

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY

Department of Energy Science and Engineering

B. Sc. Engineering 1st Year 2nd Term Examination, 2018

Math 1213

(Differential Equations and Coordinate Geometry)

Time: 3 Hours.

Full 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). State whether the following differential equations are linear or non-linear and also write their order – 09
- (i) $x \frac{d^3y}{dx^3} - \left(\frac{dy}{dx}\right)^4 + y = 0$ (ii) $\frac{d^2y}{dx^2} = \sqrt{1 + \left(\frac{dy}{dx}\right)^2}$
- (iii) $\frac{d^2u}{dr^2} + \frac{du}{dr} + u = \cos(r + u)$
- 1(b). Solve, $(x^3 + 3xy^2)dx + (y^3 + 3x^2y)dy = 0$. 11
- 1(c). Solve, $(6x - 2y - 6)dx = (-2x + 3y - 5)dy$. 15
- 2(a). Find the most general function $N(x, y)$ so that the equation – 10
 $[y \cos(xy) + e^x]dx + N(x, y)dy = 0$ is exact
- 2(b). Identify and solve $\frac{dy}{dx} - 5y = -\frac{5}{2}xy^3$. 12
- 2(c). Initially 100mg of a radioactive substance was present. After 6 hours the mass had decreased by 3%. If the rate of decay is proportional to the amount of substance present at time t , find the amount remaining after 24 hours. 13
- 3(a). Find the general solution of the following differential equation – 11
 $(D^2 - 1)y = xe^x + \cos^2(x)$, where, $D^2 = \frac{d^2}{dx^2}$.
- 3(b). Solve the following differential equation by using the method of variation of parameters 12
 $3y'' - 6y' + 6y = e^x \sec(x)$
- 3(c). Solve the initial value problem to obtain $x(t)$ – 12
 $\frac{d^2x}{dt^2} + \omega^2x = F_0 \cos(\gamma t); x(0) = 0, x'(0) = 0$
Also find $\lim_{\gamma \rightarrow \omega} x(t)$.
- 4(a). Define periodic function. Find the Laplace transform for the following function – 10
 $F(t) = \begin{cases} 3t, & 0 < t < 2 \\ 6, & 2 < t < 4 \end{cases}$, where $F(t)$ has period 4.
- 4(b). Find the inverse Laplace transform by using the convolution theorem – 10
 $\mathcal{L}^{-1} \left\{ \frac{1}{(s^2 + k^2)^2} \right\}$
- 4(c). Determine the current $i(t)$ in a single loop LRC circuit when $L = 0.1 \text{ h}$, $R = 2 \Omega$, $C = 0.1 \text{ f}$, $i(0) = 0$ and the impressed voltage is $E(t) = 120t - 120t u(t - 1)$, where, $u(t - 1)$ is delayed unit step function. 15

SECTION – B

- 5(a). What is meant by Cartesian coordinate and polar coordinate? Also find the relation between them. 10
- 5(b). The equation $3x^2 + 2xy + 3y^2 - 18x - 22y + 50 = 0$ is transformed to $4x^2 + 2y = 1$ when the origin is shifted to the point (2,3) and a rotation θ is made referred to the previous axes. Find the inclination θ . 15
- 5(c). Find the cylindrical and spherical polar coordinate for the point (-6,3,1). 10
- 6(a). Determine the angle through which the axes must be rotated to remove xy -term in the equation $4x^2 + 2\sqrt{3}xy + 2y^2 - 1 = 0$. 10
- 6(b). Reduce the equation $x^2 - 4xy + y^2 + 8x + 2y - 5 = 0$ to the standard form. Find also the equation of latus rectum and axes. 15
- 6(c). Define dot product and cross product with example. Find the angle which the vector $3\hat{i} - 6\hat{j} + 2\hat{k}$ makes with the coordinate axes. 10
- 7(a). Find the equation of straight line which passes through the point (2,1,3) and is parallel to the vector $2\hat{i} + \hat{j} - 2\hat{k}$. 12
- 7(b). Find the shortest distance between the straight lines through the points $P(6,2,2)$ and $Q(-4,0,-1)$ in the direction $(1,-2,2)$ and $(3,-2,-2)$ respectively. 13
- 7(c). Find the angle between the plane $3x + 4y + z + 5 = 0$ and the line $\frac{x-2}{3} = \frac{y+1}{-1} = \frac{z-3}{2}$. 10
- 8(a). Find the equation of plane through (5,2,-3) and perpendicular to each of the planes $\vec{r} \cdot (2\hat{i} - \hat{j} + 2\hat{k}) = 0$ and $\vec{r} \cdot (\hat{i} + 3\hat{j} - 5\hat{k}) + 3 = 0$. 12
- 8(b). The position vectors of two points A and B are $3\hat{i} + \hat{j} + 2\hat{k}$ and $\hat{i} - 2\hat{j} - 4\hat{k}$ respectively. Find the vector equation of the plane passing through B and perpendicular to \overline{AB} . 12
- 8(c). Relative to a fixed origin O , the point A has the position vector $(2\hat{i} - \hat{j} + 5\hat{k})$, and the point B has the position vector $(5\hat{i} + 2\hat{j} + 10\hat{k})$, and D has the position vector $(-\hat{i} + \hat{j} + 4\hat{k})$. Find the vector equation of a line ℓ that passes through the points A and B , and hence find the shortest distance from the point D to the line ℓ . 11

