KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
Department of Mechatronics Engineering
B. Sc. Engineering 1st Year 2nd Term Examination, 2021

Ph 1231
(Physics)

Time: 3 Hours | Total 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) Assume reasonable data if any missing.

SECTION-A

1(a) Derive Coulomb's law from Gauss' law. Derive an expression for the electric field due to a non-conducting sheet of charge using Gauss's law. 13

1(b) What is an electric dipole? If an electric dipole is placed in a uniform electric field then prove that the torque on the dipole $\vec{\tau} = \vec{P} \times \vec{E}$ and its potential energy $U = -\vec{P}.\vec{E}$ where the symbols have their usual meanings. 12

1(c) A 3.55 μF capacitor is charged to a potential difference 6.30 V using a battery. The battery is then removed and the capacitor is connected to an uncharged 8.95 μF capacitor until the capacitors have the same potential difference V. What is V? 10

2(a) What is Wheatstone Bridge? Prove the Wheatstone principle. 12

2(b) State Ampere's law. Applying Ampere's law, obtain an expression for the force per unit length between two parallel current carrying conductors. 13

2(c) Two coils are at fixed locations. When coil 1 has no current and the current in coil 2 increases at the rate 15.0 A/s, the emf in coil 1 is 25 mV. What is their mutual inductance? When coil 2 has no current and coil 1 has a current of 3.60 A, what is the flux linkage in coil 2? 10

3(a) Define the magnetic permeability, magnetic susceptibility and magnetic induction. Prove that $\mu_r = 1+\chi$ and hence show that $B = \mu_0(1+\chi)H$. 12

3(b) Describe the formation and significance of the hysteresis loop and explain the terms hysteresis, retentivity, coercivity, and hysteresis loss. 13

3(c) An iron rod of 85 cm long and 3 mm^2 cross-section is placed in a long solenoid of 38 turns cm^{-1} carrying a current of 2.7 A. The rod gains a magnetization of 14.5×10^5 A/m. Determine the magnetic moment, susceptibility, and the magnetic field. 10

4(a) What is telephoto lens? Discuss the importance of a telephoto lens. 10

4(b) Discuss the constructional details and working principle of Galileo's telescope and obtain an expression for the magnification factor $M = \frac{F}{f}(1 - \frac{f}{D})$ where the symbols have their usual meanings. 15

4(c) A compound microscope has lenses of focal lengths 1 cm and 3 cm. An object is placed 1.2 cm from the object lens when a virtual image is formed at a distance of 25 cm from the eye-piece. Calculate the separation of the lenses and the resultant magnification of the microscope. 10

SECTION-B

5(a) What is SHM? Show that simple harmonic motion is an oscillatory motion. 10

5(b) Show that total energy of a particle executing simple harmonic remains constant throughout and is proportional to the square of the amplitude of the motion. 15

5(c) The force and displacement of a simple dynamic system undergoing sinusoidal excitation is given by the following equations 10

$$F = 10\ Sin\ (\frac{\vec{u}t}{10})N$$

$$y = 0.10\ Sin\ (\frac{\vec{u}t}{10} - \frac{\vec{u}}{3})m$$

Calculate the work done by the excitation force in i) 20s and ii) 120s.

6(a) What is a plane progressive wave? Show that the energy density of a plane progressive wave is given by $E=2\pi^2\rho n^2a^2$, where the symbols have their usual meanings. 12

6(b) What is stationary wave? Discuss analytically the formation of stationary waves when reflection occurs at a free boundary. Why are they referred to as stationary waves? 13

6(c) Car sounding a horn producing a note of 500Hz, approaches and then passes a stationary observer at a steady speed of $20ms^{-1}$. What will be the frequencies apparent to the observer when the car is (i) approaching and (ii) receding? (velocity of sound=$340ms^{-1}$) 10

7(a) What is doping? Explain briefly p-type and n-type semiconductors. 12

7(b) Discuss the behavior of a p-n junction under forward and reverse biasing. 13

7(c) For a class-A amplifier $V_{CE(max)} = 25V$, $V_{CE(min)} = 5V$, $V_{CC} = 30\,V$. Find its overall efficiency. 10

8(a) Write down the properties of LASER. Mention some applications of LASER. 10

8(b) What is population inversion? Discuss the constructional details and working principle of a ruby LASER. 15

8(c) The coherence length for sodium light $2.945\times10^{-2}m$. the wavelength of sodium light is 5890Å. Calculate (i) the number of oscillations corresponding to the coherence length and (ii) the coherence time. 10

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KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
Department of Mechatronics Engineering
B. Sc. Engineering 1st Year 2nd Term Examination, 2021

ME 1231
(Manufacturing Processes)

Time: 3 Hours Total 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) Assume reasonable data if any missing.

