BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, BUET

L-1/T-2 B.Sc. Engineering Examinations 2019-2020

Sub: **ME 141** (Engineering Mechanics)

Full Marks: 180   Time: 2 Hours

The figures in the margin indicate full marks.

Symbols used have their usual meaning and interpretation.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION-A

There are **FOUR** questions in this section. Answer any **THREE**

1. (a) For the pulley system as shown in Fig. for Q. 1(a), velocity of object A is known. Determine   **(8)**
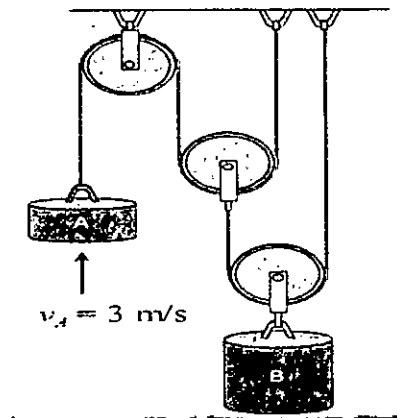   the velocity of object B.

Fig. for Q. 1(a)

(b) At the instant shown in Fig. for Q. 1(b), object A is travelling along the circular path and
   its speed is increasing at 10 m/s^2; object B is travelling along the straight path and its   **(22)**
   speed is decreasing at 5 m/s^2. Determine the magnitude and direction of (a) relative
   velocity of A with respect to B, (b) relative acceleration of A with respect to B.
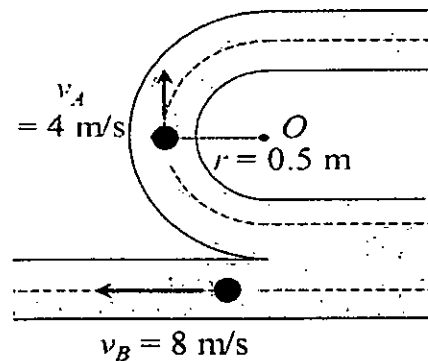

$v_B = 8$ m/s

Fig. for Q. 1(b)

2. (a) The 15-kg block *B* is supported by the 25-kg block *A* and is attached to a cord to which a 225-N horizontal force is applied as shown in Fig. for Q. 2(a). Neglecting friction, draw "Free Body Diagram" and "Kinetic Diagram" of both blocks. (6)
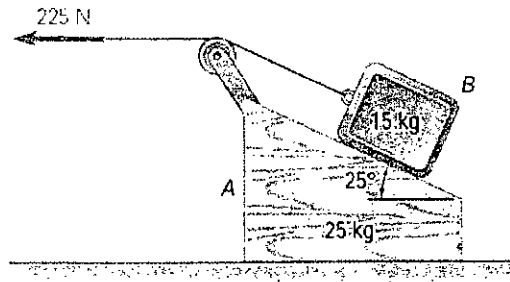

Fig. for Q. 2(a)

(b) In Fig. for Q. 2(b), block *A* has a mass of 9-kg, and blocks *B* and *C* have masses of 4-kg each. Knowing that the blocks are initially at rest and that *B* moves through 2.5 m in 2 s in downward direction, determine (*a*) the magnitude of the force *P*, (*b*) the tension in the cord *AD*. Neglect the masses of the pulleys and axle friction. (24)
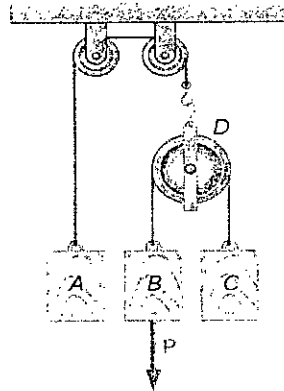

Fig. for Q. 2(b)

