



Exam Preparatory Manual for **NURSES**

ANATOMY & PHYSIOLOGY

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Epithelial Tissue

LONG ESSAYS

10 MARKS

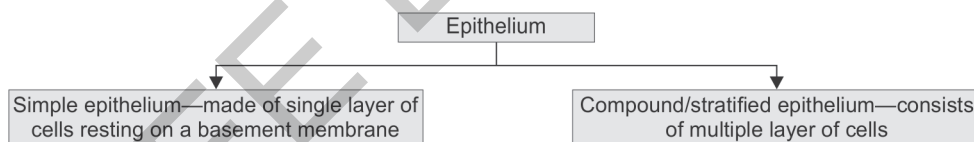
1. **Classify epithelial tissue with examples. Explain about simple epithelium in detail.**

Ans. Definition— epithelium tissue is a basic tissue that covers the body surfaces, lines body cavities, ducts and forms glands.

Epithelial tissue is made of cells resting on a basement membrane. This layer will be supported further by a layer of connective tissue which contains blood vessels, lymphatics and nerves. The cells are interconnected and with the basement membrane by various types of cell junctions.

Classification

Epithelium is broadly classified as simple and compound epithelium.



Simple epithelium: This type is further classified into various types depending on the type of cells lining.

- i. **Simple squamous epithelium (Fig. 3.1)**—made of single layer of flat cells, and on surface view gives pavement-like appearance.
Function—diffusion, filtration and osmosis, e.g., alveolar sacs in lungs, inner lining of blood vessels, etc.
- ii. **Simple cuboidal epithelium (Fig. 3.2)**—single layer of cuboidal cells, e.g., tubules of kidney, surface of ovary, lens of eye.
- iii. **Simple columnar epithelium (Fig. 3.3)**—single layer of columnar cells. Primarily involved in absorption, secretion, protection and lubrication, e.g., lining of gastrointestinal tract (GIT), gallbladder, glands.
- iv. **Pseudostratified epithelium (Fig. 3.4)**—it appears falsely stratified. It consists of tall columnar cells along with short basal cells, hence nuclei are at different levels. It lines the larger excretory ducts of many glands, epididymis, parts of male urethra and auditory tubes. Its functions are: protection and secretion. The lining

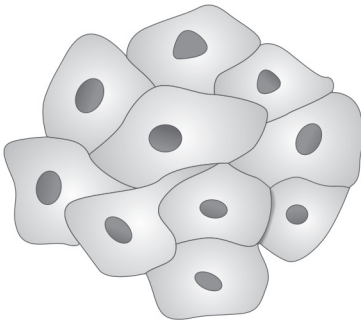


Fig. 3.1: Simple squamous epithelium.



Fig. 3.2: Simple cuboidal epithelium.



Fig. 3.3: Simple columnar epithelium.



Fig. 3.4: Pseudostratified epithelium.

of trachea and bronchi is by ciliated pseudostratified epithelium with goblet cells.

Simple epithelium presents some modifications with a specialized function. They are:

- v. Simple columnar **with microvilli** (**Fig. 3.5**)—microvilli help to increase the surface area for absorption, e.g., small intestine.
- vi. Simple cuboidal with microvilli (called **brush border**)—found in proximal convoluted tubule (PCT) of kidney.
- vii. Simple columnar **with cilia and goblet cells** (**Fig. 3.6**)—cilia are involved in movements, e.g., trachea and bronchi of lungs.
- viii. Columnar epithelium **with stereo cilia**—stereo cilia are modified microvilli (followed by comma) and useful in increasing surface area for absorption as in epididymis of the male genital tract.

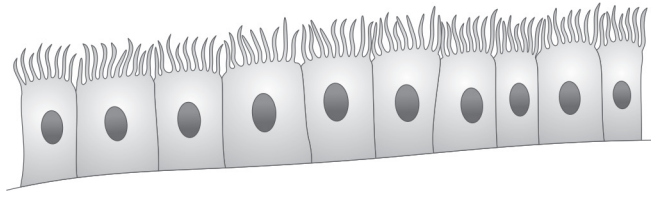


Fig. 3.5: Columnar epithelium with microvilli.

