# KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
### *Department of Mechanical Engineering*
B. Sc. Engineering 1st Year Backlog Examination, 2020

## ME 1209
(Engineering Mechanics I)

Time: 3 Hours                                                                                 Total Marks: 210
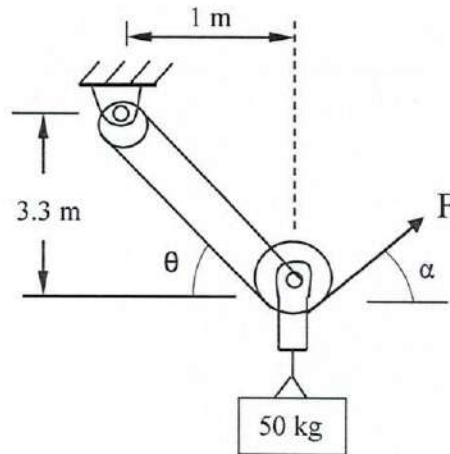
**N.B.**: i) Answer any THREE questions from each section in separate scripts.
    ii) Figures in the right margin indicate full marks.
    iii) Assume reasonable data if any missing.

## SECTION-A

1(a)  A crate is to be supported by the rope and pulley arrangement as shown in figure.     17
Determine the magnitude and direction of the force F which should be exerted on the free
end of the rope.



1(b)  The uniform rod AB of length 3R and weight W rests inside a hemispherical bowl of radius     18
R as shown in Figure. Neglecting friction, determine the angle $\theta$ corresponding to
equilibrium.
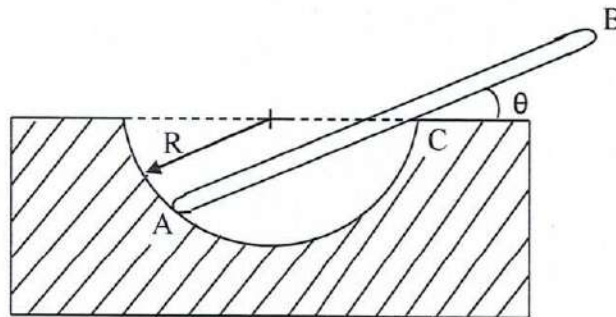


2(a)  A 10 m boom has a fixed end A as shown in figure, and is subjected to its 100 kg weight     17
and to the 140 N force which makes an angle 150°, 74° and 116° with the x, y and z axis
respectively. Find out the force and couple at A equivalent to the given force system.
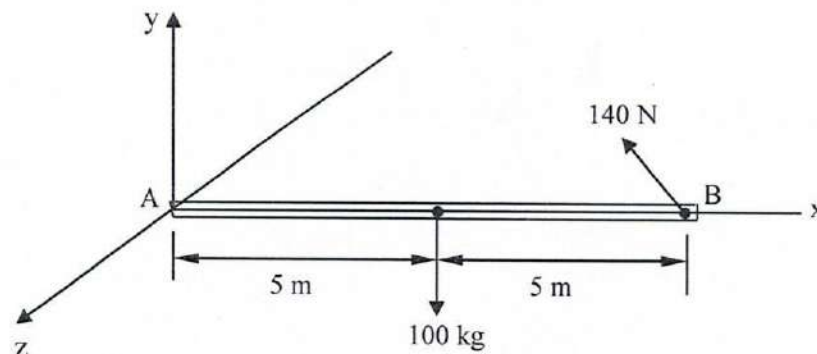
2(b) In addition to the 15.6 kN force shown in figure, a force Q is applied at D in a direction parallel to the y-axis. Determine the required magnitude and sense of Q if the tension in cable CD is zero.  18
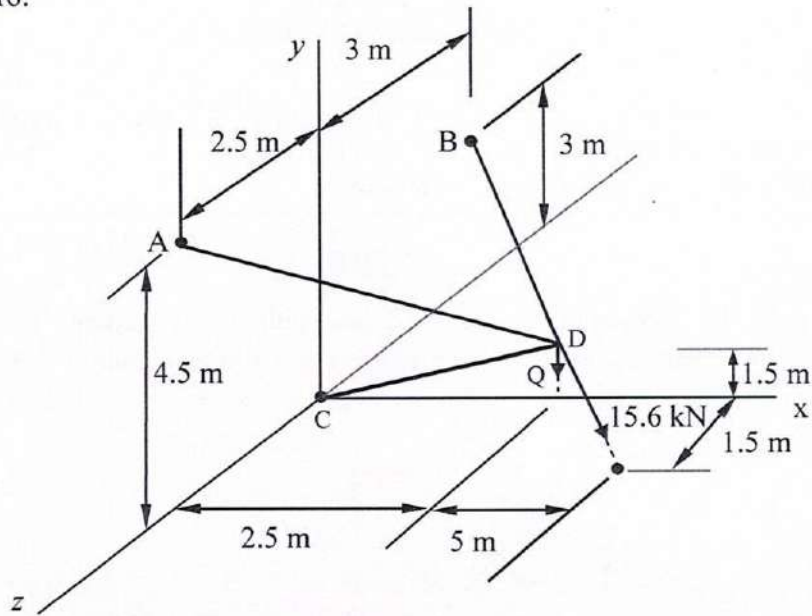