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY

Department of Energy Science and Engineering

B. Sc. Engineering 1st Year 2nd Term Examination, 2018

EE 1213

(Electrical Circuits and Electronics)

Time: 3 Hours.

Full Marks: 210

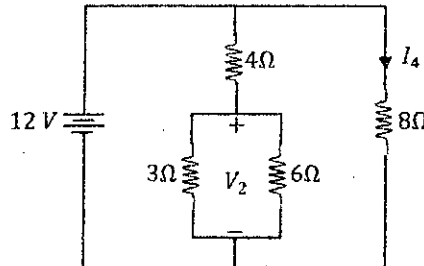
N.B. i) Answer any THREE questions from each section in separate scripts.

ii) Figures in the right margin indicate full marks.

iii) Assume reasonable data if any missing.

SECTION - A

- 1(a). What is linear and nonlinear circuit? 04
- 1(b). Define active and passive element. 04
- 1(c). State Kirchoff's voltage and current law. What are the limitations of Ohm's law? 07
- 1(d). Find the current I_4 and voltage V_2 for the following network – 10

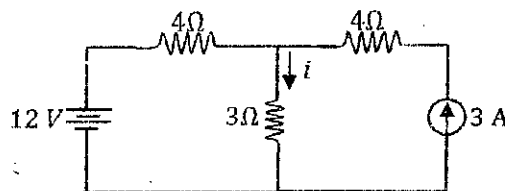


- 1(e). Derive the condition for which load will extract maximum power from a network and thus show that – 10

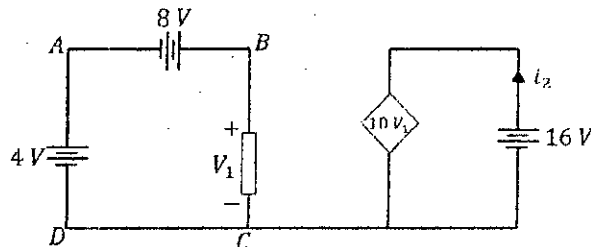
$$P_{L(max)} = \frac{E^2}{4R_i}$$

where, the symbols bear usual meaning.

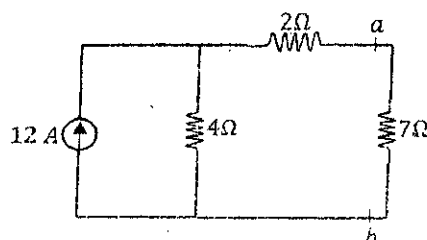
- 2(a). State superposition theorem. Using superposition theorem, find i of the following network – 12



