SECTION – A

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

1. (a) Design the tie bar and tie bar arrangements for the following column sections as shown in Figure 1(a) and 1(b). Main (longitudinal) bar diameter = 1 inch (#8 bar).
(b) Determine the number of bolts required and an appropriate layout, to transmit a DL force of 24 kips and a LL of 33 kips through one C 10 × 30 (web thickness = 0.673 inch) to a 0.9375 inch thick gusset plate (see Figure 2). All material is A 36 steel and bolts are \( \frac{5}{8} \) inch diameter (A 325 bolts in standard holes) in a bearing type connection with threads excluded from shear planes. Use two lines/rows of bolts across the web of the channel. Follow AISC/LRFD specification.

2. (a) It is needed to transmit dead load of 100 kip and live load of 160 kip by a welded connection. Determine the fillet weld length \( L_1 \) and \( L_2 \) required on the two sides of the angle \( 2L5 \times \frac{1}{2} \times \frac{2}{16} \) to connect it with \( \frac{7}{8} \) inch gusset plate (see Figure 3).
Follow AISC/LRFD method & use E80XX electrode.

Table 1: Minimize size of fillet weld

<table>
<thead>
<tr>
<th>Minimum fillet weld size (inch)</th>
<th>Maximum thickness of part (inch)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2/16</td>
<td>To ( \frac{3}{8} ) inclusive</td>
</tr>
<tr>
<td>3/16</td>
<td>Over ( \frac{3}{8} ) to ( \frac{1}{2} )</td>
</tr>
<tr>
<td>4/16</td>
<td>Over ( \frac{1}{2} ) to ( \frac{3}{4} )</td>
</tr>
<tr>
<td>5/16</td>
<td>Over ( \frac{3}{4} ) to 1 ( \frac{1}{2} )</td>
</tr>
<tr>
<td>6/16</td>
<td>Over 1 ( \frac{1}{2} ) to 2 ( \frac{3}{4} )</td>
</tr>
</tbody>
</table>

Table 2: Minimum size of fillet weld

<table>
<thead>
<tr>
<th>Maximum fillet weld size (inch)</th>
<th>Minimum thickness of part (inch)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thickness of material</td>
<td>Less than ( \frac{3}{4} ) inch</td>
</tr>
<tr>
<td>(Thickness of material – 1/16 inch)</td>
<td>( \frac{3}{4} ) inch &amp; over ( \frac{3}{4} ) inch</td>
</tr>
</tbody>
</table>

Contd ………… P/2
(b) Determine the maximum value of axial load "P_{ultimate}" that the bearing type connection (see Figure 4) can transmit in tension. Bolts (A 325) are 7/8" in diameter in standard holes and threads are excluded from shear planes. Follow AISC/LRFD method & use ASTM A 36 steel. Consider tension failure of upper plate (i.e., plate '1', \( t = 5/8 \) inch) only and no need to consider failure of gusset plate.

3. (a) Select a lightest W 18 shape as a steel column (length = 13 feet) to support an axial dead load of 150 kip & live load of 300 kip. Support conditions about X-axis & Y-axis bucking are shown in Figure 5.

\[
\sigma_{\text{crring}} = 0.658 \frac{\lambda_c}{1 + \frac{\lambda_c}{1.5}} \sigma_y; \quad \text{when,} 0 \leq \lambda_c \leq 1.5
\]

\[
\sigma_{\text{crring}} = 0.877 \frac{\lambda_c}{1} \sigma_y; \quad \text{when,} \lambda_c \leq 1.5
\]

\[
\lambda_c = \frac{KL}{E} \sqrt{\frac{\sigma_y}{\rho}}
\]

Properties of W18 sections are attached at the end. Follow AISC/LRFD method & use ASTM A 36 steel.

(b) Design a circular spiral column to support a dead load (DL) of 90 kip and live load of (LL) of 110 kip (Figure 6). Also, design the spirals. Given \( f_e = 3000 \) psi, \( f_y = 40000 \) psi. Follow USD method. Assume, initial steel ratio (\( \rho_g \)) = 2.50%.

