KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY

Department of Energy Science and Engineering

B. Sc. Engineering 1st Year 2nd Term Examination, 2017

ESE 1205

(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). Define and write short notes on the following terms – 06
(i) Open System
(ii) Thermodynamic Equilibrium
(iii) Quasi-equilibrium Process

1(b). Draw an energy mind map and describe each term in it. 10

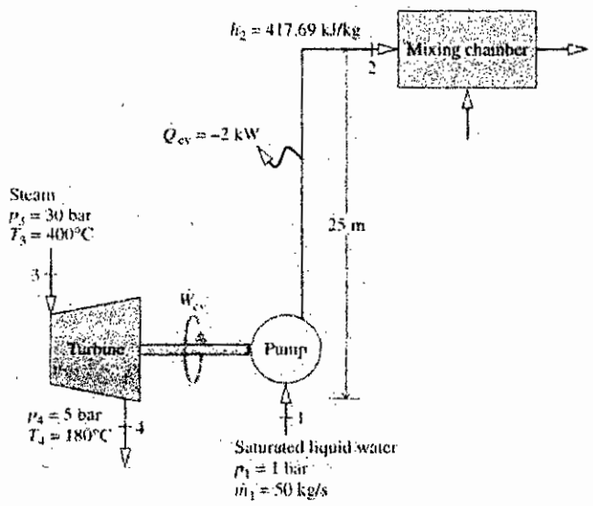
1(c). Write down state postulate of a simple compressible system. Define quality and derive the equation $x = \frac{v-v_f}{v_g-v_f}$ for a simple compressible system (the symbols have usual meaning). 07

1(d). What are the equations used when a gas is modeled as an ideal gas? One kilogram of air in a piston-cylinder assembly undergoes a thermodynamic cycle consisting of three processes. Process $1-2$: constant specific volume, Process $2-3$: constant temperature expansion, Process $3-1$: constant pressure compression. At state 1, the temperature is $300\ K$, and ther pressure is $1.012\ bar$. At state 2, the temperature is $2.0\ bar$. Using ideal gas equation of state – 11
(i) Sketch the cycle on $p-v$ coordinate.
(ii) Determine the temperature at state 2.
(iii) Determine the specific-volume at state 3 (molecular weight of air is $29\ g/mol$).

2(a). State the first law of thermodyanics. Write down the energy rate balance equation for a control volume and mention what each term in the equation mean? 06

2(b). Define a turbine. What are the different kinds of turbine used in power generation? Air enters a compressor operating at steady state at a pressure of $1\ bar$, a temperature of $290\ K$, and a velocity of $6\ m/s$ through an inlet with an area of $0.1\ m^2$. At the exit, the pressure is $7\ bar$, the temperature is $450\ K$, and the velocity is $2\ m/s$. Heat transfer from the compressor to its surroundings occurs at a rate of $180\ kJ/min$. Employing the ideal gas model, calculate the power input to the compressor, in kW. 12

2(c). The following figure shows a turbine-driven pump that provides water to a mixing chamber located $25\ m$ higher than the pump. Steady-state operating data for the turbine and pump are labeled on the figure. Heat transfer from the water to its surroundings occurs at a rate of $2\ kW$. For the turbine, heat transfer with the surroundings and potential energy effects are negligible. Kinetic energy effects at all numbered states can be ignored. Determine with appropriate control volumes – 17
(i) The power required by the pump, in kW, to supply water to the inlet of the mixing chamber
(ii) The mass flow rate of steam, in kg/s, that flows through the turbine



3(a). State Kelvin-Plank statement of second law of thermodynamics together with Carnot corollaries. 06

3(b). State Clausius inequality and prove that $dS = \left(\frac{\delta Q}{T}\right)_{internally\ revesible}$. Derive the first and second TdS equations. 11

3(c). Write down the entropy rate balance equation for a control volume and mention what each term in the equation mean.. 06