SECTION-A

1(a)	What is meant by manufacturing process? Discuss its importance in Mechatronics Engineering.	08
1(b)	What are the objectives of a pattern? Compare and contrast between removable and disposable pattern.	10
1(c)	Explain the sand-casting procedure with neat sketch.	10
1(d)	Describe the significance of shrinkage allowance in casting.	07
2(a)	Describe the complete step by step procedure of lost wax casting. What are the disadvantages of lost wax casting?	10
2(b)	Enumerate some common casting defects and explain the reasons which cause these defects.	10
2(c)	How does permanent mold casting differ from die casting? Briefly explain the semi-centrifugal casting.	10
2(d)	Differentiate between welding, soldering, and brazing.	05
3(a)	Explain the principle of arc welding process.	10
3(b)	Why flux is used in arc welding electrode? What are various elements used in flux coating? Explain their functions.	10
3(c)	Briefly describe the procedure of EBW with neat sketch.	08
3(d)	Sketch the three types of gas welding flames and give differences between them.	07
4(a)	What is the significance of recrystallisation temperature in metal forming process? Explain.	08
4(b)	Write short notes on the following terms: i) Drawing, ii) Blanking, iii) Coining, iv) Punching	12
4(c)	Explain the principle of extrusion process with neat sketch.	10
4(d)	How cold working process differ from hot working process?	05

SECTION-B

5(a) What is metal cutting? What are the factors affecting metal cutting?

5(b) Draw a single point cutting tool and label it properly. What is meant by tool signature 10-18-8-6-7-15-1/32?

5(c) Describe different types of chips formed in metal cutting with neat sketches. 08

5(d) Develop a relationship between rake angle and shear plane angle in the case of orthogonal cutting. 09

6(a) What is the importance of machining process? Describe five operations that can be performed in lathe machine with necessary figures. 13

6(b) Why quick return motion is provided in shaper and planer machine? Describe the quick return mechanism with neat sketch. 10

6(c) What is indexing? Classify the various indexing methods and explain any one of them. 12

7(a) Explain the need for the use of modern machining process compared to conventional ones. 08

7(b) Describe the working principle of EDM with neat sketch. Write down the functions of dielectric fluid in EDM process. 15

7(c) Describe the working procedure of USM with necessary diagram. Mention its advantages and disadvantages. 12

8(a) How does CNC machine work? Compare between 3-axis and 5-axis CNC machine. 10

8(b) Explain the stages of manufacturing of a plastic bottle with necessary diagram. 10

8(c) What is meant by PCB? Explain its importance in the field of Mechatronics Engineering. Briefly describe the PCB fabrication process with neat sketch. 15

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KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY

Department of Mechatronics Engineering

B.Sc. Engineering 1st Year 2nd Term Examination, 2021

Math 1231

(Vector, Matrix and Ordinary Differential Equation)

Time: 3.00 Hrs. Total 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

1(a) Define linearly dependent and independent of vectors. Test the vectors $\underline{A} = 2\underline{i} + \underline{j} - 3\underline{k}$, $\underline{B} = \underline{j} - 4\underline{k}$, $\underline{C} = 4\underline{i} + 3\underline{j} - \underline{k}$ are linearly dependent or independent. 10

1(b) Find the equations of tangent plane and normal line to the surface $z = x^2 + y^2$ at the point $(1, -1, 2)$. 15

1(c) Find the directional derivative of $\phi = 4xz^3 - 3x^2y^2z$ at $(2, -1, 2)$ in the direction $2\underline{i} - 3\underline{j} + 6\underline{k}$. 10

2(a) If $\underline{A} = (2y + 3)\underline{i} + xz\underline{j} + (yz - x)\underline{k}$, evaluate $\int_c \underline{A}.d\underline{r}$ along the following path c: The straight lines from (0,0,0) to (0,0,1), then to (0,1,1), and then to (2,1,1). 10

2(b) Evaluate $\iint_s \phi \underline{n} ds$ where $\phi = \frac{3}{8}xyz$ and s is the surface of the cylinder $x^2 + y^2 = 16$ included in the first octant between $z = 0$ and $z = 5$. 11