4. (a) Determine concrete stresses at top and bottom fiber at mid-span section of the prestressed concrete multi-cell box-girder (simply supported) as shown in Figure 7 due to the following loading condition:

(i) Initial pre-stress only

(ii) Effective pre-stress + self-weight + dead load + live load

Draw stress distribution at these loading stages. Also, determine the decompression moment. Given, initial pre-stress (\( f_{ps} \)) = 180 ksi, prestressing steel (\( A_{ps} \)) = 6 inch\(^2\) (total), prestressing loss = 18%, cross-sectional area of beam section = 1200 inch\(^2\), moment of inertia of the beam section = 1440000 inch\(^4\). Location of centroid = 25 inch (from top) & = 35 inch (from bottom).

(b) Two plates are lap connected (see Figure 8) using 6/16 inch fillet weld deposited by E80XX electrode to transmit an ultimate load of 275 kip. Determine additional transverse weld "L" at the end of the plates.

5. (a) Determine shape factor of the beam section (see Figure 9). Consider bending about horizontal axis. Use ASTM A 36 stee.
(b) Design the one way slab as shown in Fig. 15. The slab carries a uniform live load of 50 psf and a dead load of 30 psf in addition to its self-weight. Draw the reinforcement detail also.

Thickness of the slab = 6 inch

Given $f'_c = 4 \text{ ksi}, f_y = 60\text{ ksi.}$

(c) What do you mean by balanced strain condition?

9. (a) An interior column carries total service loads $DL = 500$ kips and $LL = 514$ Kips. The column is $22 \times 22$ inch in cross section and is supported on a square footing, with the bottom of the footing 6 ft below grade. Design the footing and show the reinforcements. The allowable soil bearing pressure is 8000 psf. Use $f'_c = 3 \text{ ksi}, f_y = 60\text{ ksi}$ for footing design.

(b) Design the beam as shown in Fig. 16. The beam carries a uniform live load of 3 k/ft. Consider self-weight of the beam in addition to the live load. Draw the reinforcement details also. Use USD method.

Given $f'_c = 4 \text{ ksi}, f_y = 60\text{ ksi.}$
CE 363
Contd... Q. No. 5

(b) Check the suitability of using the following built-up beam section (see Figure 10(a)). The beam has to carry a dead load of 200 lb/ft (excluding beam self-weight) and live load of 300 lb./ft on simple span of 20 feet (see Figure 10(b)) deflection under service load is limited to \( \frac{1}{350} \) of span length. Follow AISC/LRFD method & use ASTM A 36 steel.

SECTION-B

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

6. (a) A rectangular beam has the dimensions as shown in Fig.11 and reinforced with 3-#9 bars. Determine the stresses caused by a bending moment, \( M = 150 \) k-ft.
   Given, \( f'c = 4000 \) psi, \( f_y = 60\)ksi, \( n = 8 \)
   \( f_r \) (modulus of rupture) = 475 psi.
   (b) An 8-ft span cantilever beam has a rectangular section and reinforced as shown in Fig.12. The beam carries a dead load, including its own weight of 1.5 k/ft and a live load of 0.9 k/ft. Using \( f'_c = 4 \) ksi. and \( f_y = 60\)ksi, check if the beam is safe to carry the above loads. Use USD method.
   (c) Determine the ultimate moment capacity of the beam section as shown in Fig. 11.

7. (a) It is good practice to design the beam such that the failure would be initiated by yielding of steel rather than by crushing of concrete. Why?
   (b) Design the web- reinforced of the beam as shown in Fig. 13 by USD method.
   Given \( f'_c = 3 \) ksi, \( f_y = 60\)ksi.
   (c) Design a tied column with 2% reinforcement to support a service dead load of 500 kip and live load of 400 kip. Due to architectural reason one side of the column is to be 12". Also, design the tie.

8. (a) A floor system consists of a 4-inch concrete slab supported by continuous T beams of 24-ft span, 48 inch on centers, as shown in Fig. 14. What tensile steel area is required at mid span to resist a factored moment of 8200 kip-inch.
   Given \( f'_c = 3 \) ksi, \( f_y = 60\)ksi.

