

ME 2115
Basic Mechanics and Thermodynamics

Time: 1 Hour 30 Minutes

Full Marks: 120

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

Section A

(Answer ANY TWO questions from this section in Script A)

1. a) When and why a liquid droplet brakes down? Deduce the pressure jump across the surface of a liquid droplet. (10)
- b) Show that the shearing stress applied on fluid is directly proportional to the velocity gradient. (10)
- c) Gasoline ($\rho = 680\text{kg/m}^3$) is pumped through a smooth uniform diameter pipe of 10 km long, at a velocity of 2 m/s. The inlet is equipped with a pump, creating 25 atm pressure (absolute). The exit is at standard atmospheric pressure and is 160 m higher than inlet. Estimate the frictional head loss. (10)

2. a) Show the relationship between absolute, gauge and atmospheric pressure in neat sketch. (06)
- b) What is mean by stability of a floating body? Explain the stability criteria of floating body with neat sketch. (12)
- c) A 5 cm long curved gate is located in the side of a reservoir containing water above it as shown in Figure 2(c) below. Determine the horizontal and vertical components of force of water on the gate. (12)

3. a) A lever AB is hinged at C and attached to a control cable at A shown in Figure 3(a) below. If the lever is subjected to a 600 N horizontal force at B, determine- (15)
 - i) The tension in the cable,
 - ii) The reaction at C

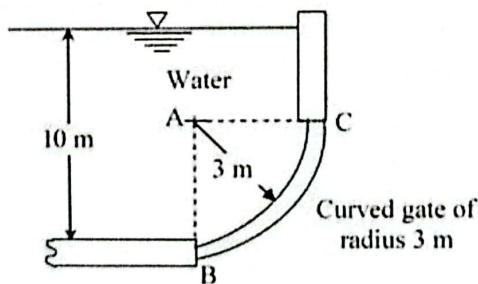


Figure 2(c)

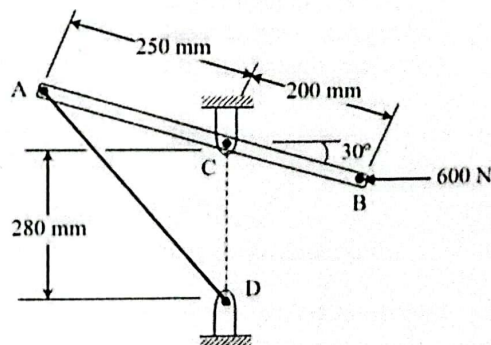


Figure 3(a)

- b) The force P is applied at the end C of 600 mm rod AC attached to a bracket at A and B as shown in Figure 3(b) below. Replace the force P with
- an equivalent force-couple system at B ,
 - an equivalent system formed by two parallel force applied at A and B .

Section B

(Answer ANY TWO questions from this section in Script B)

- 4 a) Find the centroid of the shaded area with reference to x and y axes as shown in the Figure 4(a) below. (16)

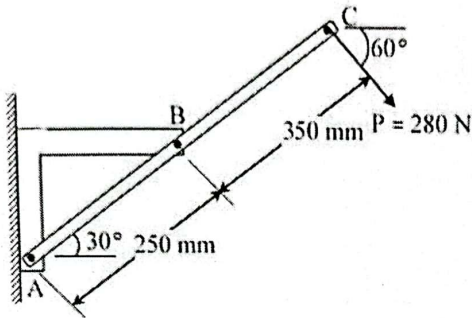


Figure 3(b)

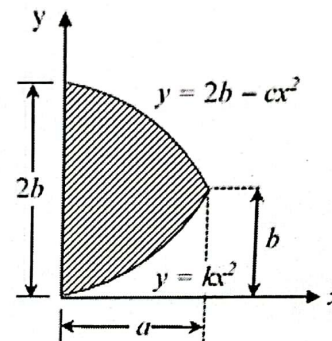


Figure 4(a)