3(a) State and prove Verignon's theorem.  05

3(b) The 30 kg boom AB supports a load of 1500 N as shown. The boom is held by a ball and a socket at A and by two cables BC and BD. Determine the tension in each cable and the reaction at A.  30
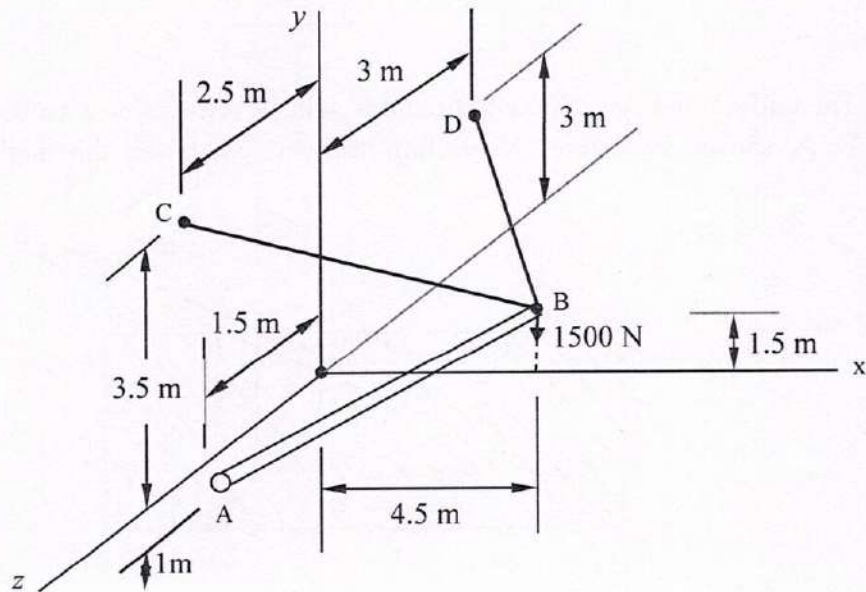


4(a) Determine the forces in the members AC, BC and CD of the truss as shown in figure.  17
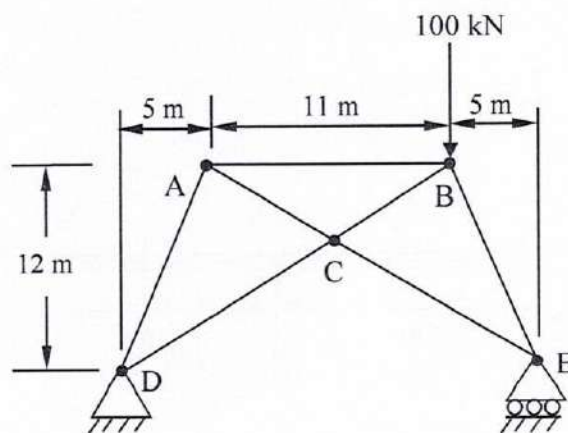


4(b) A pipe weighs 35 kg/m and is supported every 10 m by a small frame: a typical frame is shown in figure. Knowing that θ = 35°, determine the components of the reactions and the components of the force exerted at B on member BC.  18
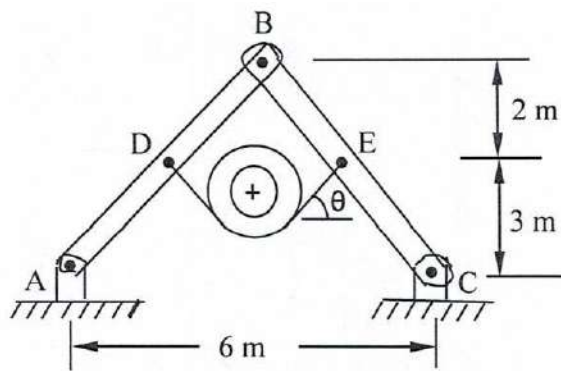
## SECTION-B