3(d). Steam enters a turbine with a pressure of 30 bar, a temperature of 400 °C, and a velocity of 160 m/s. Saturated vapor at 100 °C exits with a velocity of 100 m/s. At steady state, the turbine develops work equal to $540kJ/kg$ of steam flowing through the turbine. Heat transfer between the turbine and its surroundings occurs at an average outer surface temperature of 350 K. Determine with appropriate control volume the rate at which entropy is produced within the turbine per kg of steam flowing, in $kJ/kg\ K$. Neglect the change in potential energy between inlet and exit. 12

4(a). Prove that $-\left(\frac{Q_L}{Q_H}\right)_{reversible} = \frac{T_L}{T_H}$ with appropriate assumptions. 17

4(b). What is exergy? Show that exergy of a system is given by – 10
$\xi = (U - U_o) + p_o(V - V_o) - T_o(S - S_o) + KE + PE.$

4(c). State van der Waals equation of state and calculate the unknown constants in terms of critical pressure and temperature. 08

SECTION – B

5(a). Draw the following cycle on $p - v$ and $T - s$ plane indicating heat and work transfer. 06
(i) Diesel cycle
(ii) Brayton cycle
(iii) Otto Cycle

5(b). Prove that the efficiency of the Carnot engine working between the temperature limits T_1 and T_2 is equal to $\frac{T_1 - T_2}{T_2}$. 07

5(c). What is air standard cycle efficiency? Derive an expression for air-standard cycle efficiency of diesel cycle in terms of pressure ratio and compression ratio. 12

5(d). In an Otto cycle, the temperatures at the beginning and end of the isentropic compression are 316 K and 596 K respectively. Determine the air-standard efficiency and compression ratio. Take $\gamma = 1.4$. 10

6(a). Describe Rankine cycle using $T - s$ and $h - s$ diagram and calculate its thermal efficiency. 07

6(b). When is reheating of steam recommended in steam power plant? How does the reheat pressure get optimized? 08

6(c). Describe the Mechanism of a Vapor Compression Refrigeration system with $p - h$ and $T - s$ diagrams. 08

6(d). An ice plant produces 10 *tonnes* of ice per day at 0 °C using water at room temperature of 20 °C. Estimate the power rating of the compressor motor, if the C.O. P. of the plant is 2.5 and overall electro mechanical efficiency is 90%. 10

7(a). What is ment by the term 'psychometric'? Why a wet cloth dries faster in winter than in summer? 07

7(b). Distinguish between dry bulb and wet bulb temperature. What is meant by degree of saturation? 08

7(c). Derive an expression for specific humidity and show that it is a function of vapor pressure and barometric pressure. 10

7(d). The atmospheric air has a dry bulb temperature of 30 °C and wet bulb temperature of 18 °C. If the barometer reads 760mm of Hg, determine: 10
- (i) Partial pressure of water vapor
- (ii) Relative humidity
- (iii) Dew point temperature

8(a). Write down the comparison between Ideal gases and real gases. 05

8(b). What is the apparent molar mass for a gas mixture? Does the mass of every molecule in the mixture equal the apparent molar mass? 08

8(c). Suppose a homogeneous mixture of ideal gases is given with temperature, pressure, and volume, $T, p,$ and V respectively. 12
- (i) Derive Dalton's law of partial pressure.
- (ii) Show that sum of mole fraction of the gases equal to 1.
- (iii) Calculate specific gas constant for the mixture.

8(d). Consider a gas mixture that consists of 3 kg of O_2, 5 kg of N_2, and 12 kg of CH_4. Determine – 10
- (i) The mole fraction of each component.
- (ii) The average molar mass.
- (iii) Gas constant of the mixture.

