BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA
L-2/T-1 B. Sc. Engineering Examinations 2012-2013
Sub: HUM 277 (Fundamentals of Economics)
Full Marks: 210 Time: 3 Hours
USE SEPARATE SCRIPTS FOR EACH SECTION
The figures in the margin indicate full marks.

SECTION – A
There are FOUR questions in this section. Answer any THREE.

1. (a) Define supply function. (5)
(b) What are the main determinants of supply? Explain them. (10)
(c) What are the differences between change in quantity demanded and change in demand? (10)
(d) From the following demand function make a hypothetical demand schedule and plot the curve. (10)
\[ Q = 100 - 15P + P^2 \]

2. (a) Define budget line and budget set. (10)
(b) Explain the properties of an indifference curve. (15)
(c) From the following two functions, calculate the amount of two commodities that maximizes utilities. What will be the maximum amount of utility? (10)
\[ U = 300X^{0.7}Y^{0.6} \]
\[ 3000 = 30X + 45Y \]

3. (a) How would you measure price elasticity of demand at any point on a straight line demand curve? Explain graphically. (15)
(b) From the following table calculate elasticity of demand if you move from point A to C and explain what you understand from the result. (10)

<table>
<thead>
<tr>
<th>Point</th>
<th>Y</th>
<th>Q</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>5000</td>
<td>350</td>
</tr>
<tr>
<td>B</td>
<td>7000</td>
<td>250</td>
</tr>
<tr>
<td>C</td>
<td>9000</td>
<td>150</td>
</tr>
</tbody>
</table>

(c) Show that any straight line supply curve that passes through the origin has a unitary elasticity. (10)

4. (a) Graphically explain the price determination process of a commodity under competition. (10)
(b) What will happen to the equilibrium price and quantity due to change in supply? (10)

Contd .......... P/2
(c) From the following demand and supply functions, calculate equilibrium price and quantity and show the result in a graph.

\[ P = 0.25Q + 18 \]
\[ P = -0.40Q + 70 \]

(i) What will happen to the equilibrium price and quantity if government imposes a unit tax of Tk. 5 per unit?

(ii) Describe the change in the equilibrium points.

**SECTION - B**

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

5. (a) Critically analyse the concept of optimization.

(b) Make a comparison between perfect competition and monopoly market.

(c) Explain the equilibrium of a firm under perfect competition.

(d) Calculate the profit maximizing level of output and maximum profit from the following total revenue (TR) and total cost functions

\[ TR = 1200Q - 2Q^2 \]
\[ TC = Q^3 - 61.25Q^2 + 1538.5Q + 2000 \]

6. (a) What is production possibility frontier (PPF)? Discuss how resources can be allocated in a society with the help of production possibility frontier.

(b) Describe three applications of production possibility frontier.

(c) State and prove the application of Euler's theorem in the theory of distribution of production.

7. (a) Discuss the product method of measuring national income.

(b) What are the causes of demand pull and cost push inflation. Graphically explain the effects of demand pull and cost push inflation on the price level and output.

(c) Discuss in detail the macroeconomic equilibrium with the help of aggregate demand curve and aggregate supply curve.

(d) Given that

- \[ GNP = Tk. 1,07,000 \text{ crore} \]
- \[ \text{Depreciation} = Tk. 9,000 \text{ crore} \]
- \[ \text{Indirect tax} = Tk. 12,500 \text{ crore} \]
- \[ \text{Subsidy is 20\% of indirect tax.} \]

Calculate national income.

8. (a) What are the characteristics of least developed countries? Explain them.

(b) Explain the concept of vicious circle of poverty.

(c) What is inflation? Explain any one of the policies for controlling inflation.
SECTION – A

There are FOUR questions in this section. Answer any THREE questions including Q. No. 1 as compulsory.

1. (a) Explain with reference to the context any two of the following: (15)
   (i) "I often wondered whether any of the others grasped that I had done it solely to avoid looking a fool."
   (ii) "This is our island. It's a good island until the grown-ups come to fetch us, we'll have fun."
   (iii) "I thought I had the blood of a man on my hands all these years."

(b) Attempt any one of the following: (15)
   (i) Comment on the narrator's dilemma regarding shooting the elephant as you find in Orwell's "Shooting an Elephant".
   (ii) Golding's "Fire on the Mountain" symbolically represents the progress of civilization – elucidate.