5(a)  Determine the centroid of the shaded area as shown below by direct integration.  18



$$y_1 = k_1 x^{1/2}$$

$$y_2 = k_2 x^2$$
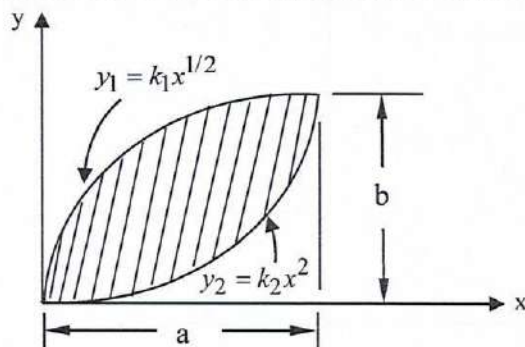
5(b)  Determine the volume of the solid obtained by rotating the parabolic spandrel as shown in figure (i) about the x-axis and (ii) about the axis AA′.  17
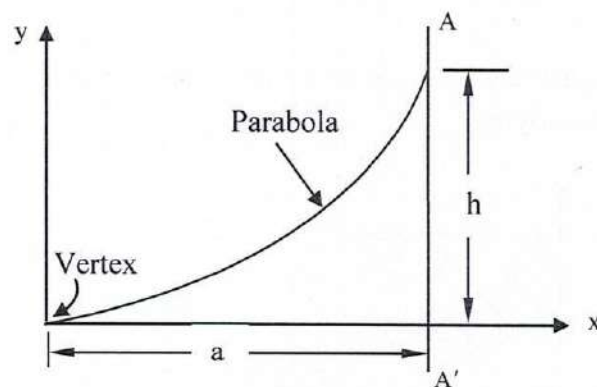


6(a)  A brass collar of length 50 mm is mounted on an aluminum rod of length 80 mm. Locate the center of gravity of the composite body.  17
(Density of brass is 8470 kg/m³, and density of aluminum is 2800 kg/m³).
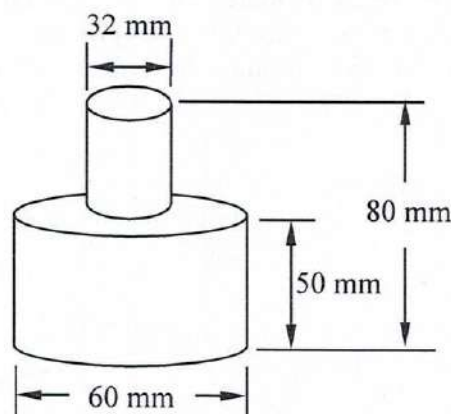


6(b)  Two 8° wedges of negligible weight are used to move and position the 800 kg block. Knowing that the coefficient of static friction is 0.30 at all surfaces of contact, determine the smallest force P which should be applied as shown to the wedge.  18
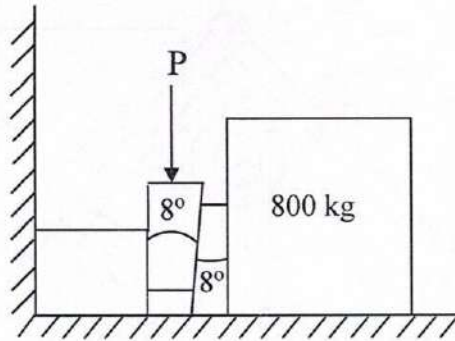
7(a) For a V-belt, show that $T_2/T_1 = e^{(\mu_s \beta/\sin(\alpha/2))}$; where $\beta$ is the angle of contact, $\alpha$ is the angle of V and other symbols have their usual meanings.   17

7(b) A band brake is used to control the speed of a flywheel as shown. The coefficients of friction are $\mu_s = 0.30$ and $\mu_k = 0.25$. What couple should be applied to the flywheel to keep it rotating counter clockwise at a constant speed when $P = 50$ N.   18
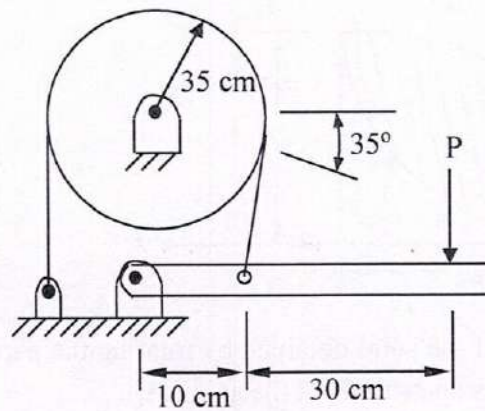