Contd ......... P/4
Figure 1(a)

Figure 1(b)

Figure 2

Figure 3
Figure 4

Figure 5

Figure 6

Figure 7
Filet weld = 6/16\"  
E80 electrode  
\[ \mathbf{P}_u = 275 \text{ kip} \]  

Figure 8

\[ \mathbf{D}_L = 200 \text{ lb. per linear foot (excluding self-weight)} \]  
\[ \mathbf{L}_L = 300 \text{ lb. per linear foot} \]  

Figure 10 (b)
Fig. 11

Fig. 12

Fig. 13

Total Working load = 8 k/ft

Fig. 14

Fig. 15
**Beam's Component** | **Width-Thickness Ratio ($\lambda$)** | **$\lambda_p$** | **$\lambda_r$**
---|---|---|---
Flange of I/W section | $\frac{b_f}{2t_f}$ | $0.38 \frac{E}{F_y}$ | $0.83 \frac{E}{(F_y - 10)}$
Web of I/W section | $\frac{h_w}{t_w}$ | $3.76 \frac{E}{F_y}$ | $5.70 \frac{E}{F_y}$

---

**Appendix D: Beam Deflections and Slopes**

<table>
<thead>
<tr>
<th>Beam and Loading</th>
<th>Elastic Curve</th>
<th>Maximum Deflection</th>
<th>Slope at End</th>
<th>Equation of Elastic Curve</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>$y = \frac{P}{6EI} \left( x^3 - 3x\frac{L}{2} \right)$</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>$y = -\frac{Mx}{EI}$</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td>$y = -\frac{M}{EI} x^2$</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td>$y = \frac{P x^3}{48EI}$</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td>$y = \frac{P x^3}{96EI}$</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td>$y = \frac{ML}{3EI}$</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td></td>
<td>$y = -\frac{ML}{6EI}$ (for $x &gt; L/3$)</td>
</tr>
</tbody>
</table>

---

**Web of I/W Section**

![Fig. 6.16](image)
# Wide Flange Section (W Shapes)

## Dimensions & Properties

<table>
<thead>
<tr>
<th>Designation</th>
<th>Area (A)</th>
<th>Depth (d)</th>
<th>Web Thickness (t_w)</th>
<th>Flange Thickness (t_f)</th>
<th>Nominal weight per foot</th>
<th>Axis X - X</th>
<th>Axis Y - Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>W 18×175</td>
<td>51.3</td>
<td>20.04</td>
<td>0.890</td>
<td>11.375</td>
<td>1.590</td>
<td>175</td>
<td>3450</td>
</tr>
<tr>
<td>W 18×158</td>
<td>46.3</td>
<td>19.72</td>
<td>0.810</td>
<td>11.300</td>
<td>1.440</td>
<td>158</td>
<td>3060</td>
</tr>
<tr>
<td>W 18×143</td>
<td>42.1</td>
<td>19.49</td>
<td>0.730</td>
<td>11.220</td>
<td>1.320</td>
<td>143</td>
<td>2750</td>
</tr>
<tr>
<td>W 18×130</td>
<td>38.2</td>
<td>19.25</td>
<td>0.670</td>
<td>11.160</td>
<td>1.200</td>
<td>130</td>
<td>2460</td>
</tr>
<tr>
<td>W 18×119</td>
<td>35.1</td>
<td>18.97</td>
<td>0.655</td>
<td>11.265</td>
<td>1.060</td>
<td>119</td>
<td>2190</td>
</tr>
<tr>
<td>W 18×106</td>
<td>31.1</td>
<td>18.73</td>
<td>0.590</td>
<td>11.200</td>
<td>0.940</td>
<td>106</td>
<td>1910</td>
</tr>
<tr>
<td>W 18×97</td>
<td>28.5</td>
<td>18.59</td>
<td>0.535</td>
<td>11.145</td>
<td>0.870</td>
<td>97</td>
<td>1750</td>
</tr>
<tr>
<td>W 18×86</td>
<td>25.3</td>
<td>18.39</td>
<td>0.480</td>
<td>11.090</td>
<td>0.770</td>
<td>86</td>
<td>1530</td>
</tr>
<tr>
<td>W 18×76</td>
<td>22.3</td>
<td>18.21</td>
<td>0.425</td>
<td>11.035</td>
<td>0.680</td>
<td>76</td>
<td>1330</td>
</tr>
<tr>
<td>W 18×71</td>
<td>20.8</td>
<td>18.47</td>
<td>0.495</td>
<td>7.635</td>
<td>0.810</td>
<td>71</td>
<td>1170</td>
</tr>
<tr>
<td>W 18×65</td>
<td>19.1</td>
<td>18.35</td>
<td>0.450</td>
<td>7.590</td>
<td>0.750</td>
<td>65</td>
<td>1070</td>
</tr>
<tr>
<td>W 18×60</td>
<td>17.6</td>
<td>18.24</td>
<td>0.415</td>
<td>7.555</td>
<td>0.695</td>
<td>60</td>
<td>984</td>
</tr>
<tr>
<td>W 18×55</td>
<td>16.2</td>
<td>18.11</td>
<td>0.390</td>
<td>7.530</td>
<td>0.630</td>
<td>55</td>
<td>890</td>
</tr>
<tr>
<td>W 18×50</td>
<td>14.7</td>
<td>17.99</td>
<td>0.355</td>
<td>7.495</td>
<td>0.570</td>
<td>50</td>
<td>800</td>
</tr>
<tr>
<td>W 18×46</td>
<td>13.5</td>
<td>18.06</td>
<td>0.360</td>
<td>6.060</td>
<td>0.605</td>
<td>46</td>
<td>712</td>
</tr>
<tr>
<td>W 18×40</td>
<td>11.8</td>
<td>17.90</td>
<td>0.315</td>
<td>6.015</td>
<td>0.525</td>
<td>40</td>
<td>612</td>
</tr>
<tr>
<td>W 18×35</td>
<td>10.3</td>
<td>17.70</td>
<td>0.300</td>
<td>6.000</td>
<td>0.425</td>
<td>35</td>
<td>510</td>
</tr>
</tbody>
</table>