2(c) Verify divergence theorem of Gauss for the problem $\iint_s \underline{F}.\underline{n} ds$, where $\underline{F} = 4xz\underline{i} - y^2\underline{j} + yz\underline{k}$ and s is the surface of the cube bounded by $x = 0, x = 1, y = 0, y = 1, z = 0, z = 1$. 14

3(a) Define orthogonal matrix, Hermitian matrix and involuntary matrix with examples. 09

3(b) Write the matrix $A = \begin{bmatrix} 1 & 2i-1 & 3i \\ 5i & -i & 6i+1 \\ 7 & 8 & 2i \end{bmatrix}$ as the sum of a Hermitian and skew-Hermitian matrices. 14

3(c) If possible, find the inverse of the matrix $A = \begin{bmatrix} 2 & -1 & 3 \\ 5 & 4 & -7 \\ 1 & 0 & 6 \end{bmatrix}$ by elementary transformations. 12

4(a) Determine the value of k so that the following system has (i) a unique solution, (ii) no solution, and (iii) infinite number of solutions, where 12

$$x + y - z = 1$$
$$2x + 3y + kz = 3$$
$$x + ky + 3z = 2$$

4(b) Show that the matrix A satisfies its own characteristic equation. Hence find A^{-1}, where 12

$$A = \begin{bmatrix} 1 & -2 & 1 \\ 1 & -2 & 3 \\ 0 & -1 & 2 \end{bmatrix}$$

4(c) Reduce the matrix A into canonical form and hence find its rank, where 11

$$A = \begin{bmatrix} 1 & 2 & 3 & 2 & 1 \\ 3 & 1 & -5 & -2 & 1 \\ 7 & 8 & -1 & 2 & 5 \end{bmatrix}$$

SECTION-B

5(a) Define order and degree of differential equation with example. Form a differential equation of the family of curves $xy = ae^x + be^{-x} + x^2$, where a and b are arbitrary constants. Hence determine its order and degree. 12

5(b) Define homogenous differential equation. Solve $(2x - 6y + 3)dx - (x - 3y - 1)dy = 0$ 13

5(c) Find the value of k so that the given differential equation is exact. Hence, find its solution 10

$$(y^3 + kxy^4 - 2x)dx + (3xy^2 + 20x^2y^3)dy = 0$$

6(a) Define integrating factor. Find an integrating factor of $(xy^2 sinxy + ycosxy)dx + (x^2 ysinxy - xcosxy)dy = 0$. Hence find the general solution of the given differential equation. 13

6(b) Solve $(x - ycosx)dx - sinxdy = 0, y(\frac{\pi}{2}) = 1.$ 10

6(c) A body of temperature 80°F is placed in a room of constant temperature 50°F at time $t = 0$. At the end of 5 minutes, the body has cooled to a temperature of 70°F. Find the temperature of the body at the end of 10 minutes. After how many times, the temperature of the body will be within 1°F compared to the room temperature? 12

7(a) Solve $y'' - 2y' - 3y = x + e^{-x} + sin2x$ using the undetermined coefficient method. 12

7(b) Solve $y'' + y = secx; y'' = \frac{d^2y}{dx^2}$ 13

7(c) Identify and solve $(x^2D^2 - xD + 4)y = \cos(logx) + xsin(logx); D = d/dx$ 10

8(a) Solve $(D^3 - 7D - 6)y = x^2e^{2x}$ 12

8(b) Solve $(D^2 - 4D + 4)y = 3x^2e^{2x}sin2x$ 13

8(c) Solve $\frac{dy}{dx} = \sin(x + y) + \cos(x + y)$ 10

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KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
Department of Mechatronics Engineering
B. Sc. Engineering 1st Year 2nd Term Examination, 2021

HUM 1231
(Technical and Communicative English)

Time: 3 Hours Total 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

1(a) Make sentence with the following structures using the words given in brackets. 14
i. Subj. + Linking verb + Adj. Complement. (Look as verb)
ii. Subj. + Transitive verb + Object. (Deliver as verb)
iii. What + Subj. + Verb + Adv. of Manner + Verb + Adj. Complement. (Say and is as verb)
iv. Since + Subj. + Verb + Adj. Complement, Subj + Verb + Object. (is and hate as verb)
v. Though + Subj. + Verb + Adj. Complement, Subj. + Verb + Adv. (is and succeed as verb)
vi. Subj. + Verb + not only + object + but also + obj. (write as verb)
vii. Neither + Subj.+ nor + Subj. + Verb + Adv. of place. (progress as verb)

1(b) Change the following words as directed and make sentences with the changed forms: 12
Debate (into adj.), economic (into verb), envy (into adv.), strengthen (into adv.), deceive (into noun), moist (into verb)

1(c) Make a new word with the following prefixes and suffixes and use the new word in sentence. 09
Ab_____, Be_____, Im_____, _____ment, _____ish, _____ate.