(c) Answer any three of the following: (15)
   (i) What did Maugham say about Bertrand Russell in "The Use of Philosophy"?
   (ii) Describe the island as presented in "Fire on the Mountain".
   (iii) How was the astrologer as a young boy?
   (iv) Why did the narrator hate his job in "Shooting and Elephant"?
   (v) What are the common pieces of advice of the astrologer for people seeking his help?

2. (a) Correct any ten of the following sentences: (15)
   (i) The boys are very anxious to taste the new ice cream.
   (ii) They walked further down the street.
   (iii) Robin's arriving early presented a real dilemma.
   (iv) The memoranda is not important.
   (v) The players, they like the idea.
   (vi) Sabiha doesn't want none of that cake.
   (vii) Jabin planned on hunting, fishing, and to sleep.

Contd .......... P/2
(viii) They will combine the four departments into one.
(ix) We plan to reevaluate the situation.
(x) It was someone's else coat.
(xi) Emon looks like he is a man in distress.
(xii) The bus was alongside of the garage.

(b) Given meanings of, and then make sentences with any ten of the following words:
Alleviate, Beckon, Chasm, Durable, Explicit, Synopsis, Shrewd, Loathe, Luminous, Nadir, Meticulous, Oration.

3. Amplify any one of the following ideas:
(a) Our sweetest songs are those that tell of saddest thought.
(b) Everyone thinks of changing the world, but no one thinks of changing himself.

4. Write a precis of the following passage with a suitable title:
There is an enemy beneath our feet—an enemy more deadly for his complete impartiality. He recognizes no national boundaries, no political parties. Everyone in the world is threatened by him. The enemy is the earth itself. When an earthquake strikes, the world trembles. The power of a quake is greater than anything man himself can produce. But today scientists are directing a great deal of their effort into finding some way of combating earthquakes, and it is possible that at some time in the near future mankind will have discovered a means of protecting itself from earthquakes. An earthquake strikes without warning. When it does, its power is immense. If it strikes a modern city, the damage it causes is an great as if it has struck a primitive village. Gas Mains burst, explosions are caused and fires are started. Underground railways are wrecked, buildings collapse, bridges fall, dams burst, gaping crevices appear in busy streets. If the quake strikes at sea, huge tidal waves sweep inland. If it strikes in mountain regions, avalanches roar down into the valley. Consider the terrifying statistics from the past, 1755: Lisbon, capital of Portugal— the city destroyed entirely and 450 killed. 1970: Peru, 50,000 killed. In 1968 an earthquake struck Alaska. As this is a relatively unpopulated part, only a few people were killed. But it is likely that this was one of the most powerful quakes ever to have hit the world. Geologists estimate that during the tremors, the whole of the state moved over 80 feet farther west into the Pacific Ocean. Imagine the power of something that can move an entire subcontinent! This is the problem that the scientists face. They are dealing with forces so immense that man cannot hope to resist them. All that can be done is to try to pinpoint just where the earthquake will strike and work from there. At least some precautionary measures can then be taken to save lives and some of the property.
The Mayan Indians lived in Mexico for thousands of years before the Spanish arrived in the 1500s. The Maya were an intelligent, culturally rich people whose achievements were many. They had farms, beautiful palaces, and cities with many buildings. The Mayan people knew a lot about nature and the world around them. This knowledge helped them to live a better life than most people of that time, because they could use it to make their lives more comfortable and rewarding. Knowledge about tools and farming, for instance, made their work easier and more productive.

In ancient Mexico there were many small clearings in the forest. In each clearing was a village with fields of corns, beans, and other crops around it. To clear the land for farms, the Maya cut down trees with stone axes. They planted seeds by digging holes in the ground with pointed sticks. A farmer was able to grow crops that produced food for several people. But not every Maya had to be a farmer. Some were clothmakers, builders, or priests.

The Maya believed in many gods, including rain gods, sun gods, and corn gods. The people built large temples to honour the Mayan gods. Skilful workers built cities around these temples. It was difficult for them to construct these cities, because they had no horses to carry the heavy stones they used to build with. Workers had to carry all of the building materials themselves. Today, many of these ancient Mayan cities and temples are still standing.