- b) "Heat is energy in transition"- justify this statement. (05)

c) Explain the physical mechanism of different modes of heat transfer. (09)
- a) Prove that thermodynamic properties are point function whether heat and work are path function. (06)

b) What are the limitations of 1st law of thermodynamics? Prove that Kelvin-Planck's statement and Clausius statement for 2nd law of thermodynamics are equivalent. (12)

c) What is meant by PMM-1 and PMM-2? Can we just take the condenser out of the steam power plant? Why this plant won't work? (12)
- a) What is meant by reversible process? What are the causes of irreversibilities? If reversible process is impossible in practice then why are we interested in reversible process? (10)

b) What is COP? Explain the working principle of a vapour compression refrigeration system with appropriate diagram. (12)

c) A fan that consumes 20 W of electric power when operating is claimed to discharge air from a ventilated room at a rate of 1.1 kg/sec at a discharge velocity of 9 m/sec. determine, if this claim is reasonable. (08)

BME 2101
Human Anatomy

Time: 1 Hour 30 Minutes

Full Marks: 120

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

Section A

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

1. a) Draw and label the different parts of the Gall-bladder. (08)
b) Mention the structure of parotid gland with its blood supply. (07)
c) How the cerebrum is divided into two hemispheres. List the functions of right hemisphere. (07)
d) Discuss the histological structure of : (08)
 i) Pancreas ii) Supra-renal gland
2. a) What is blood-brain barrier? Discuss about the formation and circulation of cerebrospinal fluid. (08)
b) Write down the boundary and contents of anterior triangle of the Neck. (07)
c) Draw and label the different parts of stomach. (06)
d) Describe the structure of kidney. (09)
3. a) Write down the boundary and contents of orbit. (08)
b) List the blood supply of anterior abdominal wall. (07)
c) What are the parts of temporal bone? Write down about Maxillary sinus. (08)
d) Write down the functions of cerebellum. (07)

Section B

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

4. a) Describe the structure and lymphatic drainage of breast. (12)
b) Write down the boundary and contents of Superior mediastinum. (10)
c) Mention the area supplied by left and right coronary artery. (08)
5. a) Mention the origin, insertion, and nerve supply of the following muscles: (12)
 i) Brachialis ii) Deltoid iii) Supinator
b) What is pacemaker? Write down the classification of Ribs in human. (10)
c) What is Musculotendinous cuff? Discuss about the movement of shoulder joint. (08)
6. a) Describe the intra-articular structure of knee joint. Write down the bursa around the knee joint. (10)
b) Give the boundary and contents of popliteal fossa with diagram. (08)
c) Give the origin, insertion, and nerve supply of the following muscles: (12)
 i) Gluteus maximus ii) Soleus iii) Tibialis anterior

BME 2151
Numerical Methods and Statistics

Time: 1 Hour 30 Minutes

Full Marks: 120

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

Section A

(Answer ANY TWO questions from this section in Script A)

1. a) What are the types of numerical error? Compare the absolute and relative errors in $w = (x^2z + y)(1/z)$ when, $x = 0.12 \times 10^4$, $y = 0.256 \times 10^4$, $z = 0.45 \times 10^4$ as stored in a system with four digit mantissa. (10)

- b) Use the false position method to find the root of the function (10)
 $f(x) = x(x - 1) = 2$ in range $1 < x < 3$ (up to 4th iteration).

- c) Solve the following systems of equations by simple Gauss elimination method. (10)
- $$\begin{aligned} 2x_1 + 3x_2 + 4x_3 &= 5 \\ 3x_1 + 4x_2 + 5x_3 &= 6 \\ 4x_1 + 5x_2 + 6x_3 &= 7 \end{aligned}$$

2. a) Find the Lagrange interpolation polynomial to fit the following data (15)

i	0	1	2	3
x_i	0	1	2	3
$e^{x_i} - 1$	0	1.7183	6.3891	19.0855

Use the polynomial to estimate the value of $e^{1.5}$

- b) Approximate the derivative of $f(x) = x + 2x^2$ at $x = 4$ using the Forward, Backward and Central difference method with step size 1. (10)
- c) Use Simpson's $3/8$ rule to evaluate $\int_3^4 (x^4 + 1)dx$ (05)
3. a) Estimate $y(2)$ by Euler's method for the following equation using $y(1) = 2$ and $h = 0.25$ (05)

$$y'(x) = \frac{2y + 1}{x}$$

- b) Use the Secant method to estimate the root of the equation (10)
 $x^2 - 4x - 10 = 0$
 with the initial estimates of $x_1 = 4$ and $x_2 = 2$.

