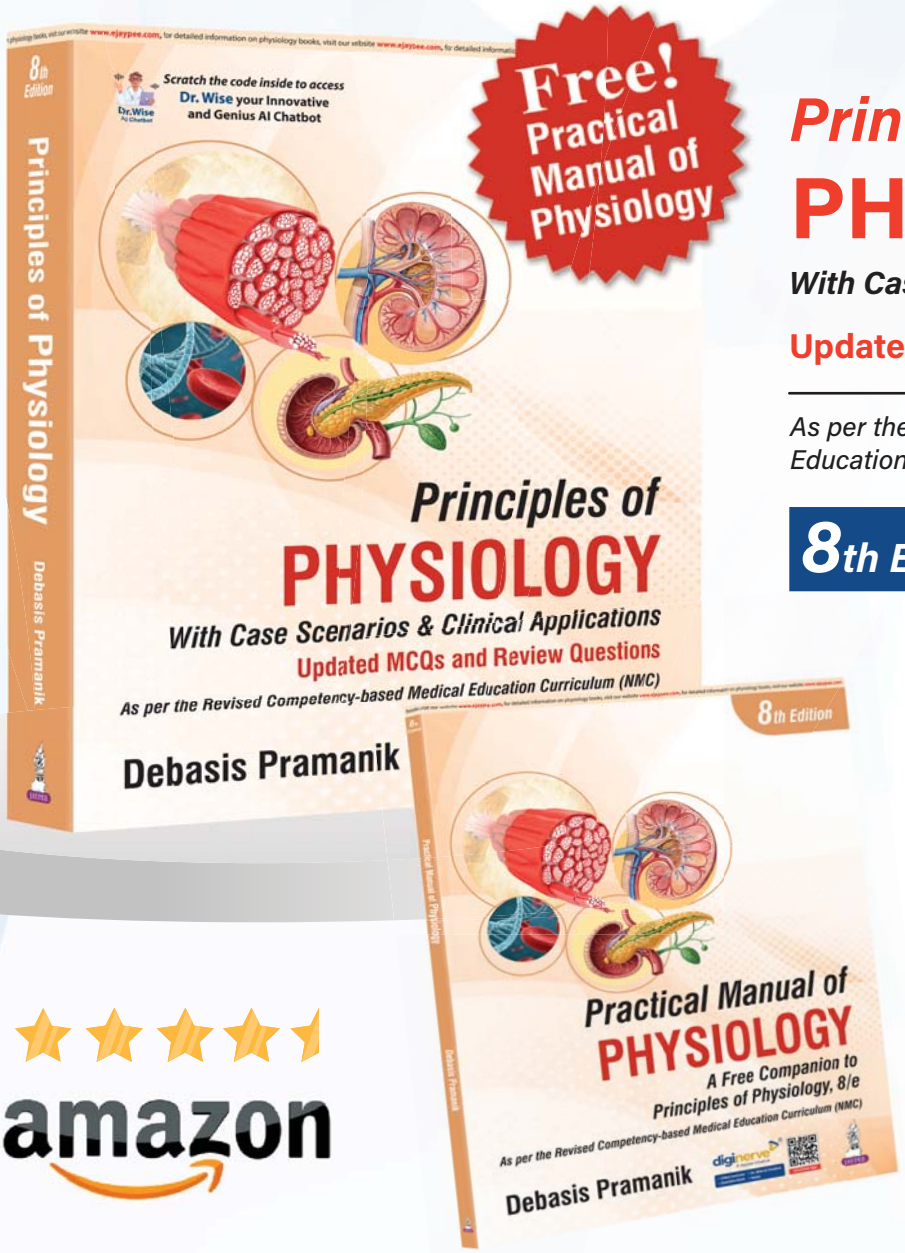

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As per the Latest Complementary-based Medical Education Curriculum (NMC)

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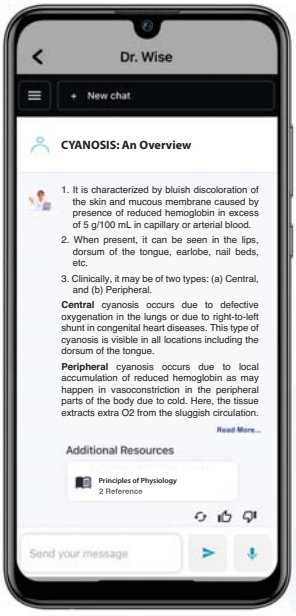
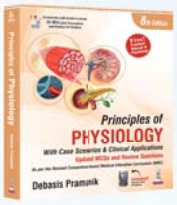
- It includes a concise coverage of **physiological principles** and **competencies enumerated** in **CBME curriculum**.
- New formatting style for **easier memorization** of keywords has been used.
- New **tables and summaries** have been added for easy retention of complex topics.
- A few important chapters have been rewritten entirely with improved presentation.
- A list of wide-ranging **MCQs** have been retained with helpful explanations while a list of **probable questions** including short notes have been added as per **NMC guidelines**.
- The usual **student-friendly approach** and **lucid language** have been maintained.



