KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY

Department of Mechanical Engineering

B.Sc. Engineering **1st** year **1st** Term Examination, **2025**

Math 1105

(Mathematics I)

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) Define continuous fuction. Find the values of a and b such that the function, 13

$$f(x) = \begin{cases} x + \sqrt{2}\ asinx, & for\ 0 \le x \le \frac{\pi}{4} \\ 2x\ cotx\ + b, & for\ \frac{\pi}{4} < x \le \frac{\pi}{2} \\ a\ cos2x\ -\ b\ sinx, & for\ \frac{\pi}{2} < x \le \pi \end{cases}$$

is continuous for all values of x within $0 \le x \le \pi$

1(b) A function f(x) is defined as 12

$$f(x) = \begin{cases} x, & for\ 0 < x < 1 \\ 2 - x, & for\ 1 \le x \le 2 \\ x - \frac{1}{2}x^2, & x > 2 \end{cases}$$

1(c) If $y = e^{(sin^{-1}x)^2}$ and $z = (sinx)^{tanx}$, find the value of $\frac{dy}{dz}$ 10

2(a) Expand $e^x sinx$ in the power of x. 10

2(b) State Leibnitz's theorem and use it to find a relation connecting y_n, y_{n+1} and y_{n+2}, where $y = sin(mcos^{-1}x)$. 12

2(c) Find the values of a and b, so that $\lim_{x\to 0} \frac{x(1+a\ cosx) - bsinx}{x^2} = 1$ 10

2(d) Define homogeneous function with example. 03

3(a) State Rolle's theorem and verify it for the function $f(x) = (x+2)(x+3)(x-2)$ *in* $-3 \le x \le 2$. 12

3(b) Define maxima of a function at a point. Also find extreme values if exist for the function $f(x) = 3\ sinx + 4\ cosx$ in $0 \le x \le \pi/2$. 12

3(c) If $u(x,y) = y^2 f(x/y) + y\varphi(x/y)$, then find the value of 11

$$x^2\frac{\partial^2 u}{\partial x^2} + 2xy\frac{\partial^2 u}{\partial x \partial y} + y^2\frac{\partial^2 u}{\partial y^2}$$

4(a) Find the equation of tangent to the parabola $y^2 - 4x - 5 = 0$ which is parallel to the straight line $2x - y - 3 = 0$. Also find the equation of normal at that point. 11

4(b) Define asymptote for a curve. Find all possible asymptotes for the curve $x^3 - 2x^2y + xy^2 + x^2 - xy + 5 = 0$. 12

4(c) Find the radius of curvature of the curve $\sqrt{x} + \sqrt{y} = \sqrt{a}$ at the point where the straight line $x = y$ cuts it. 12

SECTION – B

5(a) Evaluate the integrations, 12

i) $\int(\sqrt{tanx} + \sqrt{cotx})\,dx$; ii) $\int \frac{dx}{(x-3)\sqrt{x^2-6x+8}}$

5(b) Obtain the reduction formula for $\int cos^m x\, cosnx\, dx$ and hence find the value of $\int cos^5 x\, cos7x\, dx$. 13

5(c) Find the value of $\int e^x\{f(x) + f'(x)\}dx$, and evaluate $\int \left\{\frac{1}{logx} - \frac{1}{(logx)^2}\right\} dx$. 10

6(a) Define the integration of a function f(x) within $a \le x \le b$ as the limit of a sum. Also find the value of $\lim_{n\to\infty}\left(\frac{n}{n^2+1^2} + \frac{n}{n^2+2^2} + \ldots\ldots\ldots + \frac{n}{n^2+n^2}\right)$. 10

6(b) Calculate the value of $\int_0^{\pi} \frac{dx}{1-2acosx+a^2}$, according as a>1 or a<1. 13

6(c) State the fundamental properties of definite integration, and derive the integration $\int_0^1 \frac{log(1+x)}{(1+x^2)}\,dx$ by using the properties. 12

