PG/IVS/PHY/403(A_1, A_2, B_1, B_2, C_1, C_2, D_1, D_2,)/25

M.Sc. 4th Semester Examination, 2025

PHYSIOLOGY

(*Human Physiology*)

PAPER – PHY-403(A_1, A_2, B_1, B_2, C_1, C_2, D_1, D_2)

Full Marks : 50

Time : 2 hours

Answer all questions

The figures in the right hand margin indicate marks

Candidates are required to give their answers in their own words as far as practicable

PAPER – PHY-403A.1

[Marks : 20]

GROUP–A

Answer any *two* questions of the following : 2 × 2

1. Define genetic recombination.

2. Write down the importance of sigma factor in transcription in bacteria.

3. Mention RNA polymerase that transcribe tRNA and mRNA in eukaryotic cells.

4. What is the importance of telomere ?

GROUP–B

Answer any *two* questions of the following : 4 × 2

5. Describe Hershey-Chase experiment in establishment of DNA as genetic material. 4

6. Write a note on 'attenuation'. 4

7. Write down the importance of VNTRs and SINEs in eukaryotic chromosomes. 2 + 2

8. What are conservative transposons ? Discuss in brief the mechanism of jumping of the transposons into a target site. 1 + 3

GROUP – C

Answer any *one* question of the following : 8×1

9. Describe the interplay of regulation of gene expression with reference to *lac* operon. What is IPTG ? $7 + 1$

10. Discuss the 'intrinsic termination' mechanism of transcription with special emphasis on the regulatory action of RNA. What are siRNA ? $5 + 3$

PAPER – PHY-403A.2

[Marks : 20]

GROUP – A

Answer any *two* questions of the following : 2×2

11. What is meant by ADCC ?

12. Write a short note on 'C5a'.

13. What is tumor antigen ?

14. Write down the role of histamine in tissue inflammation.

GROUP–B

Answer any *two* questions of the following : 4×2

15. Differentiate between four types of hypersensitivity reactions.

16. Describe in detail how mast cells get sensitized upon exposures to primary and secondary pollen antigens.

17. Write a note on p53.

18. Write the principle and application of FACS.

GROUP–C

Answer any *one* question of the following : 8×1

19. Write a brief note on 'Sandwich ELISA'. Discuss in detail the activation of cytotoxic T cells and their function. $4 + (2 + 2)$

20. Describe in detail how DTH reaction takes place under exposure to TB bacillus. Write down the role played by tumor suppressor genes. 4 + 4

[Internal Assessment — 10 Marks]

PAPER — PHY-403B.1

[Marks : 20]

GROUP—A

Answer any *two* questions from the following : 2 × 2

1. Write down the advantages of karyotyping.
2. State the key differences between prokaryotic and eukaryotic replication.
3. Define Quantum Dots (QDs).
4. What do you know about the reverse transcription of RNA ?

GROUP–B

Answer any *two* questions from the following : 4×2

5. Describe the process of the Q-banding technique, mentioning its advantages and disadvantages. $2 + 1 + 1$

6. How does replication take place at telomeric ends ? 4

7. Describe critically the biological role of the lipase enzyme and mention its importance in the food processing industry. $3 + 1$

8. Discuss the physical, chemical and electrical properties of nanoparticles. $1 + 1 + 2$

GROUP–C

Answer any *one* question of the following : 8×1

9. State the pleiotropism and antagonism of cytokines with examples. Write notes on the functions of the protease enzyme. $(2 + 2) + 4$

10. Discuss the mechanism of action of glutamate as a neurotransmitter, mentioning its synthesis and the fate of glutamine in astrocytes. Write down the relation between glutamate synthesis and the citric acid cycle. 5 + 3

PAPER — PHY-403B.2

[Marks : 20]

GROUP—A

Answer any *two* questions of the following : 2 × 2

11. What is secondary hypertension ?

12. Mention the etiology of type -I diabetes mellitus.

13. What are sedatives ? Give example. 1 + 1

14. What do you mean by Sertoli and Leydig cell aging ? 1 + 1

GROUP–B

Answer any *two* questions of the following : 4×2

15. Describe the action of insulin on carbohydrate and protein metabolism. $2 + 2$

16. Discuss briefly the effects of alcohol on growth and endocrine function at puberty. $2 + 2$

17. What are stimulant drugs ? Describe the pharmacological effect of cocaine. $1\frac{1}{2} + 2\frac{1}{2}$

18. How does aging influence testosterone production ? Write down briefly on the genetic risks of aging. $2 + 2$

GROUP–C

Answer any *one* question of the following : 8×1

19. What do you know about angiotensin-converting enzyme and angiotensin receptors ? Write down about the renin-angiotensin-aldosterone and potassium-aldosterone negative feedback loop ? $(2\frac{1}{2} + 2\frac{1}{2}) + 3$

20. What are the abnormal endothelial cell function and microvascular cell loss seen in diabetes mellitus ? State the antiatherogenic and proatherogenic effects of insulin. 4 + (2 + 2)

[Internal Assessment — 10 Marks]