- Clinical MCQs
- Case Scenarios
- Short Notes
- Long Notes
- Images
- Flashcards
- Comparison Tables
- Drugs



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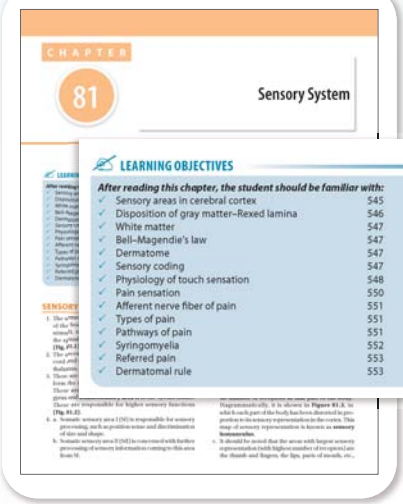
Main Book

Chapters start with specific **Learning Objectives** that highlight the main ideas to be covered.



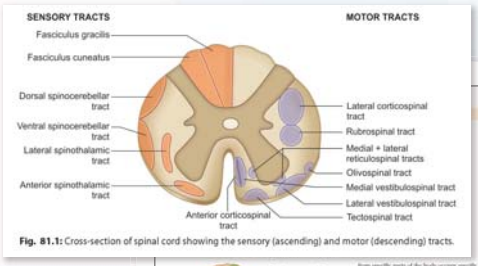
CHAPTER 81

Sensory System

LEARNING OBJECTIVES

After reading this chapter, the student should be familiar with:

The content uses a redesigned, memory-friendly layout that **incorporates Figures** to support better recall and **reinforce learning**.



SENSORY TRACTS

MOTOR TRACTS

Fasciculus gracilis

Fasciculus cuneatus

Dorsal spinocerebellar tract

Ventral spinocerebellar tract

Lateral spinothalamic tract

Anterior spinothalamic tract

Lateral corticospinal tract

Rubrospinal tract

Medial + lateral reticulospinal tracts

Olivospinal tract

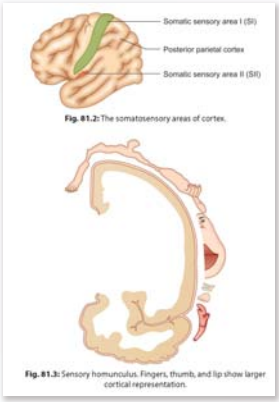
Medial vestibulospinal tract

Lateral vestibulospinal tract

Tectospinal tract

Anterior corticospinal tract

Fig. 81.1: Cross-section of spinal cord showing the sensory (ascending) and motor (descending) tracts.



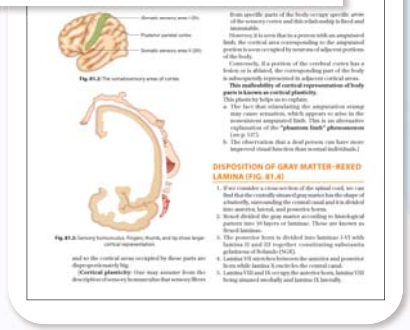
Somatic sensory area I (SI)

Posterior parietal cortex

Somatic sensory area II (SII)

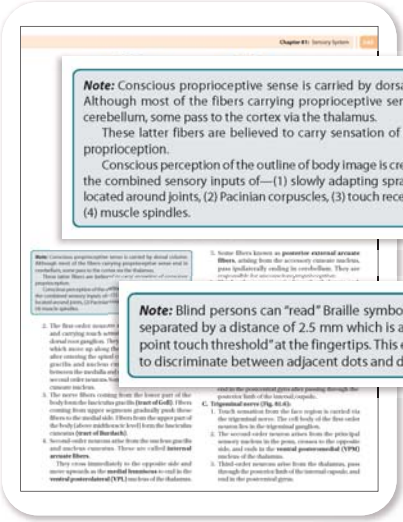
Fig. 81.2: The somatosensory areas of cortex.