Although the cities that the Maya built were beautiful, and the people worked hard to build them, very few of the people lived in them. Usually, only the priests lived in the cities.

The other people lived in the small villages in the forests. Their houses were much simpler than the elaborate structures in the cities. They lived in small huts with no windows. The walls were made of poles covered with dried mud, and the roof was made of grass or leaves. Most Maya lived a simple life close to nature.

Measuring time was important to the Maya; so they developed a system for measuring it accurately. Farmers needed to know when to plant and harvest their crops. Mayan priests made a system to keep track of time. They wrote numbers as dots (...) and bars (−). A dot was one and a bar was five.

The Mayan priests studied the sun, moon, stars and planets. They made a calendar from what they learned. The year was divided into 18 months of 20 days each with five days left over. The Mayan Calendar was far more accurate than the European calendars of the time.
Around the year 800, the Maya left their villages and beautiful cities, never to return. No one knows why this happened. They may have left because the soil could no longer grow crops. Archaeologists are still trying to find the lost secrets of the Maya. They are still one of our greatest mysteries.

Questions:
(a) How is the Mayan calendar same as or different from our current calendar?
(b) How do we know that the Mayan civilisation was an intelligent and cultured one?
(c) Who used to live in the Mayan cities? Where did the common people live?
(d) How were the Mayans' belief in and treatment to the gods?
(e) Give a suitable title of the passage and justify it.

6. (a) Discuss briefly the different types of report.  
(b) As the General Manager of a company you have received a claim from one of your customers that your consignment did not conform to their order. Now, write an adjustment letter to settle the issue.  
(c) Give phonetic spellings of the following words (Any five): Monday, examination, church, prefect, morning, fate.

7. (a) What are the characteristics of a good business letter?  
(b) Write a composition on any one of the following:  
(i) Sky water Harvesting  
(ii) Democracy – the American Style  
(iii) Beautification of Dhaka city  
(c) Write a dialogue between a teacher and a student about the latter's availing a scholarship abroad.

8. (a) Transform the following sentences as directed (Any five):
(i) If I make a promise, I keep it. (Simple)  
(ii) Life and hope are inseparable. (Complex)  
(iii) I have found the book that I had lost. (Compound)  
(iv) He lost more than he could afford. (Compound)  
(v) You can talk to your heart's content. (Complex)  
(vi) He was so tired that he could not stand. (Simple)  
(b) What do you mean by glossary in a report? Where does it occur?  
(c) Write short notes on any three of the following:  
(i) Pure vowels  
(ii) Genre and discourse  
(iii) Cohesion and coherence  
(iv) Letter of acknowledgement.
SECTION – A
There are FOUR questions in this section. Answer any THREE.
Symbols have their usual meaning.

1. (a) Define skew Hermitian and Periodic matrices with examples. If A and B are Hermitian, show that AB is Hermitian if and only if A and B commute.

\[(\lambda - 1)x + (3\lambda + 1)y + 2\lambda z = 0\]

(b) Find all the values of \(\lambda\) for which the equations

\[\begin{align*}
(\lambda - 1)x + (4\lambda - 2)y + (\lambda + 3)z &= 0 \\
2x + (3\lambda + 1)y + 3(\lambda - 1)z &= 0
\end{align*}\]

are compatible. Find the ratios \(x : y : z\) when \(\lambda\) has the smallest of these values. What happens when \(\lambda\) has the greatest of these values?

(c) Find the adjoint of the matrix

\[
\begin{pmatrix}
1 & 2 & 3 \\
2 & 3 & 1 \\
4 & 3 & 3
\end{pmatrix}
\]

2. (a) Find the inverse of

\[
\begin{pmatrix}
1 & 0 & 1 \\
2 & 3 & 0
\end{pmatrix}
\]

by algebraic method.

(b) Show that if B is a skew-symmetric matrix of odd order, then adj B is symmetric.

(c) Write the normal form of the matrix

\[
\begin{pmatrix}
1 & 2 & 3 & 4 \\
2 & 7 & 3 & 5 \\
3 & 8 & 1 & -2 \\
2 & 4 & 6 & 8
\end{pmatrix}
\]

Find the rank of it.

