BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-II B.Sc. Engineering Examination 2018-19

Sub: **EEE 105** (Electrical Circuits II)

Full Marks: 180   Time 2 Hours

The Figures in the margin indicate full marks

USE SEPARATE SCRIPTS FOR EACH SECTION

There are 6 page(s) in this question paper.

SECTION – A

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

All the symbols have their usual meanings.

Assume reasonable values for missing data.

1.   (a) Prove that single-phase system uses 33% more material than three-phase   (12)
      system for the same line voltage and same absorbed power and for the same
      length of transmission line.

      (b) A three-phase delta connected motor load, as shown in Fig. for Q. No. 1(b),   (18)
      is connected to a line voltage of 440V (balanced Y-connected source) and
      draws 4 kVA at a power factor of 72% lagging. A single 1.8 kVAR capacitor is
      connected between lines a and b, while a 800-W lighting load is connected
      between lines c and neutral. Assuming abc sequence and taking $V_{an} = V_p\angle 0^o$,
      find the currents I_a, I_b, I_c and I_n.
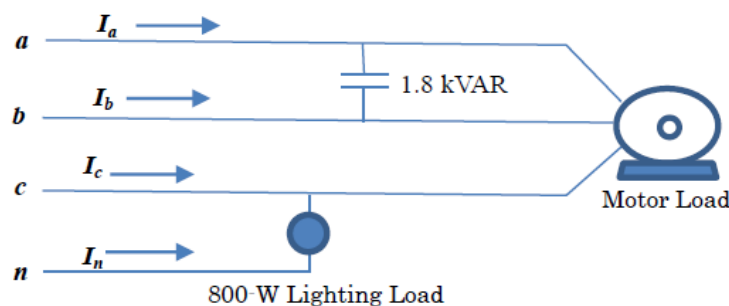
Fig. for Q. No. 1(b)

2.   (a) In a balanced three-phase Y-connected source, the phase voltage is $V_{an} =$ (16)
      $220\angle 90^o$ V and the phase sequence is negative. The source is connected to a

balanced delta-connected load. The line impedance per phase is $1 + j2$ Ω and the load impedance per phase is $60\angle30°$ Ω. Determine the line voltages at source and draw the phasor diagram illustrating the relationship between the line voltages and phase voltages. Also calculate the line currents, the complex power absorbed by the source, line and the load.

(b) A three-phase motor (assume Y-connected) takes 10 kVA at 0.8 power (14) factor lagging from a source of 240 volts. It is in parallel with a balanced delta load having 16 ohms resistance and 12 ohms capacitive reactance in series in each phase. Assuming positive phase sequence, calculate the total volt-ampere, line currents, real power, reactive power and power factor of the combined load.

3.   (a) Sketch the asymptotic Bode plot of the magnitude and phase for   (12)

$$H(\omega) = \frac{250(j\omega + 1)}{j\omega(-\omega^2 + 10j\omega + 25)}$$

(b) For a parallel RLC resonant circuit, show that the bandwidth of pass band (18) $B = \frac{1}{RC}$, and the quality factor $Q = \omega_0 RC$, also express the half-power frequencies in terms of ω_0 and Q, where the symbols have their usual meaning. What is the physical significance of Q of a resonant circuit?

4.   (a) For the circuit shown in Fig. for Q. No. 4(a), obtain the transfer (14) function $V_o(\omega)/V_i(\omega)$. Identify the type of filter the circuit represents and determine the cutoff frequency. Consider $R_1 = R_2 = 100$ Ω and L $= 2$ mH.

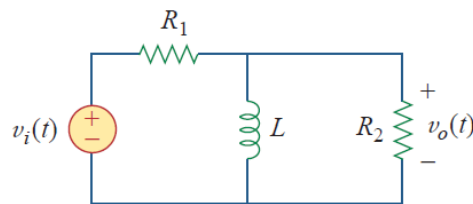
Fig for Q. No. 4(a)

(b) Show that for a bandpass filter, $H(s) = \frac{sB}{s^2+sB+\omega_0^2}$, where B is bandwidth of (16) the filter and ω_o is the center frequency. Determine the center frequency and bandwidth of the bandpass filter shown in Fig. for Q. No. 4(b).
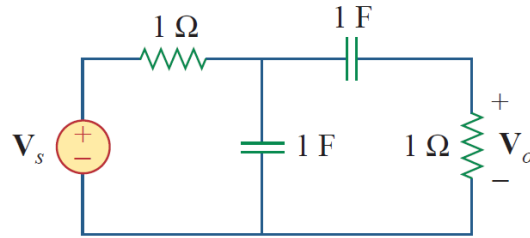
Fig for Q. No. 4(b)

SECTION – B

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

All the symbols have their usual meanings

Assume reasonable values for missing data. B-H curve is attached.