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
Department of Energy Science and Engineering
B. Sc. Engineering 1st Year 2nd Term Examination, 2017
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).	Derive the rate equation for the first order reaction and show that the half-life is independent of initial concentration.	12
1(b).	Explain briefly the Transition State Theory. Mention the advantages of this theory over Collision Theory.	12
1(c).	Differentiate between molecularity and order of a reaction? What does it mean when a reaction is first order?	06
1(d).	The specific reaction rate for the decomposition of Nitrogen Pentaoxide vapor is found to be 3.46×10^{-5} at 298 K and 4.87×10^{-3} at 338 K. Calculate the activation energy per mole of Nitrogen Pentaoxide.	05
2(a).	In the photochemical reaction $B \rightarrow C$, 1.00×10^{-5} $mols$ of C is formed as a reault of the absorption of 6.00×10^{7} $ergs$ at 3600 A^o. Calculate the quantum yield.	07
2(b).	Distinguish between fluorescence and phosphorescence. Draw energy level diagram to explain the process and discuss them briefly.	12
2(c).	What is quantum yield? Write down the reasons responsible for abnormal quantum yield.	10
2(d).	With suitable diagram define singlet and triplet state.	06
3(a).	Write notes on the 'mechanism of enzyme action'.	10
3(b)	Write down the rate equation for enzyme catalyzed reaction and define all symbols used in it. What will be the effect of very high and low substrate concentration?	10
3(c).	What are the geometries of sp^2 and sp^3 hybridization. Explain with example.	10
3(d).	How does an enzyme differ from any inorganic catalyst?	05
4(a).	Define Bateh fermentation. Write down the importance of microrganism.	10
4(b).	State and explain Stark-Einstein law of photochemical equivalence.	10
4(c).	What do you understand by biological catalysis? Give the conditions of optical isomerism with example.	08
4(d).	How can foaming be measured and controlled during fermentation?	07

SECTION – B

5(a).	State the types of spectroscopy. Why atomic spectrum appears as sharp line spectrum?	08
5(b).	How many numbers of fundamental vibrations are available for linear and non-linear molecules? Calculate the number of available vibration modes for the following molecules (i) CO_2 (ii) H_2O (iii) O_2 (iv) N_2	08
5(c).	Draw the block diagram of UV –visible spectroscopy.	04
5(d).	Explain the different types of electronic transition occurring in an organic molecule.	10
5(e).	A solution of thickness 2 cm transmits 40% incident light. Calculate the concentration of the solution. ($\varepsilon = 6000\ litre\ mol^{-1}cm^{-1}$)	05
6(a).	Can a Cu spoon be used to stir a solution of $ZnSO_4$?	05
6(b).	Briefly describe the electrochemical corrosion method.	10
6(c).	Explain the Pilling –Bedworth rule.	10
6(d).	Discuss differential aeration or concentration cell corrosion.	10
7(a).	Discuss the various factors that affect corrosion.	10
7(b).	Discuss the various methods of controlling corrosion.	10
7(c).	Sketch lock-and-key model of enzyme catalysis and explain the model.	10
7(d).	Draw a figure to show that a catalyst does not change the position of equilibrium but can only shorten the time required to attain the equilibrium.	05
8(a).	Define the term adsorbent and adsorbate giving suitable examples.	06
8(b).	What is the effect of temperature on adsorption of gases on solid?	06
8(c).	What is an adsorption isotherm? How can you derive Langmuri adsorption isotherm mathematically?	12
8(d).	Define fractional coverage (θ) and mention few applications of adsorption.	06
8(e).	Draw a graph of 'amount adsorbed' vs. 'pressure' for the following system. (i) Monolayer surface (ii) Multilayer surface	05

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
Department of Energy Science and Engineering
B. Sc. Engineering 1st Year 2nd Term Examination, 2017
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). Make sentence with the following structures using the words given in brackets – 14
(i) Subj.+ verb + object + adverb. (*trouble* as verb)
(ii) Subj.,+ appositive, + linking verb + adj. complement. (*look* as verb)
(iii) That + subj. + verb + adj. complement + verb + object. (*is* and *please* as verb)
(iv) Subj. + verb + adjective + that + subj + verb + adv. of manner + adv. of place. (*is* and *attend* as verb)
(v) Subj. + verb + adj. complement, so + verb + adverb. (*is* and *succeed* as verb)
(vi) Subj. + verb + as + adjective + as + subj. + verb. (*is* and *think* as verb)
(vii) Since + subj. + verb + adv. of manner, subj. + verb + adv. of manner. (*come* and *behave* as verb)

1(b). Change the following words as asked in brackets and make sentence with the changed forms – 12
Attention (into verb); Accession (into verb); Comply (into noun); Literacy (into adj.); Suspicion (into adj.); Damage (into adj.).

1(c). Make new words with the following prefixes and use the new words in sentence – 09
Ante__, Be__, Co__, Em__, Im__, In__.