3. (a) Solve the system of equation with the help of matrix:

\[\begin{align*}
x + 2x_2 + 3x_3 - 16 &= 0 \\
x_1 - 3x_2 + 5x_4 - 14 &= 0 \\
9x_1 + 4x_2 - 7x_3 + 4 &= 0 \\
6x_1 + 4x_2 + 6x_3 - 32 &= 0
\end{align*}\]

(b) Find the proper roots and vectors of the matrix

\[
\begin{pmatrix}
5 & -1 & 1 \\
1 & 2 & -4 \\
1 & -4 & 2
\end{pmatrix}
\]

Also find the characteristic spaces.

(c) Prove that every singular matrix has at least one characteristic root zero.

4. (a) Define quadratic form of the matrix. Write the condition that the form is non-singular. Reduce the real quadratic form

\[q = x_1^2 + 5x_2^2 + 6x_3^2 + 4x_1x_2 - 6x_1x_3 - 8x_2x_3\]

to the diagonal matrix. Also write down the corresponding equations of transformation.

\[
\begin{pmatrix}
1 & 5 & -2 \\
3 & 6 & -3
\end{pmatrix}
\]

(b) State Cayley-Hamilton theorem. Find inverse of

\[
\begin{pmatrix}
1 & 2 & -1 \\
3 & 6 & -3
\end{pmatrix}
\]

using this theorem.

(c) Define Derogatory matrix. Find the minimal polynomial of the matrix

\[
\begin{pmatrix}
1 & -1 & 1 \\
1 & 2 & 1 \\
1 & 0 & 3
\end{pmatrix}
\]

Contd ............ P/2
5. (a) Find the standard matrix for the transformation $T$ on $\mathbb{R}^3$, where $T$ is the composition of a rotation of 60° about y-axis, followed by a reflection about yz-plane, followed by a dilation with factor $k = 2$. Then find $T(2, -5, 8)$ using the standard matrix.  

(b) Find the eigenvalues and corresponding eigenvectors of the linear transformation $T$ on $\mathbb{R}^3$ defined by the reflection about the xy-plane. Is the transformation one-to-one? If so, find the standard matrix for $T^{-1}$.

6. (a) Consider the set $P_2$ of all polynomials of degree 2 and the set $S = \{ p_1, p_2, p_3 \}$, where $p_1 = 1 + x$, $p_2 = 1 + x^2$, $p_3 = x + x^2$. Is the set $S$ a basis for $P_2$? If so, find the coordinate vector of the polynomial $p(x) = 2 - x + x^2$ relative to the basis $S$.

(b) Determine whether the following subsets are subspaces of $\mathbb{R}^4$.

(i) all vectors of the form $(a, b, c, d)$, where $d = a + b$ and $c = a - b$.

(ii) all vectors of the form $(a, b, c, d)$, where $a = b = c = d$. If so, find the dimensions of the subspaces of $\mathbb{R}^4$.

7. (a) Find a basis for the row space of $A = \begin{bmatrix} 1 & -2 & 0 & 0 & 3 \\ 2 & -5 & -3 & -2 & 6 \\ 0 & 5 & 15 & 10 & 0 \\ 2 & 6 & 18 & 8 & 6 \end{bmatrix}$.

Find the nullspace of $A$ and write down the basis of nullspace. Also verify the dimension theorem for $A$.

(b) Let $W$ be the subspace of $\mathbb{R}^5$ spanned by the vectors $v_1 = (1, 4, 5, 6, 9), v_2 = (3, -2, 1, 4, -1), v_3 = (-1, 0, -1, -2, -1), v_4 = (2, 3, 5, 7, 8)$. Find a basis for the orthogonal component of $W$.

8. (a) Let $T : P_2 \to P_3$ be the linear transformation defined by $T(p(x)) = xp(x-3)$, that is, $T(c_0 + c_1 x + c_2 x^2) = x(c_0 + c_1 (x-3) + c_2 (x-3)^2)$. Find the matrix for $T$ with respect to the bases $B = \{ u_1, u_2, u_3 \}$ and $B' = \{ v_1, v_2, v_3, v_4 \}$, where $u_1 = 1, u_2 = x, u_3 = x^2$; $v_1 = 1, v_2 = x, v_3 = x^2, v_4 = x^3$.