3. (a) A group of three toy cars (with mass marked in Fig. for Q. 3(a)) connected together is being pulled by a horizontal force of magnitude of F = 3.5 N. If this group of cars starts from the rest, determine the velocity of this group of cars after 2 seconds by neglecting friction. (5)
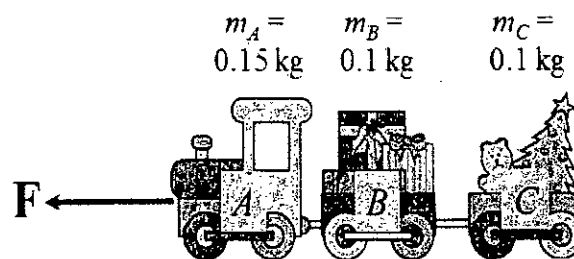
$m_A =$ $m_B =$ $m_C =$
0.15 kg 0.1 kg 0.1 kg

Fig. for Q. 3(a)

(b) An 8-kg plunger is released from rest in the position as shown in the Fig. for Q. 3(b) and is stopped by two nested springs. The spring constant of the outer spring is $k_1 = 3$ kN/m and the spring constant of the inner spring is $k_2 = 10$ kN/m. If the plunger is released from the height $h = 600$ mm, determine the maximum deflection of the outer spring. **(25)**
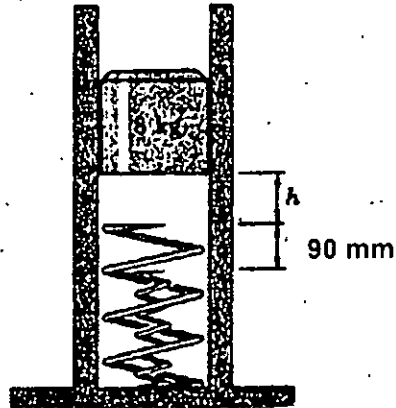

Fig. for Q. 3(b)

4. In the position shown in Fig. for Q. 4, end A of rod AB has a velocity of 2.5 m/s and an acceleration of 1.5 m/s², both directed to the right. Determine the angular acceleration of rod AB. **(30)**
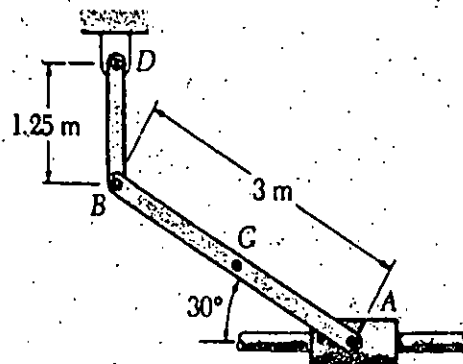

Fig. for Q. 4

5. (a) The 100 kg uniform slab AB supported on the roller and a horizontal anchor cable at A is **(15)** held in equilibrium by another cable at B as shown in Fig. for Q. 5(a) in the position where $\theta = 60°$. Determine the tension forces in both cables.
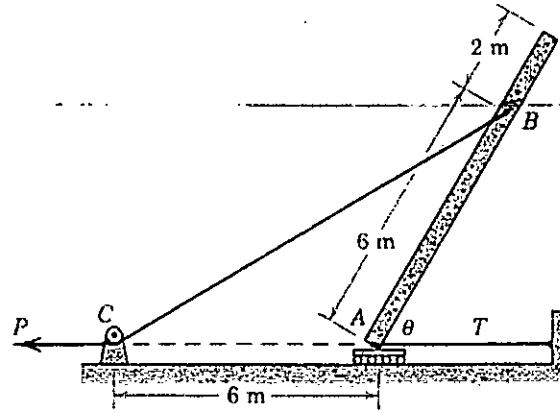

Fig. for Q. 5(a)