2(a). Frame Wh questions from the underlined parts of the following answers – 14
(i) We can keep our freedom by <u>being concious</u>.
(ii) <u>Maintenance of freedom</u> requires contant vigilance.
(iii) The weather is <u>foul</u> today.
(iv) The class starts at <u>8 *a. m.*</u>
(v) We are sucessful <u>for doing evergything</u> in the right time.
(vi) They are envious <u>of their rivals</u>.
(vii) I like to play <u>cricket</u>.

2(b). Make use of the following words in sentence as asked in brackets – 12
Love (as noun), Abstract (as verb), Bad (as adv.), Backstairs (as adj.), Forward (as verb), Access (as verb).

2(c). Write two synonyms for each of the following words and make sentence with the synonyms – 09
Honest, Reveal, Confidence.

3(a). Correct the follwing sentences – 14
(i) He likes his son.
(ii) Mom resembles to his father.
(iii) You what say about women development is creditable.
(iv) BGB watch sincerely the frontier of Bangladesh.
(v) Cut the line.
(vi) Look after the word in the dictionary.
(vii) When it is winter, we should wear warm clothes.

3(b) Transform the following sentences as directed – 12
(i) If you don't move, you will die. (Compound)
(ii) He was never late. (Affirmative)
(iii) Nobody can ever count my love for you. (Interrogative)
(iv) Dhaka is the biggest city in Bangladesh. (Positive)
(v) It is difficult to catch a bird that is flying. (Simple)
(vi) They must hear me. (Passive)

3(c). Make sentences with the following phrases and idioms – 09
Eat crow; Virgin soil; Palmy days; High time; Out and out; In fine.

4(a). Make sentences with each of the following modals as asked in brackets – 14
(i) Can (to express approval)
(ii) Can (to express ability)
(iii) Be + to + base form of verb (to express command)
(iv) Should (to express the past duty, which was not implemented)
(v) Dare (to express indulgence)
(vi) May (to give premission)
(vii) Would (to express polite request)

4(b). Express the following notation/function is sentence – 12
(i) Love
(ii) Condolence
(iii) Certaity
(iv) Honesty
(v) Patience
(vi) Confidence

4(c). Fill in the gaps of the following sentences – 09
(i) She is ___ the charge of the ___.
(ii) He finally ___ his release after twenty ___ in jail.
(iii) She was ___ love ___ him.

SECTION – B

5(a). Read the passage and answer the questions that follow – 20

Self-reliance is the pilgrim's best staff, the worker's best tool. It is the master key that unlocks all the difficulties of life. 'Help yourself and Heaven will help you' is a maxim which receives daily confirmation. Help from within always strengthens, but help from without invariably weakens the recipient. The habit of depending on others trends to weakens the intellectual faculties and paralyse the judgement. The struggle against adverse circumstances has on the contrary, a strengthening effect, like that of the pure mountain air on an enfeebled frame. This is a lesson which is not taught in the school nowadays. The vice of the modern system of education is that lays down too many royal reads to knowledge. The difficulties which formally compelled the students to think and labour for himself are now most carefully removed. The race of thorough and complete scholars is dying out. Our young men are equipped to such an extent with manuals that explain everything and guides that go everywhere, that they find no occasion for thought. Why take any trouble at all when so many are willing to relieve you of it?

Questions:
(i) Why should we be self-reliant?
(ii) What are the evil effects of dependence on others?
(iii) What is the voice of the modern system of education?
(iv) Why is the race of thorough scholars dying out?

5(b). Make a precis of the above passage (Q 5(a).) with a suitable title. 15

6(a). Amplify the idea contained in of the following statement – 20
'Chicken is the country's but the city eats it.'