8(a) Compute $I_x$ and $I_y$ for the shaded area as shown in figure. Also calculate the polar moment of inertia with respect to the origin.   18
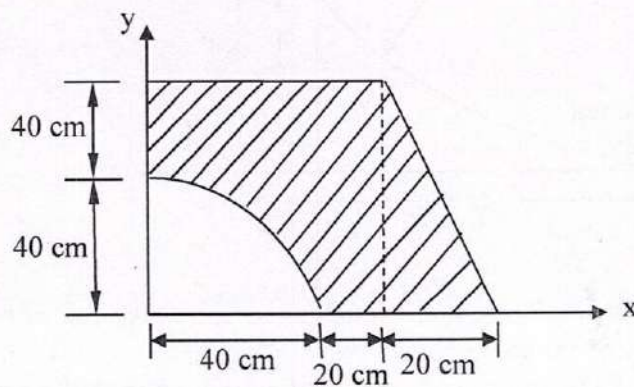


8(b) Determine the mass moment of inertia of the right circular cone with respect to (i) its longitudinal axes, (ii) an axis through the apex of the cone and perpendicular to its longitudinal axis; (iii) an axis through the centroid of the cone and perpendicular to its longitudinal axis.   17
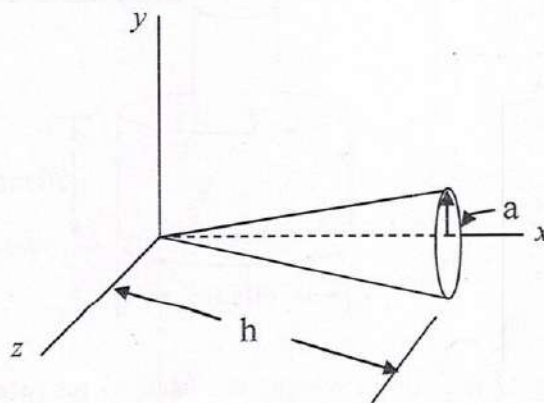
KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
*Department of Mechanical Engineering*
B. Sc. Engineering 1st Year Backlog Examination, 2020

**Hum 1205**
(Economics and Accounting)

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 Economics. What are the basic economic problems of an economy? | 15 |
| 1(b) | Explain the factors behind the downward sloping demand curve? | 10 |
| 1(c) | Discuss market equilibrium with the help of demand and supply curve. | 10 |
| 2(a) | What is supply? Explain the law of supply with diagram. | 15 |
| 2(b) | Why does supply curve slope upward to the right? | 05 |
| 2(c) | What is demand elasticity? What are the determinants of demand elasticity? | 15 |
| 3(a) | "Total cost = Fixed cost + Variable cost." Explain with necessary figure. | 15 |
| 3(b) | Define short-run. Discuss short-run equilibrium of a firm under perfect competition. | 20 |
| 4(a) | What is GDP? Why do economists use real GDP rather than nominal GDP to gauge economic wellbeing? | 15 |
| 4(b) | What is inflation? Explain the causes of inflation. | 15 |
| 4(c) | Define national saving and private saving. | 05 |

## SECTION-B

| | | |
|---|---|---|
| 5(a) | What is accounting? Discuss the objectives of accounting. | 15 |
| 5(b) | Who are the users of accounting information? | 10 |
| 5(c) | Briefly describe the steps of accounting cycle. | 10 |

6   On 1st July 2021 Mr. Hafiz started a business with cash TK 300,000 and furniture worth   35
50,000. Other transactions are as follows:

| | |
|---|---|
| July 2 | Deposited cash into bank TK 100,000 |
| July 3 | Office rent paid by cheque TK 15,000 |
| July 4 | An advertisement bill received but not yet paid TK 3,000 |
| July 5 | Hired an office assistant for the month of salary TK 10,000 |
| July 6 | Advertisement bill paid by cheque (transaction July 4) |
| July 8 | Office supplies purchased by cheque TK 5000 |
| July 9 | Furniture purchased for office use TK 50,000 |
| July 10 | Utility bill received but unpaid TK 1500 |
| July 11 | Cash withdrawn from Bank for office use TK 20,000 |

Required: Journalize above the transaction in the book of Mr. Hafiz.

