

The figures in the margin indicate full marks.

Symbols indicate their usual meaning.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

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

1. (a) What is Externality? (10)
 (b) Discuss how negative externality in production can be internalized by imposing tax to producer? (10)
 (c) Explain how externality can be internalized by applying Coase theorem. (15)

2. (a) Briefly explain the first and second welfare theorem. (10)
 (b) Explain how market system ensures maximum welfare society under appropriate assumptions. (25)

3. (a) What is public good? (5)
 (b) Explain how under-production of public good is occurred is public good is provisioned by private sector market. (10)
 (c) Derive the efficient provision of public good both mathematically and graphically. (20)

4. (a) Discuss "Cyclical Voting Phenomenon" in case majority voting. (15)
 (b) What is "Median Voter Rule"? (10)
 (c) Discuss the concept of "Log Rolling" under majority voting. (15)

SECTION – B

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

5. Discuss any two of the following three scenarios of fixed quantity subsidy. (35)
 - (a) Fixed quantity subsidy results in overconsumption.
 - (b) Fixed quantity subsidy results in reduction in private purchase.
 - (c) Fixed quantity subsidy results in under-consumption.

HUM 221/URP

6. Consider the following inverse demand and supply function:

Demand Function: $P = 110 - 2Q_d$; Supply Function: $P = 10 + 2Q_s$; here P is price in Tk and Q_d and Q_s represent quantity demand and quantity supply respectively.

(a) Find the equilibrium price and quantity. (5)

(b) Suppose per unit subsidy of Tk. 10 has been given to supplier then what will be the benefit on consumers and what will be the benefit on suppliers of this subsidy. (5)

(c) What will be welfare cost of subsidy? (5)

(d) What would happen if the subsidy was given to consumers? Compare this with (b) and explain. (10)

(e) Suppose the supply curve has been changed to, $P = 10 + 3Q_s$. How will the burden of per unit subsidy of Tk. 10 be distributed between consumers and suppliers? Compare this with (b) and explain the outcome. (10)

7. What are the arguments advanced in favor and against the government intervention to redistribute income? Discuss with suitable examples. (35)

8. (a) Explain how welfare cost of per-unit tax depends on elasticity of both demand and supply, and tax rate. (5)

(b) Demonstrate that progressive income tax discourages labor supply. (10)

(c) Describe the welfare loss of proportional and progressive income tax from individual perspective. (20)

SECTION – A

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

1. (a) "A Master Plan is also called a Comprehensive or a Perspective plan" – Explain. (5)
 (b) "In case of fast growing cities, Master Plan adopted by the British Town Planning system is inappropriate" – analyze this statement in the context of Dhaka city. (12)
 (c) What analyses are particularly important in the preparation of a Master Plan and which surveys are prerequisite to conduct those analyses? (18)

2. (a) What is the main difference between Sites and Services (S&S) Schemes and Land Readjustment (LR) techniques regarding public investment and cost recovery? Do you think that S&S scheme is effective in providing housing for its target people? Justify your answer. (4+10=14)
 (b) Who can be the implementing authority of LR project? After the approval of scheme text, LR goes through a sequential process, briefly describe the process. (2+12=14)
 (c) Define followings with examples based on Dhaka – (7)
 (i) Blighted area, (ii) Slum area, (iii) Squatter settlement area

3. (a) Why urban upgrading is different from S&S scheme? What are the underlying principles of urban upgrading? (3+5=8)
 (b) What strategies or standards do you think are suitable for the provision of infrastructure and service in slum upgrading program of Dhaka? Give your answer based on the best examples from South and South-East Asian countries. (20)
 (c) Define zoning as a tool of development control. Why is density zoning an indirect approach? (4+3=7)

4. (a) Does the old part of Dhaka city need an urban renewal program? Justify your opinion. (5)
 (b) Explain the context in which different methods of urban renewal deem particularly suitable. (9)
 (c) Which problems can arise in the absence of property tax? Why betterment tax has never been acted upon in Bangladesh? (10+6=16)
 (d) "Phasing is important to carry out the interdependent proposals in the local plan will be carried out" – explain. (5)

PLAN 215

SECTION – B

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

5. (a) Briefly describe the steps followed in the land use plan making process. Why step five demands critical thinking and analysis? (12+6)
- (b) Give example of cities where "Urban Growth Boundary" were adopted as a tool to control and guide development. Explain how this concept works. (9)
- (c) Briefly explain the Detroit system of land classification. (8)
6. (a) Briefly discuss the flood zone policies mentioned in Dhaka Metropolitan Development Plan (DMDP 1995-2015). What strategies would you suggest to protect these water bodies? (6+8)
- (b) Distinguish between 'compact' and 'sprawl' development. Which type of development would you suggest for Bangladesh – give explanation for your answer. (13+8)
7. (a) Explain why "Ecological Footprint" has emerged as the world's premier measure of humanity's demand on nature? (10)
- (b) Elaborate the term "Ecological Deficit" with relevant example. (10)
- (c) The land use design policies are sometimes incorporated into development management plan as explicit criteria for development permits and public investment decisions – explain this statement. (10)
- (d) What are the dimensions of Development management Plan? (5)
8. (a) Allan Jacob and Donald Appleyard listed a set of problems of modern urban design – briefly discuss those problems with reference to Bangladesh. (16)
- (b) Briefly discuss two goals for better urban life that are appropriate for residents of Dhaka. (8)
- (c) "Path" and "Edge" are two elements of city image. Briefly describe these two elements and suggest how these elements can improve the image of Dhaka city. (11)
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SECTION – A

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

1. (a) Explain the importance of spatial information in planning. (10)
(b) Describe the relative advantages and disadvantages of raster and vector data format in GIS. (25)
2. (a) Explain with examples the different types of relations in a relational database model. (12)
(b) What do you understand by the term "reclassification" in GIS? Explain the methods used to reclassify data in GIS. (4+9=13)
(c) Describe the use of "rubbersheeting" method in GIS. (10)
3. (a) Describe the database model which is used in GIS to store attribute data. (15)
(b) Overlay is performed in GIS to integrate geographic data from different sources. Explain how the process of overlay is executed in GIS for raster and vector data format. (20)
4. (a) What is the purpose of map projection? Describe briefly the basic map projection techniques and their specific uses. (4+15=19)
(b) There are several compaction techniques available to reduce raster data size. Explain these techniques with the help of suitable diagrams. (16)

SECTION – B

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

Acronyms have their usual meanings.