(b) The 22 kg force is applied at the tip of the bar as shown in Fig. for Q. 5(b) with angle 'θ' **(15)** measured from the horizontal and $0 \le \theta \le 180°$. Determine the angle 'θ' for which the moment of the force about point 'O' is zero.
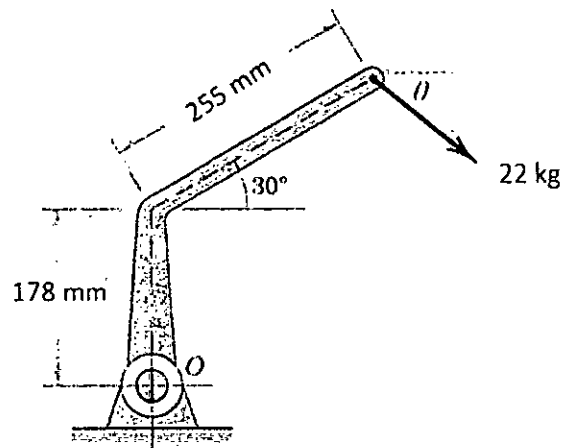
Fig. for Q. 5(b)

6. (a) The uniform rectangular door panel weighs 300 N and is supported by two hinges at A **(18)** and B as shown in Fig. for Q. 6(a). A strut C is used to prevent the door from swinging when a horizontal force $P = 230$ N is applied perpendicular to the door panel as shown in Fig. for Q. 6(a). Determine the magnitude of force F_C in the strut. Consider, $a = 200$ mm.

There are **FOUR** questions in this section. Answer any **THREE**
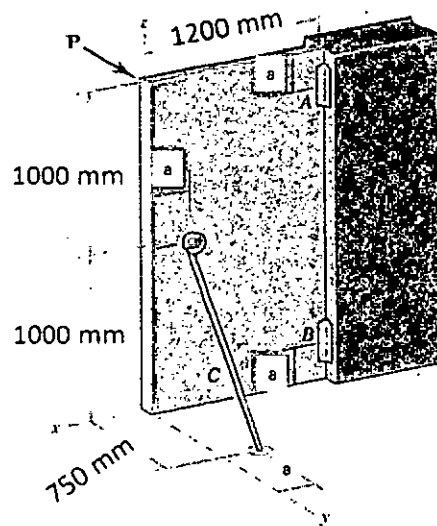
Fig. for Q. 6(a)

(b) Block *A* weighs 40 kg and is placed at rest on the rough incline. A downward force *P* is **(12)** applied as shown in Fig. for Q. 6(b) pulling the rope that passes over the round corner and connected to the block. Determine the minimum force *P* that will cause impending slippage of the block up along the incline.
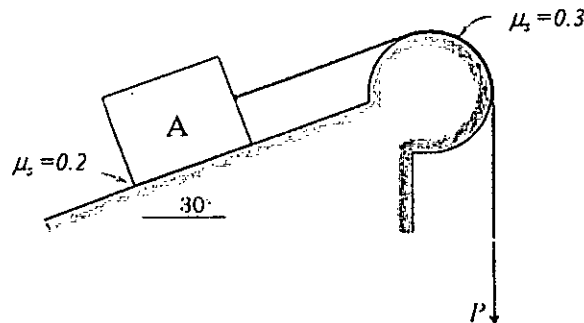
Fig. for Q. 6(b)

7. (a) Determine the force in the member *DE* of the loaded truss as shown in Fig. for Q. 7(a). **(15)**
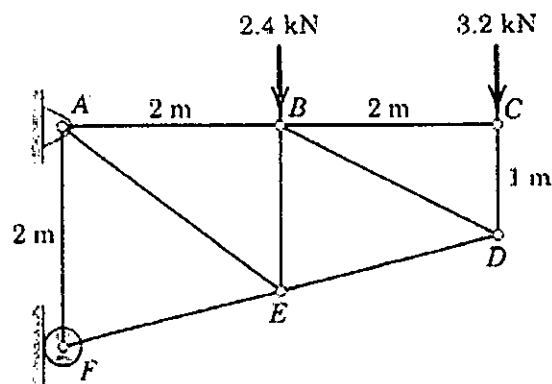
Fig. for Q. 7(a)