7(a)    Define trial balance. What are the differences between trial balance and balance sheet?    10

7(b)    From the following ledger balances of X & Co. you are required to prepare a trial balance    25
as on 31st December 2021:

Cash balance ------------------- TK 40,000      Furniture --------------------TK 60,000

Account Receivable----------- TK 80,000      Rent expense ---------------TK 36,000

Accounts payable ------------- TK 20,000      Salary expense -------------TK 48,000

Insurance premium ----------- TK 2,000      Advertisement expense ---TK 4,000

Utility expense ---------------- TK 3,000      Capital --------------------- TK 300,000

Sales --------------------------- TK 250,000      Purchase ------------------- TK 150,000

Sales return -------------------- TK 5,000      Transportation-in---------- TK 7,000

Depreciation of furniture ---- TK 6,000

Accumulated depreciation- Furniture ----- TK 6,000

Bad debts expense ----------- TK 1,500      Unpaid rent ---------------- TK 8,000

Office supplies ------------ TK 15,000

10% Loan from Bank 1-1-2021-------- TK 80,000

Interest on above bank loan – TK 8,000

Discount allowed -------------- TK 2,500

8(a)    What are differences between financial accounting and cost accounting?    15

8(b)    What are the elements of accounting equation?    05

8(c)    Describe the objectives of financial statement.    15

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
*Department of Mechanical Engineering*
B. Sc. Engineering 1st Year Backlog Examination, 2020
**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.

## SECTION-A

1(a)  Put the correct form of verb to fill up the gaps of the following sentences.          14

i)   When did you post the letter to Mary? This morning. So she ......... it tomorrow.   (get)

ii)  I ate too much. Now I feel sick. I ............ so much. (eat)

iii) If you ............. a wallet in the street, what would you do with it?   (find)

iv)  I must hurry. My friend will be annoyed if I ............. on time. (not/be)

v)   If the phone ............, can you answer it?  (ring)

vi)  I can't decide what to do? What would you do if you .......... in my position? (be)

vii) I am glad we had a map. I'm sure we would have got lost if we ......... one. (not/have)

1(b)  Change the following words as directed in brackets and make sentence with the changed      12
forms.

Relieve (into noun), Reduction (into verb), weak (into verb), objection (into adjective),
Better (into noun), Honest (into noun).

1(c)  Make a new word with the following prefixes and suffixes and use the new words in    09
sentence.

Auto-------, By............, Co............., ............ate, ...............ism, ............ing.

2(a)  Transform the following sentences as asked in brackets.                                     14

i)   Taju, a hard working student, studies in BSc. (Complex)

ii)  Shakil walking fast tries to catch the train. (Complex)

iii) That he is punctual is admiring. (Simple)

iv)  He exercises regularly, so is healthy. (Simple)

v)   Besides helping own relatives, he helps other peoples. (compound)

vi)  What you write reveals simplicity. (Simple)

vii) He is no less hard working than Mim. (Positive)

2(b)  Make sentences using the following words as directed.                                        12

Phone (as verb); Phone (as adjective); Mobile (as adjective); Back (as verb); Head (as
verb); But (as adverb).

2(c)  Write one antonym and one synonym for each of the following words and make sentence    09
with the antonyms and synonyms.

Industrious, Principle, Ambition.

3(a)  Correct the following sentences.                                                            14

i)    His father was died last year.

ii)   English is easy to be learnt.

iii)  The authority exempted the boy to pay the fine.

iv)   His father died recently.

v)    The book was belonging to me.

vi)   Study hard lest you do not fail.

vii)  He has resigned from the post.

3(b)  Make Wh questions with the underlined words of the following sentences.  12
    i)    Simu wrote an essay <u>on honesty</u>.
    ii)   The teacher warned the students <u>at class</u>.
    iii)  The Second World War started <u>in 1939</u>.
    iv)  He required <u>the book on life</u>.
    v)   He is teaching <u>in class XII</u>.
    vi)  He drives the car <u>at a speed of 60 km</u> per hour.
    vii) The pond is <u>10 feet</u> deep.

3(c)  Complete the following sentences with clauses as directed.  09
    i.    _____ is right. (Noun clause)
    ii.   He ensures us _____ . (Noun clause)
    iii.  _____ we can continue discussion. (Adv. clause)
    iv.  _____ , he can't attend at the meeting (Adv. clause).
    v.   Rabu, _____ , is gentle. (Adj. clause)
    vi.  Liza, _____ , is a doctor. (Adj. clause)

4(a)  Make sentences using the following Modals as directed.  14
    i.    Be to         (To express command)
    ii.   Be to         (To express arrangement)
    iii.  Be going to   (To express plan)
    iv.  Be going to   (To express strong possibility)
    v.   Should       (To express duty in the past)
    vi.  Ought to     (To express duty)
    vii. Need         (To express unnecessary action).