5. (a) You are working in a project which would use remote sensing image for land cover analysis. What are the factors you would consider for selecting the image? (18)
(b) Briefly describe the structure of digital remote sensing image. Why do you think radiometric error occurs in remotely sensed image? (6+6)
(c) Depending upon level of error correction there are three levels of 'SPOT Scene'. Briefly describe the characteristics of these scenes. (5)

PLAN 261

6. (a) "Image interpreters employ five strategies to read and analyze remotely sensed image visually" – describe these strategies. (15)
 (b) Describe the methodology of conducting supervised classification. What are the advantages of using supervised classification? (15+5)

7. Write short notes on (Any five) (7×5)
- (a) Effect of scattering on images
 - (b) Types of sensor platform
 - (c) Spectral resolution
 - (d) Characteristics of Landsat image
 - (e) Sentinel-2
 - (f) Format of image data
 - (g) Contrast Stretching

8. You are working in a project to develop a marine park in the coast of Barisal. You have acquired images for the purpose.
- (a) Which enhancement tool you would use to delineate land-sea boundary? Explain how you are going to use the tool. (10)
- (b) You have decided to use supervised classification to identify the landcover. Table 1 provides the error matrix for the classification of the training set.

Table 1: Error matrix from classification training set pixels

| Classification data | Training Set data (Known cover type)* | | | | |
|---------------------|---------------------------------------|-----|-----|-----|-----------|
| | S | L | H | U | Row Total |
| S | 110 | 08 | 02 | 00 | 120 |
| L | 15 | 109 | 27 | 15 | 166 |
| H | 05 | 23 | 124 | 25 | 177 |
| U | 00 | 21 | 26 | 190 | 237 |
| Column Total | 130 | 161 | 179 | 230 | 700 |

- * S : indicates Sea
- L : indicates Area only visible during low tide
- H : indicates Area submerged during high tide
- U : indicates Area submerged only during unusual tide

- (i) Determine user, producer and overall accuracy of the classification. Explain the result. (10+3)
 (ii) Determine the K_{hat} statistics for the classification. (7)
 (iii) What is your interpretation of the classification result comparing K_{hat} statistics and overall accuracy? (5)

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The symbols have their usual meanings.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

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

1. (a) Why the understanding of population projection is important for planners? (7)
 (b) Distinguish between –
 (i) aggregate and composite approach of population projection, (8)
 (ii) parametric and non-parametric tests. (10)
 (c) Transform the following equations in the form of linear regression equations. (3×2=6)
 (i) $y = Ae^{\beta x}$
 (ii) $y = Ax^{\beta}$
 (d) What is a 'seasonal index' in time series analysis? (4)

2. (a) How many kinds of variations can be observed in the time series analysis? Explain any two of these variations with examples. (10)
 (b) The following information are calculated from 10 randomly selected taxi passengers of a region. (25)

$$\begin{aligned} \sum X &= 420, & \sum Y &= 1922, & \sum XY &= 84541 \\ \sum X^2 &= 18228, & \sum Y^2 &= 395024 \end{aligned}$$
 Where, X is the length of trip made by taxi (meter) and Y is taxi-fare. Test the hypothesis, $H_0 : \beta = 6$ against the alternative hypothesis $\beta > 6$ at the 5% significance level. Here, β stands for the regression co-efficient.

3. A real estate developer company hires most of its planners from the two major universities which offer planning degree from years back. Over the last year, the company has been taking a test to the newly graduated planners entering the company to determine which school, if either seems to educate its planners better. Based on the following scores (out of 100), help the personnel office of the company determine whether the schools differ in quality. Use a rank sum test with a 10% level of significance.

Test Scores

| | | | | | | | | | | | |
|----------|----|----|----|----|----|----|----|----|----|----|----|
| School A | 97 | 69 | 73 | 84 | 76 | 92 | 90 | 88 | 84 | 87 | 93 |
| School B | 88 | 99 | 65 | 69 | 97 | 84 | 85 | 89 | 91 | 90 | 87 |
| | 91 | 72 | | | | | | | | | |

Contd P/2

(35)

PLAN 293

4. A ward commission, designed to monitor water consumption, assembled the following seasonal data on water consumption (in millions of gallons):

| Year | Winter | Spring | Summer | Fall |
|------|--------|--------|--------|------|
| 2011 | 293 | 246 | 231 | 282 |
| 2012 | 301 | 252 | 227 | 291 |
| 2013 | 304 | 259 | 239 | 296 |
| 2014 | 306 | 265 | 240 | 300 |

- (a) Calculate a 4-quarter centered moving average. (12)
- (b) Determine the modified seasonal indices and the seasonal indices. (15)
- (c) Deseasonalize the data regarding water consumption. (8)

SECTION – B

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

5. (a) A researcher became interested to know if average daily income of hawkers is the same in two cities. To test his hypothesis he carried out a sample survey in two cities.

The survey data are as follows:

| City | Mean daily income (Taka) | Standard deviation of mean daily income (Taka) | Sample size |
|------|--------------------------|--|-------------|
| A | 695 | 40 | 200 |
| B | 710 | 60 | 175 |

- (i) State the null and alternate hypothesis. (2 1/2)
- (ii) What is the decision rule at 5% level of significance? (5)
- (iii) Calculate the test statistic. (5)
- (iv) What is the decision of the researcher regarding his hypothesis? (5)
- (b) The Mayor of a city claims that at most 20% of households in the city are extremely poor. A planner wanted to test the Mayor's claim. She selected 400 households randomly and found that 70 households are extremely poor.
- (i) State null and alternate hypothesis. (2 1/2)
- (ii) What is the decision rule if $\alpha = 0.05$? (5)
- (iii) Compute the test statistics. (5)
- (iv) What can the planner conclude about the claim of the Mayor? (5)

PLAN 293

6. Bangladesh Medical Association reports that 40 percent of people with age 60 years and over in a given year are not admitted to hospitals. 30% are admitted once, 20% are admitted twice and 10% are admitted 3 or more times. A survey of 150 people (60 years and over) in Dhaka revealed that 55 were not admitted, 50 were admitted once, 32 were admitted twice and the rest were admitted 3 or more times. Can we suggest that the information obtained from survey in Dhaka is consistent with BMA information?