7(a) Define improper integral and classify the category of the following improper integrals. 12

i) $\int_0^{\infty} \frac{xdx}{x^4+x^2+1}$; ii) $\int_0^1 \frac{sin\,tx}{x}\,dx$

7(b) Evaluate $\int_0^{\infty} e^{-y^{1/n}}\,dy$ and hence derive the value of $\int_0^{\infty} e^{-y^2}\,dy$. 12

7(c) Define Gamma and Beta functions and use them to evaluate $\int_0^1 x^2(1-x^3)^{3/2}\,dx$. 11

8(a) Find the area enclosed between the curve $xy^2 = 4a^2(2a - x)$ and its asymptote. 10

8(b) Find the area of the largest portion of the region bounded by the curves, $x^2 + y^2 = 5$ and $y^2 = 4x$. 12

8(c) Find the volume and surface area of the solid generated by revolving the curve $x = a(\theta + sin\theta)$, $y = a(1-cos\theta)$ around x-axis. 13

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY

Department of Mechanical Engineering

B.Sc. Engineering **1st** year **1st** Term Examination, **2025**

Ch 1105

(Engineering Chemistry)

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)	Describe the molecular structure of natural rubber. How does cis-1, 4-polyisoprene contribute to elasticity?	10
1(b)	Compare crude rubber and vulcanized rubber in terms of structure, properties and engineering applications.	10
1(c)	What are the major steps in rubber compounding? Explain the role of fillers, plasticizers, accelerators, reinforcing agents and antioxidants.	10
1(d)	Crically analyze why rubber is an excellent materials for tire performance?	05
2(a)	Describe the manufacturing steps of synthetic fibres using the spinning process.	10
2(b)	Compare melt spinning and solution spinning processes of polymer material.	10
2(c)	Discuss the concept of molecular weight of polymers in terms of weight average molecular weight.	10
2(d)	Calculate the number average molecular weight of polymer sample containing equal number of particles with molecular weight 20000 and 22000.	05
3(a)	Why plastic materials are resistant to acids, alkalis, oils and water?	05
3(b)	Critically analyze why plastics are widely used for engineering component despite having lower strength compared to metals and ceramics.	07
3(c)	Explain the role of following additives in modifying plastic properties. i. Dye's and pigments ii. Lubricants iii. Plasticizers.	12
3(d)	Describe compression moulding process for manufacturing plastic materials.	11
4(a)	Describe the various steps of the fabrication of ceramic wares.	13
4(b)	What is silica? What are the different forms of silica?	10
4(c)	Describe the industrial uses of different types of glasses.	12

SECTION – B

5(a) Illustrate the electrochemical mechanism of rusting os iron including the reactions at the anode and cathode. 09

5(b) Why does corrosion occur on a metal surface at the adjacent to the gap of two joining surface? Explain the detail mechanism and the prevention of this type of corrosion. 10

5(c) What are the effects of dissove salts on the rate of underwater corrosion? 08

5(d) Explain the principle involved in impressed current cathodic protection method of prevention of corrosion. 08

6(a) Write down the essential differences between lyophilic and liophobic colloid. 07

6(b) "A sol is coagulated by adding a little amount of an electrolyte whereas a gelatin roll is unaffected"- explain this statement. 10

6(c) What is critical micelle concentration? Discuss the formation of micelles and their applications in detergency and nano-emulsion technologies. 10

6(d) Explain the dialysis method for the purification of sol. 08

7(a) What is meant by electrical double layer? Discuss the origin of charge on sol particles. 13

7(b) How are the metal surfaces prepared for the applications of protective coating? 12

7(c) Mention the important process parameters for the manufacturing of a good cement clinker. 10

8(a) Write down the functions of water line and SO_2 for the manufacturing process of sugar. 10

8(b) Briefly describe the urea production process with the flow diagram using NH_3 and CO_2 as the basic raw materials in the total recycle process. 13

8(c) Expain the Kraft pulping process for the manufacturing of pulp. 12

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY

Department of Mechanical Engineering

B.Sc. Engineering 1st year 1st Term Examination, **2025**

ME 1105

(Thermal Engineering)

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) Classify the major sources of energy. Write short note on the share of total primary energy of Bangladesh. 10

1(b) Describe the ways by which solar energy can be converted into mechanical energy. Also draw a prospect of hydropower for power generation in Bangladesh. 13

1(c) Explain the energy harvesting techniques of Geothermal and Tidal energy. 12

2(a) Define pure substance. Explain the different phase of steam formation from water with necessary diagrams. 11

2(b) Derive an expression of enthalpy, external work and internal energy for the different condition of steam. 10

2(c) Find the internal energy of 1 kg of steam at 20 bar in the following cases: 14
i. When the steam is wet having a dryness fraction of 0.9, and
ii. When the steam is superheated and its temperature is 400°C. Assume the specific heat of superheated steam is as 2.1 kJ/kg.K.