- Wide Flange Sections – W Shapes -
SECTION – A

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

1. (a) “The final distinction in the use of the growth pole theory is between the use of a growth pole policy or growth center policy” – which one of these policies you think is more appropriate in the context of Bangladesh? Explain your reasoning. (10)
   
   (b) Discuss two basic concepts associated with Central Place Theory. (15)
   
   (c) “To indicate whether the optimum location was close to the source of materials or to the market, Weber devised an index” – describe this index. (10)

2. (a) How do you think the bottom up planning approach at distinct level can integrate urban and rural development? Discuss with examples, if necessary. (10)
   
   (b) Discuss the importance of industrial policies for Bangladesh. (15)
   
   (c) While formulating regional policy options for depressed regions, do you think policies regarding reallocation of labor can play any important role? Describe accordingly. (10)

3. (a) Criticize Industrial Policy 2005 of Bangladesh. (8)
   
   (b) How do you think “k values” in central place theory help to understand the alternative forms of hierarchy? Discuss briefly. (21)
   
   (c) What policy options do you suggest for management of lands while planning for regions? (6)

4. (a) “In particular, there are problems of formulating a general theory for a wide variety of industries and firms” – state these problems. Discuss the factors that actually influence the location of industries in practice. (5+20=25)
   
   (b) Differentiate between spread effect and backwash effect. (10)

Contd .......... P/2
PLAN 333

SECTION-B

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

5. (a) "Regional level of planning is concerned with the planning for an area with distinctive economic and social characteristics." Explain the statement with relevant examples. (20)

(b) Write short notes on the following: (5x3=15)
   (i) Natural region.
   (ii) Planning regions.
   (iii) Basic employment.

6. (a) How does ‘gravitational analysis’ help to identify the relative attractiveness and spheres of influence of various centres? Explain using necessary illustration(s). (20)

(b) Why the understanding of regional economic structure is important for regional planners? What are the methods available for understanding short-run changes in the regional economy? (10+5=15)

7. (a) Minimum requirement method should be used with other economic base methods to avoid calculating basic employments for sectors which clearly serve only local market. Explain the statement with relevant examples. (20)

(b) Being a Regional Planner, you can use economic base multiplier for projection purpose. How? (15)

8. (a) In industrial structure analysis, the differential shift component measures the shift resulting from internal location factors. Explain the statement. (10)

(b) Briefly explain Lewis’ Dual Sector Model of economic growth. (18)

(c) The output multipliers of agriculture and industry sectors of a simplified economy are 1.52 and 1.98 respectively. Interpret the values. What is the implication of these values for the investors? (5+2=7)
SECTION – A