Then verify the result $[T]_{B,B'}([x]) = [T(x)]_{B'}$, for any $x$ in $P_2$.

(b) Let $\mathbb{R}^3$ have the Euclidean inner product. Use Gram-Schmidt process to transform the basis $\{ u_1, u_2, u_3 \}$, where $u_1 = (0,1,2), u_2 = (-1,0,1)$, and $u_3 = (-1,1,3)$ into an orthogonal basis $\{ v_1, v_2, v_3 \}$; then normalize the orthogonal basis vectors to obtain an orthonormal basis $\{ q_1, q_2, q_3 \}$. Finally, find the QR-decomposition of $A = \begin{bmatrix} 0 & -1 & -1 \\ 1 & 0 & 1 \\ 2 & 1 & 3 \end{bmatrix}$.
L-2/T-1/EEE

Date : 12/05/2014

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-1  B. Sc. Engineering Examinations 2012-2013

Sub: EEE 203 (Energy Conversion I)

Full Marks: 210  Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The questions are of equal value.

SECTION - A

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

1. (a) What are the assumptions made for an ideal transformer? Show that in a real transformer,
   
   (i) $\frac{V_p}{V_s} \neq a$
   
   (ii) $\frac{I_p}{I_s} \neq 1$

   (b) A single phase power source feeds a 200 KVA 20 kV/2.4 kV transformer through a feeder impedance of $(38.2+j140) \Omega$. The transformer's equivalent impedance referred to L.T. side is $(0.25 + j1.0) \Omega$. The load on the transformer is 190 kW at 0.9 PF lagging and 2300 V. Calculate
   
   (i) The voltage at the power source
   (ii) The voltage regulation of the transformer
   (iii) The efficiency of the overall power system

2. (a) Show the connection diagram for the open circuit test. In which side of the transformer the meters are connected? What magnitude of voltage is applied during the test? Describe the procedure to obtain the correct value of core loss.

   (b) To determine the parameters of the equivalent circuit of a 15 kVA, 2300/230 volt single phase transformer the open circuit and short circuit tests are performed. The recorded test data are;

<table>
<thead>
<tr>
<th></th>
<th>Open circuit test</th>
<th>Short circuit test</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{oc}$ = 230 volt</td>
<td></td>
<td>$V_{sc}$ = 47 volt</td>
</tr>
<tr>
<td>$I_{oc}$ = 2.1 Amp</td>
<td></td>
<td>$I_{sc}$ = 6.0 Amp</td>
</tr>
<tr>
<td>$P_{oc}$ = 50 watt</td>
<td></td>
<td>$P_{sc}$ = 160 watt</td>
</tr>
</tbody>
</table>

   Find,
   
   (i) The equivalent circuit reference to H.T
   (ii) The equivalent circuit referred to L.T
   (iii) The equivalent circuit in per unit
   (iv) The core loss and copper loss at rated condition

Contd ......... P/2
3. (a) What are the problems in a three phase Y-Y connected transformer, without the neutral grounding? Draw connection and wiring diagrams of a Y-Δ three phase transformer.
(b) A 100-VA, 120/12 volt transformer is to be connected so as to form a step-up autotransformer. A primary voltage of 120 volt is applied to the transformer (across the common winding).
   (i) What is the secondary voltage?
   (ii) What is its maximum VA rating in this mode of operation?
   (iii) Calculate the rating advantage of this autotransformer over the transformer's rating in conventional (two winding) 120/12 volt operation.

4. (a) If two transformers are connected in parallel, show that the loads are divided between them in inverse proportion to their equivalent impedances when their turns ratios are equal.
   (b) Two transformers are operated in parallel to supply a load of 200 Amps. at 0.8 PF lagging. The ratings of the two transformers are

<table>
<thead>
<tr>
<th>Transformer 1</th>
<th>Transformer 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>41,000/2400 V.</td>
<td>42,000/2400 V.</td>
</tr>
<tr>
<td>200 kVA</td>
<td>400 kVA</td>
</tr>
<tr>
<td>a = 17.1</td>
<td>a = 17.5</td>
</tr>
<tr>
<td>$\text{Z}_{eq} = (0.4 + j0.3)\Omega$ (referred to L.T.)</td>
<td>$\text{Z}_{eq} = (0.2 + j0.3)\Omega$ (referred to L.T.)</td>
</tr>
</tbody>
</table>

Find,
   (i) Load supplied by each transformer
   (ii) Circulating current if load current is zero
   (iii) Load supplied by each transformer if turns ratios are equal.