3(a) Mention the factors which should be considered for the selection of a boiler. Differentiate water tube boiler from fire tube boiler. 10

3(b) Draw a forced circulation, high pressure boiler and explain its working principle. 11

3(c) Interpret the importance of integrating the safety valve with a steam boiler. Briefly describe its working princliple. 10

3(d) List out the major components of a coal based power plant. 04

4(a) Explain why air preheaters are used in a high pressure boiler. How do mountings differ from accessories of a boiler? 09

4(b) Define equivalent evaporation and boiler efficiency. Enlist the various losses occurred in a boiler with their equations. 10

4(c) The following data were obtained from a boiler trial: 16
Generation of steam = 4500 kg/hr, coal used = 570 kg/hr, calorific value of coal = 32000 kJ/kg, steam pressure = 15 bar, temperature of feed water entering the economizer = 25°C, temperature of water entering the boiler = 120°C, dryness fraction of steam entering the superheater = 0.93, temperature of steam from the superheater = 312°C. Determine
i) Equivalent evaporation;
ii) Overall efficiency of the plant;
iii) Percentage of the available heat utilized in the boiler, economizer and superheater, respectively.

SECTION – B

5(a) Interpret the requirements of a good fuel. Compare the merits and demerits of liquid fuels over solid fuels. 07

5(b) Define the HCV and LCV. Explain the process of determining higher calorific value of liquid fuel. 10

5(c) For the combustion of fuel, write down the equations of combustion by mass for the followings: 06

i) Complete combustion of carbon (C) to carbon dioxide (CO_2);
ii) Burning of sulphur (S) to sulphur dioxide (SO_2), and
iii) Burning of marsh gas (CH_4).

12

5(d) A fuel oil has following analysis by mass:
C 85%, H_2 12.5%, O_2 2% and the residue 0.5%.
The dry flue has the following composition by volume:
CO_2 9%, CO 1%, O_2 7.77% and N_2 82.23%.
Determine per kg of fuel oil:

i. The minimum air required for the combustion.
ii. Actual air supplied, and
iii. The excess air supplied and the air-fuel ratio.

6(a) Differentiate two-stroke and four-stroke cycle engines. 05

6(b) Explain the working principle of four stroke cycle petrol engine with neat sketch. Also mention the valve timing diagram of it. 11

6(c) Write short note on the followings for IC engine: 09
i). Scavenging; ii) Detonation; iii) Lubrication.

6(d) With neat sketches, explain the working principle of close cycle gas turbine. How does close cycle gas turbine differ from open cycle gas turbine? 10

7(a) Interpret the properties of good refrigerants. Define the terms of tonne of refrigeration and COP of the refrigeration. 08

7(b) With the neat sketches, describe the working principle of vapour compressor refrigeration (VCR) system. Also show the effect on COP by superheating refrigerant vapour before compression and subcooling after condensation take place in VCR cycle. 12

7(c) Draw the vapour absorption refrigeration (VAR) system. How does VCR system differ from VAR system? 08

7(d) Write short note on: 07
i) Expansion valve; ii) Rectifier; iii) Analyzer.

8(a) "Human comfort is the condition of mind which express the satisfaction with the thermal environment"- Justify your answer. 07

8(b) Describe the working principle of summer air conditioning system. 10

8(c) Interpret the reasons for increasing the demand of air conditioner usage now-a-days. Also write the advantages of year round air conditioning system. 08

8(d) Describe the working principle of an Orsat apparatus which is used for flue gas analysis. 10

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
Department of Mechanical Engineering
B.Sc. Engineering **1st** year **1st** Term Examination, **2025**
Hum 1105
(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.
iii) Assume reasonable data if any missing.