5. (a) What is an electromagnet? For the electromagnet shown in Fig. 5(a), (10)
(i) Find the flux density in the core. (ii) Sketch the magnetic flux lines and indicate their direction. (iii) Indicate the north and south poles of the magnet.
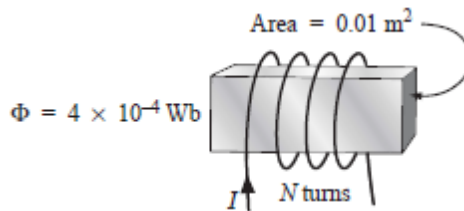

Fig. 5(a)

(b) For the series-parallel circuit shown in Fig. 5(b), find the value of I required (20)
to establish a flux in the gap of $\varphi_g = 3 \times 10^{-4}$ Wb. It is also given that
$l_{ab} = l_{bg} = l_{gh} = l_{ha} = 0.3$ m, $l_{bc} = l_{fg} = 0.2$ m, $l_{cd} = l_{ef} = 0.149$ m.

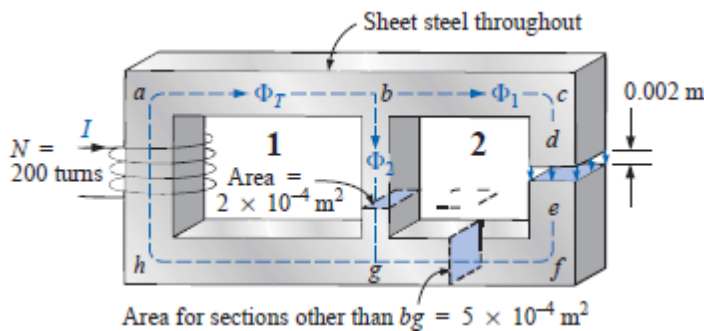Area for sections other than $bg = 5 \times 10^{-4}$ m^2

Fig. 5(b)

6. (a) Two coils connected in series-aiding fashion have a total inductance of 300 (10)
mH. When connected in a series-opposing configuration, the coils have a total

inductance of 200 mH. If the inductance of one coil (L_1) is three times the other, find L_1, L_2, and M. What is the coupling coefficient?

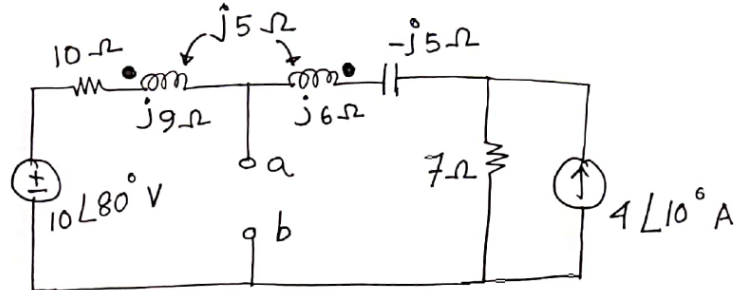(b) Obtain the Thevenin equivalent circuit for the circuit in Fig. 6(b) at (20) terminals a-b.

Fig. 6(b)

7. (a) Compute the effective value of the current wave $i(t) = I_{m1} \sin(\omega t + 20°) + I_{m5} \sin(5\omega t + 70°)$ by integration showing all steps. (10)

(b) A voltage $v(t) = 220 \sin(\omega t - 30°) + 110 \sin(5\omega t + 20°)$ is applied (20) across a series circuit consists of resistance 15 ohm, capacitance 70 microfarads, inductance 15 milihenrys. Determine the ammeter reading of the circuit, power dissipated in the circuit and power factor of the whole circuit for $\omega = 314 \, radian \, per \, sec$.