- (i) State the null and alternate hypothesis. (5)
- (ii) What is the decision rule at 5% level of significance? (5)
- (iii) Compute the test statistic. (20)
- (iv) What is your decision regarding the null hypothesis? (5)

7. The table below shows the per acre production data for three varieties of wheat, each grown on four plots of land. The objective is to compare per acre production for three varieties of wheat.

| Plot of land | Variety of Wheat | | |
|--------------|------------------|---|---|
| | A | B | C |
| 1 | 6 | 5 | 5 |
| 2 | 7 | 5 | 4 |
| 3 | 3 | 3 | 3 |
| 4 | 8 | 7 | 4 |

- (i) State the null hypothesis and alternate hypothesis. (5)
- (ii) Calculate SST, SSE and SS_{total} . (15)
- (iii) Develop an ANOVA table. (10)
- (iv) At the 0.05 significance level, is there a difference in the average output/production of three varieties of wheat? (5)

8. In a sample survey the employers of planners were requested to indicate on a five-point scale the performance of the planners in certain qualities. The responses are shown in the table below:

| Qualities | Values | | | | | Total |
|---------------------------|--------|----|----|----|----|-------|
| | 0 | 1 | 2 | 3 | 4 | |
| General Technical Ability | 03 | 04 | 12 | 20 | 10 | 49 |
| Special Technical Ability | 02 | 02 | 10 | 20 | 10 | 44 |
| Planning Ability | 03 | 10 | 12 | 10 | 10 | 45 |
| Implementation Ability | 02 | 05 | 08 | 15 | 08 | 38 |
| Problem-Solving Ability | 03 | 05 | 10 | 20 | 12 | 50 |
| Ability to Organize | 02 | 03 | 13 | 16 | 13 | 47 |
| Ability to coordinate | 03 | 03 | 10 | 15 | 12 | 43 |
| Teaching Ability | 02 | 06 | 08 | 16 | 13 | 45 |

- (i) Construct a suitable scale and specify the computational formula. (10)
- (ii) Compute the indexes of performance with respect to various qualities of the planners. (20)
- (iii) Interpret the results. (5)

Table A.7 Critical Values F_{α, v_1, v_2} for the F Distribution

$\alpha = .05$

| $v_1 \backslash v_2$ | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 12 | 15 | 20 | 24 | 30 | 40 | 60 | 120 | ∞ |
|----------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|----------|
| 1 | 161.4 | 199.5 | 215.7 | 224.6 | 230.2 | 234.0 | 236.8 | 238.9 | 240.5 | 241.9 | 243.9 | 245.9 | 248.0 | 249.1 | 250.1 | 251.1 | 252.2 | 253.3 | 254.3 |
| 2 | 18.51 | 19.00 | 19.16 | 19.25 | 19.30 | 19.33 | 19.35 | 19.37 | 19.38 | 19.40 | 19.41 | 19.43 | 19.45 | 19.45 | 19.46 | 19.47 | 19.48 | 19.49 | 19.50 |
| 3 | 10.13 | 9.55 | 9.26 | 9.12 | 9.01 | 8.94 | 8.89 | 8.85 | 8.81 | 8.79 | 8.74 | 8.70 | 8.66 | 8.64 | 8.62 | 8.59 | 8.57 | 8.55 | 8.53 |
| 4 | 7.71 | 6.94 | 6.59 | 6.39 | 6.26 | 6.16 | 6.09 | 6.04 | 6.00 | 5.96 | 5.91 | 5.86 | 5.80 | 5.77 | 5.75 | 5.72 | 5.69 | 5.66 | 5.63 |
| 5 | 6.61 | 5.79 | 5.41 | 5.19 | 5.05 | 4.95 | 4.88 | 4.82 | 4.77 | 4.74 | 4.68 | 4.62 | 4.56 | 4.53 | 4.50 | 4.46 | 4.43 | 4.40 | 4.36 |
| 6 | 5.99 | 5.14 | 4.76 | 4.53 | 4.39 | 4.28 | 4.21 | 4.15 | 4.10 | 4.06 | 4.00 | 3.94 | 3.87 | 3.84 | 3.81 | 3.77 | 3.74 | 3.70 | 3.67 |
| 7 | 5.59 | 4.74 | 4.35 | 4.12 | 3.97 | 3.87 | 3.79 | 3.73 | 3.68 | 3.64 | 3.57 | 3.51 | 3.44 | 3.41 | 3.38 | 3.34 | 3.30 | 3.27 | 3.23 |
| 8 | 5.32 | 4.46 | 4.07 | 3.84 | 3.69 | 3.58 | 3.50 | 3.44 | 3.39 | 3.35 | 3.28 | 3.22 | 3.15 | 3.12 | 3.08 | 3.04 | 3.01 | 2.97 | 2.93 |
| 9 | 5.12 | 4.26 | 3.86 | 3.63 | 3.48 | 3.37 | 3.29 | 3.23 | 3.18 | 3.14 | 3.07 | 3.01 | 2.94 | 2.90 | 2.86 | 2.83 | 2.79 | 2.75 | 2.71 |