2(a) Transform the following sentences as asked in brackets. 14
i. That he speaks sweetly is really nice. (Simple)
ii. We entitle the poem what the theme carries. (Simple)
iii. John, an engineer, works in London. (Complex)
iv. He has not come in meeting because of his illness. (Complex)
v. We left the meeting before his reaching in the meeting. (Complex)
vi. Shihab is as nice in behavior as other boys in the class. (Superlative)
vii. Soma being lazy can't complete her course in time. (Compound)

2(b) Make use of the following words in sentence as asked in brackets. 12
Cloud (as verb), Above (as adv.), All (as adv.), Tea (as adj.), Pen (as verb), Table (as verb)

2(c) Write two synonyms for the words given below and use the synonyms in sentence. 09
Industrious, Sincerity, Liberty

3(a) Make wh question with the underlined words of the following sentences. 14
i. Shila read <u>a book.</u>
ii. Bipu reads a book <u>to enrich her knowledge.</u>
iii. Sabuj is <u>five feet and six inches</u> tall.
iv. Habib runs his car <u>at high speed</u>.
v. The pond is <u>ten feet</u> deep.
vi. He comes in class <u>from hall</u> every day.
vii. Liza has been living in this town <u>for ten years</u>.

3(b) Complete the sentences with subordinate clauses:

i) We work _____ (adv. clause of purpose)
ii) _____ remains a mystery (Noun clause)
iii) _____, I would go there (adv clause of condition)
iv) This is the building _____ (adj. clause)
v) I believe _____ (Noun clause)
vi) This is my brother _____ (adj. clause)

3(c) Make sentences using the following phrases and idioms. 09

Beat around the bush, On cloud nine, Boil the ocean, Fair and square, Give it a whirl, Crying wolf.

4(a) Correct the following sentences. 14

i. Rupsha express will arrive at Khulna at 8.30 pm
ii. He got the poem by the heart.
iii. Since he tries heart and soul, he can't succeed in life.
iv. I and you must your work.
v. My all books are lost.
vi. Ruba, works in London who, is doctor a.
vii. This is a faithful report.

4(b) Express the following notions/functions in sentence. 12

i. Love, ii. Determination, iii. Honesty, iv. Thrilling, v. Happiness, vi. Annoyance.

4(c) Make use of the following modals in sentence as asked in brackets. 09

i. May. (To express uncertainty)
ii. May. (To express a polite request)
iii. Could. (To express a past ability)
iv. Would rather (To express preference)
v. Had better (To express propriety at present)
vi. Should (To express propriety)

SECTION-B

5(a) If you think of the jobs robots could never do, you would probably put doctors and teachers at the top of the list. It's easy to imagine robot cleaners and factory workers, but some jobs need human connection and creativity. But are we understanding what robots can do? In some cases, they already perform better than doctors at diagnosing illness. Also, some patients might feel more comfortable sharing personal information with a machine that a person. Could there be a place for robots in education after all? 20

British education experts think that robots will takeover of the classroom 2027. He predicts robots will do the main job of transferring information. Intelligent robots will read students' face, movements, and even brain signals. Then they will adapt the information to each student. It's not a popular opinion and it's unlikely robots will ever have empathy and the ability to really connect with humans like another human can. One thing is certain, though. A robot teacher is better than no teacher at all.

In some parts of the world, there aren't enough teachers. That problem could be partly solved by robots because they can teach anywhere and won't get stressed, or tired, or move somewhere for an easier, higher-paid job.

Those negative aspects of teaching are something everyone agrees on. Teachers all over the world are leaving because it is a difficult job and they feel overworked. Perhaps the question is not 'Will robots replace teachers?' but 'How can robots help teachers?' Office workers can use software to do things like organize and answer emails, arrange meetings and update calendars. Teachers waste a lot of time doing non-teaching work. If robots could cut the time teachers spend marking homework and writing reports, teachers would have more time and energy for the parts of the job humans do best.

