# UNIVERSITY OF THE PUNJAB

B.S. 4 Years Program / Eighth Semester – 2019

Roll No. in Fig. .....

Roll No. in Words. .....

.....

.....

Signature of Supdt.:

Paper: Particle Physics-III

Course Code: PHY-427 Part – I (Compulsory) Time: 15 Min. Marks: 10

**ATTEMPT THIS PAPER ON THIS QUESTION SHEET ONLY.**

**Division of marks is given in front of each question.**

**This Paper will be collected back after expiry of time limit mentioned above.**

**Q.1. Encircle the correct option.** **(10x1=10)**

(i) The combination $u\bar{d}$ belongs to an

(a) isospin doublet (b) isospin triplet

(c) isospin singlet (d) none of them

(ii) The rank of SU(3) group is

(a) 3 (b) 1

(c) 8 (d) 2

(iii) In scattering problem, if $\eta_l = 1$, then

(a) inelastic scattering occurs (b) symmetric potential is present

(c) elastic scattering occurs (d) none of them

(iv) The unified Electromagnetic and Weak force can be explained by

(a) SU(3) (b) SU(2) × U(1)

(c) U(1) (d) SU(3) × U(1)

(v) The plane wave solution in asymptotic region is a superposition of

(a) two spherical waves (b) four spherical waves

(c) infinite partial waves (d) none of them

(vi) The general formula to find number of generators of SU($n$) is

(a) $n^2 - n$ (b) $n^2$

(c) $n^2 - 1$ (d) $n^2 + 1$

P.T.O.

(vii) When $\delta_l$ is positive, then potential is

(a) attractivc (b) symmetric

(c) repulsive (d) non central

(viii) The full width half maximum of resonance curve is related to

(a) life time of the state (b) energy

(c) momentum (d) all of these

(ix) In a weight diagram multiplicity decreases until — layer is reached

(a) single point (b) triangular

(c) hexagonal (d) rectangular

(x) The action of $I_+$ produces change of

(a) $\Delta Y = 0,\ \Delta I_3 = 1$ (b) $\Delta Y = 0,\ \Delta I_3 = -1$

(c) $\Delta Y = 0,\ \Delta I_3 = +1/2$ (d) $\Delta Y = 0,\ \Delta I_3 = -1/2$

# UNIVERSITY OF THE PUNJAB

**B.S. 4 Years Program / Eighth Semester – 2019**

Roll No. .....

**Paper: Particle Physics-III**
**Course Code: PHY-427 Part – II**

**Time: 2 Hrs. 45 Min. Marks: 50**

**ATTEMPT THIS (SUBJECTIVE) ON THE SEPARATE ANSWER SHEET PROVIDED**

**Question 2:** **(2 × 10 = 20)**

Give short answers of the following questions.

(i) Define H-type and E-type generators.

(ii) Verify standard form of Lie algebra of SU2 group by showing $[H_1, E_+] = +1E_+$.

(iii) Show that differential cross section has dimension of area.

(iv) What is hadron spectroscopy?

(v) State optical theorem.

(vi) What is Grand Unification Theory?

(vii) Using $[\lambda_i, \lambda_j] = 2if_{ijk}\lambda_k$, find value of $f_{345}$.

(viii) Define elastic and inelastic scattering.

(ix) What is phase shift and how is it related to potential?

(x) What is Standard model of Particle Physics?

**Question 3:** **(10)**

Derive the following Breit Wigner formula for elsatic scattering of spinless particles. Also explain in detail its importance/use in Particle Physics.

$$\sigma_{el}(E) = \frac{4\pi}{k^2}(2l+1)\frac{\Gamma^2/4}{(E-E_R)^2+\Gamma^2/4}$$

**Question 4:** **(5 + 5 = 10)**

**a):** Using fundamental representations of SU(3), evaluate $3\otimes3\otimes3$ product representation and reduce it to the irreducible representation.

**b):** For an elastic scattering between spinless particles, the scattering amplitude is

$$f(\theta) = \sum_l \frac{(2l+1)}{2ik}(e^{2i\delta_l} - 1)P_l(\cos\theta)$$

Use this to calculate the differential cross section.

**Question 5:** **(10)**

Find out the matrix representation of the generators of SU(3). Relate the obtained set of generators with Gell-Mann matrices.