| 10 | 4.96 | 4.10 | 3.71 | 3.48 | 3.33 | 3.22 | 3.14 | 3.07 | 3.02 | 2.98 | 2.91 | 2.85 | 2.77 | 2.74 | 2.70 | 2.66 | 2.62 | 2.58 | 2.54 |
| 11 | 4.84 | 3.98 | 3.59 | 3.36 | 3.20 | 3.09 | 3.01 | 2.95 | 2.90 | 2.85 | 2.79 | 2.72 | 2.65 | 2.61 | 2.57 | 2.53 | 2.49 | 2.45 | 2.40 |
| 12 | 4.75 | 3.89 | 3.49 | 3.26 | 3.11 | 3.00 | 2.91 | 2.85 | 2.80 | 2.75 | 2.69 | 2.62 | 2.54 | 2.51 | 2.47 | 2.43 | 2.38 | 2.34 | 2.30 |
| 13 | 4.67 | 3.81 | 3.41 | 3.18 | 3.03 | 2.92 | 2.83 | 2.77 | 2.71 | 2.67 | 2.60 | 2.53 | 2.46 | 2.42 | 2.38 | 2.34 | 2.30 | 2.25 | 2.21 |
| 14 | 4.60 | 3.74 | 3.34 | 3.11 | 2.96 | 2.85 | 2.76 | 2.70 | 2.65 | 2.60 | 2.53 | 2.46 | 2.39 | 2.35 | 2.31 | 2.27 | 2.22 | 2.18 | 2.13 |
| 15 | 4.54 | 3.68 | 3.29 | 3.06 | 2.90 | 2.79 | 2.71 | 2.64 | 2.59 | 2.54 | 2.48 | 2.40 | 2.33 | 2.29 | 2.25 | 2.20 | 2.16 | 2.11 | 2.07 |
| 16 | 4.49 | 3.63 | 3.24 | 3.01 | 2.85 | 2.74 | 2.66 | 2.59 | 2.54 | 2.49 | 2.42 | 2.35 | 2.28 | 2.24 | 2.19 | 2.15 | 2.11 | 2.06 | 2.01 |
| 17 | 4.45 | 3.59 | 3.20 | 2.96 | 2.81 | 2.70 | 2.61 | 2.55 | 2.49 | 2.45 | 2.38 | 2.31 | 2.23 | 2.19 | 2.15 | 2.10 | 2.06 | 2.01 | 1.96 |
| 18 | 4.41 | 3.55 | 3.16 | 2.93 | 2.77 | 2.66 | 2.58 | 2.51 | 2.46 | 2.41 | 2.34 | 2.27 | 2.19 | 2.15 | 2.11 | 2.06 | 2.02 | 1.97 | 1.92 |
| 19 | 4.38 | 3.52 | 3.13 | 2.90 | 2.74 | 2.63 | 2.54 | 2.48 | 2.42 | 2.38 | 2.31 | 2.23 | 2.16 | 2.11 | 2.07 | 2.03 | 1.98 | 1.93 | 1.88 |
| 20 | 4.35 | 3.49 | 3.10 | 2.87 | 2.71 | 2.60 | 2.51 | 2.45 | 2.39 | 2.35 | 2.28 | 2.20 | 2.12 | 2.08 | 2.04 | 1.99 | 1.95 | 1.90 | 1.84 |
| 21 | 4.32 | 3.47 | 3.07 | 2.84 | 2.68 | 2.57 | 2.49 | 2.42 | 2.37 | 2.32 | 2.25 | 2.18 | 2.10 | 2.05 | 2.01 | 1.96 | 1.92 | 1.87 | 1.81 |
| 22 | 4.30 | 3.44 | 3.05 | 2.82 | 2.66 | 2.55 | 2.46 | 2.40 | 2.34 | 2.30 | 2.23 | 2.15 | 2.07 | 2.03 | 1.98 | 1.94 | 1.89 | 1.84 | 1.78 |
| 23 | 4.28 | 3.42 | 3.03 | 2.80 | 2.64 | 2.53 | 2.44 | 2.37 | 2.32 | 2.27 | 2.20 | 2.13 | 2.05 | 2.01 | 1.96 | 1.91 | 1.86 | 1.81 | 1.76 |
| 24 | 4.26 | 3.40 | 3.01 | 2.78 | 2.62 | 2.51 | 2.42 | 2.36 | 2.30 | 2.25 | 2.18 | 2.11 | 2.03 | 1.98 | 1.94 | 1.89 | 1.84 | 1.79 | 1.73 |
| 25 | 4.24 | 3.39 | 2.99 | 2.76 | 2.60 | 2.49 | 2.40 | 2.34 | 2.28 | 2.24 | 2.16 | 2.09 | 2.01 | 1.96 | 1.92 | 1.87 | 1.82 | 1.77 | 1.71 |
| 26 | 4.23 | 3.37 | 2.98 | 2.74 | 2.59 | 2.47 | 2.39 | 2.32 | 2.27 | 2.22 | 2.15 | 2.07 | 1.99 | 1.95 | 1.90 | 1.85 | 1.80 | 1.75 | 1.69 |
| 27 | 4.21 | 3.35 | 2.96 | 2.73 | 2.57 | 2.46 | 2.37 | 2.31 | 2.25 | 2.20 | 2.13 | 2.06 | 1.97 | 1.93 | 1.88 | 1.84 | 1.79 | 1.73 | 1.67 |
| 28 | 4.20 | 3.34 | 2.95 | 2.71 | 2.56 | 2.45 | 2.36 | 2.29 | 2.24 | 2.19 | 2.12 | 2.04 | 1.96 | 1.91 | 1.87 | 1.82 | 1.77 | 1.71 | 1.65 |
| 29 | 4.18 | 3.33 | 2.93 | 2.70 | 2.55 | 2.43 | 2.35 | 2.28 | 2.22 | 2.18 | 2.10 | 2.03 | 1.94 | 1.90 | 1.85 | 1.81 | 1.75 | 1.70 | 1.64 |
| 30 | 4.17 | 3.32 | 2.92 | 2.69 | 2.53 | 2.42 | 2.33 | 2.27 | 2.21 | 2.16 | 2.09 | 2.01 | 1.93 | 1.88 | 1.84 | 1.79 | 1.74 | 1.69 | 1.62 |
| 40 | 4.08 | 3.23 | 2.84 | 2.61 | 2.45 | 2.34 | 2.25 | 2.18 | 2.12 | 2.08 | 2.00 | 1.92 | 1.84 | 1.79 | 1.74 | 1.69 | 1.64 | 1.58 | 1.51 |
| 60 | 4.00 | 3.15 | 2.76 | 2.53 | 2.37 | 2.25 | 2.17 | 2.10 | 2.04 | 1.99 | 1.92 | 1.84 | 1.75 | 1.70 | 1.65 | 1.59 | 1.53 | 1.47 | 1.39 |
| 120 | 3.92 | 3.07 | 2.68 | 2.45 | 2.29 | 2.17 | 2.09 | 2.02 | 1.96 | 1.91 | 1.83 | 1.75 | 1.66 | 1.61 | 1.55 | 1.50 | 1.43 | 1.36 | 1.25 |
| ∞ | 3.84 | 3.00 | 2.60 | 2.37 | 2.21 | 2.10 | 2.01 | 1.94 | 1.88 | 1.83 | 1.75 | 1.67 | 1.57 | 1.52 | 1.45 | 1.39 | 1.32 | 1.25 | 1.00 |