(b) Use method of joints to calculate the force in the member *DE* of the loaded truss as shown **(15)** in Fig. for Q. 7(b). Indicate tension or compression.
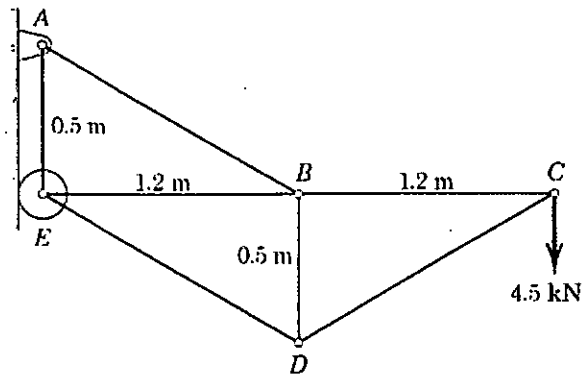
Fig. for Q. 7(b)

8. (a) Determine the *x* and *y*-coordinates of the centroid of the shaded area as shown in Fig. for **(15)** Q. 8(a).
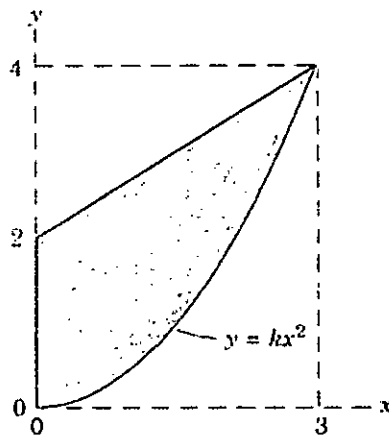
Fig. for Q. 8(a)

(b) Determine the moment of inertia of the shaded area as shown in Fig. for Q. 8(b) about **(15)** a-a axis. Consider, *x* = 2 mm.
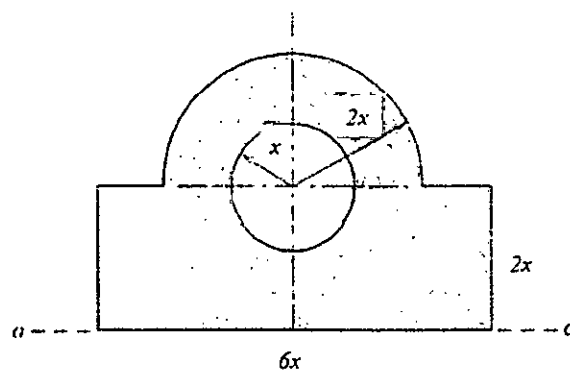
Fig. for Q. 8(b)

Bangladesh University of Engineering and Technology, Dhaka
L-1/T-2 B.Sc Examinations of January 2020
Subject: Chem-121 (Organic Chemistry)
Full Marks: 180   Time: 2 hours
Figure in the margin indicate the full marks
Use separate scripts for each section and upload in the LMS system separately

SECTION A
(There are FOUR questions in the section. Answer any THREE)

1a. Three alkenes are formed from the E1 reaction of 3-bromo-2,3-dimethylpentane.   12
     Give the IUPAC names and structures of the alkenes, and rank them according to
     the amount that would be formed. Give the mechanism.

b.   What products would be obtained from the addition of Br_2 to cyclohexene, if the   12
     reaction is carried out in solvent H_2O and in solvent CH_2Cl_2. Propose the mechanism
     for the reactions.

c.   Draw a reaction coordinate diagram for the E2 reaction of 2-bromo-2,3-   06
     dimethylbutane with sodium tert-butoxide.

2.a How will you prepare 3,3-dimethyl-1-butanol from 3,3-dimethyl-1-butene ?   10

b.   Draw the two chair conformers for each of the stereoisomers of trans-1-tert-butyl-4-   10
     methylcyclohexane. For each pair, indicate which conformer is more stable.

c.   Arrange the following compounds in ascending order of their boiling points and   10
     justify in favour of your arrangement.
     (i) n-Hexane   (ii) Neopentane (iii) n-Pentane   (iv) 2-Methylbutane

3a. Acid-catalyzed dehydration of neopentyl alcohol, $(CH3)_3CCH_2OH$, yields 2-   12
     methyl-2butene as the major product. Outline a mechanism showing all steps in its
     formation.

b.   In the industrial synthesis of ethanol, ethene is first dissolved in 95% sulfuric acid,   08
     then water is added and finally the mixture is heated. Outline the reactions involved.

c.   Explain the following facts: Treating (Z)-2-butene with OsO_4 in pyridine and then   10
     $NaHSO_3$ in water gives a diol that is optically inactive and cannot be resolved.
     Treating (E)-2-butene with the same reagents gives a diol that is optically inactive
     but can be resolved into enantiomers.