Fig. 81.3: Sensory homunculus. Fingers, thumb, and lip show larger cortical representation.



DISPOSITION OF GRAY MATTER–REXED LAMINA (FIG. 81.4)

Note Boxes aid retention of key or specialized topics.



Note: Conscious proprioceptive sense is carried by dorsal column. Although most of the fibers carrying proprioceptive sense end in cerebellum, some pass to the cortex via the thalamus.

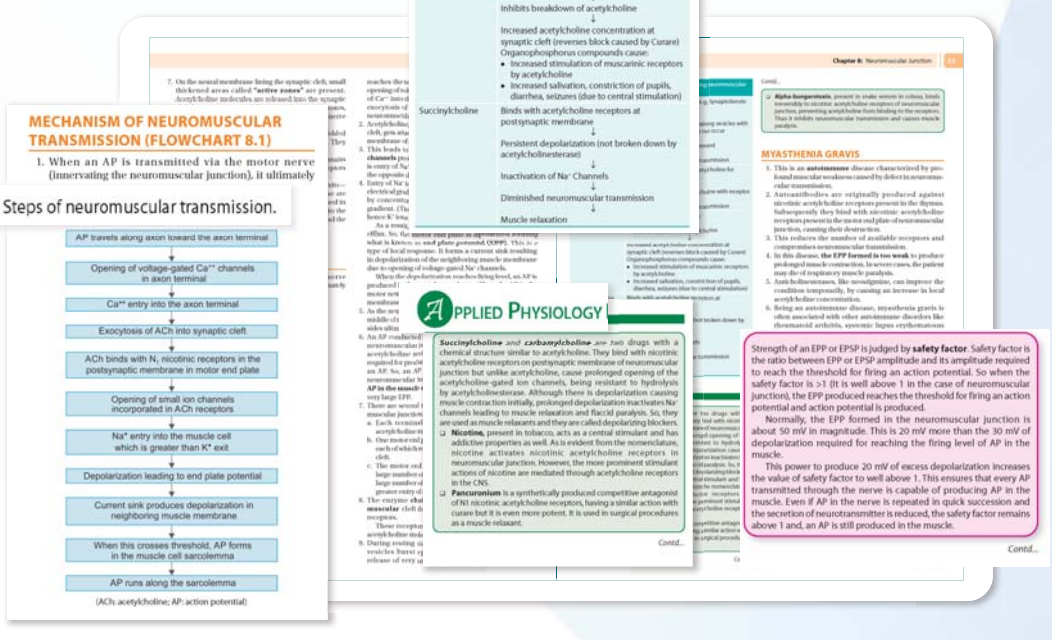
These latter fibers are believed to carry sensation of conscious proprioception.

Conscious perception of the outline of body image is created from the combined sensory inputs of—(1) slowly adapting spray endings located around joints, (2) Pacinian corpuscles, (3) touch receptors, and (4) muscle spindles.

Note: Blind persons can "read" Braille symbols, which are raised dots separated by a distance of 2.5 mm which is a little greater than "two-point touch threshold" at the fingertips. This enables the blind person to discriminate between adjacent dots and decipher the symbols.

Table 8.1: Mechanism of action of agents affecting neuromuscular transmission.

Botulinum toxin	Damages docking proteins, e.g., Synaptobrevin and syntaxin and SNAP-25 ↓ Fusion of acetylcholine-containing vesicles with presynaptic membrane does not occur ↓ Release of acetylcholine prevented ↓ Diminished neuromuscular transmission
Curare and pancuronium	Competes with/displaces acetylcholine for binding with receptors ↓ Diminished binding of acetylcholine with receptor ↓ Diminished neuromuscular transmission
Anticholinesterases	Inhibits acetylcholinesterase ↓ Inhibits breakdown of acetylcholine ↓ Increased acetylcholine concentration at synaptic cleft (reverses block caused by Curare) Organophosphorus compounds cause: • Increased stimulation of muscarinic receptors by acetylcholine • Increased salivation, constriction of pupils, diarrhea, seizures (due to central stimulation)
Succinylcholine	Binds with acetylcholine receptors at postsynaptic membrane ↓ Persistent depolarization (not broken down by acetylcholinesterase) ↓ Inactivation of Na^+ Channels ↓ Diminished neuromuscular transmission ↓ Muscle relaxation



MECHANISM OF NEUROMUSCULAR TRANSMISSION (FLOWCHART 8.1)

1. When an AP is transmitted via the motor nerve (innervating the neuromuscular junction), it ultimately

Flowchart 8.1: Steps of neuromuscular transmission.