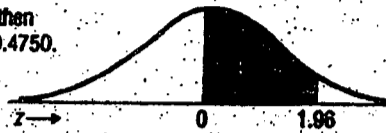
Appendix Tables

(continued)

Appendix D

Areas under the Normal Curve

Example:
If $z = 1.96$, then
 $P(0 \leq z) = 0.4750$.

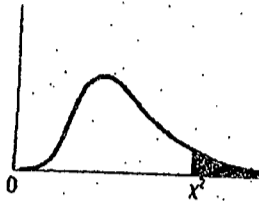


| z | 0.00 | 0.01 | 0.02 | 0.03 | 0.04 | 0.05 | 0.06 | 0.07 | 0.08 | 0.09 |
|-----|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 0.0 | 0.0000 | 0.0040 | 0.0080 | 0.0120 | 0.0160 | 0.0199 | 0.0239 | 0.0279 | 0.0319 | 0.0359 |
| 0.1 | 0.0398 | 0.0438 | 0.0478 | 0.0517 | 0.0557 | 0.0596 | 0.0636 | 0.0675 | 0.0714 | 0.0753 |
| 0.2 | 0.0793 | 0.0832 | 0.0871 | 0.0910 | 0.0948 | 0.0987 | 0.1026 | 0.1064 | 0.1103 | 0.1141 |
| 0.3 | 0.1179 | 0.1217 | 0.1255 | 0.1293 | 0.1331 | 0.1368 | 0.1406 | 0.1443 | 0.1480 | 0.1517 |
| 0.4 | 0.1554 | 0.1591 | 0.1628 | 0.1664 | 0.1700 | 0.1736 | 0.1772 | 0.1808 | 0.1844 | 0.1879 |
| 0.5 | 0.1915 | 0.1950 | 0.1985 | 0.2019 | 0.2054 | 0.2088 | 0.2123 | 0.2157 | 0.2190 | 0.2224 |
| 0.6 | 0.2257 | 0.2291 | 0.2324 | 0.2357 | 0.2389 | 0.2422 | 0.2454 | 0.2486 | 0.2517 | 0.2549 |
| 0.7 | 0.2580 | 0.2611 | 0.2642 | 0.2673 | 0.2704 | 0.2734 | 0.2764 | 0.2794 | 0.2823 | 0.2852 |
| 0.8 | 0.2881 | 0.2910 | 0.2939 | 0.2967 | 0.2995 | 0.3023 | 0.3051 | 0.3078 | 0.3106 | 0.3133 |
| 0.9 | 0.3159 | 0.3186 | 0.3212 | 0.3238 | 0.3264 | 0.3289 | 0.3315 | 0.3340 | 0.3365 | 0.3389 |
| 1.0 | 0.3413 | 0.3438 | 0.3461 | 0.3485 | 0.3508 | 0.3531 | 0.3554 | 0.3577 | 0.3599 | 0.3621 |
| 1.1 | 0.3643 | 0.3665 | 0.3688 | 0.3708 | 0.3728 | 0.3748 | 0.3770 | 0.3790 | 0.3810 | 0.3830 |
| 1.2 | 0.3849 | 0.3869 | 0.3888 | 0.3907 | 0.3925 | 0.3944 | 0.3962 | 0.3980 | 0.3997 | 0.4015 |
| 1.3 | 0.4032 | 0.4049 | 0.4066 | 0.4082 | 0.4099 | 0.4115 | 0.4131 | 0.4147 | 0.4162 | 0.4177 |
| 1.4 | 0.4192 | 0.4207 | 0.4222 | 0.4236 | 0.4251 | 0.4265 | 0.4279 | 0.4292 | 0.4306 | 0.4319 |
| 1.5 | 0.4332 | 0.4345 | 0.4357 | 0.4370 | 0.4382 | 0.4394 | 0.4406 | 0.4418 | 0.4429 | 0.4441 |
| 1.6 | 0.4452 | 0.4463 | 0.4474 | 0.4484 | 0.4495 | 0.4505 | 0.4515 | 0.4525 | 0.4535 | 0.4546 |
| 1.7 | 0.4554 | 0.4564 | 0.4573 | 0.4582 | 0.4591 | 0.4599 | 0.4608 | 0.4616 | 0.4625 | 0.4633 |
| 1.8 | 0.4641 | 0.4649 | 0.4658 | 0.4664 | 0.4671 | 0.4678 | 0.4686 | 0.4693 | 0.4699 | 0.4706 |
| 1.9 | 0.4713 | 0.4719 | 0.4726 | 0.4732 | 0.4738 | 0.4744 | 0.4750 | 0.4756 | 0.4761 | 0.4767 |
| 2.0 | 0.4772 | 0.4778 | 0.4783 | 0.4788 | 0.4793 | 0.4798 | 0.4803 | 0.4808 | 0.4812 | 0.4817 |
| 2.1 | 0.4821 | 0.4826 | 0.4830 | 0.4834 | 0.4838 | 0.4842 | 0.4846 | 0.4850 | 0.4854 | 0.4857 |
| 2.2 | 0.4861 | 0.4864 | 0.4868 | 0.4871 | 0.4875 | 0.4878 | 0.4881 | 0.4884 | 0.4887 | 0.4890 |
| 2.3 | 0.4893 | 0.4896 | 0.4898 | 0.4901 | 0.4904 | 0.4906 | 0.4909 | 0.4911 | 0.4913 | 0.4916 |
| 2.4 | 0.4918 | 0.4920 | 0.4922 | 0.4925 | 0.4927 | 0.4929 | 0.4931 | 0.4932 | 0.4934 | 0.4936 |
| 2.5 | 0.4938 | 0.4940 | 0.4941 | 0.4943 | 0.4945 | 0.4946 | 0.4948 | 0.4949 | 0.4951 | 0.4952 |
| 2.6 | 0.4953 | 0.4955 | 0.4956 | 0.4957 | 0.4959 | 0.4960 | 0.4961 | 0.4962 | 0.4963 | 0.4964 |
| 2.7 | 0.4965 | 0.4966 | 0.4967 | 0.4968 | 0.4969 | 0.4970 | 0.4971 | 0.4972 | 0.4973 | 0.4974 |
| 2.8 | 0.4974 | 0.4975 | 0.4976 | 0.4977 | 0.4977 | 0.4978 | 0.4979 | 0.4979 | 0.4980 | 0.4981 |
| 2.9 | 0.4981 | 0.4982 | 0.4982 | 0.4983 | 0.4984 | 0.4984 | 0.4985 | 0.4985 | 0.4986 | 0.4986 |
| 3.0 | 0.4987 | 0.4987 | 0.4987 | 0.4988 | 0.4988 | 0.4989 | 0.4989 | 0.4989 | 0.4990 | 0.4990 |

Appendix B

Critical Values of Chi-Square

This table contains the values of χ^2 that correspond to a specific right-tail area and a specific number of degrees of freedom.



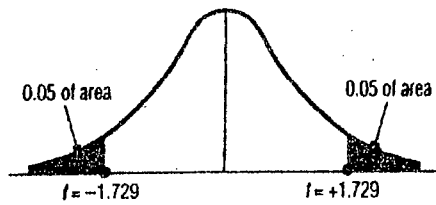
Example: With 17 df and a .02 area in the upper tail, $\chi^2 = 30.995$