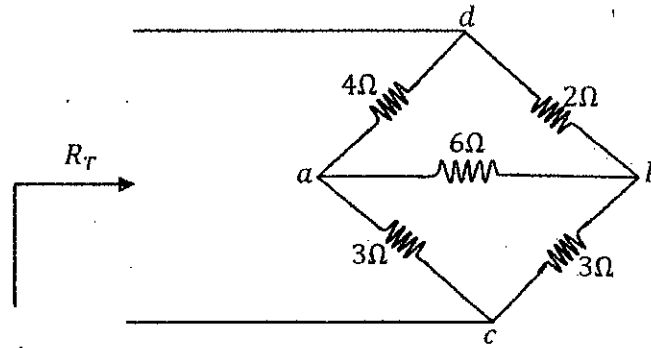
- 2(b). Find the value of i_2 of the following figure – 06



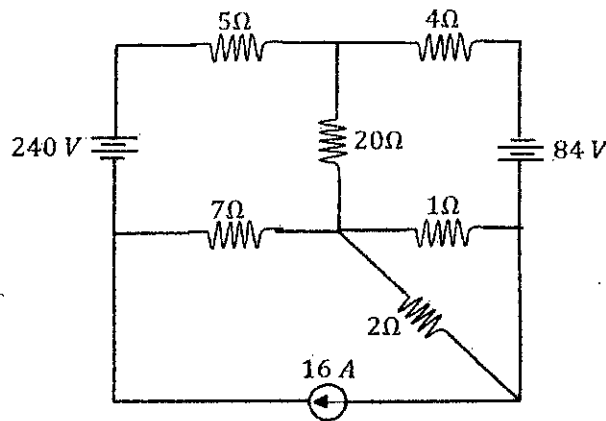
- 2(c). Find the Thevenin equivalent circuit of the following network for the left of 'ab'. Thus find the current through 7Ω resistor. 10



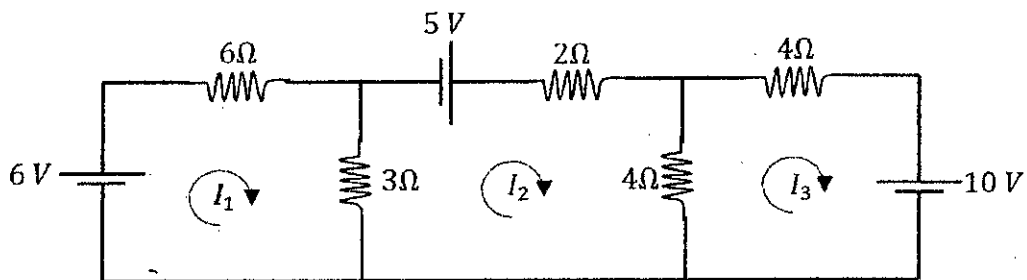
2(d). Find the total resistance of the following network –



3(a). Using nodal analysis technique, determine the power dissipated in $20\ \Omega$ resistor of the following circuit –

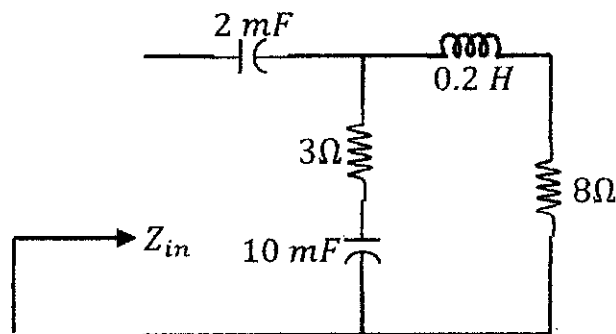


3(b) Find the loop current for the circuit shown in the following circuit using loop current or mesh current method.



3(c). What is meant by real and reactive power? Show that the average power consumed by inductance or capacitance is zero.

4(a). Find the input impedance of the following circuit. The circuit operates at $\omega = 50\text{ rad/s}$.



4(b). A series connected load draws a current $i(t) = 4 \cos(100\pi t + 10^\circ)\text{ A}$ when the applied voltage is $v(t) = 120 \cos(100\pi t - 20^\circ)\text{ V}$. Find the apparent power and power factor of the load. Determine the element values that form the series connected load.

4(c). What is meant by resonance in RLC circuit? Derive the expression of resonant frequency and Q -factor of series resonance circuit.