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

1. (a) Write a comparative synopsis among three techniques of traffic assignment. (10)
   (b) What are the underlying principles of growth factor and synthetic methods of trip distribution? (5)
   (c) Given a residential zone (i) that produces a total of 1280 shopping trips per day, distribute these trips to the shopping centers (j) in Table 1. Distances between zones are shown in Figure 1. Assume the value of the exponential constant $W$ be 2.5. (15)

<table>
<thead>
<tr>
<th>Shopping center (j)</th>
<th>Floor Space (thousand ft²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>192</td>
</tr>
<tr>
<td>2</td>
<td>231</td>
</tr>
<tr>
<td>3</td>
<td>333</td>
</tr>
<tr>
<td>4</td>
<td>75</td>
</tr>
</tbody>
</table>

   (d) Differentiate among diverted, converted and shifted traffic. (5)

2. (a) Illustrate different segments of model with a comprehensive example. (10)
   (b) Suppose a zone 'I' is currently producing a total of 3000 vehicle trips that follow the equation:
   
   $$ Y = a_0 + 0.03X_1 + 0.45X_2 + 0.20X_3 + 0.55X_4 $$

   The zonal variables in the present year are given in Table 2, which are assumed to increase by 25% in 2050. Determine the number of trips 'I' will be producing in 2050. (10)

   Contd ............. P/2
PLAN 345
Contd... Q. No. 2(b)

Table 2

<table>
<thead>
<tr>
<th>Variable</th>
<th>Observed Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zonal population (X₁)</td>
<td>15000</td>
</tr>
<tr>
<td>No. of working members (X₂)</td>
<td>3750</td>
</tr>
<tr>
<td>No. of students (X₃)</td>
<td>534</td>
</tr>
<tr>
<td>No. of cars owned (X₄)</td>
<td>877</td>
</tr>
</tbody>
</table>

(c) Table 3 shows the trip rates of a study area for 2017. Table 4 and 5 show the projected characteristics trip production and attraction centers in 2035. Calculate the total number of trips that will be generated in the study area in 2035.

Table 3

<table>
<thead>
<tr>
<th>Type of area</th>
<th>Trips per household</th>
<th>Trips per 1000 sq.ft.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Vehicles per HH</td>
<td>Persons per Household</td>
</tr>
<tr>
<td>Home-based work</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Home-based shop</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High density</td>
<td>0</td>
<td>0.46</td>
</tr>
<tr>
<td>Low density</td>
<td>0</td>
<td>0.86</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>1.36</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>1.86</td>
</tr>
</tbody>
</table>

Table 4

<table>
<thead>
<tr>
<th>Type of Area</th>
<th>Vehicles per HH</th>
<th>Persons per Household</th>
<th>Area in 2035 (in 100000 sq.ft.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Density</td>
<td>0</td>
<td>1</td>
<td>Non-retail CBD Shop center Other</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>167</td>
<td>263 352 369</td>
</tr>
<tr>
<td>Low Density</td>
<td>0</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>167</td>
<td>263 352 369</td>
</tr>
</tbody>
</table>

Table 5

<table>
<thead>
<tr>
<th>Trip Purpose</th>
<th>Area in 2035 (in 100000 sq.ft.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-retail</td>
<td>CBD Shop center Other</td>
</tr>
<tr>
<td>Home-based work</td>
<td>8.34</td>
</tr>
<tr>
<td>Home-based shop</td>
<td>14.62</td>
</tr>
</tbody>
</table>

Table 6

<table>
<thead>
<tr>
<th>Modes</th>
<th>Average time spent in minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walking to transit</td>
<td>Waiting for transit</td>
</tr>
<tr>
<td>Car</td>
<td>-</td>
</tr>
<tr>
<td>Transit</td>
<td>5</td>
</tr>
</tbody>
</table>

3. (a) Discuss the advantages and disadvantages of two variations of modal split procedures.

(b) 'Future transportation demand is tied up with future socio-economic activity and future land use'- explain.

(c) Table 6 shows the particulars associated with 3500 daily trips from Mount Washington to West Pittsburgh by two modes.

Contd ........... P/3
Based on the above information determine the number of daily trips by each mode using Figure 2. Also determine the revenue from transit given the out-of-pocket costs for transit is 50 cents/person.

