oblique sinus.

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

    b) Mention the boundary and contents of pelvic inlet with neat sketch. (10)

    c) How the popliteal fossa is formed? Which structures are within it? (05)

    d) Give the origin, insertion, nerve supply and action of the following muscles: (10)
        (i) Sartorius,
        (ii) Gastrocnemius.

8. a) Give the boundary and contents of cubital fossa with diagram and clinical importance. (10)

    b) How the superficial and deep palmar arch is formed. (08)

    c) Draw and label the brachial plexus with short description. (10)

    d) Discuss about the Brachial artery with its clinical correlations. (07)