Reg. No. | | | | | | | | | |

BSCPHCN 301

Third Semester B.Sc. Degree Examination, February/March 2023
(NEP 2020) (2022 – 23 Batch Onwards)
PHYSICS (DSCC)
Wave Motion and Optics

Time : 2 Hours Max. Marks : 60

Instructions : *1) Answer questions from **all** Parts.*
*2) Scientific calculators are **allowed**.*

PART – A

Answer **any four** questions. **Each** question carries **2** marks : **(2×4=8)**

1. How Newton's formula for the velocity of sound in air corrected by Laplace ?
2. What are nodes and antinodes in stationary waves ?
3. Write any two factors on which the reverberation time depends.
4. Mention two examples of interference by division of amplitude.
5. State any two differences between ordinary and extraordinary ray.
6. Give any two differences between Fresnel and Fraunhofer diffraction.

PART – B

Answer **all** questions : **(10×4=40)**

Unit – I

7. a) Derive the differential equation of wave motion. **4**

b) Derive an expression for the velocity of longitudinal waves in a fluid. **6**

OR

8. a) What do you mean by beats ? Show analytically that the number of beats produced per second is equal to the difference of their frequency. **4**

b) What are Lissajous figures ? Give the analytical treatment of formation of these figures when the frequency of vibrations of two mutually perpendicular simple harmonic motions are in the ratio 2:1. **6**

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Unit – II

9. a) Discuss the formation of overtones in a rod clamped at the centre. 4

   b) What is an open pipe ? Obtain the relation between fundamental frequency and overtones in an open pipe. 6

OR

10. a) State the laws of vibrations of stretched string. What harmonics are present in it ? 4

    b) What are reverberation and reverberation time? Write Sabine's formula and explain the terms. Discuss in detail about the requisites for good acoustics. 6

Unit – III

11. a) Describe the construction and working of a Michelson's interferometer. 4

    b) Give the theory of interference in reflected light in thin films and explain the formation of colors in thin films. 6

OR

12. a) Give the relation between path difference and phase difference. Write the conditions for constructive and destructive interference in terms of

    i) Path difference   ii) Phase difference. 4

    b) Explain with diagram the formation of interference fringes by an air wedge. Derive an expression for the fringe width. 6

Unit – IV

13. a) Compare zone plate and a convex lens. 4

    b) Explain Fraunhofer diffraction at a double slit with necessary theory for intensity distribution and draw the intensity distribution curve. 6

OR

14. a) Obtain the expression for resolving power of a grating. 4

    b) Give the mathematical theory of production of different types of polarized light. 6

PART – C

Answer **any three** questions. **Each** question carries **4** marks. **(4×3=12)**

15. a) Calculate the velocity of sound in dry hydrogen at 363 K assuming the density of hydrogen as 0.089 kgm^{-3} at 10^5 Pascal and γ of hydrogen = 1.41.

b) What is the frequency of fundamental note emitted by a closed pipe of length 0.3 m if the velocity of sound is 336 ms^{-1} ? What will be the frequency if the pipe is open at both ends ?

c) The distance between two coherent sources is 1 mm and the screen is 1 m away from the sources. The second dark band is 0.1 cm from the central bright fringe. Find the wavelength and the distance of the second bright fringe from the central bright fringe.

d) A diffraction grating having 4000 lines per cm is illuminated normally by lights of wavelength 500 nm. Calculate the dispersive power in the third order spectrum.