(d) Suppose in the previous context government wants to elongate the transit route by adding two extra bus stoppages. This change will increase the transit riding time. Determine the maximum time in riding that can be allowed if government does not want the revenue to fall below 8750 cents.

4. (a) Find the shortest path from Node A to Node D (Figure 3) using Dijkstra's algorithm.
(b) Table 7 shows the trips emanating from Node A to the network. Assign the trips using Multipath Traffic Assignment technique by taking the intermodal impedance values as disutility. Also, upgrade the shortest path after assigning the trips between nodes.
SECTION-B
There are FOUR questions in this section. Answer any THREE questions.

5. (a) What do you understand by the term ‘TDM’? Describe the features of any three TDM measures with examples. (10+25)

6. Discuss the problem and prospects of IWT sector of Bangladesh and water transport system of Dhaka city. (20+15)

7. (a) What were the limitations of the inherited network of Bangladesh Railway (BR)? (10)

(b) What would you propose to overcome these limitations and what other steps would you propose to make BR play a bigger role in the transportation system of Bangladesh? (25)

8. Write short notes on any three of the following: (11 \times 3 = 35)

(a) Sustainable modes for Bangladesh

(b) Any three methods used to control of movements of trains.

(c) Transportation system

(d) BRT.

-------------------------
1. (a) A suitable site has to be selected for coal based power plant. Three sites are available: site A, site B, and site C. Planners have agreed on four major criteria—environmental, engineering, economic, and social. The following comparison matrices have been developed (Fig 1-5).

(i) Recommend the suitable site for power plant and rank them in order of priority.

(ii) Check the consistency of the comparison.

(iii) Demonstrate the whole process with a diagram.

(b) Consider the following game in context of international cooperation for the reduction of carbon emission. Each country has two alternatives—to pollute and to reduce the emission. Find the Nash equilibrium for the game and explain why international cooperation and social optimum output is not always possible to cut emission.
2. (a) Find the Nash equilibrium/equilibria for the following game.

\[
\begin{array}{c|cc}
\text{Strategies} & \text{Abate} & \text{Pollute} \\
\hline
\text{Abate} & 2,2 & 0,3 \\
\text{Pollute} & 3,0 & 1,1 \\
\end{array}
\]

(b) Solve the following game using graphical method. Assume the payoffs are for player A.

\[
\begin{array}{c|ccc}
\text{Strategies} & X & Y & Z \\
\hline
J & 5,6 & 3,7 & 0,4 \\
K & 8,3 & 3,1 & 5,2 \\
L & 7,5 & 4,4 & 5,6 \\
M & 3,5 & 7,5 & 3,3 \\
\end{array}
\]

3. (a) A pre-timed signal controls a four-way intersection. The Eastbound (EB) and the West bound (WB) traffic volumes are 1200 veh/hr and 900 veh/hr and the two movements share the same green and red portion of cycles. The Northbound (NB) and the South bound (SB) directions also share cycle times, with volumes 600 veh.hr and 750 veh/hr respectively. If the saturation flow of all the approaches is 2200 veh/hr, the cycle length is 60 seconds (s) and D/D/1 queuing applies, optimize the signal timing of the intersection.

(b) Solve the following assignment problem. Check whether the distribution is optimum or not using Modified Distribution (MODI) Method.
4. (a) A suitable flood management strategy has to be planned for the future to protect the coastal communities. Planners are considering three possible sea level rise scenarios—low, medium and high which are totally uncertain. Three flood protection strategies are under primary consideration. The following table summarizes the cost matrix for the strategies. Recommend a strategy under following criteria—

1. Laplace
2. Savage Regret

(b) Three villages need to be supplied water in dry season. The following table summarizes the supply capacity of the sources, demand of the villages, and cost of water supply from the sources to villages. Allocate water supply from the sources to each village to optimize the cost using Modified Distribution (MODI) Method.
5. Weenies and Buns is a food processing plant which manufactures hot dogs and hot dog buns. They grind their own flour for the hot dog bun at a maximum rate of 200 pounds per week. Each hot dog bun requires 0.1 pound of flour. They currently have a contract with Pigland, Inc, which specifies that a delivery of 800 pounds of cow product is delivered every Monday. Each hot dog requires $\frac{1}{4}$ pound of cow product.