AP travels along axon toward the axon terminal

Opening of voltage-gated Ca^{++} channels in axon terminal

Ca^{++} entry into the axon terminal

Exocytosis of ACh into synaptic cleft

ACh binds with N, nicotinic receptors in the postsynaptic membrane in motor end plate

Opening of small ion channels incorporated in ACh receptors

Na^+ entry into the muscle cell which is greater than K^+ exit

Depolarization leading to end plate potential

Current sink produces depolarization in neighboring muscle membrane

When this crosses threshold, AP forms in the muscle cell sarcolemma

AP runs along the sarcolemma

(ACh: acetylcholine; AP: action potential)

APPLIED PHYSIOLOGY

Succinylcholine *and* ***carbamylcholine*** *are two* drugs with a chemical structure similar to acetylcholine. They bind with nicotinic acetylcholine receptors on postsynaptic membrane of neuromuscular junction but unlike acetylcholine, cause prolonged opening of the acetylcholine-gated ion channels, being resistant to hydrolysis by acetylcholinesterase. Although there is depolarization causing muscle contraction initially, prolonged depolarization inactivates Na^+ channels leading to muscle relaxation and flaccid paralysis. So, they are used as muscle relaxants and they are called depolarizing blockers.

- **Nicotine,** present in tobacco, acts as a central stimulant and has addictive properties as well. As is evident from the nomenclature, nicotine activates nicotinic acetylcholine receptors in neuromuscular junction. However, the more prominent stimulant actions of nicotine are mediated through acetylcholine receptors in the CNS.
- **Pancuronium** is a synthetically produced competitive antagonist of N1 nicotinic acetylcholine receptors, having a similar action with curare but it is even more potent. It is used in surgical procedures as a muscle relaxant.

Contd...

MYASTHENIA GRAVIS

1. This is an **autoimmune** disease characterized by profound muscular weakness caused by defect in neuromuscular transmission.
2. Autoantibodies are originally produced against nicotinic acetylcholine receptors present in the thymus. Subsequently they bind with nicotinic acetylcholine receptors present in the motor end plate of neuromuscular junction, causing their destruction.
3. This reduces the number of available receptors and compromises neuromuscular transmission.
4. In this disease, **the EPP formed is too weak** to produce prolonged muscle contraction. In severe cases, the patient may die of respiratory muscle paralysis.
5. Anticholinesterases, like neostigmine, can improve the condition temporarily, by causing an increase in local acetylcholine concentration.
6. Being an autoimmune disease, myasthenia gravis is often associated with other autoimmune disorders like rheumatoid arthritis, systemic lupus erythematosus.

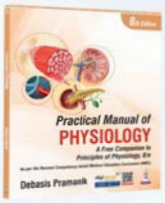
Strength of an EPP or EPSP is judged by **safety factor**. Safety factor is the ratio between EPP or EPSP amplitude and its amplitude required to reach the threshold for firing an action potential. So when the safety factor is >1 (it is well above 1 in the case of neuromuscular junction), the EPP produced reaches the threshold for firing an action potential and action potential is produced.

Normally, the EPP formed in the neuromuscular junction is about 50 mV in magnitude. This is 20 mV more than the 30 mV of depolarization required for reaching the firing level of AP in the muscle.

This power to produce 20 mV of excess depolarization increases the value of safety factor to well above 1. This ensures that every AP transmitted through the nerve is capable of producing AP in the muscle. Even if AP in the nerve is repeated in quick succession and the secretion of neurotransmitter is reduced, the safety factor remains above 1 and, an AP is still produced in the muscle.

Contd...

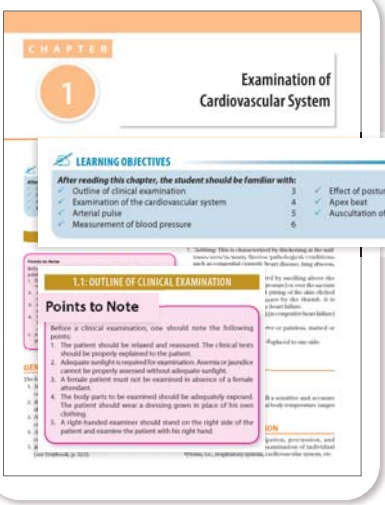
A wide range of **Flowcharts**, **Tables**, **Applied Physiology Sections**, and **Summaries** are included to simplify and support retention of complex topics.