8   (a) In the circuit shown in Fig. 8(a), the switch closes at $t = 0$. Find the current (15) in the switching resistance R_1. The circuit parameters are: $R_1 = R_2 = 15 \, \Omega$, $L = 0.02$ H and $v_s(t) = 220\sqrt{2} \sin(2\omega t + 15°)$ at $f = 60$ Hz.
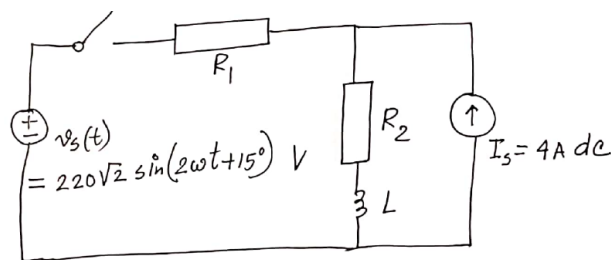

Fig. 8(a)

(b) In the circuit shown in Fig. 8(b), the switch closes at $t = 0$. Find the current (15) in the resistance R_2. The circuit parameters are: $R_1 = R_2 = R_3 = 30 \, \Omega$, $C = 200$ μF and $v_s(t) = 220\sqrt{2} \sin(\omega t + 40°)$ at $f = 60$ Hz.
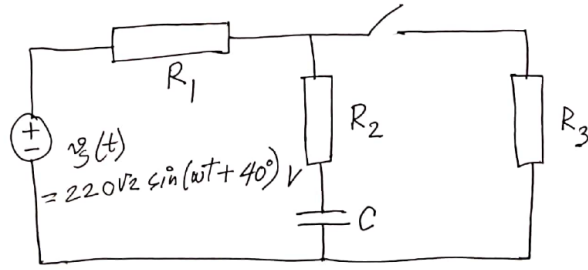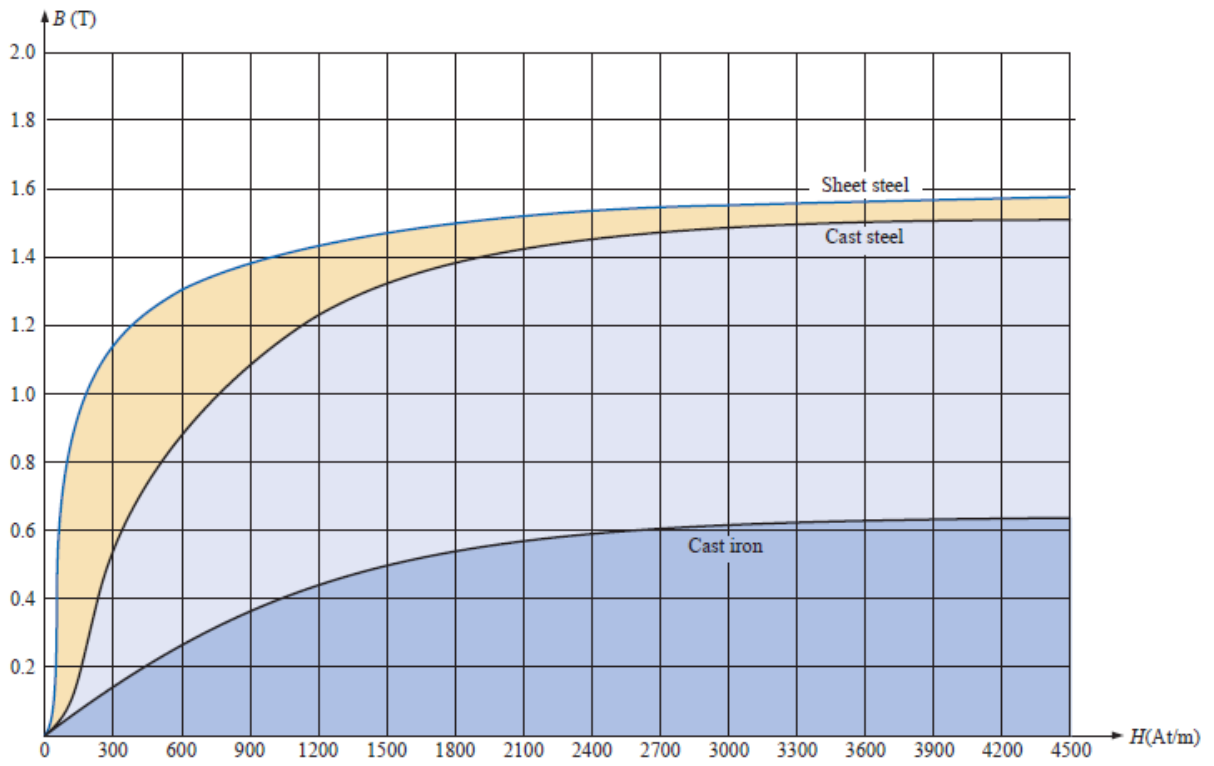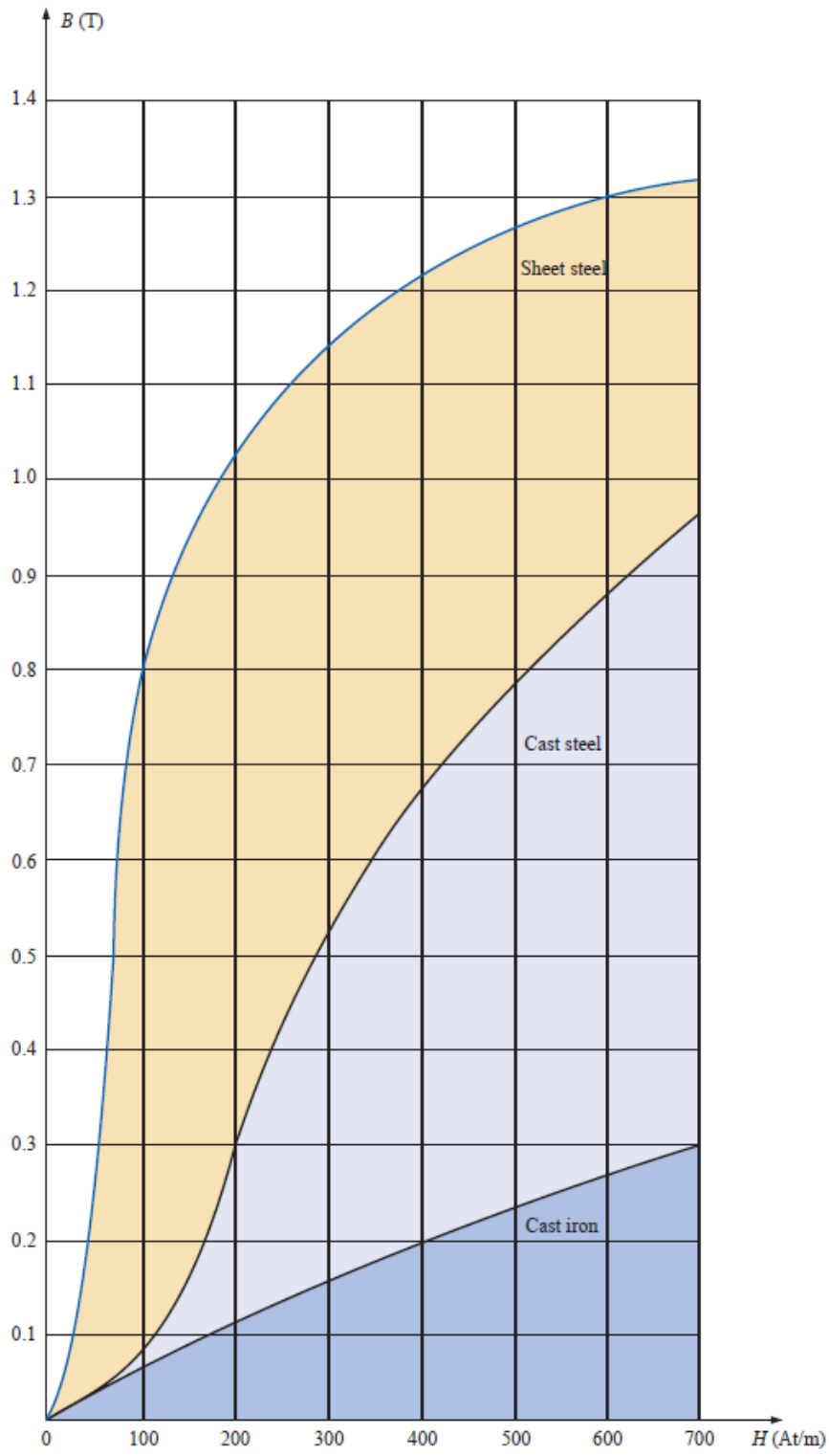
$v_3(t) = 220\sqrt{2}\sin(\omega t + 40°)\,V$

Fig. 8(b)

B-H curve

B-H curve (expanded)