4a. Which product (or products) would you expect from each of the following reactions?   20
     In each reaction give the mechanisms (SN1, SN2, E1, or E2) and predict the relative
     amount of the products formed by different mechanisms.
     (i)   (R)-2-bromobutane + OH^-, at 25°C

(ii)   (*S*)-3-Bromo-3-methylhexane + MeOH, at 25°C

b.   An alkane with molecular weight 72 formed only one monochloro substitution   10
product. Suggest the structure of the alkane and give the mechanism by which the
product is formed.

SECTION B
(There are **FOUR** questions in the section. Answer any **THREE**)

5a.   Draw the structures of the following compounds and show whether they are   (4x2=8)
aromatic or not.
i) Isoquinoline   ii) 1,3,5,7- Cyclooctatetraene   iii) Pyrrolidine   iv)
Quinoline

b.   Show how the five membered heterocycle furan can be obtained from the   (7)
pentosans?

c.   How would you bring out the following conversions?   (5x3=15)
i) Pyrrole-2-aldehyde from pyrrole   ii) 2-Phenylazopyrrole from pyrrole
iii) 2-Lithiumfuran from furan   iv) Tetrahydrothiophene from thiophene
v) n-Butane from thiophene

6.a   Give the mechanism of Fischer-Indole synthesis of indole.   (6)

b.   Unlike pyrrole, indole undergoes electrophilic substitution at C-3 rather than   (9)
C-2 position. Give reasons.

c.   How pyridine can be converted into the following :   (5x3=15)
i)Piperidine   ii) Pyridine -3-sulphonicacid   iii) N-Methylpyridinium
bromide   iv) 2-Aminopyridine   v) Pyridine –N-oxide

7a.   Friedel-Crafts acylation reaction is synthetically more valuable than Friedel-   (8)
Crafts alkylation reaction. Justify.

b.   Show the sulphonation of benzene with mechanism.   (7)

c.   What happens when toluene is treated with the following?   (5x3=15)
i) Bromine in presence of Lewis acid in the dark
ii) Chlorine in presence of sunlight
iii) Concentrated nitric acid and sulphuric acid
iv) Alkaline potassium permanganate
v) Hydrogen in presence of nickel catalyst

8a.   How the functional nature of nitrogen can be identified in the structure of   (10)
alkaloids?

b.   Prove that nicotine contains a pyridine nucleus with a side chain of pyrrole   (10)
derivative.

c. What are the necessary and sufficient conditions for a substance to be a perfect (5+5=10) dye? Show the preparation of an azo dye involving the various steps.

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

B. Sc. Engineering Examinations January 2020

Sub: **PHY 157** (Properties of Matter, Electricity & Magnetism and Modern Physics)

Full Marks: 180   Time: 2 Hours

The figures in the margin indicate full marks. Symbols have their usual meaning.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION-A

There are **FOUR** questions in this Section. Answer any **THREE**.