SAMPLE PAGES

Free Book

Each chapter begins with clear **Learning Objectives** outlining key concepts.



CHAPTER 1

Examination of Cardiovascular System

LEARNING OBJECTIVES

After reading this chapter, the student should be familiar with:

- Outline of clinical examination 3
- Examination of the cardiovascular system 4
- Arterial pulse 5
- Measurement of blood pressure 6
- Effect of posture on BP 9
- Apex beat 10
- Auscultation of heart sounds 11

1.1: OUTLINE OF CLINICAL EXAMINATION

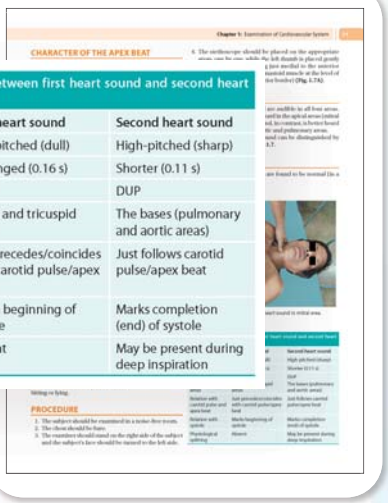
Points to Note

Before a clinical examination, one should note the following points:

1. The patient should be relaxed and reassured. The clinical tests should be properly explained to the patient.
2. Adequate sunlight is required for examination. Anemia or jaundice cannot be properly assessed without adequate sunlight.
3. A female patient must not be examined in absence of a female attendant.
4. The body parts to be examined should be adequately exposed. The patient should wear a dressing gown in place of his own clothing.
5. A right-handed examiner should stand on the right side of the patient and examine the patient with his right hand.

Chapters include **Points to Note** for easy understanding.

Table organizes essential information sequentially for better understanding.



CHARACTER OF THE APEX BEAT

Table 1.7: Differences between first heart sound and second heart sound.

	First heart sound	Second heart sound
Pitch	Low-pitched (dull)	High-pitched (sharp)
Duration	Prolonged (0.16 s)	Shorter (0.11 s)
Onomatopoeia	LUBB	DUP
Best heard in areas	Mitral and tricuspid areas	The bases (pulmonary and aortic areas)
Relation with carotid pulse and apex beat	Just precedes/coincides with carotid pulse/apex beat	Just follows carotid pulse/apex beat
Relation with systole	Marks beginning of systole	Marks completion (end) of systole
Physiological splitting	Absent	May be present during deep inspiration

PROCEDURE

1.4: MEASUREMENT OF BLOOD PRESSURE

MEASUREMENT OF BLOOD PRESSURE BY SPHYGMOMANOMETRY

Notes

Note: The knobs of the earpiece should be directed forwards and medially when inserted into the ear, so that they are aligned in the direction of the auditory canal. The chest piece is usually a combination of a bell, preferred for hearing low-pitched sounds and a diaphragm for better definition of high-pitched sounds.

Original figures and **Images** of instruments are included to enhance student understanding.

Fig. 1.4A: Stethoscope.

Fig. 1.4C: Measuring blood pressure.

Fig. 1.4B: Sphygmomanometer.

Fig. 4.15A: Biceps jerk.

Fig. 4.15C: Supinator jerk.

Fig. 4.15B: Triceps jerk.

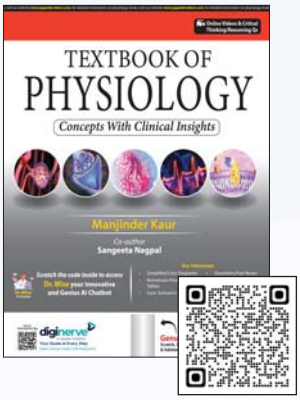
Fig. 4.15D: Knee jerk (supine).