4(b)  Make sentences on the following structures.  12
    i.    Subject + Intransitive verb + Adverbial + Extension.
    ii.   Subject + Linking verb + Adjective complement + Extension.
    iii.  Subject + Linking verb + Noun complement + Extension.
    iv.  Subject + Transitive verb + Object + Objective complement
    v.   Subject + Transitive verb + Infinitive as object
    vi.  There + Verb + Subject + Extension.

4(c)  Make sentence with the following phrases and idioms.  09
Pull well, pick a quarrel, pros and cons, slip of the pen, square meal, In force.

# KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
## *Department of Mechanical Engineering*
B. Sc. Engineering 1st Year Backlog Examination, 2020

### Math 1105
#### (Mathematics I)

Time: 3 Hours                                                                Total Marks: 210

**N.B.**: i) Answer any THREE questions from each section in separate scripts.
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## SECTION-A

1(a)   What is meant by the continuity of a function at a point? A function $f(x)$ is defined as   13
follows:
$$f(x) = \begin{cases} 1 + \sin x & \text{for } 0 \le x \le \pi/2 \\ 2 + (x - \pi/2)^2 & \text{for } x \ge \pi/2 \end{cases}$$
Discuss the continuity and differentiability of $f(x)$ at $x = \pi/2$.

1(b)   Write the physical meaning of derivative. If $f(x) = \dfrac{x^3 - 8x^2 + 13x - 6}{x^2 - 11x + 10}$, find the   12
values of $x$ for which $f'(x) = 0$.

1(c)   If $y = \sin^{-1} \dfrac{2x}{1 + x^2}$, then find $y_n$.   10

2(a)   State Rolle's theorem. Is Rolle's theorem applicable to $f(x) = \dfrac{1}{2 - x^2}$ in [-1, 1]?   13
Justify your answer.

2(b)   Establish a relationship between $y_n$, $y_{n+1}$ and $y_{n+2}$, where $y^{\frac{1}{m}} + y^{-\frac{1}{m}} = 2x$.   12

2(c)   Write the indeterminate forms. Evaluate $\lim\limits_{x \to 0} \dfrac{(1+x)^{1/x} - e}{x}$.   10

3(a)   Find two non-negative numbers whose sum is 10 and the sum of whose squares is the   12
maximum or minimum.

3(b)   State Euler's theorem on homogeneous functions. If $u = \dfrac{x^2 y^2}{x + y}$, apply Euler's   13
theorem to find the value of $x \dfrac{\partial u}{\partial x} + y \dfrac{\partial u}{\partial y}$, and hence deduce that
$x^2 \dfrac{\partial^2 u}{\partial x^2} + 2xy \dfrac{\partial^2 u}{\partial y \partial x} + y^2 \dfrac{\partial^2 u}{\partial y^2} = 6u$.

3(c)   Verify the application of Mean Value theorem for the function   10
$f(x) = x^3 - x^2 - 4x + 4$ in the interval [-2, 1].

4(a)   Determine the equation of tangent and normal to the curve $y(x-2)(x-3) - x + 7 = 0$   12
at the point where it cuts the x-axis.

4(b)   Find the asymptotes of the curve $x^4 + 3yx^2 + 3xy^2 - y^4 + xy = 0$.   12

4(c)   Find the radius of curvature at the point $(r, \theta)$ on the cardioid $r = a(1 - \cos\theta)$ and   11
show that it varies as $\sqrt{r}$.

## SECTION-B

5    Integrate the following integrals:

(a) $\int \cos^4 x \sin 3x \, dx$             11

(b) $\int \dfrac{dx}{x^4 + 1}$             12

(c) $\int \sqrt{\dfrac{2x+1}{3x+2}} \, dx$             12

6    Evaluate the following definite integrals:

(a) $\displaystyle\int_0^1 \dfrac{x^3 \sin^{-1} x}{\sqrt{1-x^2}} \, dx$             11

(b) $\displaystyle\int_0^{\pi/2} \ln \cos x \, dx$             12

(c) $\displaystyle\int_0^{\pi} \dfrac{dx}{a^2 - 2ab \cos x + b^2}; \quad a > b > 0$             12

7(a)    Obtain reduction formula for $\int \tan^n x \, dx$ and hence find $\displaystyle\int_0^{\pi/4} \tan^6 x \, dx$.             14