PAPER — PHY-403C.1

[Marks : 20]

GROUP–A

Answer any *two* questions from the following : 2 × 2

1. Write down the application of patch clamp techniques. 2

2. What do you understand by the encoding of phototransduction ? 2

3. What is the Nernst equation for membrane potential ? 2

4. How could you calculate the mechanical advantages of any lever system ? Give an example of 1st first-class lever present in the human body. 1 + 1

GROUP–B

Answer any *two* questions from the following : 4 × 2

5. What is the contact mode and tapping mode of AFM ? 2 + 2

6. Write down the principle of optical rotatory dispersion and circular dichronism. 2 + 2

7. Describe the types of osteokinematics as a part of fundamental motions. What is limit of stability (LOS) ? 3 + 1

8. Describe the role of cGMP in producing current flow in photosensative receptors, with a suitable diagram. 4

GROUP – C

Answer any *one* question from the following : 8×1

9. Define zeta potential. Mention its significance. Write down the limitations of Beer's law. $2 + 2 + 4$

10. Classify and describe the fundamental concept of ionizing radiation. Established the relation between decay energy ($Q\alpha$) and binding energy (E_B) of the alpha particle (α). Discuss the nature of three categories of beta (β) decay in radiation. $(1 + 2) + 2 + 3$

PAPER – PHY-403C.2

[Marks : 20]

GROUP – A

Answer any *two* questions from the following : 2×2

11. Briefly mention the types of photo-chemical reactions. 2

12. Define biomagnetism with its application. $1 + 1$

13. Write the principle of ion-exchange chromatography. 2

14. What is optical density ? How it is related to transmittance ? 1 + 1

GROUP–B

Answer any *two* questions from the following : 4 × 2

15. Write down the second law of photochemistry with an example. How the Grotthuss-Draper law correlates with photochemistry ? 2 + 2

16. Why is nuclear medicine so important ? Write down the clinical importance of PET (Position Emission Tomography) scan. 1 + 3

17. Write the difference between absorption and adsorption. Mention the difference between paper chromatography and thin layer chromatography. 2 + 2

18. Write down the application of circular dicroism in spectroscopy. 4

GROUP – C

Answer any *one* question from the following : 8×1

19. Classify different types of luminescence. with a suitable diagram. Describe the nature of Jablonski diagram in terms of excitation of electrons. Explain the Stern-Volmer concept in the light of quenching of fluorescence. $2 + 3 + 3$

20. What are FCC and BCC structures of crystal ? Write Bragg's law with equation. Draw the structure of a ionic crystal. $3 + 3 + 2$

[Internal Assessment – 10 Marks]

Special Paper : Neurophysiology

PAPER — PHY-403D.1

(*Neurophysiology of Brain*)

[Marks : 20]

GROUP—A

Answer any *two* questions from the following : 2×2

1. What is operant conditioning ?

2. How do the rate coding and motor unit recruitment contribute to the muscle force production as training intensity increases ?

3. Show in a labeled diagram of the neural circuitry for the pupillary reflex and accommodation of the eye.

4. What is Wada test ?

GROUP–B

Answer any *two* questions from the following : 4×2

5. Write a brief note on the non-REM sleep. 4

6. Describe briefly the simultaneous conditioning and delayed conditioning. 2 + 2

7. With relevant diagram(s) elaborate on the involvement of CA1 neurons in LTP. 4

8. What is meant by status epilepticus ? Describe different types of epilepsy. 1 + 3

GROUP–C

Answer any *one* question from the following : 8×1

9. Elaborate on the neural circuitry involved in visual processing events. Establish the relationship among the retinal receptive fields, its eccentricity and corresponding cortical magnification. 4 + 4

10. "Small motoneurons are easier to activate than large ones".-Explain it on the basis of their electrophysiological properties. Describe the verbal and non-verbal functions of cerebral hemispheres of a split brain patient in tachistoscopical test. 2 + 6

PAPER – PHY-403D.2

(*Applied and clinical Neurophysiology*)

[Marks : 20]

GROUP–A

Answer any *two* questions from the following : 2 × 2

11. What is urotensin and sauvagine ?

12. How does LC-PUFAs influence neuro-inflammation ?

13. Mention the functions of CRH-binding protein.

14. How are oxidative stress responsible for the development of Parkinson's disease ?

GROUP–B

Answer any *two* questions from the following : 4 × 2

15. Discuss the molecular mechanism of feedback inhibition of glucocorticoids on corticotroph of anterior pituitary and CRH neurons of hypothalamus.

16. Briefly describe the neural basis of circadian rhythm.

17. Discuss the regulation of HPA axis in psychological stress.

18. How would an imbalance in dietary omega-6 to omega-3 fatty acid intake can have impact on neurodevelopment ?

GROUP—C

Answer any *one* question from the following : 8×1

19. What are meant by sporadic and familial Alzheimer's disease? Describe the biochemical pathway of the development of Alzheimer's disease. 2+6

20. Discuss the regulation of CRH secretion in hemorrhage, osmotic challenges and inflammation. 8

[Internal Assessment — 10 Marks]