6(b). Write a listing paragraph on the qualities of an ideal political leader. 15

7(a). Write a letter to the editor of a newspaper regarding high price of essential commodities. 20

7(b). Prepare a CV with a job application. 15

8(a). Write a free-composition on one of the following (approximately 2200 words) – 35
(i) Education and ignorance
(ii) Humanity and democracy

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
Department of Energy Science and Engineering
B. Sc. Engineering 1st Year 2nd Term Examination, 2017
Math 1213
(Differential Equation and Co-ordinate 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). Solve the following differential equations (any two) – 22

(i) $(x^2 + y^2 + 1)\,dx - 2xy\,dy = 0$

(ii) $(2x + 3y - 5)\,d + (3x + 2y - 5)\,dx = 0$

(iii) $2x\,dy - 2y\,dx - \sqrt{(x^2 + 4y^2)}\,dx = 0$

1(b). A body at a temperature of 50 °F is placed outdoors, where the temperature is 100 °F. If after 5 minutes the temperature of the body is 60 °F, find the time required by the body to reach a temperature of 75 °F. 13

2(a). Solve any three of the following differential equations – 35

(i) $(D^2 - 1)y = xe^{2x}$

(ii) $(D^2 + 4)y = \sin(2x)\sin(x)$

(iii) $(D^2 + 1)y = \text{cosec}(x)$

(iv) $\frac{d^2y}{dx^2} + y = x\sin(x)$

3(a). Find the Laplace transform of $te^{2t}\sin(3t)$. 09

3(b). Find the inverse Laplace transform of the following using Heaviside expression formula 11

$$\frac{2s^2 - 4}{(s+1)(s-2)(s-3)}$$

3(c). Solve the following using Laplace transforms – 15

$y'' + 9y = \cos(2t)$ with $y(0) = 1, y(\pi/2) = -1$

4(a). Solve the differential equation – 13

$$(1 + 2x)^2\frac{d^2y}{dx^2} - 6(1 + 2x)\frac{dy}{dx} + 16y = 8(1 + 2x)^2$$

4(b). Find the particular solution of the differential equation – 10

$$\frac{d^2y}{dx^2}4y = x^2$$

When $x = 0$ then $y = 0$ & $\frac{dy}{dx} = 0$.

4(c). A generator having e.m.f 100 volts is connected in series with a 10 ohm resistor and an inductor of 2 henries. If the switch is closed at a time $t = 0$, determine the current at time $t > 0$. 12

SECTION – B

5(a). Transform the equation $x^2 + y^2 = z^2 tan^2(\alpha)$ to cylindrical and spherical polar coordinates. 10

5(b). Find the rectangular and spherical coordinate of the point whose cylindrical coordinate is $\left(3, \frac{2\pi}{3}, 4\right)$. 10

5(c). Transform the equation $9x^2 + 15xy + y^2 + 12x - 11y - 15 = 0$ so as to remove the terms in x, y and xy. 15

6(a). Identify the conic represented by the equation $x^2 - 4xy + y^2 + 8x + 2y - 5 = 0$ and reduce it to its standard form, and hence find its equation of directix and length of latus rectum. 15

6(b). Find the equation of the plane through the point $(2, -1, -4)$ and perpendicular to the planes $3x + 4y - 5z + 6 = 0$ and $x - 2y + 2z + 1 = 0$ 10

6(c). Find the equation of the planes through $(0,4,-3)$, $(6,-4,3)$ which cut off from the axes intercepts whose sum is zero. 10

7(a). The position vectors of two points A and B are $3\hat{\imath} + \hat{\jmath} + 2\hat{k}$ and $\hat{\imath} - 2\hat{\jmath} - 4\hat{k}$ respectively. find the equation of the plane passing through B and perpendicular to $\overrightarrow{AB}$. 11

7(b). Find the magnitude and equation of the lines of shortest distance between the lines $\frac{x-3}{1} = \frac{y-5}{-2} = \frac{z-7}{1}$ and $\frac{x+1}{7} = \frac{y+6}{-6} = \frac{z-1}{1}$ 15

7(c). Show that the four points $(-3,2,5)$, $(0,1,3)$, $(5,4,2)$, and $(7,0,-1)$ are coplanar. 08

8(a). Find the relation how the volume element $dV = dx\,dy\,dz$ in Cartesian coordinates transform into cylindrical and spherical coordinates. 13

8(b). Verify whether or not the straight lines $\frac{x-4}{3} = \frac{y-1}{2} = \frac{z-3}{1}$ and $x + y + 2z - 4 = 0 = 3x - 2y - z - 3$ are coplanar. 13