All the other ingredients in the hot dogs and hot dog buns are in plentiful supply. Finally the labor force at Weenies and Buns consists of 5 employees working full time (40 hours per week each). Each hot dog requires 3 minutes of labor, and each hot dog bun requires 2 minutes of labor. Each hot dog yields a profit of $0.20 and each bun yields a profit of $0.10. Weenies and Buns would like to know how many hot dog buns they should produce each week so as to achieve the highest possible profit. (a) Formulate a linear programming model for this problem. (b) Use the graphical method to solve this model.

6. The Fagersta Steelworks currently is working in two mines to obtain its iron ore. This iron ore is shipped to either of two storage facilities. When needed it then is shipped on to the company’s steel plant. The diagram below depicts this distribution network, where M1 and M2 are the two mines, S1 and S2 are the two storage facilities, and P is the steel plant. The diagram shows the monthly amounts produced at the mines and needed at the plant, as well as the shipping coat and the maximum amount that can be shipped per month through each shipping lane.

Management now wants to determine the most economic plan for shipping the iron ore from the mines through the distribution network to the steel plan. (a) Show the mathematical formulation of the model. (b) Solve this model by the simplex method (tabular form).
PLAN 393

7. Consider the following problem:

Maximize $Z = x_1 - x_2 + 2x_3$

Subject to

\[
\begin{align*}
x_1 + x_2 + 3x_3 & \leq 15 \\
2x_1 - x_2 + x_3 & \leq 2 \\
-x_1 + x_2 + x_3 & \leq 4
\end{align*}
\]

and $x_1 \geq 0$, $x_2 \geq 0$, $x_3 \geq 0$

Let $x_4$, $x_5$, and $x_6$ denote the slack variables for the respective constraints. After the simplex method is applied, a portion of the final simplex tableau is as follows:

<table>
<thead>
<tr>
<th>Basic Variables</th>
<th>Eq.</th>
<th>Coefficient of $x_1$</th>
<th>Coefficient of $x_2$</th>
<th>Coefficient of $x_3$</th>
<th>Coefficient of $x_4$</th>
<th>Coefficient of $x_5$</th>
<th>Coefficient of $x_6$</th>
<th>Right Side</th>
</tr>
</thead>
<tbody>
<tr>
<td>$Z$</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>$\frac{1}{2}$</td>
<td>$\frac{1}{2}$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$x_4$</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>-1</td>
<td>-2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$x_5$</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>$\frac{1}{2}$</td>
<td>$\frac{1}{2}$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$x_6$</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>$-\frac{1}{2}$</td>
<td>$\frac{1}{2}$</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Use the revised simplex method to identify the missing numbers in the final simplex tableau. Show your calculations.

8. (a) Consider the following problem.

Maximize $Z = 8x_1 + 4x_2 + 6x_3 + 3x_4 + 9x_5$

Subject to

\[
\begin{align*}
x_1 + 2x_2 + 3x_3 + 3x_4 & \leq 180 \text{ (resource 1)} \\
4x_1 + 3x_2 + 2x_3 + x_4 + x_5 & \leq 270 \text{ (resource 2)} \\
x_1 + 3x_2 + x_4 + 3x_5 & \leq 180 \text{ (resource 3)}
\end{align*}
\]

and $x_j \geq 0, j = 1, \ldots, 5$

You are given the facts that the basic variables in the optimal solution are $x_1$, $x_3$, and $x_5$, and that

\[
\begin{bmatrix}
3 & 1 & 0 \\
2 & 4 & 1 \\
0 & 1 & 3 \\
\end{bmatrix}
\begin{bmatrix}
1 \\
11
\end{bmatrix} = \begin{bmatrix}
11 \\ -3 \\ 1
\end{bmatrix}
\]

Use the given information to identify the optimal solution.