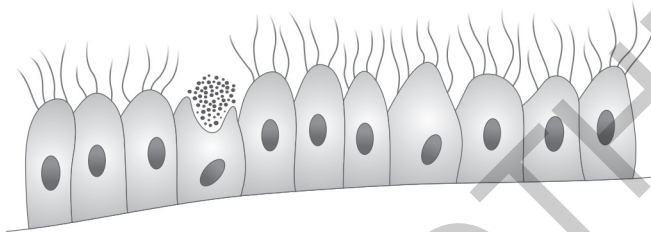
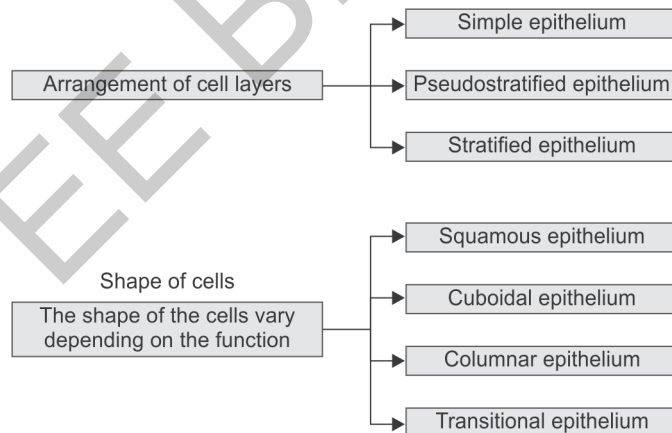


Fig. 3.6: Ciliated columnar with goblet cells.

2. Classify epithelial tissue with examples. Explain about stratified epithelium in detail.

Ans. Epithelial tissue is classified based on cell layers and the shape of cells.



If these are combined, we get the following broad classification:

Simple epithelium

- Simple squamous
- Simple cuboidal
- Simple columnar—can be with ciliated or nonciliated
- Pseudostratified

Compound epithelium

- Stratified squamous epithelium—keratinized or nonkeratinized
- Stratified cuboidal
- Stratified columnar
- Transitional epithelium

A. Stratified squamous epithelium (Figs. 3.7 and 3.8).

It is more durable, protects underlying tissues from external environment as well as from wear and tear.

Stratified squamous epithelium consists of multiple layers of cells (10–12 layers).

- Basal cells are either cuboidal or columnar resting on a basement membrane.
- The next layer of cells become polyhedral, then flat. Superficial most cells are squamous, hence the name.
- The superficial cells are dead; hence the proteins accumulate to form keratin. Later keratin with the dead cells is shed of.
- New cells replace old cells that migrate from the basal cells.

It consist of five layers from deep to superficial. They are:

1. Stratum basale
2. Stratum spinosum
3. Stratum granulosum
4. Stratum lucidum
5. Stratum corneum

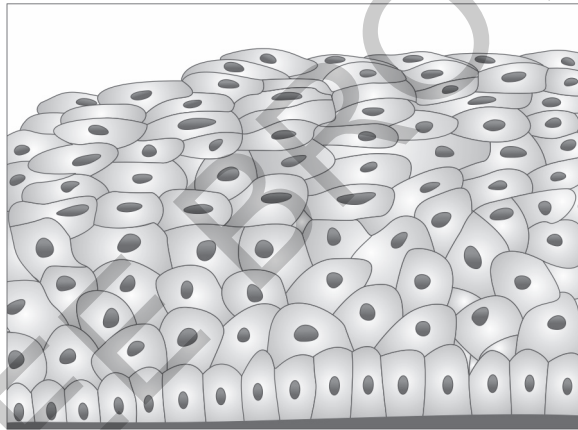


Fig. 3.7: Stratified squamous nonkeratinized epithelium.

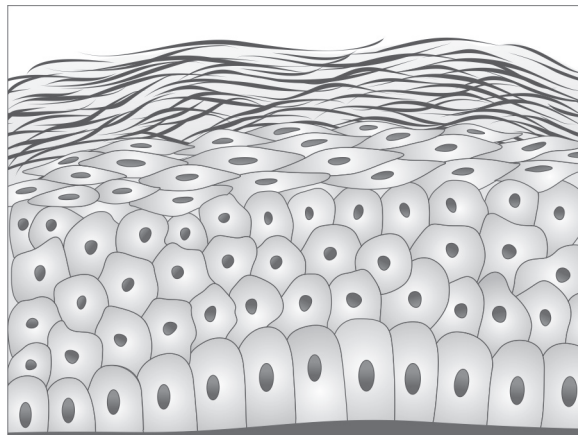


Fig. 3.8: Stratified squamous keratinized epithelium.