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BSCMTCN 301

III Semester B.Sc. Degree Examination, February/March 2023
(NEP 2020) (2022 – 2023 Batch Onwards)
MATHEMATICS (DSCC)
Ordinary Differential Equations and Real Analysis – I

Time : 2 Hours

Max. Marks : 60

Instructions : 1) *Answer **any ten** questions from Part – **A**. **Each** question carries **2** marks.*

2) *Answers to Part – **A** should be written in the **first** few pages of the answer book before answers to Part – **B**.*

3) *Answer **any eight** questions from Part – **B** by choosing **two** questions from **each** Unit. **Each** question carries **5** marks.*

4) ***Use** of scientific calculator is **permitted**.*

PART – A **(10×2=20)**

1. Check the exactness of the differential equation $(x^2 - 4xy - 2y^2)\,dx + (y^2 - 4xy - 2x^2)dy = 0$.

2. Find orthogonal trajectories of the family of curves $y = ax^2$, where a is the parameter.

3. Find the general solution of $y = px + p^n$.

4. Solve $(D^2 + 2D + 5)y = 0$.

5. Find the particular integral of $(D^2 - 3D + 2)y = e^{5x}$.

6. Find the complementary function for $(D^2 + D - 6)y = x$.

7. Verify the condition of integrability $(yz + 2x)dx + (zx - 2z)dy + (xy - 2y)dz = 0$.

8. Prove that every convergent sequence is bounded.

9. Show that $\lim\limits_{n\to\infty} \dfrac{2n-3}{n+1} = 2$.

10. Show that the sequence $\{S_n\}$, where $S_n = 1+\frac{1}{2}+\frac{1}{3}+...+\frac{1}{n}$ cannot converge.

11. Show that the series $\frac{1}{2}+\frac{2}{3}+\frac{3}{4}+...$ is not convergent.

12. Test the convergence of the series $\sum_{n=1}^{\infty}\frac{1}{n^2+1}$ by applying Cauchy's Integral Test.

13. Test the convergence of the series whose general term is $\sin\frac{1}{n}$.

14. Show that the series $\frac{1}{1^p}-\frac{1}{2^p}+\frac{1}{3^p}-\frac{1}{4^p}...$ converges for $p > 0$.

PART – B **(8×5=40)**

Unit – I

15. Solve $(x^2 + y^2 + 2x)dx + 2ydy = 0$.

16. Solve $(2x - y + 1)dx + (2y - x - 1)dy = 0$.

17. Solve $y = 3x + \log p$.

18. Find the general and singular solution of $y = px + \frac{a}{p}$.

Unit – II

19. Solve $(D^2 - 1)y = e^x \cos x$.

20. Solve $x^2y_2 + xy_1 - 4y = 0$.

21. Solve $y_2 + y = \sec x$, using the method of variation of parameters.

22. Solve $\frac{xdx}{y^2z}=\frac{dy}{xz}=\frac{dz}{y^2}$.

Unit – III

23. Every bounded sequence with a unique limit point is convergent.

24. Show that $\lim_{n\to\infty}\sqrt[n]{n}=1$

25. If $\{a_n\}$, $\{b_n\}$, $\{c_n\}$ are 3 sequences such that

i) $a_n \le b_n \le c_n$, for every n, and (ii) $\lim a_n = \lim c_n = l$, then prove that $\lim b_n = l$.

26. Show that sequence $\{s_n\}$, where $s_n = \frac{1}{n+1} + \frac{1}{n+2} + ... + \frac{1}{n+n}$ is convergent.

Unit – IV

27. Test for convergence of the series $\sum \frac{n^2-1}{n^2+1} x^n, x > 0$.

28. If Σu_n is a positive term series such that $\lim_{n \to \infty} (u_n)^{\frac{1}{n}} = l$, then prove that the series

    i) converges if $l < 1$

    ii) diverges if $l > 1$, and

    iii) the test fails to give any definite information, if $l = 1$.

29. Test for convergence of the series $\frac{1.2}{3^2.4^2} + \frac{3.4}{5^2.6^2} + \frac{5.6}{7^2.8^2} + ...$

30. If the alternating series $u_1 - u_2 + u_3 - u_4 + ...$ $(u_n > 0, \forall n)$ is such that

    i) $u_{n+1} \leq u_n, \forall$ n and

    ii) $\lim_{n \to \infty} u_n = 0$, then prove that series converges.