(b) Construct the dual problem for the following primal problem:

Maximize $Z = 6x_1 + 8x_2$

Subject to

\[
\begin{align*}
5x_1 + 2x_2 & \leq 20 \\
x_1 + 2x_2 & \leq 10
\end{align*}
\]

and $x_1 \geq 0$, $x_2 \geq 0$
SECTION – A

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

1. (a) Identify the poverty concept which focuses on “inability to attain a standard of living adequate from the perspective of the society in which an individual lives”. Describe the measurement steps and criticism of this concept. (15)

(b) Describe the importance of infrastructure provision in rural markets in the context of Bangladesh. (20)

2. (a) State the criteria for selection of growth centers in Bangladesh. (6)

(b) State the categories of monitorable targets of Seventh Five Year Plan. (5)

(c) “Growth center initiative in Bangladesh has failed to achieve expected objectives” - Do you agree with this statement? Justify your answer. (7)

(d) “Some of the Millennium Development Goals have been achieved in Bangladesh as an outcome of the programmes undertaken during Sixth Five Year Plan especially for rural development” - Explain this statement with proper justification. (17)

3. (a) “Growth center can be identified and selected on the basis of economic activity or geographical location” - Provide a comparative analysis of these two methods. (15)

(b) Compare the strategic priorities and strategies of Sixth Five Year Plan and Seventh Five Year Plan for rural transport development and management in Bangladesh. (20)

4. (a) Explain why infrastructure services in rural areas are largely provided by the public sector. (7)

(b) The following table (Table 1) summarizes monthly income of households in four regions. Compare the poverty condition of these four regions. Consider, the poverty line = 1.37 USD (per person per day) and average HH size = 3. (28)

<table>
<thead>
<tr>
<th>Region 1</th>
<th>Region 2</th>
<th>Region 3</th>
<th>Region 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
<td>13.2</td>
<td>10.7</td>
<td>22</td>
</tr>
<tr>
<td>5</td>
<td>12.4</td>
<td>12.5</td>
<td>15</td>
</tr>
<tr>
<td>8.7</td>
<td>10.5</td>
<td>2.6</td>
<td>8.5</td>
</tr>
<tr>
<td>5.9</td>
<td>3.1</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>14.9</td>
<td>2</td>
<td>10.4</td>
<td>8.2</td>
</tr>
<tr>
<td>7.5</td>
<td>10.1</td>
<td>10.3</td>
<td>9</td>
</tr>
<tr>
<td>11.5</td>
<td>2.3</td>
<td>2</td>
<td>2.2</td>
</tr>
<tr>
<td>5</td>
<td>11.9</td>
<td>11.9</td>
<td>29</td>
</tr>
<tr>
<td>10</td>
<td>15</td>
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<td>10</td>
</tr>
<tr>
<td>6.8</td>
<td>2.8</td>
<td>12</td>
<td>26</td>
</tr>
<tr>
<td>12.8</td>
<td>14.5</td>
<td>11.6</td>
<td>18</td>
</tr>
<tr>
<td>5.9</td>
<td>3.3</td>
<td>11</td>
<td>2.8</td>
</tr>
<tr>
<td>9.2</td>
<td>2.7</td>
<td>8.7</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>10.1</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>7.8</td>
</tr>
</tbody>
</table>

Contd……….. P/2
There are FOUR questions in this section. Answer any THREE questions.

5. (a) Briefly discuss the strategies and institutional mechanism of Comprehensive Village Development Program (CVDP).

(b) Differentiate between area development IRD model and comprehensively integrated rural development model. Also exemplify when these two IRD models should be applied.

(15)

(10+10=20)

6. (a) Write down the key features of Integrated Rural Development Program (IRDP).

(b) Categorize rural-urban linkage with examples.

(c) Discuss the idea of several types of potential compact towns. Do you think that such compact towns can reasonably be expected to provide a stimulating nursery for the most important inputs involved in economic growth-education, entrepreneurship and technology- spread out over the Bangladeshi Countryside?

(10)

(5)

(7+13=20)

7. (a) Define sustainable livelihood. Explain the parameters which can be used to evaluate the sustainability of different livelihood outcomes.

(b) Explain the "Virtuous Circle" model of rural-urban development.

(c) Differentiate between functions of Bangladesh Academy for Rural Development (BARD) and Bangladesh Rural Development Board (BRDB).

(5+10=15)

(10)

(10)

8. (a) Differentiate between Participatory Rural Appraisal (PRA) and Rapid Rural Appraisal (RPA).

(b) Discuss how different participatory methods can be applied to gather information while adopting a production oriented Integrated Rural Development (IRD) model for a particular village.

(c) What are the fundamental principles that must be kept in mind while performing Rapid Rural Appraisal (RRA)?

(12)

(15)

(8)