- c) Use the classical RK method to estimate $y(0.5)$ when (15)
 $\frac{dy}{dx} = \frac{2x}{y}$
 with $y(0) = 1$ and $h = 0.25$

Section B

(Answer ANY TWO questions from this section in Script B)

- 4 a) A basketball team consists of 6 black and 6 white players. The players are to be paired in groups of two for the purpose of determining roommates. If the pairing are done at random, what is the probability that none of the black players will have a white roommate? (10)
- b) If the average number of claims handled by an insurance company is 5, what proportion of days have less than 3 claims? What is the probability that there will be 4 claims in exactly 3 of the next 5 days? Assume that the number of claims on different days is independent. (12)
- c) Define normal random variable. If X is a normal random variable with mean $\mu = 3$ and variable $\sigma^2 = 16$, find $P\{2 < X < 7\}$ (08)
- 5 a) Two varieties of potato plants (A and B) tuber yield is shown in the following Table 1. Does the mean of tuber of the variety "A" significantly differ from that of variety "B"? (16)

Table 1: Tuber yield, kg/plant.

Variety "A"	2.2	2.5	1.9	2.6	2.6	2.3	1.8	2.0	2.1	2.4	2.3
Variety "B"	2.8	2.5	2.7	3.0	3.1	2.3	2.4	3.2	2.5	2.9	

Note. Table value of t for 19 d.f. at 5% level of significance is 2.09.

- b) What is correlation coefficient? Find the linear correlation coefficient of the data given below: (14)

X	1	3	4	6	8	9	13	15	17	21
Y	1	2	3	3	4	8	7	9	11	13

6. a) Define Rank correlation. Use the frequency distribution of heights in the following Table 2 to find the mean height of the 100 male students at XYZ University (short method) (14)

Table 2: Height of 100 male students at XYZ University.

Height (in)	Number of students
60-62	5
63-65	18
66-68	42
69-71	27
72-74	8
Total	100

- b) Fit a least square-parabola (least-squares regression curve of Y on X) having the form $Y = a_0 + a_1X + a_2X^2$ to the data given below: (16)

X	1.2	1.8	3.1	4.9	5.7	7.1	8.6	9.4
Y	4.5	5.9	7.0	7.8	7.2	6.8	4.5	2.7

Khulna University of Engineering & Technology
B. Sc. Engineering 2nd Year 1st Term Examination, 2020
Department of Biomedical Engineering

Math 2115
Transforms Analysis

Time: 1 Hour 30 Minutes

Full Marks: 120

- Q.B.** i) Answer ANY TWO questions from each section in separate scripts.
ii) Figures in the right margin indicate full marks.

Section A

(Answer ANY TWO questions from this section in Script A)

1. a) Write down the important property of the ROC for z-transform. Find the z-transform of

$$x(n) = \left(\frac{1}{2}\right)^n u(n) - 2^n u(n-1) \quad \text{as well as its ROC.} \quad (15)$$

- b) Determine the causal sequence $x(n]$ for $X(z)$ given by

$$X(z) = \frac{1 + z^{-1}}{1 - 2z^{-1} + 4z^{-2}} \quad (15)$$

2. a) Define causal and non-causal system with example. Using convolution property find the signal of

$$X(z) = \frac{1}{\left(1 - \frac{1}{2}z^{-1}\right)\left(1 + \frac{1}{4}z^{-1}\right)} \quad (15)$$

- b) Find the 4-point DFT of the sequence $x(n) = \cos \frac{n\pi}{4}$

and compute the corresponding amplitude and phase spectrum. (15)

3. a) Define Integral transform also find the kernel of Fourier transform. Find the Fourier cosine transform of

$$f(x) = \frac{1}{1 + x^2} \quad \text{and hence derive Fourier sine transform of } \varphi(x) = \frac{x}{1 + x^2} \quad (15)$$

- b) Define discrete Fourier transform. Find the inverse DFT of $X(k) = \{1, 2, 3, 4\}$ (15)

Section B

(Answer ANY TWO questions from this section in Script B)

4. a) Write down the assumption for the validity of Fourier series expansion. Obtain the Fourier series of the function $f(x) = x \sin x$ in the interval $-\pi < x < \pi$ and hence deduce that

$$\frac{\pi}{4} = \frac{1}{2} + \frac{1}{1.3} - \frac{1}{3.5} + \frac{1}{5.7} - \dots \quad (18)$$