8(c). Find the angle between the line $\frac{x-2}{3} = \frac{y+1}{-1} = \frac{z-3}{2}$ and the plane $3x + 4y + z + 5 = 0$. 09

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
Department of Energy Science and Engineering
B. Sc. Engineering 1st Year 2nd Term Examination, 2017
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.
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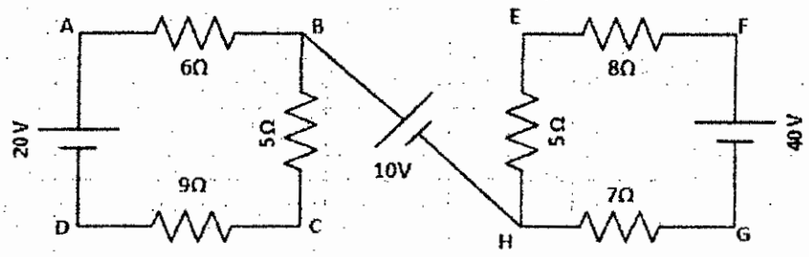
SECTION – A

1(a). Differentiate between DC and AC. Define the following terms – 12
i. Active elements & passive elements
ii. Unilateral & bilateral network

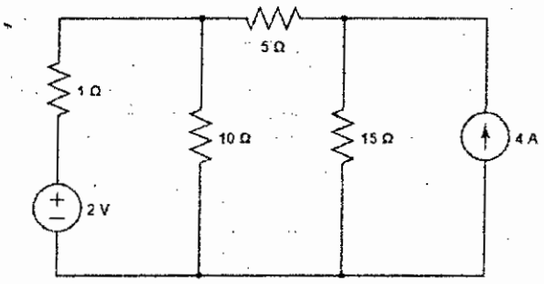
1(b). Explain Ohm's law. Also mention of its limitations. 05

1(c). Find V_{CE} and V_{AG} for the network as shown in the following figure - 08



1(d). What is the maximum power transfer theorem? Explain when a load will receive maximum power? 10

2(a). State superposition theorem. Describe the source conversion process. Find the current through 10 Ω resistor using superposition theorem as shown in the following figure - 10



2(b). Find the current through 10 Ω resistor of the network as shown in the following figure - 08

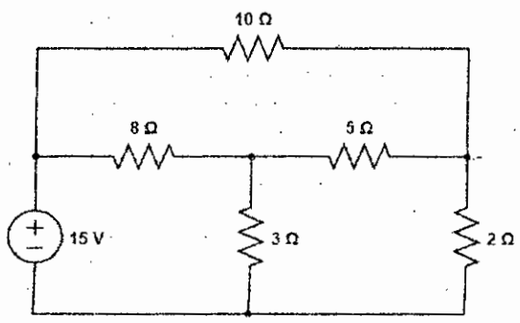
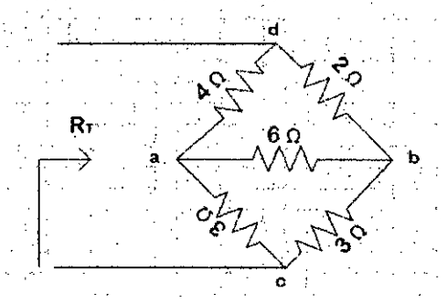
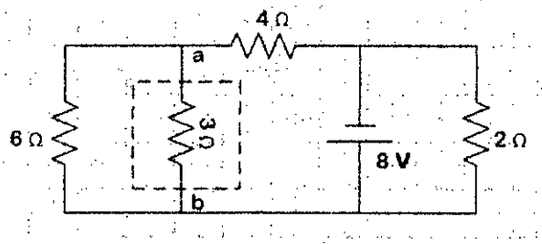


Fig. 2(b)

2(c). Find the total resistance of the network as shown in the following figure - 07



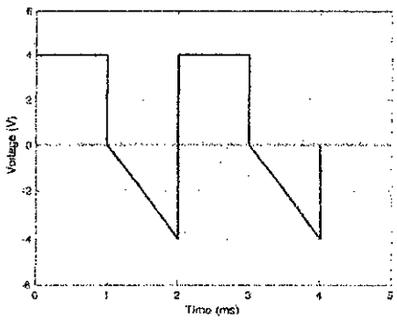
2(d). State Thevenin's theorem. Find the Thevenin's equivalent circuit for the network in the shaded area as shown in the following figure - 10