Based on the presence or absence of keratin, it is classified into:

- i. Nonkeratinized stratified squamous epithelium—without keratin layer on the exposed surface. It is found on moist surfaces and are subjected to considerable wear and tear, e.g., mouth, tongue and vagina.
 - ii. Keratinized stratified squamous epithelium—here the keratin forms a thick layer adjacent to the superficial squamous cells, e.g., skin. Keratin is a waterproof protein, resists friction and bacterial invasion.
- B. **Stratified cuboidal epithelium**—it is made of more than two layer of cuboidal cells. Its main function is secretion, e.g., duct of sweat glands, conjunctiva of eye, pharynx and epiglottis.
- C. **Stratified columnar epithelium**—it is made of more than two layer of columnar cells. Functions: protection and provides passage to secretions as in ducts, e.g., milk duct of mammary gland and anal canal.
- D. **Transitional epithelium (Fig. 3.9)**—special feature is that the cells of outer layer tend to be large and rounded (called umbrella cells). This feature allows the tissue to stretch when filled with urine, and return to original state after emptying. It also prevents seepage of urine into the underlying tissue layers. It is found in urinary bladder, part of ureters and urethra.

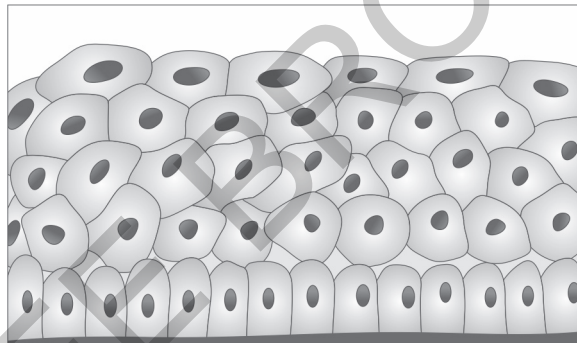


Fig. 3.9: Transitional epithelium.

SHORT ESSAYS

5 MARKS

3. General features of epithelial tissue.

Ans. Epithelium is a tissue lining the outer surface of the body as well as forms internal lining of the hollow organs, ducts, and blood vessels.

- It chiefly consists of cells arranged as single layer or multiple layers. The cells rest on a basement membrane.
- Basement membrane is made up of connective tissue rich in blood vessels. It provides support to the overlying avascular epithelium.
- Metabolic exchange between the epithelium and connective tissue is by diffusion
- The epithelial cells exhibit three surfaces which differ in function (**Fig. 3.10**), namely:
 1. **Apical surface**—is free. It is the site for absorption, secretion.
 2. **Lateral surface** attach to each other by cell junctions viz. tight, gap junctions and desmosomes.
 3. **Basal surface**—by which cells attach to the basement membrane.

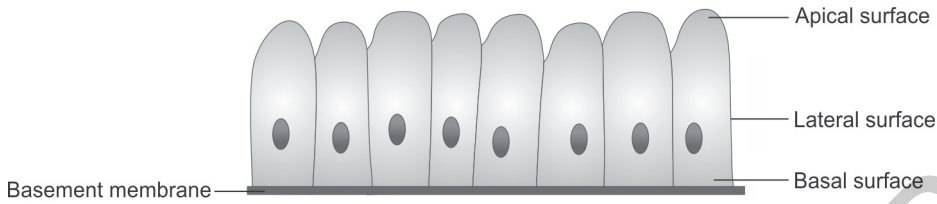


Fig. 3.10: Surfaces of columnar cell.

- It has great capacity for regeneration as it is exposed to wear and tear.
- The functions are:
 - Protection—as in skin.
 - Filtration—as in Bowman's capsule of kidney.
 - Secretion—as in GIT and glands.
 - Absorption—as in GIT.
 - Excretion—as in glomeruli of kidneys.

4. Transitional epithelium (Fig. 3.9).

Ans. Transitional epithelium is a specialized epithelium found lining the urinary passages.