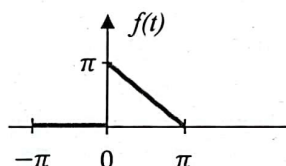
- b) Using Fourier integral formula show that,

$$e^{-x} \cos x = \frac{2}{\pi} \int_0^{\infty} \frac{(u^2 + 2) \cos ux}{u^2 + 4} du \quad (12)$$

5. a) Determine whether the following function is even, odd or neither:

$$f(x) = \begin{cases} x^2; & -1 < x < 0 \\ -x^2; & 0 \leq x < 1 \end{cases} \quad \text{Verify your answer with its graph.} \quad (12)$$

- b) A periodic function has the following graph over its period:



Describe the function mathematically and hence find its Fourier series up to 3rd harmonics at least. (18)

6. a) Using Laplace Transform and Inverse Laplace Transform solve the differential equation:

$$y'' + y = f(t); y(0) = 1, y'(0) = 0$$

$$\text{where, } f(t) = \begin{cases} 1; & 0 \leq t < \frac{\pi}{2} \\ \sin t; & t \geq \frac{\pi}{2} \end{cases} \quad (18)$$

- b) Find the Laplace transform of

$$q(t) = te^{2t} \sin 6t + u(t - t_0)$$

where $u(t - t_0)$ is unit step function. (12)

ECE 2115
Digital Electronics and Logic Design

Time: 1 Hour 30 Minutes

Full Marks: 120

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

Section A

(Answer ANY TWO questions from this section in Script A)

1. a) Calculate the binary equivalent of $2/3$ out to eight places. Then convert from binary to decimal. How close is the result to $2/3$? (10)
- b) A and B are integer variables in a computer program with $A = (25)_{10}$ and $B = -(46)_{10}$. Assuming that the computer uses 8-bit 2's complement arithmetic, show how it would compute $A + B$ and $A - B$. (10)
- c) Find the complement of the following Boolean function and reduce this complement function to a minimum number of literals: (10)

$$F = [(AB)'A][(AB)'B]$$
2. a) Determine the base of the numbers for the following operations to be correct: (08)

$$24 + 17 = 40$$
- b) Simplify the following Boolean function using Karnaugh's map: (10)

$$F(A, B, C, D) = \sum(0, 2, 4, 5, 6, 7, 8, 10, 13, 15)$$
- c) Design a combinational circuit that accepts a bit BCD number and generates an output binary number same as the excess-3 code of corresponding BCD number. (12)
3. a) What is decoder? Show that a full adder circuit can be implemented with a decoder and two OR gates. (10)
- b) Implement the following Boolean function with a multiplexer: (10)

$$F(A, B, C, D) = \sum(0, 2, 5, 7, 11, 14,)$$
- c) Design a combinational circuit using a ROM. The circuit accepts a 2-bit number and generates an output binary number equal to the multiple of 2 of the input number. (10)

Section B

(Answer ANY TWO questions from this section in Script B)

4. a) What is mean by sequential logic circuits? How does it differ from combinational circuits? (08)
- b) How can you overcome 'race around' condition? Design a RS flip flop using NOR gate which operates when clock = 1 and draw its characteristics table with proper explanation. (12)
- c) Construct a Johnson counter with 06 timing signals. (10)
5. a) Design a synchronous counter that will count 3-5-8-10-14 and repeat using JK flip flop. (14)
- b) Illustrate the tristate output configuration of Transistor Transistor Logic (TTL) gates with appropriate circuit diagram and truth table? (09)
- c) Draw the internal structure of Random Access Memory (RAM) with detailed circuit logic analysis. (07)
6. a) A sequential circuit diagram is shown in Figure 6(a) below. Draw the state diagram of the given circuit. (20)

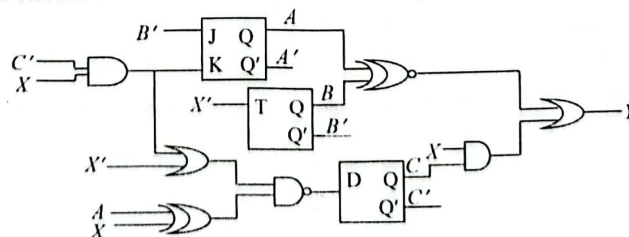


Figure 6(a)

- b) What is state reduction? Can you reduce the total number of states of the state diagram obtained from Figure 6(a) above? If possible justify the state reduction table for an input sequence of 0011010110. (10)