1. (a) How does relative velocity of an object is calculated in relativistic mechanics? As a consequence of special theory of relativity explain the relativity of simultaneity.   **(15)**

   (b) Why and how Einstein's mass-energy relation is modified to explain the energy of a mass-less particle? How much work (in MeV) is required to increase the speed of an electron from $1.2 \times 10^8 \, ms^{-1}$ to $2.4 \times 10^8 \, ms^{-1}$?   **(15)**

2. (a) Show that how wave theories of radiation failed to explain the results of photo-electric and Compton effects? Graphically represent the relative probability of occurring photo-electric effect, Compton scattering and pair production when an electromagnetic radiation interacts with matter.   **(15)**

   (b) Show how Planck's radiation formula successfully explains the spectrum of black body radiation. How many 600 nm photons does represent in the electromagnetic radiation of energy 1.0×10^{-18} J detectable by human eye under favourable circumstances?   **(15)**

3. (a) Explain the variation of binding energy per nucleon with atomic mass number. Why mostly heavier nucleus become radioactive?   **(15)**

   (b) Why to generate nuclear power fusion is safer than fission? If half-life of uranium-238 against alpha decay is 4.5×10^9 y, find the activity of 1.0 gm of uranium-238.   **(15)**

4. (a) Explain Coulomb's law and Gauss's law in electrostatics. Apply Gauss's law to find the electric field for point, a short distance above the surface of an insulated charged conductor with the surface charge density σ.   **(20)**

   (b) A certain charge Q is to be divided into two parts, q and $Q-q$. What is the relationship of Q to q if the two charges are placed a given distance apart to have a maximum Coulomb repulsion?   **(10)**

There are **FOUR** questions in this Section. Answer any **THREE**.

5. (a) What is an electric dipole? Draw the schematic diagram of an electric dipole and show its axis and the direction of dipole moment. Derive an expression for the electric potential energy of an electric dipole placed in a uniform electric field E.

(20)

(b) Calculate the dipole moment of a water molecule under the assumption that all ten electrons in the molecule circulate symmetrically about the Oxygen atom. The O-H distance is 0.96×10^{-8} cm and the angle between the two O-H bonds is $104°$. (10)

6. (a) With the help of a schematic diagram show how a Hall potential difference is developed across a metallic strip of copper exposed to an external magnetic field with a current set up in the strip. (20)

(b) A proton, a deuteron, and an α-particle, accelerated through the same potential difference, enter a region of uniform magnetic field, moving at right angles to B. (i) Compare their kinetic energies (ii) If the radius of the proton's circular path is 10 cm, what are the radii of the deuteron and the α-particle paths? (10)

7. (a) Derive Poiseuille's equation for the rate of flow of a viscous liquid through a narrow tube. (20)

(b) Calculate the volume rate of flow of water through a tube 0.10 cm in diameter, 40 cm long if there is a constant pressure head of 20 cm of water. The coefficient of viscosity of water is 0.0089 cgs unit. (Given, $g = 980$ cm/s^2) (10)

8. (a) Establish the relation between Young modulus, bulk modulus and modulus of rigidity. (20)

(b) A wire, 4.0 m long and 0.3 mm in diameter, is stressed by a force of 800 gm-wt. If the extension in length amounts to 1.5 mm, calculate the energy stored in the wire. (10)

2

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA
L-1/T-2   B. Sc. Engineering Examinations 2018-2019
Sub: **MATH 173** (Vector Analysis and Matrices)
Full Marks: 180   Time: 2 Hours
USE SEPARATE SCRIPTS FOR EACH SECTION
The figures in the margin indicate full marks.
Symbols used have their usual meaning.

SECTION-A

There are **FOUR** questions in this section. Answer any **THREE**.

1.   (a)   If $\mathbf{p}, \mathbf{q}, \mathbf{r}$ are the position vectors of the non-collinear points P, Q, R respectively   (15)
in space, show that $\mathbf{p} \times \mathbf{q} + \mathbf{q} \times \mathbf{r} + \mathbf{r} \times \mathbf{p}$ is perpendicular to the plane PQR.

    (b)   Let $\mathbf{a}$ = 2i - 3j + k, $\mathbf{b}$ = i -2 j +3k, c = -i -2j +2k, then find the corresponding   (15)
reciprocal set of vectors.

2.   (a)   Is $\mathbf{F}$ = (y^2cosx+z^3)i + (2 ysinx-4)j + (3xz^2+2)k represents a conservative force   (17)
field? If so, find the scalar potential for F. Hence find the work done in moving
an object in this field from (1, -1, 1) to (π/2, -1, 1).