- It is made of 4–5 layers of cells resting on basement membrane.
- Basal cells are low cuboidal.
- The cells of the superficial layer tend to be large and rounded called umbrella cells. This feature allows the epithelial tissue to stretch when filled with urine, and return to original state after emptying.
- It also prevents seepage of urine into the underlying tissue layers.
- When the bladder is full, the epithelium stretches, giving stratified squamous appearance. When the bladder is empty, it appears stratified cuboidal.
- Location—urinary bladder, part of ureters and urethra.

5. Stratified squamous epithelium (Figs. 3.7 and 3.8).

Ans. Stratified squamous epithelium consists of multiple layers of cells. It consists of five layers from deep to superficial. They are:

1. *Stratum basale*—basal cells are either cuboidal or columnar resting on a basement membrane. New cells replace old cells that migrate from the basal cells.
2. *Stratum spinosum*—the next layer of cells become polyhedral with spiny projections.
3. *Stratum granulosum*—it is made of flat cells with keratohyalin granules inside.
4. *Stratum lucidum*—here the cells begin to lose organelles, nuclei disappear.
5. *Stratum corneum*—superficial most cells are squamous, hence the name. They are superficial cells and are dead; hence the proteins accumulate to form keratin. Later keratin with the dead cells are shed off.

Functions—it is more durable, **protects** underlying tissues from external environment as well as from **wear and tear**.

Stratified squamous epithelium is subdivided into two types based on the presence or absence of keratin.

- a. **Nonkeratinized stratified squamous epithelium**—without keratin layer on the exposed surface. It is found on moist surfaces and is subjected to considerable wear and tear, e.g., mouth, tongue and vagina.

- b. **Keratinized stratified squamous epithelium**—here the keratin forms a thick layer adjacent to the superficial squamous cells. Example: skin. Keratin is a waterproof protein, resists friction and bacterial invasion.

6. Pseudostratified columnar epithelium (Fig. 3.4).

Ans. Pseudo means false. This epithelium gets the name as pseudostratified since:

- All the columnar cells rest on basement membrane.
- But few cells do not reach the superficial surface.
- The nuclei are at different levels as the columnar cells differ in their height.
- Some cells may possess cilia; they help in movement of particles.
- Some have goblet cells dispersed between them which secrete mucus.

Hence there is:

Pseudostratified ciliated columnar epithelium with goblet cells—as in respiratory passages. The mucus traps foreign particles and cilia move it out of the passage.

Pseudostratified nonciliated columnar epithelium—found in larger duct of glands, epididymis and male urethra. Here the epithelium is involved in secretion and absorption.

7. Classify glands.

Ans. A gland may consist of one cell or a group of highly specialized epithelial cells. Their main function is secretion.

Glands can be classified:

A. According to where they release their secretion:

- i. **Exocrine**—glands that empty their secretion onto a surface via ducts/tubes. Their main products are mucous, oil, wax, perspiration and digestive enzymes, e.g., sweat and salivary glands.
- ii. **Endocrine**—glands that empty their secretion directly into bloodstream are endocrine glands, e.g., pituitary, thyroid, etc. Their secretions are called hormones which are chemicals that regulate various physiological activities in the body.

B. Based on structure:

- i. **Unicellular**—it is a single-celled gland, e.g., goblet cell.
- ii. **Multicellular**—contain many cells and form majority of the glands.

C. Based on the shape of the secretory portion (called acini):

- i. **Tubular**—the gland is tubular shaped.
- ii. **Acinar**—flask/spherical shaped secretory portion.
- iii. **Tubuloacinar**—both tubular and flask shaped acini.

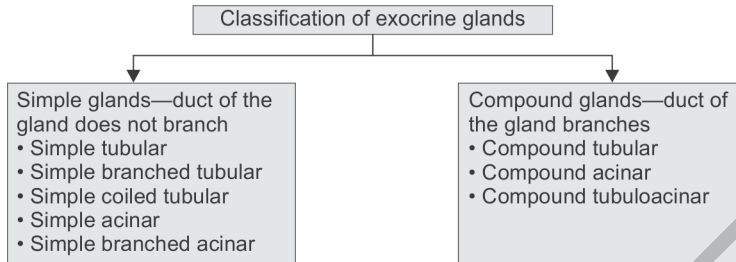
8. Structural classification of exocrine glands.

Ans. Exocrine glands secrete their products through a duct onto a skin surface or lumen of hollow organs.