7(b)    Define Gamma and Beta function. Use Gamma function to evaluate $\displaystyle\int_0^{\infty} \dfrac{x^4}{\left(1+x^2\right)^4} \, dx$.             12

7(c)    Find that $\Gamma\left(\dfrac{1}{2}\right) = \sqrt{\pi}$.             09

8(a)    Indicate the region bounded by $2y = 16 - x^2$ and $x + 2y - 4 = 0$ graphically and find the area.             12

8(b)    Find the perimeter of the cardioid $r = 2\left(1 - \cos\theta\right)$.             11

8(c)    Find the volume of the solid obtained by revolving the area bounded by the cycloid $x = a\left(\theta - \sin\theta\right)$, $y = a\left(1 - \cos\theta\right)$ and $\theta = 0$, $\theta = 2\pi$ about x-axis.             12

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
*Department of Mechanical Engineering*
B. Sc. Engineering 1st Year Backlog Examination, 2020

**Math 1205**
(Mathematics II)

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) Find the Cartesian and spherical polar coordinates of a point whose cylindrical polar coordinates are $(4, 2\pi/3, -2)$.                                                              10

1(b) If the direction ratios of a line are 2, 3, 6 which passes through $(2, -3, 4)$, then find the distance of this line from the point $(1, 2, -3)$.                                         12

1(c) If the direction cosines of two lines are connected by the relation $l-5m+3n=0$ and $7l^2 +5m^2 -3n^2 = 0$, then find the angle between the lines.                                     13

2(a) Find the equation of the plane through $(2, 2, 1)$ and $(9, 3, 6)$ and perpendicular to the plane $2x+6y+6z=9$.                                                                          12

2(b) Check that the four points $(0, -1, 0)$, $(1, 1, 1)$, $(3, 3, 0)$ and $(2, 1, -1)$ are coplanar or not. If coplanar, then find the equation of plane containing them.                     12

2(c) What are the direction cosines of the line joining $P(0, 2, 3)$ and $Q(3, 2, 1)$? Find the projection of PQ on the line $\frac{x}{1}=\frac{y}{2}=\frac{z}{3}$.                            11

3(a) Find the symmetrical form of the equation of a line $2x+3y-4z-2=0=3x-4y+z$ and find its direction cosines.                                                                              11

3(b) Find the distance of the point $(2, -3, 1)$ from the plane $x-2y+3z=6$ measured parallel to the line $\frac{x}{3}=\frac{y}{1}=\frac{z-2}{-4}$.                                           12

3(c) Find the magnitude and equation of the line of a shortest distance between the lines $\frac{x-3}{2} = \frac{y+15}{-7} = \frac{z-9}{5}$ and $\frac{x+1}{2} = \frac{y-1}{2} = \frac{z-9}{-3}$.   12

4(a) Find the centre and nature of the surface represented by the equation $x^2 +2y^2 -3z^2 -4yz+8zx-12xy+1=0$.                                                                               12

4(b) Find the equation of the right circular cone whose axis is $x=y=z$, vertex is origin and whose semi-vertical angle is $45°$.                                                             12

4(c) Find the equation of the sphere in which the circle $x^2 +y^2 +z^2 +7y-2z+2=0$, $2x+3y+4z-8=0$ is a great circle.                                                                        11

## SECTION-B

5(a) Define order and degree of the differential equation with example. Determine the differential equation of all circles with center (a, b) and radius r.  12

5(b) Solve $ydx + \left(x^2 - 4x\right)dy = 0$  11

5(c) Find a family of oblique trajectories that intersect the family of straight lines $y = cx$ at an angle of 45°.  12

6(a) Solve $(1+y)\dfrac{dy}{dx} = x - x\left(y^2 + 2y\right)$.  12

6(b) Solve $y^2dx + (3xy - 1)dy = 0$.  12

6(c) Solve $\dfrac{dy}{dx} = \dfrac{6x - 2y - 7}{3x - y + 4}$  11

7(a) Solve $\left(D^2 - 3D + 2\right)y = \sin 3x$; $D = \dfrac{d}{dx}$ by short method.  11

7(b) Solve $\dfrac{d^2y}{dx^2} + 4 = x\sin x$  12

7(c) Solve $y'' + 4y = 4e^{2x}$; $y'' = \dfrac{d^2y}{dx^2}$ by undetermined coefficient method.  12

8(a) Solve the differential equation $\dfrac{d^2y}{dx^2} + y = \cosec x$ using the method of variation of parameter.  18

8(b) Solve the Cauchy-Euler differential equation $x^2\dfrac{d^2y}{dx^2} + x\dfrac{dy}{dx} + 4y = 2x\log x$.  17

# KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
## *Department of Mechanical Engineering*
B. Sc. Engineering 1st Year Backlog Examination, 2020

## ME 1105
### (Thermal Engineering)

Time: 3 Hours                                                                                  Total Marks: 210

**N.B.:** i) Answer any THREE questions from each section in separate scripts.
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iii) Assume reasonable data if any missing.