L-1/T-2/EEE   **Date: 13/01/2021**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA
B. Sc. Engineering Examinations January 2020
Sub: **PHY 165** (Electricity & Magnetism, Modern Physics and Mechanics)
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) Discuss how you will prove that the ether medium does not exist and the speed of light is the same in all inertial frames. [22]

   (b) A body moving at $0.5c$ (where c is the velocity of light) with respect to an observer disintegrates into two fragments that move in opposite directions relative to their center of mass along the same line of motion as the original body. One fragment has a velocity of $0.6c$ in the backward direction relative to the center of mass and the other has a velocity of $0.5c$ in the forward direction. What velocity will the observer find? [08]

2. (a) Write down the mechanism of X-ray diffraction from a crystal. Describe how wavelength of unknown X-rays are measured? [22]

   (b) A positron collides head on with an electron and both are annihilated. Each particle had a kinetic energy of 1 MeV. Find the wave length of the resulting photons. [08]

3. (a) In case of the semi-empirical mass formulae of a nucleus, establish the relationships of volume energy, surface energy and Coulomb energy in terms of mass number of the atom. [22]

   (b) Show that the nuclear density of ${}^1_1 H$ is over 10^{14} times greater than its atomic density. Assume the atom to have the radius of the first Bohr orbit. [08]

4. (a) Explain the phenomenon of different types of polarizations occurring in the dielectric system under the static electric field. [15]

   (b) Applying a dielectric medium in between the plates of a parallel plate capacitor deduce the relation, $\varepsilon_o k \oint \vec{E}.d\vec{s} = q$. [15]

SECTION-B

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

5. (a) Explain under what condition Biot-savart law becomes more useful than Ampere's law?

[15]

(b) An electron is moving at 10^6 ms^{-1} in a direction parallel with a current of 5 A, flowing through an infinitely long straight wire, separated by a perpendicular distance of 10 cm in the air. Calculate the magnitude of the force experienced by the electron. [15]

6. (a) What are the reasons of magnetic property in materials? Discuss the properties that exist in the anti-ferromagnetic and ferromagnetic materials. [15]

(b) Explain the hysteresis loop of a ferromagnetic material. What information can be obtained from such a loop? [15]

7. (a) Distinguish between expectation value and average value. [06]

(b) A wave function is defined as $\Psi(x,t) = Ax^2 e^{-(i9\omega t^2 + 3bx^2)}$, where ω and b are constant?

    (i)   Normalize the wave function.

    (ii)   Calculate the expectation value of x^2 and p^2. [24]

8. (a) Briefly describe the assumptions that are made to derive the time dependent Schrodinger equation. [08]

(b) What do you mean by orthonormality of wave function? A function is defined in the region $0 < x < L$ as $\Psi_m(x,t) = cos(\frac{m\pi}{L}x)$, $m = 1, 2, 3, 4, \ldots$ Verify the orthonormality of this wave function. [22]

Bangladesh University of Engineering and Technology, Dhaka
L-1/T-2 B.Sc Examinations of January 2020
Subject: Chem-101 (Chemistry-I)

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. Discuss the quantum-mechanical model of an atom with an electron probability density   15
diagram. How accurately can an umpire know the position of a baseball (mass $=0.142$ kg)
moving at 100.0 mile/h $\pm 1.00\%$ (44.7 m/s $\pm 1.00\%$)?

b. What factors are affecting the atomic orbital energies? After scandium (Sc), why the   15
energy of 3d goes down than 4s? Explain with diagram.

2.a Discuss the periodic trends of the second row (period 2) elements in terms of ionization   15
energy and electron affinity. Write down the structure of different oxoacids of phosphorus
and calculate their formal charge.

b. How are interhalogen compounds formed? Calculate the oxidation number and discuss   15
the shape of interhalogen compounds.

3a. What are the criteries of a molecule to absorb IR radiation? How to differentiate a   15
symmetric internal alkyne and asymmetric terminal alkyne by IR spectroscopy?

b. Draw the Lewis structures and predict the shape of i) PF_5 ii) ClO_3^- and iii) CO_3^{2-} 15

4a. Predict the change in energy and bond length, if one electron is released from N_2 and Ne_2 15
to form N_2^+ and Ne_2^+ respectively? Explain with energy diagram.

b. Draw and explain the energy diagram for molecular orbital of NO and HF with   15
their electronic configuration.

Section B

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

5a. Consider the following reaction: 20

$$A \xrightarrow{k_1} B \xrightarrow{k_2} C$$
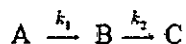
The rate constants k_1 and k_2 are comparable in magnitude and the rate of overall reaction depends on both constants.