| Degrees of Freedom, df | Right-Tail Area | | | |
|--------------------------|-----------------|--------|--------|--------|
| | 0.10 | 0.05 | 0.02 | 0.01 |
| 1 | 2.706 | 3.841 | 5.412 | 6.635 |
| 2 | 4.605 | 5.991 | 7.824 | 9.210 |
| 3 | 6.251 | 7.815 | 9.837 | 11.345 |
| 4 | 7.779 | 9.488 | 11.668 | 13.277 |
| 5 | 9.236 | 11.070 | 13.388 | 15.086 |
| 6 | 10.645 | 12.592 | 15.033 | 16.812 |
| 7 | 12.017 | 14.067 | 16.622 | 18.475 |
| 8 | 13.362 | 15.507 | 18.168 | 20.090 |
| 9 | 14.684 | 16.919 | 19.679 | 21.666 |
| 10 | 15.987 | 18.307 | 21.161 | 23.209 |
| 11 | 17.275 | 19.675 | 22.618 | 24.725 |
| 12 | 18.549 | 21.026 | 24.054 | 26.217 |
| 13 | 19.812 | 22.362 | 25.472 | 27.688 |
| 14 | 21.064 | 23.685 | 26.873 | 29.141 |
| 15 | 22.307 | 24.996 | 28.259 | 30.578 |
| 16 | 23.542 | 26.296 | 29.633 | 32.000 |
| 17 | 24.769 | 27.587 | 30.995 | 33.409 |
| 18 | 25.989 | 28.869 | 32.346 | 34.805 |
| 19 | 27.204 | 30.144 | 33.687 | 36.191 |
| 20 | 28.412 | 31.410 | 35.020 | 37.566 |
| 21 | 29.615 | 32.671 | 36.343 | 38.932 |
| 22 | 30.813 | 33.924 | 37.659 | 40.289 |
| 23 | 32.007 | 35.172 | 38.968 | 41.638 |
| 24 | 33.196 | 36.415 | 40.270 | 42.980 |
| 25 | 34.382 | 37.652 | 41.566 | 44.314 |
| 26 | 35.563 | 38.885 | 42.856 | 45.642 |
| 27 | 36.741 | 40.113 | 44.140 | 46.963 |
| 28 | 37.916 | 41.337 | 45.419 | 48.278 |
| 29 | 39.087 | 42.557 | 46.693 | 49.588 |
| 30 | 40.256 | 43.773 | 47.962 | 50.892 |

✓
DISTRIBUTION OF χ^2

| Degrees of Freedom | Probability | | | | | | |
|--------------------|-------------|--------|--------|--------|--------|--------|--------|
| | .50. | .30. | .20. | .10. | .05. | .02. | .01. |
| 1 | .455 | 1.074 | 1.642 | 2.706 | 3.841 | 5.412 | 6.635 |
| 2 | 1.386 | 2.408 | 3.219 | 4.605 | 5.991 | 7.824 | 9.210 |
| 3 | 2.366 | 3.665 | 4.642 | 6.251 | 7.815 | 9.837 | 11.345 |
| 4 | 3.357 | 4.878 | 5.989 | 7.779 | 9.488 | 11.668 | 13.277 |
| 5 | 4.351 | 6.064 | 7.289 | 9.236 | 11.070 | 13.388 | 15.086 |
| 6 | 5.348 | 7.231 | 8.558 | 10.645 | 12.592 | 15.033 | 16.812 |
| 7 | 6.346 | 8.383 | 9.803 | 12.017 | 14.067 | 16.622 | 18.475 |
| 8 | 7.344 | 9.524 | 11.030 | 13.362 | 15.507 | 18.168 | 20.090 |
| 9 | 8.343 | 10.656 | 12.242 | 14.684 | 16.919 | 19.679 | 21.666 |
| 10 | 9.342 | 11.781 | 13.442 | 15.987 | 18.307 | 21.161 | 23.209 |
| 11 | 10.341 | 12.899 | 14.631 | 17.275 | 19.675 | 22.618 | 24.725 |
| 12 | 11.340 | 14.011 | 15.812 | 18.549 | 21.026 | 24.054 | 26.217 |
| 13 | 12.340 | 15.119 | 16.985 | 19.812 | 22.362 | 25.472 | 27.688 |
| 14 | 13.339 | 16.222 | 18.151 | 21.064 | 23.685 | 26.873 | 29.141 |
| 15 | 14.339 | 17.322 | 19.311 | 22.307 | 24.996 | 28.259 | 30.578 |
| 16 | 15.338 | 18.418 | 20.465 | 23.542 | 26.296 | 29.633 | 32.000 |
| 17 | 16.338 | 19.511 | 21.615 | 24.769 | 27.587 | 30.995 | 33.409 |
| 18 | 17.338 | 20.601 | 22.760 | 25.989 | 28.869 | 33.346 | 34.805 |
| 19 | 18.338 | 21.689 | 23.900 | 27.204 | 30.144 | 33.687 | 36.191 |
| 20 | 19.337 | 22.775 | 25.038 | 28.412 | 31.410 | 35.020 | 37.566 |
| 21 | 20.337 | 23.858 | 26.171 | 29.615 | 32.671 | 36.343 | 38.932 |
| 22 | 21.337 | 24.939 | 27.301 | 30.813 | 33.924 | 37.659 | 40.289 |
| 23 | 22.337 | 26.018 | 28.429 | 32.007 | 35.172 | 38.968 | 41.638 |
| 24 | 23.337 | 27.096 | 29.553 | 33.196 | 36.415 | 40.270 | 42.980 |
| 25 | 24.337 | 28.172 | 30.675 | 34.382 | 37.652 | 41.566 | 44.314 |
| 26 | 25.336 | 29.246 | 31.795 | 35.563 | 38.885 | 42.856 | 45.642 |
| 27 | 26.336 | 30.319 | 32.912 | 36.741 | 40.113 | 44.140 | 46.963 |
| 28 | 27.336 | 31.391 | 34.027 | 37.916 | 41.337 | 45.419 | 48.278 |
| 29 | 28.336 | 32.461 | 35.139 | 39.087 | 42.557 | 46.693 | 49.588 |
| 30 | 29.336 | 33.530 | 36.250 | 40.256 | 43.773 | 47.962 | 50.892 |

Appendix L is abridged from Table IV of Fisher and Yates: *Statistical Tables for Biological, Agricultural, and Medical Research*, published by Oliver and Boyd Ltd., Edinburgh, and by permission of the authors and publishers.



Appendix Table 2

Areas in Both Tails Combined for Student's *t* Distribution

Example:
 To find the value of *t* that corresponds to an area of 0.10 in both tails of the distribution combined when there are 19 degrees of freedom, look under the 0.10 column and proceed down to the 19 degrees of freedom row. The appropriate *t* value there is 1.729.