    (b)   If $\mathbf{r}$ = Acoskt + Bsinkt, where **A** and **B** are constant vectors and k, a constant   (13)
scalar, then find $\dfrac{d^2\mathbf{r}}{dt^2} + k^2\mathbf{r}$.

3.   (a)   If $\vec{a} \times \vec{r} = \vec{b} + \lambda\vec{a}$ and $\vec{a}.\vec{r} = 2$ where $\vec{a} = 2i + 3j - 2k$ and $\vec{b} = i + 3j + k$,   (15)
$\vec{r} = x\mathbf{i} + y\mathbf{j} + z\mathbf{k}$, then find λ.

    (b)   Find the angle of intersection at the point (-3, 0, -5) of the spheres   (15)
$x^2 + y^2 + z^2 + 6x - 5y + 2z - 6 = 0$ and $x^2 + y^2 + z^2 - 34 = 0$.

4.   (a)   Determine whether the vector field $\mathbf{F}(x, y, z)$ is free of sources and sinks. If it is
not, locate them, for $\mathbf{F}(x, y, z) = (y + z)$ i $- xz^3$ j $+ (x^2 \sin y)$ k.   (13)

    (b)   Verify Green's theorem in the plane for $\oint_C (2x + y^2)dx - x^2y\,dy$ where C is   (17)
the square with vertices (0, 0), (3, 0), (3, 3) and (0, 3) oriented
counterclockwise.

MATH 173

SECTION-B

There are **FOUR** questions in this section. Answer any **THREE**.

5. Reduce $A = \begin{bmatrix} 2 & 1 & 0 & -1 \\ 3 & 4 & 2 & 5 \\ -1 & 0 & 3 & -2 \\ 4 & 1 & 1 & 0 \end{bmatrix}$ to the normal form B and hence find its rank. **(30)**

6. Find all eigenvalues and bases for the eigenspaces of $A = \begin{bmatrix} 1 & 0 & 4 \\ 0 & 5 & 4 \\ 4 & 4 & 3 \end{bmatrix}$. Hence comment on the eigenvalues and bases for the eigenspaces of $A - 3I$ and A^{-1}. **(30)**

7. (a) Express the following system of linear equations in echelon form and then solve: **(20)**

$$x_1 + 2x_2 - 3x_3 + 4x_4 = 1$$
$$2x_1 + 5x_2 - 5x_3 + 6x_4 = 3$$
$$x_1 + 4x_2 - x_3 = 3$$
$$2x_1 + 3x_2 - 7x_3 + 10x_4 = 1$$

(b) For what values of λ and μ, the equations **(10)**

$$x + y + z = 6$$
$$x + 2y + 3z = 10$$
$$x + 2y + \lambda z = \mu$$

have (i) no solution (ii) unique solution and (iii) infinite solutions.

8. Reduce the real quadratic form $q = 4x_1{}^2 + 3x_2{}^2 - x_3{}^2 + 2x_2x_3 - 4x_1x_3 +$ **(30)** $4x_1x_2$ to the canonical form and hence find the rank, signature and index of q. Write down the corresponding equations of transformation as well.

2

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2 B.Sc. Engineering Examinations- January 2020

Sub: HUM 101 (English)

Full Marks: 180   Time 2 Hours

The Figures in the margin indicate full marks

USE SEPARATE SCRIPTS FOR EACH SECTION

There are 4 page(s) in this question paper.

SECTION – A

There are FOUR questions in this section. Answer Q. No. 1 and any TWO from the rest.

1. Answer **any one** of the following: (20)

   (i) In the story "Shooting an Elephant" Orwell's morals are utterly defeated by his fears of mockery. Discuss.

   (ii) How is the mother in "The Rocking-Horse Winner" by D. H. Lawrence characterized?

2. (a) Explain with reference to the context **any one** of the following: (15)

   (i) "I started it for mother. She said she had no luck, because father is unlucky, so I thought if I was lucky, it might stop whispering."