(i) Identify the condition at which a reaction is consecutive.

(ii) Suggest the individual rate expressions with respect to A, B and C.

(iii) Demonstrate the reaction profile for A, B and C.

(iv) Justify the two conditions: $k_1 \gg k_2$ and $k_2 \gg k_1$

(v) Evaluate the *optimum time* to manufacture B in a batch process.

(vi) To determine the order of a reaction, it is always advisable to investigate it in the initial stages of the reaction. -Explain.

b. Benzene diazonium chloride decomposes as: $C_6H_5N_2Cl \rightarrow C_6H_5Cl + N_2$. Kinetics of this 10 reaction is followed by the pressure of nitrogen gas evolved at different time intervals. From the following data, investigate the order of the reaction and evaluate the rate constant.

t(min)	0	4.0	12.0	20.0	34.0	50.0
P (mm Hg)	0	2.20	5.90	9.01	13.10	16.30

6.a The addition of a nonvolatile and non-electrolyte solute lowers the freezing point and 20 elevates the boiling point of a solvent-Justify. The depression of the freezing point of a solvent due to the addition of a nonvolatile solute changes proportionately with the molality of the solution.- Illustrate with an appropriate graph.

b. A solution containing 2.43 g of sulphur in 100 g of naphthalene (mp 80.1 °C) had a 10 freezing point depression of 0.64 °C. The latent heat of fusion of naphthalene is 19.4 kJmol^{-1}. What are the molar mass and molecular formula of sulphur in the solution?

7.a. Corrosion causes tens of billions of dollars of damage to cars, ships, buildings, and 20 bridges each year. In the presence of moisture and oxygen, corrosion takes place by forming an environmental voltaic cell. Nevertheless, voltaic cells have enormous positive impacts in our daily life.

(i) Illustrate the half-reactions and the overall redox reaction involved in the corrosion process. Calculate the standard emf for this process by using the data in Appendix 1.

(ii) How cathodic protection prevents the corrosion of iron?

(iii) Design an electrochemical cell to determine the pH of a supplied solution by measuring the emf of the cell.

b. A conductance cell was calibrated with 0.02 M KCl solution of specific conductance 10 0.02768 S m^{-1}. The measured resistance was 457.3 ohm at 298 K. The cell was then filled with a CaCl$_2$ solution containing 0.555 g of CaCl$_2$ per litre. The measured resistance was 1050 ohm. Calculate the (i) cell constant for the cell (ii) conductivity of the CaCl$_2$ solution (iii) molar conductivity of CaCl$_2$ at this concentration.

8a. Napoleon's Russian campaign was a disaster as he chose to replace the brass of the 20
soldiers' winter coat buttons with tin to save money. Rationalise the fact with the help of
the phase diagram of tin. The four phases of tin cannot coexist in equilibrium. - Justify.

b. Explain: 10
(i) Termolecular reactions are infrequent.
(ii) Specific conductance decreases while equivalent conductance increases with dilution.

Appendix 1: Standard Electrode Potentials

Half-Reaction	$E^\circ_{half\text{-}cell}$ (V)
$F_2(g) + 2e^- \rightleftharpoons 2F^-(aq)$	+2.87
$Cl_2(g) + 2e^- \rightleftharpoons 2Cl^-(aq)$	+1.36
$MnO_2(s) + 4H^+(aq) + 2e^- \rightleftharpoons Mn^{2+}(aq) + 2H_2O(l)$	+1.23
$NO_3^-(aq) + 4H^+(aq) + 3e^- \rightleftharpoons NO(g) + 2H_2O(l)$	+0.96
$Ag^+(aq) + e^- \rightleftharpoons Ag(s)$	+0.80
$Fe^{3+}(aq) + e^- \rightleftharpoons Fe^{2+}(aq)$	+0.77
$O_2(g) + 2H_2O(l) + 4e^- \rightleftharpoons 4OH^-(aq)$	+0.40
$Cu^{2+}(aq) + 2e^- \rightleftharpoons Cu(s)$	+0.34
$2H^+(aq) + 2e^- \rightleftharpoons H_2(g)$	0.00
$N_2(g) + 5H^+(aq) + 4e^- \rightleftharpoons N_2H_5^+(aq)$	−0.23
$Fe^{2+}(aq) + 2e^- \rightleftharpoons Fe(s)$	−0.44
$Zn^{2+}(aq) + 2e^- \rightleftharpoons Zn(s)$	−0.76
$2H_2O(l) + 2e^- \rightleftharpoons H_2(g) + 2OH^-(aq)$	−0.83
$Na^+(aq) + e^- \rightleftharpoons Na(s)$	−2.71
$Li^+(aq) + e^- \rightleftharpoons Li(s)$	−3.05