5. (a) Draw and explain the power flow diagram of a three-phase induction motor. Find the formulae for stator copper loss, core loss, air-gap power, rotor copper loss, converted mechanical power, induced torque and load torque of the motor. Draw the per phase equivalent circuit of the motor with rotor losses and converted mechanical power separated.
   (b) A 440 V, 50 Hz, 2-pole, Y-connected three-phase induction motor is rated 75 kW. The equivalent circuit parameters are:
   
   \[
   R_1 = 0.075\Omega, \quad R_2 = 0.065\Omega, \quad X_M = 7.2\Omega, \quad X_1 = 0.17\Omega, \quad X_2 = 0.17\Omega, \quad P_{f\&w} = 1.0 \quad \text{kW}, \quad P_{misc} = 150 \quad \text{W}, \quad P_{eore} = 1.1 \quad \text{kW}.
   \]
   For a slip of 0.04, find (i) line current and its power factor, (ii) the air-gap power, (iii) power converted form electrical to mechanical power, (iv) efficiency.
   Contd ............ P/3
6. (a) By using necessary diagrams show that the induced torque in an ac machine can be expressed by the following formula:
\[ \tau_{\text{ind}} = K B_R \times B_{\text{net}} \]
where \( B_R \) is the rotor magnetic field and \( B_{\text{net}} \) is the net magnetic field. By using this formula and relevant diagram explain how induced torque of 3-phase induction motor is developed.

(b) What are the purposes of using starter in a three-phase induction motor? With diagrams explain the operation of auto-transformer starter and across-the-line starter of 3-phase induction motor. Explain the method of speed control of the motor by changing the input frequency below and above the base speed.

7. (a) By using the equivalent circuit of a three-phase induction motor and applying to it the Thevenin's theorem derive the expression of induced torque of the motor. From this expression explain the shape of torque-slip characteristic of the motor.

(b) A 208 V, 60 Hz, 6-pole, Y-connected, 25 hp induction motor is tested with the following results:

- No-load: 208 V, 22 A, 1200 W, 60 Hz
- Locked rotor: 24.6 V, 64.5 A, 2200 W, 15 Hz
- DC test: 13.5 V, 64 A.

Find the equivalent circuit of this motor referred to the stator side, showing numerical values of each circuit parameters. Find the rotational loss of the motor.

8. (a) By using double-revolving field theory explain how a single-phase induction motor develops its torque after starting. Explain why the forward field becomes higher than the backward field at \( 0 < S < 1 \).

(b) A 220 V, 50 Hz, 1.5 hp, 2-pole single phase induction motor has the following main winding impedances:

- \( R_1 = 1.4 \Omega, X_1 = 1.9 \Omega, X_M = 100 \Omega, R_2 = 1.5 \Omega, X_2 = 1.9 \Omega \).

At a slip of 0.05 the motor's rotational losses are 291 W. The rotational losses may be assumed constant over the normal operating range of the motor. Find the following quantities for the mentioned slip:

(i) stator current, (ii) input power factor, (iii) input power, (iv) air-gap power, (v) converted power (vi) induced torque, (vii) output load power and torque, (viii) efficiency.
SECTION A

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

1. (a) Determine the current in each diode and $V_A$ and $V_B$ of the circuit shown in Fig. Q. 1(a).

(b) Find values of $v_0/v_i$ for $I$ equal to (i) $0 \mu A$ and (ii) $1 \text{mA}$ for the circuit shown in Fig. Q. 1(b). Given: $\eta = 1$ for each diode.