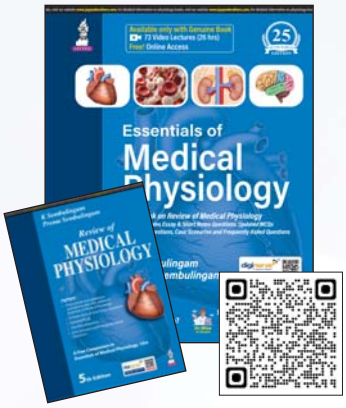
QUESTIONS

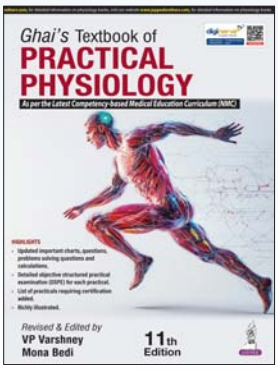
1. What is the course of olfactory nerve?
2. Describe the visual pathway. Mention the various defects of vision in lesions of visual pathway.
3. What is visual acuity? Discuss the conditions with errors of refraction.
4. Name the extrinsic muscles of the eyeball. State their innervation and actions.
5. What is diplopia? How it is caused?
6. What is squint? What are its types?
7. What is ptosis? What are its causes?
8. What are light reflex and accommodation reflex? Describe the pathways. What is Argyll–Robertson pupil?
9. What are the muscles of mastication? How do you test their function?
10. What are Bell's palsy and Bell's phenomenon?
11. What are upper motor neuron and lower motor neuron? What are the effects of lesions in them?
12. How do you distinguish between upper motor neuron lesion and lower motor neuron lesion?
13. What is nystagmus? In which conditions it is found?
14. What is muscle tone? What are the causes of hypertonia and hypotonia?
15. What are the differences between tremor of cerebellar origin and tremor in Parkinson's disease?
16. What is Romberg's sign?
17. What are the different abnormalities in gait?

Probable **Questions** and **Short notes** are included as per **NMC guidelines**.

Other Useful Titles







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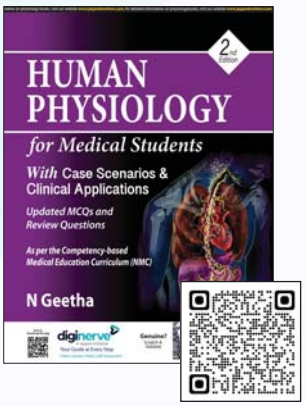

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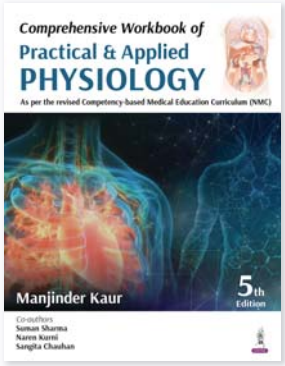

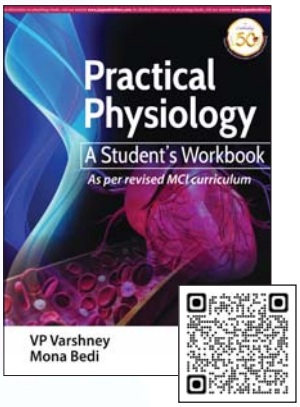

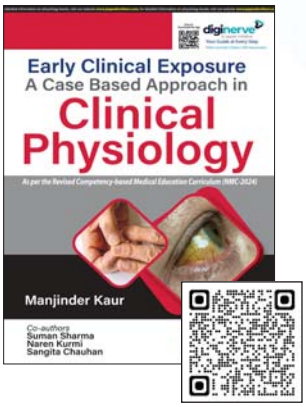

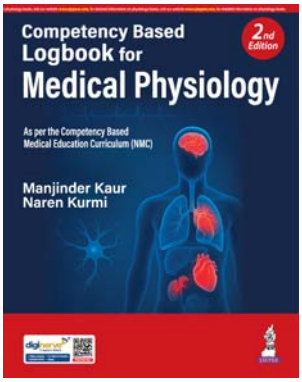

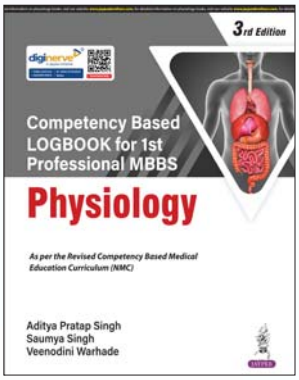

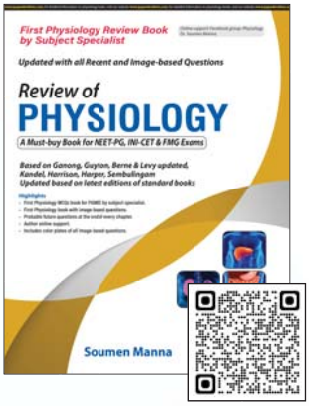

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