Strength of oxidising agent (left arrow, increasing upward)

Strength of reducing agent (right arrow, increasing downward)

Appendix 2: Periodic Table

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2   B. Sc. Engineering Examinations 2018-2019

Sub: **MATH 257** (Ordinary and Partial Differential Equations)

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)   Find the differential equation by eliminating arbitrary constants A and B from   (15)
the equation $y = A\sin2x + B\cos2x + x\sin2x$.

(b)   Solve: $y^2dx + (3xy - 1)dy = 0$, $y(0) = 1$.   (15)

2.   (a)   Radium is known to decay at a rate proportional to the amount present. If the   (15)
half life of radium is 1200 years, what percentages of radium will remain in a
given sample after 7200 months? Also determine the number of years, after
which only one-fifth of the original amount of radium would remain?

(b)   Solve the differential equation $(D^2 - 6D + 9)y = xe^{3x} \sin 2x$, where $D = \dfrac{d}{dx}$.   (15)

3.   (a)   Reduce the differential equation   (15)

$(2x-1)^3 \dfrac{d^3y}{dx^3} + (2x-1)\dfrac{dy}{dx} - 2y = \cos\log(2x-1)$ into   homogeneous   form

and then solve.

(b)   Apply the method of variation of parameters to solve: (15)

$$\dfrac{d^2y}{dx^2} - 4\dfrac{dy}{dx} + 3y = \dfrac{e^x}{1+e^x}$$

4.   (a)   Use the method of factorization of operators to solve the equation   (15)
$[(x+1)D^2 - (3x+4)D + 3]y = (3x+2)e^{3x}$

(b)   Find the charge and the current for $t > 0$ in a series RC circuit where $R = 20\Omega$,   (15)
$C = 2 \times 10^{-3}$ F and $E = 60 \sin 120t$ V. Assume that when the switch is
closed at $t = 0$, the charge on the capacitor is -0.02 C.

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

5. Identify the nature of singular point of the differential equation (30)

$$x^2 \frac{d^2y}{dx^2} + 5x\frac{dy}{dx} + (x+4)y = 0$$

Hence find the roots of the indicial equation and the recurrence relation.

6. (a) Apply Lagrange's method to solve $(y-x)p + (y+x)q = \frac{x^2+y^2}{z}$. (15)

(b) Apply Charpit's method to find the complete solution of $z^2(p^2 + q^2 + 1) = 1$. (15)

7. (a) Solve $(D_x^2 + 2D_xD_y + D_y^2 - 2D_x - 2D_y)z = \sin(x+2y)$. (15)

(b) Solve $(x^2D_x^2 + 2xyD_xD_y - xD_x)z = \frac{x^3}{y^2}$. (15)

8. Solve the wave equation $\frac{\partial^2 y}{\partial t^2} = 9\frac{\partial^2 y}{\partial x^2}$ for the displacement function $y(x,t)$ (30)

satisfying the following boundary and initial conditions by the method of separation of variables:

$$y(0,t) = 0, \ y(2,t) = 0 \text{ for } t \geq 0,$$
$$y(x,0) = x(x-2) \text{ and } y_t(x,0) = 1 \text{ for } 0 \leq x \leq 2.$$

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

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

Sub: **HUM 127** (Sociology, Science and Technology)

Full Marks: 180   Time 2 Hours

The Figures in the margin indicate full marks

USE SEPARATE SCRIPTS FOR EACH SECTION

There are 02 page(s) in this question paper.

SECTION – A

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

1.   (a) Define human ecology and environment. How can we save the environment   (15) and make it greener?

       (b) Briefly discuss the negative impacts of global warming.   (15)

2.   (a) What do you understand by 'poverty'? Define absolute and relative poverty.   (15)

       (b) What do you think to be the causes behind poverty?   (15)

3.   (a) Define the terms- crime, criminal, deviance, deviant, white collar crime and · (15) white collar criminal.

       (b) What is juvenile delinquency? Explain the reasons behind juvenile   (15) delinquency.