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY

Department of Energy Science and Engineering

B. Sc. Engineering 1st Year 2nd Term Examination, 2018

Course No ESE-1205, Course Title: Thermodynamics for Energy Engineering.

Time: 3 Hours.

Full Marks: 210

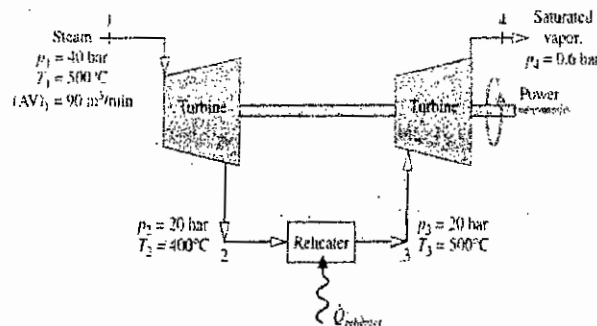
N.B. i) Answer any THREE questions from each section in separate scripts.

ii) Figures in the right margin indicate full marks.

iii) Assume reasonable data if any missing.

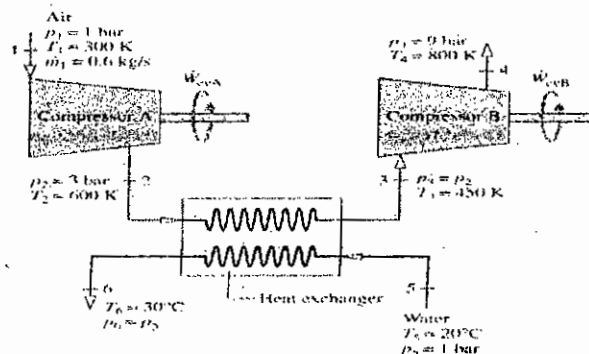
SECTION – A

- 1(a). What does it mean by macroscopic and microscopic viewpoints of thermodynamics? Explain with example. 06
- 1(b). Draw an energy mind map and describe each terms in brief. 10
- 1(c). Write the definition of the following terms – 06
 (i) Thermodynamic open system ; (ii) Pure substance and phase ; (iii) Gibbs phase rule for non-reacting systems.
- 1(d). A gas in a piston cylinder assembly undergoes an expansion process for which the relationship between pressure and volume is given by $PV^n = Constant$. The initial pressure is 3 bar. The initial volume is $0.1 m^3$ and the final volume is $0.2 m^3$. Determine the work for pressure in kJ of
 (i) $n = 1.5$ and (ii) $n = 1$ 13
- 2(a). State zeroth law of thermodynamics. Draw $T-v$ diagram of a single component pure substance, and label constant pressure line, saturation lines, critical point, constant quality lines. 07
- 2(b). State first law of thermodynamics. Write down energy rate balance equation for a control volume and describe what each term in the equation mean. 08
- 2(c). Steam enters the first stage turbine shown in figure at 40 bar and $500^\circ C$ with volumetric flow rate of $90 m^3/min$. 3+
=1



Steam exists the turbine at 20 bar and $400^\circ C$. The steam is reheated at constant pressure to $500^\circ C$ before entering the second stage turbine. Steam leaves the second stage turbine as saturated vapor at 0.6 bar. For operation at steady state, and ignoring stray heat transfer and kinetic and potential energy effects, determine the

- (i) Mass flow rate of steam.
 (ii) Total power produced by the two stages of the turbine in kW.
 (iii) Rate of heat transfer to the steam following through the reheater in kW.
- 2(d). What is compressibility factor? When a gas is modeled as an ideal gas what are the equations to be used? 05
- 3(a). Separate streams of air and water flow through the compressor and heat exchanger arrangement shown in following figure. 15



Heat transfer with the surroundings can be neglected, as can all kinetic and potential energy effects. The air is modeled as an ideal gas with $Cp = 1.063 kJ/kg - K$. Determine

- (i) The total power required by the both compressor in kW
 (ii) The mass flow rate of the water in kg/s.