3(a). Define RMS value. Show the power variations of purely inductive and capacitive branch and calculate the expression of energy for $^{T}/_{4}$ cycle. 15

3(b) A resistance of 10 Ω is in series with a 303 μF capacitor. If the voltage drop across the capacitor is $150\sin(220t - 60^{\circ})$ volts, find the expression of voltage drop across the entire circuit. Also find the expression for current at any time t. 10

3(c). Calculate the rms and average value of the voltage wave as shown in the following figure 10



4(a). Find all possible roots of the following expression – 10

$$\sqrt[3]{\frac{10\angle 45^{\circ}\, 5e^{j\,60^{\circ}}(-4.047 - j\,2.94)}{1 - j\,1.732}}$$

4(b). Define series resonance with vector diagram. 'Serise RLC circuit act as a selector' – justify this statement. 10

4(c). Show that – 'the quality factor of a series RLC circuit is $\frac{1}{R_S}\sqrt{\frac{L}{C}}$'. 05

4(d). For the following expressions of voltage and currents – 10
$v = 100\sin(1000\pi t + 30^{\circ})$ and $i = 5\cos(1000\pi t - 30^{\circ})$
which one leads the other?
Find the power factor and the elements of the circuit. Also find out the values of the elements.

SECTION – B

5(a). Write short notes on: 06
- (i) Fermi level
- (ii) Electron mobility
- (iii) Zener Breakdown
- (iv) Avalanche Breakdown

5(b). Why does energy band bend under an applied electric field? Why electrons have greater mobility then holes? 07

5(c). Derive the equation of the hole diffusion current density of a $p - n$ junction diode. 12

5(d). Given that the density of states related effective masses of electrons and holes in Si are approximately 1.08 m_e and 0.6 m_e respectively, and the electron and hole drift mobilities at room temperature are 1300 and 400 $cm^2V^{-1}s^{-1}$, respectively. Calculate the intrinsic concentrations and intrinsic resistivity of Si. 10

6(a). State and derive the mass action law. 12

6(b). Describe the importance of semiconductor doping. Explain the n-type doping of Si with necessary diagrams. 13

6(c). For a particular semiconductor material $N_c = 1.5 \times 10^{18}\ cm^{-3}$, $N_v = 1.3 \times 10^{1918}\ cm^{-3}$, and $E_g = 1.43\ eV$ at $T = 300\ K$. 10
- (i) Determine the intrinsic carrier concentration of the semiconductor at $T = 300\ K$
- (ii) Find the position of the intrinsic Fermi level with respect to the center of the band gap

7(a). Derive the equation for depletion region width of $p - n$ juction under no applied bias. 11

7(b). Show the energy band diagrams for a $p - n$ junction under following conditions 09
- (i) Open circuit
- (ii) Forward bias
- (iii) Reverse bias

7(c). A Si $p - n$ junction with cross sectional area $A = 10^{-14}\ cm^2$ is formed with $N_a = 10^{17}\ cm^{-3}$ and $N_d = 10^{15}\ cm^{-3}$ at 300 K. Calculate – 15
- (i) Contact potential V_0
- (ii) Current with forward bias of 0.5 V

Assume that the $\mu_n = 1300\ cm^2/Vs$ and $\mu_p = 450\ cm^2/Vs$ in the n-side, and $\mu_n = 700\ cm^2/Vs$ and $\mu_p = 200\ cm^2/Vs$ in the p-side. $\tau_n = 0.1\ \mu s$ and $\tau_p = 10\ \mu s$. Also Calculate –
- (iii) Current at reverse bias of $-0.5\ V$

8(a). What are the differences between sequential and combinational circuit? Why do we need to use clock pulse? 07

8(b). Discuss about the undesirable condition of RS flip-flop. How can we avoid this? Explain. 10

8(c). Discuss the operation of a 4-bit shift register. 08

8(d). Define counter. How does ripple counter work. 10