SECTION – A

1(a) Make sentences with the following structures using the words given in brackets. 14
i. Subj. + Intransitive verb + Adv. of Manner + Adv. of Place (serve as verb).
ii. Subj. + Transitive verb + Obj. (write as verb).
iii. That + Subj. + Verb + Adv. of Manner + Verb + Adj. Complement (speak and inspire as verb).
iv. Subj. + Verb + What + Subj. + Verb + Adv. of Manner (is and tell as verb).
v. Not only + Subj. + Verb + Obj., but also + Subj. + Verb + Adj. Complement (do and feel as verb).
vi. Subj., + Relative Pronoun + Verb + Adv. + Verb + Noun complement (work and is as verb).
vii. Since + Subj. + Verb + Obj., Subj. + Verb + Adj. Complement (write and feel as verb).

1(b) Make use of the following words in sentences as asked in brackets- 12
Ball (as verb), Live (as adv.), Mind (as verb), About (as adv.), Head (as verb), Tension (as verb).

1(c) Make new words with the following suffix, prefix and use it in sentence: De-, ~~Th~~, Ti 09
Oxi-, -fy, -ly, -ive.

2(a) Transform the following sentences as per instruction: 14
i. What Batman says inspires us certainly. (simple)
ii. Sheldon is the dumbest of all in the group. (comparative)
iii. Karen made me leave the place. (passive)
iv. No other mansion in the city is as large as this. (superlative)
v. We read to pass time. (compound)
vi. Nobody should pay ~~head~~ to rumor. (interrogative) → need
vii. Bangladesh is the most populated country. (comparative)

2(b) Change the following words as asked in the brackets and use the changed form in sentence: 12
Atrocity (into adj.), Tolerance (into adj.), Dissipate (into noun), International (into verb), Redemption (into verb), Bondage (into verb).

2(c) Write one antonym and one synonym for the words given below and use the antonym and synonym in sentence. 09
i) Devoted; ii) Elegant; iii) Dormant.

3(a) Make 'wh' question with the underlined word/words of the following sentences: 14
i. My name is Habib.
ii. It is a great thing in history.
iii. The road is five hundred miles.
iv. He wrote many interesting essays.
v. The girl is five feet and three inches tall.
vi. Saju weighs 65 kgs.
vii. I have forgotten his name.

3(b) Complete the following sentences with clause as asked in brackets. 12

i. ————————can't inspire us a little. (noun clause)
ii. Rajjakur Rahman,————————, is a lawyer. (adj. clause)
iii. ————————, he may do well in exam. (adv. clause)
iv. ————————, we will not support you. (adv. clause)
v. We can't allow you————————. (noun clause)
vi. ————————, we will continue our studies. (adv. clause)

3(c) Express the following notions/ functions in sentence. 09

i) Hatred; ii) Pessimism; iii) Appearance; iv) Courage; v) Separation; vi) Wonder.

4(a) Correct the following sentences: 14

i. Give the patient this medicine two times a day.
ii. The teachers are honorable men in society.
iii. He wrote us yesterday.
iv. Monir obtained full mark in the exam.
v. He hopes he will not pass.
vi. A deaf man can't listen to anything.
vii. They came and saw us.

4(b) Make use of the following model auxiliary verbs in sentence as asked in brackets. 12

i. Be + go + ing + to + base form of verb. (To express preparation)
ii. Would rather. (To express preference)
iii. Had better. (To express duty at present)
iv. Would. (To express a past irregular habit)
v. Should. (To express propriety)
vi. Must + have + past participle of verb. (To express logical deduction)

4(c) Make sentences with the following phrases and idioms. 09

i) Cold feet; ii) Snowed under; iii) Bite the bullet; iv) Pretty penny; v) Hang in there; vi) Call it a day.