2. (a) For the circuit of Fig. Q. 2(a), $V_Z = 5.6$ V at $I_Z = 0.1$ mA, and $r_Z = 10 \Omega$. (i) Determine $V_0$ with no load. (ii) Find the change in $V_0$ if $V_{ps}$ changes by $\pm 1$ V. (iii) Find $V_0$ if $V_{ps} = 10$ V and $R_L = 2 \text{k\Omega}$.
(b) Draw a full-wave rectifier circuit with load R and connect a capacitor C across R. The rectifier circuit is designed to produce a peak output voltage of 12 V, deliver 120 mA to the load, and produce an output with a ripple of not more than 5%. Obtain (i) R, (ii) C and (iii) PIV for input voltage of 120 V (rms), 50 C/S. (Use appropriate transformer if necessary)

3. (a) Draw the equivalent dc circuit of the circuit shown in Fig. Q. 3(a). Obtain R_D, V_{GS} and V_{DS}. Given: I_D = 250 μA, V_D = 2.5 V, V_m = 0.8 V, k' = 80 μA/V^2, and \( \frac{W}{L} = 3 \).

(b) For the circuit shown in Fig. Q. 3(b), the value of R is selected to obtain an output voltage V_0 of 0.7 V. Use the diode small-signal model to show that the change in V_0 corresponding to a change of 1 V in V^+ is

\[ \frac{\Delta V_0}{\Delta V^+} = \frac{nV_T}{V^+ + nV_T - 0.7}. \]

4. (a) Draw the VTC of a CMOS inverter. Obtain expressions for NM_H and NM_L.

(b) Assuming that the diodes in the circuit of Fig. Q. 4(b) are ideal, find V_0, I_{D1} and I_{D2}.

Contd. ... P/3
5. (a) Write 'T' for TRUE and 'F' for FALSE against the following statements: \(1 \times 10 = 10\)

(i) A zener diode acts as a constant current holding device under breakdown condition.

(ii) Built-in depletion layer across a pn junction is created by recombination of electron-hole pairs on both sides of the junction.

(iii) In switching operation of MOSFET, the operating point swings between cut-off and saturation regions.

(iv) Basically, BJTs are current controlled device while MOSFETs are voltage controlled device.

(v) Current gain of an emitter-follower is approximately unity.

(vi) Reverse breakdown of a pn junction diode leads to short circuit condition of the diode.

(vii) Bypass capacitors in BJT amplifier circuits are used to increase current gain of the amplifier.

(viii) CMOS devices are a kind of bipolar device.

(ix) A zener diode can be operated with multiple breakdown voltages.

(x) Reverse saturation current of a heavily doped pn junction diode is lower than that of a lightly doped pn junction diode.

(b) Two bipolar junction transistors, \(Q_p\) (p'np') and \(Q_n\) (n'pn), are biased together as shown in Fig. for Q. 5(b). Each transistor has a common emitter current gain factor of 49 and a forward junction drop of 0.8 V. Determine the collector current of \(Q_n\) and collector-to-emitter voltage of \(Q_p\). \(25\)

Contd ....., P/4
EEE 201

6. (a) The MOSFETs, Q₁ and Q₂, in Fig. for Q. 6(a) are identical. Design suitable values for R_D and R_S so that Q₂ operates in the linear region. Given: \( \mu C_{ox} = 200 \mu A/V^2 \), \( V_f = 0.6 \ V \), \( W/L = 5 \). Symbols have their usual meanings.

(b) The BJT in the circuit shown in Fig. for Q. 6(b) has a common base current gain factor of 0.98. Determine base current and emitter voltage. Assume a forward junction drop of 0.7 V.

7. (a) The transistor in Fig. for Q. 7(a) is to be operated at a dc bias point of 5mA, 5 V. Design suitable values for R_Q, R_D, R_M and R_K. Derive an expression for the voltage gain, \( A_v = \frac{v_o}{v_i} \), using small signal ac equipment circuit.
EEE 201

Contd., Q. No. 7

(b) Explain operations of the CMOS structure shown in Fig. for Q. 7(b) for $v_i = 0V$ and $-3V$.

8. (a) The transistors $Q_1$ and $Q_2$ in Fig. for Q. 8(a) are identical. Determine the Q-point values of collector current and emitter-to-collector voltage of the transistor $Q_2$. Assume a forward junction drop of $0.7V$.

(b) Derive an expression for the drain current of an enhancement type n-channel MOSFET showing all necessary diagrams. Hence, plot the drain current as a function of gate voltage ($I_D - V_G$) approximately to the scale.