- 3(b). Write down the Kelvin-Plank statement of second law of Thermodynamics . Derive the first and second Tds equations. 11
- 3(c). What is a revssible process. Show that $dS = \left(\frac{\delta Q}{T}\right)_{int rev}$ 09
- 4(a). What is exergy ? Show that the exergy of a system is given by $\xi = (U - U_0) + P_0(V - V_0) - T_0(S - S_0) + KE + PE$, where the symbols have their usual meaning. 12
- 4(b). Write down the virial equation of state. How to use this equation for substances? 06
- 4(c). Write down the entropy rate balance equation for a control volume and describe what each term in the equation mean. 07
- 4(d). Prove that $-\left(\frac{Q_C}{Q_H}\right)_{rev cycle} = \frac{T_C}{T_H}$, where, Temperature are in absolute scale. 10

SECTION – B

- 5(a). What is air standard cycle? Write down the air standard assumptions of an actual cycle. 07
- 5(b). Why dual cycle is called limited pressure cycle. From $T-s$ diagram and derivations, Show that the efficiency of dual cycle is in between the efficiency of Otto cycle and diesel cycle. 10
- 5(c). An air standard limited pressure cycle has a compression ratio of 18 and compression begins at $0.1 MPa, 40^\circ C$. The maximum pressure is limited to $7 MPa$ and the heat added is $1.675 MJ/kg$, compute 18
- (i) The heat supplied at constant volume per kg of air.
 - (ii) The heat supplied at constant pressure per kg of air.
 - (iii) The work done per kg of air.
 - (iv) The cycle efficiency.
 - (v) The temperature at the end of the constant volume heating process.
 - (vi) Cut- off ratio.
- 6(a). Write down the basic difference between the gas power cycle and vapor cycle. Why Carnot vapor power cycle is not used in practice? 05
- 6(b). Why vapor compression refrigeration system called work operated and absorption refrigeration system called heat operated system? With the $p-h$ diagram, describe the mechanism of a vapor compression refrigeration system. 12
- 6(c). Consider a steam power plant operating on ideal Regenerative cycle with one open feed water heater. Steam enters the turbine at $15 MPa$ and $550^\circ C$ and is condensed in the condenser at a pressure of $10 kPa$. Some steam leaves the turbine at a pressure of $1.2 MPa$ and enters the open feed water heater. Determine the fraction of steam extracted from the turbine and the thermal efficiency of the cycle. 18
- 7(a). State Dalton's law of partial pressure .Show that $M_m = \sum_{i=1}^k x_i M_i$, where M_m is the equivalent molecular weight of the gas mixture. 10
- 7(b). A 300 liter drum contains gas mixture at pressure $600 kPa$ and temperature $40^\circ C$. It contains oxygen 35% and CH_4 65% by volume. It is required to make new composition by volume of oxygen 70% and CH_4 30% at same pressure and temperature .How many kilogram of the mixture must be blend and what mass of oxygen is needs to be added to the original mixture. 15
- 7(c). Mixture of $CH_4, N_2, CO,$ and O_2 has partial pressure $140, 55, 70,$ and $15 kPa$ restively. Find the volumetric and gravimetric analysis. 10
- 8(a). Define :- (i) Psychometrics ; (ii) Relative humidity ; (iii) Degree of saturation ; (iv) Dew point temperature. 08
- 8(b). Why we feel sweaty in summer and dry in winter. 05
- 8(c). Show that the enthalpy of mixture remains constant during an adiabatic saturation process. 10
- 8(d). Atmospheric air at $1.0132 bar$ has $dbt 32^\circ C$ and a wbt of $24^\circ C$.Compute 12
- (i) Partial pressure of water vapor
 - (ii) Specific humidity
 - (iii) Relative humidity
 - (iv) Degree of saturation
 - (v) Enthalpy of the mixture.

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY

Department of Energy Science and Engineering

B. Sc. Engineering 1st Year 2nd Term Examination, 2018

Ch 1213

(Chemistry II)

Time: 3 Hours.