| Degrees of Freedom | Area in Both Tails Combined | | | |
|---------------------|-----------------------------|--------|--------|--------|
| | 0.10 | 0.05 | 0.02 | 0.01 |
| 1 | 6.314 | 12.706 | 31.821 | 63.657 |
| 2 | 2.920 | 4.303 | 6.965 | 9.925 |
| 3 | 2.353 | 3.182 | 4.541 | 5.841 |
| 4 | 2.132 | 2.776 | 3.747 | 4.604 |
| 5 | 2.015 | 2.571 | 3.365 | 4.032 |
| 6 | 1.943 | 2.447 | 3.143 | 3.707 |
| 7 | 1.895 | 2.365 | 2.998 | 3.499 |
| 8 | 1.860 | 2.306 | 2.896 | 3.355 |
| 9 | 1.833 | 2.262 | 2.821 | 3.250 |
| 10 | 1.812 | 2.228 | 2.764 | 3.169 |
| 11 | 1.796 | 2.201 | 2.718 | 3.106 |
| 12 | 1.782 | 2.179 | 2.681 | 3.055 |
| 13 | 1.771 | 2.160 | 2.650 | 3.012 |
| 14 | 1.763 | 2.145 | 2.624 | 2.977 |
| 15 | 1.753 | 2.131 | 2.602 | 2.947 |
| 16 | 1.746 | 2.120 | 2.583 | 2.921 |
| 17 | 1.740 | 2.110 | 2.567 | 2.898 |
| 18 | 1.734 | 2.101 | 2.552 | 2.878 |
| 19 | 1.729 | 2.093 | 2.539 | 2.861 |
| 20 | 1.725 | 2.086 | 2.528 | 2.845 |
| 21 | 1.721 | 2.080 | 2.518 | 2.831 |
| 22 | 1.717 | 2.074 | 2.508 | 2.819 |
| 23 | 1.714 | 2.069 | 2.500 | 2.807 |
| 24 | 1.711 | 2.064 | 2.492 | 2.797 |
| 25 | 1.708 | 2.060 | 2.485 | 2.787 |
| 26 | 1.706 | 2.056 | 2.479 | 2.779 |
| 27 | 1.703 | 2.052 | 2.473 | 2.771 |
| 28 | 1.701 | 2.048 | 2.467 | 2.763 |
| 29 | 1.699 | 2.045 | 2.462 | 2.756 |
| 30 | 1.697 | 2.042 | 2.457 | 2.750 |
| 40 | 1.684 | 2.021 | 2.423 | 2.704 |
| 60 | 1.671 | 2.000 | 2.390 | 2.660 |
| 120 | 1.658 | 1.980 | 2.358 | 2.617 |
| Normal Distribution | 1.645 | 1.960 | 2.326 | 2.576 |

TABLE IV(b) Values of $F_{0.01}$

| Degrees of freedom for denominator | Degrees of freedom for numerator | | | | | | | | | | | | | | | | | | |
|------------------------------------|----------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|----------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 12 | 15 | 20 | 24 | 30 | 40 | 60 | 120 | ∞ |
| 1 | 4.052 | 5.000 | 5.403 | 5.625 | 5.764 | 5.859 | 5.928 | 5.982 | 6.023 | 6.056 | 6.106 | 6.157 | 6.209 | 6.235 | 6.261 | 6.287 | 6.313 | 6.339 | 6.366 |
| 2 | 98.5 | 99.0 | 99.2 | 99.2 | 99.3 | 99.3 | 99.4 | 99.4 | 99.4 | 99.4 | 99.4 | 99.4 | 99.4 | 99.5 | 99.5 | 99.5 | 99.5 | 99.5 | 99.5 |
| 3 | 34.1 | 30.8 | 29.5 | 28.7 | 28.2 | 27.9 | 27.7 | 27.5 | 27.3 | 27.2 | 27.1 | 26.9 | 26.7 | 26.6 | 26.5 | 26.4 | 26.3 | 26.2 | 26.1 |
| 4 | 21.2 | 18.0 | 16.7 | 16.0 | 15.5 | 15.2 | 15.0 | 14.8 | 14.7 | 14.5 | 14.4 | 14.2 | 14.0 | 13.9 | 13.8 | 13.7 | 13.7 | 13.6 | 13.5 |
| 5 | 16.3 | 13.3 | 12.1 | 11.4 | 11.0 | 10.7 | 10.5 | 10.3 | 10.2 | 10.1 | 9.89 | 9.72 | 9.55 | 9.47 | 9.38 | 9.29 | 9.20 | 9.11 | 9.02 |
| 6 | 13.7 | 10.9 | 9.78 | 9.15 | 8.75 | 8.47 | 8.26 | 8.10 | 7.98 | 7.87 | 7.72 | 7.56 | 7.40 | 7.31 | 7.23 | 7.14 | 7.06 | 6.97 | 6.88 |
| 7 | 12.2 | 9.55 | 8.45 | 7.85 | 7.46 | 7.19 | 6.99 | 6.84 | 6.72 | 6.62 | 6.47 | 6.31 | 6.16 | 6.07 | 5.99 | 5.91 | 5.82 | 5.74 | 5.65 |
| 8 | 11.3 | 8.65 | 7.59 | 7.01 | 6.63 | 6.37 | 6.18 | 6.03 | 5.91 | 5.81 | 5.67 | 5.52 | 5.36 | 5.28 | 5.20 | 5.12 | 5.03 | 4.95 | 4.86 |
| 9 | 10.6 | 8.02 | 6.99 | 6.42 | 6.06 | 5.80 | 5.61 | 5.47 | 5.35 | 5.26 | 5.11 | 4.96 | 4.81 | 4.73 | 4.65 | 4.57 | 4.48 | 4.40 | 4.31 |
| 10 | 10.0 | 7.56 | 6.55 | 5.99 | 5.64 | 5.39 | 5.20 | 5.06 | 4.94 | 4.85 | 4.71 | 4.56 | 4.41 | 4.33 | 4.25 | 4.17 | 4.08 | 4.00 | 3.91 |
| 11 | 9.65 | 7.21 | 6.22 | 5.67 | 5.32 | 5.07 | 4.89 | 4.74 | 4.63 | 4.54 | 4.40 | 4.25 | 4.10 | 4.02 | 3.94 | 3.86 | 3.78 | 3.69 | 3.60 |
| 12 | 9.33 | 6.93 | 5.95 | 5.41 | 5.06 | 4.82 | 4.64 | 4.50 | 4.39 | 4.30 | 4.16 | 4.01 | 3.86 | 3.78 | 3.70 | 3.62 | 3.54 | 3.45 | 3.36 |
| 13 | 9.07 | 6.70 | 5.74 | 5.21 | 4.86 | 4.62 | 4.44 | 4.30 | 4.19 | 4.10 | 3.96 | 3.82 | 3.66 | 3.59 | 3.51 | 3.43 | 3.35 | 3.27 | 3.18 |
| 14 | 8.86 | 6.51 | 5.56 | 5.04 | 4.70 | 4.46 | 4.28 | 4.14 | 4.03 | 3.94 | 3.80 | 3.66 | 3.51 | 3.43 | 3.35 | 3.27 | 3.19 | 3.10 | 3.00 |
| 15 | 8.68 | 6.36 | 5.42 | 4.89 | 4.56 | 4.32 | 4.14 | 4.00 | 3.89 | 3.80 | 3.67 | 3.52 | 3.37 | 3.29 | 3.21 | 3.13 | 3.05 | 2.96 | 2.87 |
| 16 | 8.53 | 6.23 | 5.29 | 4.77 | 4.44 | 4.20 | 4.03 | 3.89 | 3.78 | 3.69 | 3.55 | 3.41 | 3.26 | 3.18 | 3.10 | 3.02 | 2.93 | 2.84 | 2.75 |
| 17 | 8.40 | 6.11 | 5.19 | 4.67 | 4.34 | 4.10 | 3.93 | 3.79 | 3.68 | 3.59 | 3.46 | 3.31 | 3.16 | 3.08 | 3.00 | 2.92 | 2.83 | 2.75 | 2.65 |
| 18 | 8.29 | 6.01 | 5.09 | 4.58 | 4.25 | 4.01 | 3.84 | 3.71 | 3.60 | 3.51 | 3.37 | 3.23 | 3.08 | 3.00 | 2.92 | 2.84 | 2.76 | 2.67 | 2.58 |
| 19 | 8.19 | 5.93 | 5.01 | 4.50 | 4.17 | 3.94 | 3.77 | 3.63 | 3.52 | 3.43 | 3.30 | 3.15 | 3.00 | 2.92 | 2.84 | 2.76 | 2.67 | 2.58 | 2.49 |
| 20 | 8.10 | 5.85 | 4.94 | 4.43 | 4.10 | 3.87 | 3.70 | 3.56 | 3.46 | 3.37 | 3.23 | 3.09 | 2.94 | 2.86 | 2.78 | 2.69 | 2.61 | 2.52 | 2.42 |
| 21 | 8.02 | 5.78 | 4.87 | 4.37 | 4.04 | 3.81 | 3.64 | 3.51 | 3.40 | 3.31 | 3.17 | 3.03 | 2.88 | 2.80 | 2.72 | 2.64 | 2.55 | 2.46 | 2.36 |
| 22 | 7.95 | 5.72 | 4.82 | 4.31 | 3.99 | 3.76 | 3.59 | 3.45 | 3.35 | 3.26 | 3.12 | 2.98 | 2.83 | 2.75 | 2.67 | 2.58 | 2.50 | 2.40 | 2.31 |
| 23 | 7.88 | 5.66 | 4.76 | 4.26 | 3.94 | 3.71 | 3.54 | 3.41 | 3.30 | 3.21 | 3.07 | 2.93 | 2.78 | 2.70 | 2.62 | 2.54 | 2.45 | 2.35 | 2.26 |
| 24 | 7.82 | 5.61 | 4.72 | 4.22 | 3.90 | 3.67 | 3.50 | 3.36 | 3.26 | 3.17 | 3.03 | 2.89 | 2.74 | 2.66 | 2.58 | 2.49 | 2.40 | 2.31 | 2.21 |
| 25 | 7.77 | 5.57 | 4.68 | 4.18 | 3.86 | 3.63 | 3.46 | 3.32 | 3.22 | 3.13 | 2.99 | 2.85 | 2.70 | 2.62 | 2.53 | 2.45 | 2.36 | 2.27 | 2.17 |
| 30 | 7.56 | 5.39 | 4.51 | 4.02 | 3.70 | 3.47 | 3.30 | 3.17 | 3.07 | 2.98 | 2.84 | 2.70 | 2.55 | 2.47 | 2.39 | 2.30 | 2.21 | 2.11 | 2.01 |
| 40 | 7.31 | 5.18 | 4.31 | 3.83 | 3.51 | 3.29 | 3.12 | 2.99 | 2.89 | 2.80 | 2.66 | 2.52 | 2.37 | 2.29 | 2.20 | 2.11 | 2.02 | 1.92 | 1.80 |
| 60 | 7.08 | 4.98 | 4.13 | 3.65 | 3.34 | 3.12 | 2.95 | 2.82 | 2.72 | 2.63 | 2.50 | 2.35 | 2.20 | 2.12 | 2.03 | 1.94 | 1.84 | 1.73 | 1.60 |
| 120 | 6.85 | 4.79 | 3.95 | 3.48 | 3.17 | 2.96 | 2.79 | 2.66 | 2.56 | 2.47 | 2.34 | 2.19 | 2.03 | 1.95 | 1.86 | 1.76 | 1.66 | 1.53 | 1.38 |
| ∞ | 6.63 | 4.61 | 3.78 | 3.32 | 3.02 | 2.80 | 2.64 | 2.51 | 2.41 | 2.32 | 2.18 | 2.04 | 1.88 | 1.79 | 1.70 | 1.59 | 1.47 | 1.32 | 1.00 |