## SECTION-A

1(a) What are the available sources of energy in Bangladesh? Compare the conventional and non-conventional sources of energy?                                                                    12

1(b) "Bio-energy and ocean thermal energy can be the major energy sources in the near future"- Justify the statement.                                                                                11

1(c) Briefly explain the following terms:                                                              12
    (i) Solar energy     (ii) Geothermal energy     (iii) Wind energy

2(a) Draw and explain the phase diagram of a pure substance. What important information could be obtained from it?                                                                                    10

2(b) Draw and explain T-h graph for steam formation.                                                   08

2(c) Describe the advantages and disadvantages of using Steam Table over the Mollier chart.            05

2(d) Find the internal energy of 1 kg of steam at 20 bar in the following cases:                       12
    (i) when the steam is wet having dryness fraction 0.9.
    (ii) when the steam is superheated and its temperature is 400°C. Take specific heat of superheated steam is 2.3 kJ/kgK.

3(a) What is mean by steam generator? What factors should be considered while selecting a steam generator?                                                                                          10

3(b) With neat sketch, briefly describe the working principle of a boiler that operates at above critical pressure.                                                                                  12

3(c) Why safety valves are needed in a boiler? Explain the functions of fusible plug and economizer in a boiler.                                                                                09

3(d) What are priming and foaming of a boiler?                                                         04

4(a) What is meant by equivalent evaporation and boiler efficiency? Enlist the various heat losses in boiler.                                                                                      10

4(b) Draw a simple schematic diagram of a boiler plant indicating significant notations.               10

4(c) The following particulars were recorded during a steam boiler trial:                              15

    Pressure of steam = 11 bar
    Steam condensed = 550 kg/hr
    Fuel used = 70 kg/hr
    Moisture in fuel = 2% by mass
    Temperature of dry flue gases = 325°C
    Temperature of boiler house = 28°C
    Feed water temperature = 50°C
    Heating value of fuel = 32000 kJ/kg
    Mean specific heat of flue gases = 1 kJ/kgK
    Dryness fraction of steam = 0.90
    Mass of dry flue gases = 9 kg/kg of fuel

Draw up a heat balance sheet for this boiler.

5(a)  What are the different types of fuel? What are the requirements of a good fuel?    08

5(b)  What is the different between "HCV" and "LCV"? Briefly explain the method used to    12
determine the higher calorific value of a liquid fuel.

5(c)  The percentage composition by mass of a sample coal as found by analysis is follows as:    15
$C = 89\%$, $H_2 = 3.5\%$, $O_2 = 3.5\%$, $S = 1.2\%$ and remain are ash.
Calculate the minimum mass of air required for complete combustion of 1 kg of this fuel.
If 40% excess air is supplied, find the total mass of dry flue gases per kg of fuel and the
percentage composition of the dry flue gases by volume.

6(a)  What is meant by stoichiometric air? Why excess air is always required for complete    08
combustion?

6(b)  What is meant by heat engine? State the differences between SI and CI engine.    12

6(c)  How does a closed cycle gas turbine plant differ from an internal combustion engine?    07

6(d)  State the function of cooling system and lubrication system of IC engine.    08

7(a)  Define the following terms:    09
(i) Refrigerating effect
(ii) Tonne of refrigeration
(iii) Coefficient of performance.

7(b)  What is meant by human comfort? Describe the factors that affect comfort air    11
conditioning.

7(c)  How air conditioning system can be classified? Describe the working principle of a    15
summer air conditioning system with neat sketch.

8(a)  Differentiate between heat pump and refrigerator.    12
Also show that $(COP)_{Heat\ pump} = 1 + (COP)_{Refrigerator}$.

8(b)  What are the basic differences between vapour compression and vapour absorption    08
refrigeration system?

8(c)  Draw the p-h and T-s diagram of vapour compression refrigeration cycle with superheating    07
after compression, and briefly explain them.

8(d)  What is meant by refrigerant? Why CFC and HCFC are not used as a refrigerant now-a-    08
days.