Read the above passage and answer the questions:

i) Why would some patients feel more comfortable taking to a robot than a person?
ii) How can robots contribute to education?
iii) What are the differences between robots and human beings?
iv) Would you like to have a robot as a teacher?

b)	Make a precis of the above passage with a title.	15
6(a)	Write a cause and effect paragraph on providing students with unlimited access to internet.	20
6(b)	You had been to a five star restaurant with your friends where you found an African woman was not served as other customers. Write an email to the authority to inform about the racial discrimination you witnessed that evening.	15
7(a)	Write a report about the sports day, you recently celebrated in your campus.	20
7(b)	PennWest California Mechatronics industry is looking for a trouble shooting engineer. Prepare your CV and apply for the post.	15
8	Write a free composition on Mental Health.	35

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KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
Department of Mechatronics Engineering
B. Sc. Engineering 1st Year 2nd Term Examination, 2021

CSE 1231
(Computer Programming)

Time: 3 Hours | Total 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) Assume reasonable data if any missing.

SECTION-A

1(a) What do you mean by structured programming? Is C programming an example of structured programming? Justify your answer. 07

1(b) Discuss about 4 basic data types. How could you extend the range of values they represent? 07

1(c) What are the control structures in the C programming language? Explain with appropriate examples. 08

1(d) Write a C program to check whether a number is palindrome or not. 07

1(e) Write a C program to find the GCD & LCM of a given number by using switch case. 06

2(a) Explain how a else-if ladder works with proper example. 08

2(b) Write a program to count total number of even and odd elements in an array. 12

2(c) Observe the following program: 07

```
int main () {
    int x=101;
    int y=201;
    ++x;
    inf a= ++(x+y);
    printf ("a=%d",a); }
```

What will be output of this program?

2(d) Create a C program to delete duplicate elements from array. 08

3(a) A function can be categorized depending on argument and return type-Explain this term with proper examples. 10

3(b) Write a recursive function named decimal-octal which can convert the decimal number to octal number. 10

3(c) Describe what task perform of the following functions 10
i) fseek (), ii) rewind (), iii) feof (), iv) putw ().

3(d) Write a C program to copy the content of one file to another. 05

4(a) Write a C program to store the information of a student (including roll, marks, grade) in a file and find the size of that file. 12

4(b) Briefly describe the elements of OOP with appropriate examples. 15

4(c) Explain the class specifications in C++. 08

SECTION-B

5(a) Explain the difference between postifix and prefix of increment operator with example. 08

5(b) Write the output of the following code segment 06

```
void main () {
    int r = 2, i;
    while (r--) {
    for (i=2; i<10; i=i+2)
    if (i%4)
    printf ("%d \n", i); }}
```

5(c) Admission to a professional course is subject to conditions: 15

i) Marks in mathematics > = 60
ii) Marks in physics > = 50
iii) Marks in chemistry > = 40
iv) Total in all three subjects > = 200
or
Total in mathematics and physics > = 150
Given the marks in the three subjects, write a program to process the applications to list the eligible candidates.

5(d) What is Automatic type conversion? How can you perform the casting operation of a variable? 06

6(a) Which operations are valid in string data using normal operators? How can you perform this operations explain with examples. 12

6(b) "All character arrays are not string but all strings are character arrays". Justify the statement with examples. 10

6(c) What is the limitations of using scanf function for reading string? Write the necessity of atoi () function. 08

6(d) Write the output of the following code segment 05

```
void main () {
    int m=12, n;
    float y=3;
    char ch= 'A';
    printf ("%f \n", m/y);
    printf ("%d \n", ++m-10/3 +ch);
    printf ("%d \n", (m<n)? m++: --m);
    printf ("%c \n", ch+2);
    printf ("%d \n", -ch); }
```

7(a) What is pointer? How is a pointer initialized? Write the importance of using pointer. 15

7(b) Write a program that will take a list of data using pointer and print these data in reverse order and sum the data using a pointer. 10

7(c) Write the output of the following code segment 10

```
main () {
    int a, b, *p1, *p2, x, y, z;
    a=12; b=4; p1 = &a; p2 = &b;
    x=*p1 *  * p2 -5;
    y=5*   -*p2 /  * p1  +10/3;
    printf ("%d  %d  %d  %d", a, b, x, y);
    *p1 =*p1 ++;  *p1 =*p1 -5;
    z =*p1  *     *p2 -4;
    printf ("z=%d", z); }
```

) What are the techniques of passing structure variable as arguments? Write the basic difference between struct and union with examples. 15

8(b) Suppose a person has the following attributes 12

Name, SID, Address, Phone

Write a program using union to take inputs of N number of persons and display their information.

8(c) Differentiate between structures and union with examples. 08

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