S. NO.: 59 BATCH: 2017 Reg. No.:

END OF SEMESTER EXAMINATIONS, APRIL / MAY - 2018
MATHEMATICAL PHYSICS - II
SUBJECT CODE : 17P3PH05

MAJOR : M.Sc (Physics) **SEMESTER : II**
TIME : 3 HOURS **MAX. MARKS: 70**

SECTION - A (10 X 1 = 10)

Answer All the Questions:

Choose the best Answer:

1. The product of a matrix and its transpose matrix is a unit matrix, then the matrix is called
   a. a upper triangular matrix b. a lower triangular matrix
   c. an orthogonal matrix d. an unitary matrix
2. The outer product of two mixed tensors A_j' and B_l^k is
   a. A scalar b. a tensor of rank 2
   c. a tensor of rank 4 d. a tensor of rank 3
3. The solution of the equation $\frac{d^2y}{dx^2}-8\frac{dy}{dx}+15y=0$ is
   a. $y=C_1e^{2x}+C_2e^{5x}$ b. $y=C_1e^{5x}+C_2e^{4x}$
   c. $y=C_1e^{5x}+C_2e^{x}$ d. $y=C_1e^{3x}+C_2e^{5x}$
4. The value of Hermite polynomial $H_2(x)$ is
   a. $4x-2$ b. $4x-12$ c. $2x$ d. $4x^2-2$
5. If any two elements A and B of a group commute, then the group is said to be
   a. Cyclic group b. abelian group
   c. non-Abelian group d. permutation group
6. Define Hermitian matrix.
7. Define a contravariant tensor of order two.
8. Find the solution of the equation $\frac{d^2y}{dx^2}-6\frac{dy}{dx}+9y=0$.
9. Define Gamma function.
10. Define a subgroup.

SECTION - B (5 X 4= 20)

Answer All the Questions:

11. a) Define an orthogonal matrix. Show that $A=\begin{bmatrix}\cos\theta & 0 & \sin\theta\\ 0 & 1 & 0\\ -\sin\theta & 0 & \cos\theta\end{bmatrix}$ is orthogonal.

[OR]

b) State any four theorems on eigen values and eigen vectors.

12. a) Define covariant and mixed tensor of order three.

[OR]

b) Define a tensor. Show that Kronecker delta is a mixed tensor of order two.

13. a) Write the solution of the auxillary equation when the roots are
   i) real and different
   ii) real and equal and
   iii) imaginary.

[OR]

b) Solve: $(D^2+4)y=\cos 2x$.

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14. a) Derive the generating function of Hermite polynomials.

[OR]

b) Establish the relation between Beta and Gamma functions.

15. a) State and prove Schur's lemma I in group theory.

[OR]

b) Explain i) Isomorphism and Homomorphism.
ii) Reducible and Irreducible representations in group theory.

SECTION - C (5 X 8 = 40)

Answer All the Questions:

16. a) Find the characteristic equation of the matrix $A=\begin{pmatrix}1 & 2 & 3\\ 2 & -1 & 4\\ 3 & 1 & 1\end{pmatrix}$ and verify the Cayley – Hamilton theorem for it.

[OR]

b) Diagonalise the following matrix: $A=\begin{pmatrix}\cos\theta & -\sin\theta & 0\\ \sin\theta & \cos\theta & 0\\ 0 & 0 & 1\end{pmatrix}$.

17. a) Explain:
i) Symmetric and antisymmetric tensors.
ii) Addition of two tensors.
iii) Outer product of two tensors.
iv) Inner product of two tensors.

[OR]

b) State and prove Quotient law in tensor analysis.

18. a) A body executes damped forced vibrations that are governed by the differential equation $\frac{d^2x}{dt^2}+2k\frac{dx}{dt}+b^2x=e^{-kt}\sin\omega t$. Where all the symbols have their usual meaning. Solve the above differential equation for both the cases, where $\omega^2\neq\left(b^2-k^2\right)$ and $\omega^2=\left(b^2-k^2\right)$.

[OR]

b) Solve: $\left(D^2-7D+10\right)y=e^{2x}+e^{5x}$.

19. a) Solve the Laguerre's differential equation $x\frac{d^2y}{dx^2}+(1-x)\frac{dy}{dx}+ny=0$.

[OR]

b) Prove the orthogonally relation of Hermite polynomial in the form
$\int_{-\infty}^{\infty}e^{-x^2}H_m(x)H_n(x)dx=2^n n!\pi^{1/2}\delta_{mn}$.

20. a) State and prove the great orthogonally theorem in group theory.

[OR]

b) Obtain multiplication table for the group of symmetry operations of a square (C_{4U} group).

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