SECTION – A

There are **FOUR** questions in this section. Answer **Q. No. 1** and any **TWO** from the rest.

1. (a) Define Landscape conservation planning. Discuss the key considerations of landscape conservation at site specific level. (4+8=12)
- (b) Briefly explain the current practice and challenges of landscape conservation planning in urban context of Dhaka city. (8)
- (c) Write short note: (Any two) (5+5=10)
 - (i) Ecosystem Services in Urban Areas
 - (ii) Community based landscape conservation
 - (iii) Landscape Scale
2. Briefly discuss the basic steps involved in landscape design process (Assuming any context) with appropriate illustration. (20)
3. Describe the key factors required for site investigation. (20)
4. (a) Discuss how a designer should approach while applying the principles and elements of design in the landscape. (10)
- (b) What are the function of trees? How site conditions influence the choice of plants and planting? (4+6=10)

SECTION – B

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

5. (a) Define Landscape Planning. Mention the scopes and domain of landscape planning. (1+7 $\frac{1}{3}$ = 8 $\frac{1}{3}$)
- (b) Describe the typologies of Japanese landscape. How it is different from Chinese landscape? (6+2=8)
- (c) Illustrate the typical features of French garden. (7)

ARCH 233

6. (a) What do you mean by the term 'Biodiversity'? "Ecosystem are complex adaptive system" – explain. **(3+5=8)**
- (b) Describe 'Energy Availing' relationships within an ecosystem with example. Why is it necessary to maintain proper ratio among trophic levels? **(8+1=9)**
- (c) What is 'Negative Feedback Loop'? Give example. How can ecosystem exist in alternative stable state? **(3+3 1/3=6 1/3)**
7. (a) How potential invasiveness of a plant can be judged? What are the criteria of choosing new plant species for a specific area? **(2 1/3 +4=6 1/3)**
- (b) Mention the typical horizons of a generic soil profile with their characteristics. How soil texture and structure influence ecosystem process? What should be the measures to preserve soil profile and structure? **(4+7+6=17)**
8. (a) Describe the elements of space organization. **(10)**
- (b) What is meant by ecological planning? Briefly explain the Ecological Planning Model. **(13 1/3)**
-