   (ii) "... We want to be rescued; and of course we shall be rescued".

   (b) Answer **any two** of the following: (20)

   (i) What personal effects did the astrologer use to attract people towards him?

   (ii) How did the children start making fire in the "Fire on the Mountain"?

   (iii) How did the Burmese people express their anti-European feelings?

3. Amplify **any one** of the following: (35)

   (i) A ship in the harbor is safe, but that is not what a ship is for.

   (ii) Actions speak louder than words.

4. Write a précis of the following passage with a suitable title: (35)

Among the manifold misfortunes that may befall a human being, the loss of health is the severest. All the joys that life can give are nothing before the sufferings of the sick. Give the sick man everything: land, riches and worldly comforts, but leave his sickness uncured and he will feel that half of the world is lost to him. Lay him on a soft, silken sofa, he will still feel restless under the pressure of his sickness. On the other hand, a homeless beggar, who is blessed with good health, will sleep peacefully on the hard ground. Give the sick man dainty dishes and choice drinks; he will thrust away the hand that offers him. The poor man who enjoys his dry bread is in a happier state than the rich invalid. Let the sick man be a king. Let him sit on a throne with a crown on his . head, he will still look on gold and rich dresses with contempt, but will consider himself happy in a mud house if he has the good health of the poor man.

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE** questions, including Q. No.5 as compulsory.

5. Read the following passage carefully and answer the questions that follow: 5 x 4=20

Reality shows are occupying entertainment space for few years now. Different types of innovative ideas are being searched to make programs more and more popular.There are versions of existing reality shows especially for children. Also there are few programs which are designed for children only. People enjoy such shows, follow those and forget. However, it may not be exactly the case with the children who watch such TV programs. There may have different types of impacts on children.

To understand the impact of such programs on children, it is needed to understand a basic trait of child psychology. Children see themselves

performing in a story, movie, act, or even this reality show while they are watching the program. They imagine as if they are performing the act. It might be noticed while someone tells a story to the children. They get excited and they imagine as if they are playing the role of the characters of the story. Slowly they get attached to the program, and that program becomes a part of their life. They may continue that act at home or at educational institutions which have both positive and negative effects.

If children start carrying the program in their mind in every act, they make it a goal of life. They just tend to see the popularity and privilege of the winner but they are not aware of the hard work of the winner which has made them capable to win the competition. For example, when children take part in a dance competition or a singing competition, they want to get the prestigious award as the best performers. Children start taking it seriously when the surroundings give encouragement on this thought. But they don't understand that the best performers have put years of efforts before reaching those heights. Some of them might be gifted people. If children fail to achieve that goal, they feel depressed. This depression causes adverse effects on the children.

Reality shows can be an opportunity to encourage children to learn new things. It may not be for a competition purpose but as a skill. Programs can be used to motivate children. Being an expert in any field of art does not mean winning the competition but learning the thing and enjoying the act while performing it. If children start to cultivate this ideology, there will not be the urge to win the competition. They will try to learn the skill and enjoy their performances. The TV channels should not broadcast the programs which can be injurious to the children if they try that act at home. Parents can educate their children about the dangers of performing violent acts at home so that they become aware of the consequences. **(Edited) (Written by Deepak Gaikwad)**

Questions:
a. Give an appropriate title to the passage and justify it.
b. How do reality shows leave a negative impact on children?

c. How can a reality show be used as an opportunity for children?

d. Write a summary of the given passage.

6. a. What are the principles for writing an effective business letter? Explain all (10)
the principles in details.

    b. Write a complaint letter to the manager of Bengal Tours about their poor (25)
services during your recent guided tour to Chittagong Hill Tracts and claim
reimbursement for their poor services.

7. a. Briefly describe all the distinctive features of a well-written dialogue. (10)

    b. Write a dialogue between two friends on the impact of ragging prevalent in (25)
the higher educational institutions in Bangladesh.

8. Write a short essay on any of the following topics: (35)

    a. Digital divide in higher education in Bangladesh

    b. Urban migration.