Full 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). Compare order and molecularity of a chemical reaction with definition and example. 08
- 1(b). A first order reaction is 15% complete in 20 minutes. How long will it take to be 60% completed? 06
- 1(c). How the order of a chemical reaction can be determined? Give a suitable method. 12
- 1(d). Give at least three factors with brief explanation that can affect the rate of a chemical reaction. 09
- 2(a). Deduce the law of photochemical equivalence. 10
- 2(b). Why does the $S_0 \rightarrow T_1$ transition forbidden quantum mechanically? 05
- 2(c). Let
- $$\underbrace{AB}_{\text{Ground State}} \xrightarrow{\text{UV light}} \underbrace{AB^*}_{\text{Excited State}}$$
- What are the possibilities of the fates of electronically excited states? Explain with suitable diagrams.
- 2(d). Write down the chemiluminescence reactions that occur in the firefly system. 08
- 3(a). State the assumptions of collision theory and transition state theory. 09
- 3(b). Write down the limitations of collision theory that can be overcome by transition state theory. 08
- 3(c). The rate constant for the formation of $HI(g)$ from the elements $H_2(g)$ and $I_2(g)$ are $2.7 \times 10^{-4} L/(mol \cdot s)$ at 600 K and $3.5 \times 10^{-3} L/(mol \cdot s)$ at 650 K. Find out E_a of the reaction and the rate constant at 700 K. 12
- 3(d). Draw the potential energy diagram of uncatalyzed and catalyzed chemical reaction. 06
- 4(a). What is micro-organism? What are the industrial importance of micro-organism? 08
- 4(b). Discuss the Geometrical isomerism of maleic acid and fumaric acid. 09
- 4(c). Derive Michaelis-Menten equation for enzyme catalyzed reactions. 12
- 4(d). Why n-pentane has higher boiling point than iso-pentane? 06

SECTION – B

- 5(a). Adsorption is an exothermic process – Why? 07
- 5(b). Deduce Langmuir adsorption isotherm with respect to very low and very high pressure. 10
- 5(c). What is de-ionized water? Explain with diagram how you would demineralize water? 10
- 5(d). Write down the difference between physical adsorption and chemical adsorption. 08

- 6(a). Why does the *UV* spectrum of a molecules usually consist of a broad band? 08
- 6(b). Define auto-catalysis. Explain with a reaction “hydrolysis of an ester in an example of auto-catalysis”. 10
- 6(c). Show that H_2O molecule is *IR* active as well as microwave active. 10
- 6(d). Write a short note on “catalytic poison”. 07
- 7(a). What is the finger print region in *IR* spectra? Write down the different modes of vibration of molecules, with suitable representations. 12
- 7(b). Explain about absorption and emission spectra. 09
- 7(c). Define and distinguish bathochromic shift and hypochromic shift. 08
- 7(d). The wavelength of a radiation is $2.5\mu m$. find (i) wave number, (ii) frequency, and (iii) energy of a radiation. 06
- 8(a). What is local cell corrosion? Explain with diagram the mechanism of crevice corrosion. 10
- 8(b). Define corrosion engineering. Write down the factors that influence the rate of corrosion. 10
- 8(c). Discuss the role of metal oxide formed in oxidation corrosion with the help of Pilling-Bedworth rule. 08
- 8(d). Suggest the preventive measures to control corrosion. 07

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY

Department of Energy Science and Engineering

B. Sc. Engineering 1st Year 2nd Term Examination, 2018

Hum 1213

(Technical English)

Time: 3 Hours.