Majority of them are **multicellular glands**. Second variety is the **unicellular gland** which is a single cell secreting directly onto the surface (e.g., goblet cell).

Multicellular gland—classified based on the branching of ducts and shape of secretory portions of the gland.

Accordingly, the following is the classification:



9. Describe about the cell junctions.

Ans. Cell junctions hold the cells with each other. They attach the plasma membrane of adjacent cells (**Fig. 3.11**).

- a. **Tight junctions**—consists of proteins that seal the space between adjacent cells. They prevent passage of substances into blood or surrounding tissues, e.g., stomach, urinary bladder.
- b. **Adherents junctions**—it is made of dense plaque of proteins which surround the cell. It resists separation of cells during movements.
- c. **Desmosomes**—here the cells are connected by dense plaque and intermediate filaments. It prevents separation of epidermal cells under tension, and also in cardiac muscle cells.
- d. **Hemidesmosomes**—they resemble desmosomes, but connect cells with the basement membrane.
- e. **Gap junctions**—the adjacent plasma membranes are separated by narrow intercellular space. Tiny fluid filled tunnels connect the cells that allow small molecules to pass through, e.g., involved in transfer of nutrients or nerve impulses.

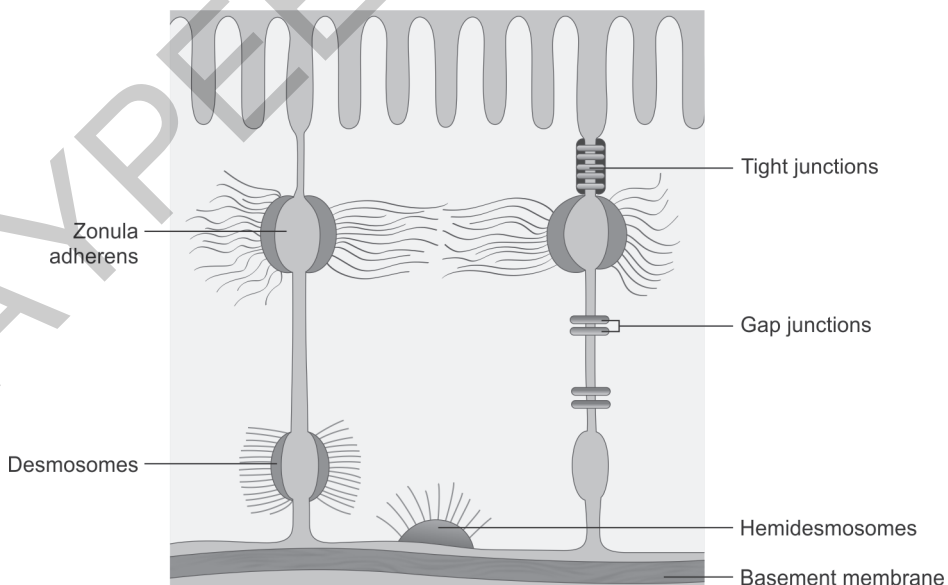


Fig. 3.11: Cell junctions.

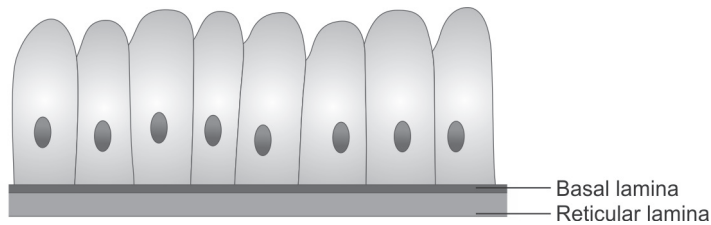


Fig. 3.12: Layers of basement membrane.

10. Explain briefly about basement membrane.

Ans. Basement membrane is a thin extracellular layer which supports the basal surface of the epithelium. It consists of two layers (**Fig. 3.12**):

- i. *Basal lamina*—is closer to the epithelial cell and secreted by them. Laminin molecules in basal lamina attach to hemidesmosomes, thus anchoring the epithelial cells.
- ii. *Reticular lamina*—is nothing but the connective tissue containing the collagen fibers and fibroblasts. It supports the epithelium and provides nutrition by diffusion.