SECTION – B

5(a) Read the following passage and answer questions. 20

Contemporary discussion on wildlife conversation increasingly reveals a tension between ecological ethics and human economic interests. While government and global institutions frequently promote protection policies, these initiatives often make deeper conflict about land use, sovereignty, and resource extraction. Wildlife is frequently treated as an abstract category-endangered species reduced to symbols of environmental virtue- rather than as part of complex ecosystems shaped by countries of human interactions. Conversation zones, for instance, may preserve biodiversity, yet they can also displace indigenous communities whose knowledge has sustained those environments long before modern environmentalism existed. Moreover, the rise of climate change introduces a new dimension of urgency: habitats transform faster than the current conversation models can adapt, leaving species to navigate disrupted migration patterns and fragmented ecosystems. In this context, human interventions such as consisted of migration or genetic rescue rise difficult questions about how far scientific authority should extend in "correcting" ecological decline. The critical challenge, therefore, lies in rethinking wildlife not as passive victim of human action but as part of a dynamic relational system. Only by acknowledging the socio-political dimensions of conservation can we begin to develop strategies that respect both ecological integrity and communities intertwined with those landscapes.

i. How is wildlife oversimplified in mainstream conservation narrations? (conversation)
ii. How can conservation policies conflict with local communities?
iii. Why does climate change intensify challenges to wildlife protection?
iv. What ethical issues emerge from scientific interventions in endangered species?

5(b) Write a precis on passage 5(a). 15

6(a)	Amplify the idea: Actions speak louder than words.	20
6(b)	Write a comparative paragraph: Virtual and Actual class.	15
7(a)	Write a report on "Online market in Bangladesh."	20
7(b)	Write a CV applying for the post of manager of "B" bank.	15
8(a)	Write free composition on one of the following: i. Gen-Z and Anti-Authority sentiment. ii. Earthquakes of Bangladesh.	35

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
Department of Mechanical Engineering
B.Sc. Engineering **1st** year **1st** Term Examination, **2025**
ME 1107
(Manufacturing Process)

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 the significance of manufacturing process? What factors need to be considered for good manufacturing? 10

1(b) Why is pattern allowance so important? Discuss different types of pattern allowances with neat sketches. 14

1(c) Explain gravity die casting with necessary features. 11

2(a) Write down the advantages and disadvantages of die casting over sand casting. 10

2(b) Explain in detail the steps of investment casting and discuss why it is used for complex and high-precision parts. 15

2(c) Write short note on: 10
i. Cope and Drag
ii. Gating system
iii. Core and core prints

3(a) Draw a welding zone in fusion welding and define related terms. 10

3(b) What are the key parameters for solid state welding? Explain a suitable solid state welding process. 13

3(c) Briefly discuss the metal cutting techniques using welding technology. 12

4(a) Write down the significance of recrystallization temperature in metal forming process. What are the purposes of metal forming processes? 10

4(b) Write down the functions of an electrode. How to read an electrode? Explain with example. 07

4(c) Interpret different types of extrusion processes with necessary sketches. 13

4(d) Why is metal spraying known as thermal spraying? Write down its possible applications. 05

SECTION – B

5(a)	Draw a single point cutting tool and show its different angles, edges and surfaces.	10
5(b)	Explain the mechanism of metal cutting and chip formation. Discuss the effect of rake angle on metal cutting.	13
5(c)	Draw the force diagram for orthogonal cutting and corelate different forces acting during orthogonal cutting.	12
6(a)	Define tool life. How does wearing occur in tool? Explain diverse types of tool wear.	15
6(b)	Distinguish between a shaper and planner. Also write down the functions of cutting fluid.	10
6(c)	Modify the quick return mechanism so that the cutting action happens in return stroke. Explain with necessary sketches.	10
7(a)	Define indexing. Classify indexing and describe any one of them.	10
7(b)	Differentiate between conventional milling and climb milling. Write down the name of various milling operations.	09
7(c)	Explain centerless grinding with advantages and limitations.	10
7(d)	What is knurling and broaching?	06
8(a)	What is the significance of unconventional machining process? Explain the working principle of ultrasonic machining. Which factors affect its performance?	14
8(b)	Write short note on the following: a) Electron discharge machining; b) Laser beam machining.	12
8(c)	Write short note on: a) Honing; b) Lapping; c) Superfinishing.	09