Full 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). Frame Wh questions from the underlined parts of the following answers. 14
(i) Dhaka is famous for mosque.
(ii) He earns 40 thousand taka per month.
(iii) Bangla is our mother tongue.
(iv) We achieved our freedom in 1971.
(v) A lion was very proud of his strength.
(vi) I got down from a train at Khulna station.
(vii) I heard the girl singing.
- 1(b). Make sentences using the following words as directed. 12
What (as pronoun); What (as adjective); What (as interjection); round (as noun);
round (as verb); right (as noun).
- 1(c). Change the following words as directed and make sentences with the changed form. 09
Focus (into adjective); Part (into adjective); Act (into verb); Novel (into noun);
Enemy (Into Noun); Hate (into adverb).
- 2(a). Make a new word with each of the following prefixes and suffixes and use then in 14
sentences.
Fore , Pro..... , Se..... , Over , encè ,let ,ster.
- 2(b). Make one antonym and one synonym of each of the following words and make sentences 12
with them.
Sink; pluck; Harmony; Liberate.
- 2(c). Make sentences with the following phrases and idioms. 09
All at once; Bad blood; Hand and glove; In full swing; High time; White lies.
- 3(a). Make sentence with the following structures using the words given in brackets. 14
(i) Subj. + Intransitive verb + Adv. of place + Adv. of manner. (Live as verb).
(ii) Subj.+ Transitive verb + Object. (Prepare as verb) .
(iii) How + subj. + Verb + Object + Verb + Adj. Complement. (Do and is as verb).
(iv) Since + Subj. + Verb + Adv.of manner, Subj. + Verb + Adj. Complement. (Work
and is as verb).
(v) Subj.+ Verb + not only + Obj. + but also + Obj.(Eat as verb).
(vi) Subj.+ Verb + neither + Obj. + nor + Obj.(Read as verb).
(vii) Subj.+ Verb + Adv.of manner, so + Subj + Verb + Obj.(Try and inspire as verb).
- 3(b). Make use of the following modals in sentence as asked in brackets . 12
(i) Must .(To Express as inference) .
(ii) Would .(To express a polite request).
(iii) Should .(To express an action in the past not implemented).
(iv) Shall .(To express an offer).
(v) Will .(To express a polite question).
(vi) Can .(To express an offer).
- 3(c). Fill in the gaps of the following sentences with the suitable words. 09
(i) He -----early in -----morning.
(ii) -----Should do -----duty.
(iii) Does she -----who-----is?.

- 4(a). Transform the following sentences as asked in brackets. 14
- (i) Your performing dutifully is admiring. (Complex).
 - (ii) You will wait here until our coming back. (Complex).
 - (iii) Besides taking a cup of tea we take a loaf of bread. (Compound).
 - (iv) He is less brilliant than his brother. (Positive).
 - (v) Since you are ignorant, We don't like you. (Simple)
 - (vi) Though you are ill, We allow you to take part in the function. (Simple).
 - (vii) He is the sincerest man in the village. (Negative)
- 4(b). Express the following notions /functions in sentence. 12
- i) Joy , ii) Shame , iii) Wish , iv) Intention , v) Distaste , vi) Congratulation.
- 4(c). Complete the following sentences with clauses as asked in brackets. 09
- (i) -----satisfies your guardians. (Noun Clause)
 - (ii) -----, you can succeed in life. (Adv. Clause)
 - (iii) -----you could play football. (Adv. Clause)
 - (iv) Rakib,-----, is a doctor. (Adj. clause)
 - (v) He is a talented student ----- . (Adj. Clause)
 - (vi) -----you are unsuccessful in life. (Adv. clause)

SECTION – B

- 5(a). Read the passage and answer the questions that follow. 20
- In the American war of independence, a corporal and a party of soldiers were sent to raise a heavy beam for a battery that was being repaired. There were too few men for the work; but the corporal, full of his dignity, did nothing but stood by and shouted orders. Presently an officer, not in uniform, rode up. "Hallo," he said to the corporal. "Why don't you lend your men a hand to get that beam up?" "Don't you know that I am a corporal?" was the reply. "Are you?" Said the officer, who then got down from his horse and joined the men. He worked till the sweat streamed down his face. When the beam had been put to its place, he made a low bow to the corporal. "Good day, Mr. Corporal. Next time when you have too few men for this kind of work, send for the commander-in-chief, and I shall be happy to help you again". It was Washington himself.
- Questions :
- (i) What were the corporal and his men required to do?
 - (ii) What did the corporal do himself and what did the officer ask?
 - (iii) What was the corporal's reply and what did the officer do?
 - (iv) What did he say after the work was done?
- 5(b). Make a precis of the above passage (Question 5.a) with a suitable title. 15
- 6(a). Prepare a report on a cultural program you enjoyed in KUET. 20
- 6(b). Write a paragraph on natural resource. 15
- 7(a). Write a letter to your friend on the quality of patriotism. 20
- 7(b). Amplify the idea "Diligence is the mother of a good luck". 15
8. Write a free composition on any of the following. 35
- i) Global warming: Bangladesh is a victim.
 - ii) Our Independence Day.