Functions of the basement membrane:

- Supports the epithelium.
- Forms surfaces along which epithelial cells migrate during wound healing or growth.
- Prevents large molecules from entering underlying connective tissue.
- Helps to form filtration barrier in kidneys.
- Applied anatomy—basement membrane can get thickened during some pathological conditions like diabetes. It leads to blindness and kidney failure.

SHORT ANSWERS

2 MARKS

11. Define tissue. Name the basic types of tissues in the body.

Ans. A tissue is defined as group of cells having common embryological origin and performs similar function.

There are four basic types of tissues namely:

- a. Epithelial tissue
- b. Connective tissue
- c. Muscular tissue
- d. Nervous tissue

12. Simple squamous epithelium.

Ans. It is made of flat, squamous cells resting on basement membrane.

- Functions— filtration, diffusion, secretion.
- Location—endothelium of blood vessels, peritoneal serous membrane, glomeruli of kidneys, alveoli of lungs.

13. Simple cuboidal epithelium.

Ans. It is made of single layer of cuboidal cells.

- Function—secretion and absorption.
- Location—tubules of kidney, surface of ovary, lens of eye, duct of small glands.

14. Simple columnar epithelium.

Ans. It is made of single layer of columnar cells.

- Function—secretion and absorption.
- Location—stomach, ducts of glands, gallbladder.
- The apical surface of the cell presents some surface modifications which impart additional function like:
 - microvilli (increase surface area for absorption).
 - cilia (for movement of substances).
 - stereo cilia (for absorption).
 - goblet cells (secrete mucus).

15. Write down the functional classification of exocrine glands.

Ans. Exocrine glands are classified into three types based on their mode of secretion.

1. **Merocrine**—most abundant type. Secretory vesicles are expelled by exocytosis, e.g., sweat glands.
2. **Apocrine**—here the apical portion is pinched off along with the secretory vesicles, e.g., mammary gland.
3. **Holocrine**—here the whole cell is ruptured with its plasma membrane, e.g., sebaceous gland of skin.

16. Differentiate exocrine and endocrine glands.

Ans. A gland is defined as a cell or group of cells, that secrete onto a surface, or ducts or directly into bloodstream. All the glands in the body can be exocrine or endocrine.

	Exocrine gland	Endocrine gland (ductless glands)
1.	Need duct for carrying secretions	Release the secretions directly into the bloodstream
2.	Target organs near to the gland	Target organs are far away from the gland that secretes it
3.	For example, sweat gland	For example, thyroid gland
Note: • Some are mixed glands—pancreas, testis and ovaries • Contain exocrine and endocrine component.		

Notes:

- Epithelium is avascular (no blood supply). It gets nutrition by diffusion from underlying connective tissue.
- Basement membrane can thicken in diseases like diabetes. It will lead to changes in blood vessels of eye, kidneys, etc. This can lead to blindness and kidney failure.
- In cases where epithelial cells can be easily obtained, screening tests can be performed. For example, cervical epithelial cells are scraped (called pap smear) to find out presence or absence of cancerous condition of female genital tract.
- **Metaplasia:** It is the conversion of one type cell to another type, e.g., nonkeratinized squamous epithelium of esophagus converts to columnar type.
- **Dysplasia:** It is the term used to denote replacement of mature epithelial cells with immature cells. It is precursor of cancer/neoplasia.

Exam Preparatory Manual
for **NURSES**

ANATOMY & PHYSIOLOGY

The book *Exam Preparatory Manual for Nurses—Anatomy and Physiology* is my dream come true. The author has been involved in teaching nursing and paramedical students the subjects of anatomy and physiology. In author's experience, the author felt the students were lacking in the art of presenting their answers in the examinations. This stimulated to write a book so that they will have guidance to face the examinations with confidence.

The book is in two sections, each dedicated to anatomy and physiology. The content has been organized chapter-wise, as they appear in standard textbooks of nursing. The questions have been in order of long answer/essay type, short answers/short essay type and answers which require very brief content. This is the pattern in most of nursing anatomy and physiology question papers.

The question is followed by the required answers, supplemented by diagrams wherever required. Some of the answers are made easy to remember with flowcharts and tables. They help in quick revision. At the end of each chapter, some applied aspects and other highlights in brief has been added, for additional information.

Hopefully, this book will help the students to write and present their answers well. This is the first edition of the book. Hence, any suggestions and comments are welcome, so that modifications can be done in future editions.

Wishing my students happy reading.

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