4   (a) Explain the changing functions of family as a social organization. Briefly   (15) discuss the recent trends of modern nuclear family.

       (b) Define industrial revolution. Explain the characteristics of the first, second,   (15) third and fourth industrial revolutions.

SECTION – B

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

5.   (a) How is inequality different from social stratification?   (15)

       (b) Describe the different types of social stratification.   (15)

6.   (a) Write in your own words what is meant by socialization and gender   (15)
       socialization.

       (b) Critically discuss the agents of socialization.   (15)

7.   (a) What is the relationship between globalization and technology?   (15)

       (b) What are the sociological implications of globalization in the Bangladeshi   (15)
       society? Discuss.

8.   Write short notes on any **three** of the following: (30)

       a) Cultural lag

       b) Chronological steps of sociological research

       c) Mass-media and communication

       d) Caste system and class system

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

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

Sub: HUM 277 (Fundamentals of Economics)

Full Marks: 180   Time 2 Hours

The Figures in the margin indicate full marks

USE SEPARATE SCRIPTS FOR EACH SECTION

There are 03 page(s) in this question paper.

SECTION – A

There are FOUR questions in this section. Answer any THREE

All the symbols have their usual meanings

Assume reasonable values for missing data.

1. A firm producing two goods "X" and "Y" has the profit function

    $Z = 640X - 20X^2 + 40XY - 40Y^2 + 320Y - 140$

    (a) What are the profit-maximizing level of output for each of the two goods?   (15)

    (b) Test whether profits are maximized.   (8)

    (c) What is the maximized amount of profit?   (7)

2. (a) What are the assumptions of a perfectly competitive market? Explain.   (5)

    (b) Explain and show graphically super normal profit, abnormal loss and zero profit/normal profit of a firm under perfect competition.   (10)

    (c) From the following total revenue (TR) and total cost (TC) functions, calculate profit maximizing level of output and maximum profit.   (15)

    $T R = 1200Q - 2Q^2$
    $TC = Q^3 - 61.25Q^2 + 1538.5Q + 2000$

3. (a) Define Gross Domestic Product (GDP) deflator. How can you calculate inflation rate using GDP deflator?   (10)

(b) Consider a hypothetical economy. Using the information given in the following table, calculate the inflation rates from 2017 to 2018, from 2018 to 2019, and from 2019 to 2020. (20)

	2017	2018	2019	2020
Nominal GDP	20,000	25,000	27,000	30,000
Real GDP	18,000	18,700	20,000	24,000

4. (a) Write short notes on Millennium Development Goals (MDGs) and Sustainable Development Goals (SDGs). (10)

(b) Do you think that construction of the Padma bridge will help Bangladesh achieve Sustainable Development Goals (SDGs)? If yes, which goals and how? Explain. (20)

SECTION – B

There are FOUR questions in this section. Answer any THREE

All the symbols have their usual meanings

5. (a) Define demand function. What are the factors that influence the shifting of the demand curve? (15)

(b) How would you derive the market demand curve of a commodity? Explain graphically. (15)

6. (a) What is the relation between price elasticity of demand and total revenue? There are two parallel straight line demand curves. Show that the curve which is nearer to the origin has a higher price elasticity of demand at any point. Explain graphically. (15)

(b) From the following table calculate elasticity of demand if you move from (15) point A to C and explain what you understand from the result.

POINT	Px	Qy
A	500	120
B	600	150
C	700	180

7.   (a) What is an indifference curve? Explain the properties of an indifference curve.   (15)

(b) Explain consumer's equilibrium with the help of budget line and indifference curve.   (15)

8.   (a) How is price determined in an economy Under competition? What will   (10)

happen to the price and quantity because of change in demand?

(b) From the following demand and supply functions, calculate equilibrium   (20) price and quantity and show the result in a graph.

$$P = 0.1\,Q + 8$$
$$P = -0.5Q + 50$$

   i)   Plot the new demand function $P = -0.6Q + 36$ on the graph and calculate new equilibrium price and quantity.
   ii)   Describe the change in equilibrium. Show the equilibrium coordinates on the same graph.
   iii)   What will happen to the equilibrium price and quantity if government imposes a unit tax of TK 2 per unit?
   iv)   What will happen if government gives a subsidy of TK 3 per unit?

Describe the change in equilibrium after imposition of taxes. Show the equilibrium coordinates on the same graph.