Dr.Memarzadeh Group Theory
Deadline: 1401/03/07 23:59

Problem Set 5(40 points)

Question 1 (Zee I.3 Q2). *[10 points] Verify that* $R \simeq I + A$, *with* A *given by* $A = \theta_x \mathcal{J}_x + \theta_y \mathcal{J}_y + \theta_z \mathcal{J}_z$, *satisfies the condition* $\det R = 1$.

Question 2 (Zee I.3 Q5). *[20 points] Calculate* $\left[J_{(mn)}, J_{(pq)}\right]$ *by brute force using (24).*

$$\left(J_{(mn)}\right)^{ij} = -i\left(\delta^{mi}\delta^{nj} - \delta^{mj}\delta^{ni}\right) \qquad (24)$$

Question 3 (Zee I.3 Q6). *[10 points] Of the six 4-by-4 matrices* $J_{12}, J_{23}, J_{31}, J_{14}, J_{24}, J_{34}$ *that generate* $SO(4)$, *what is the maximum number that can be simultaneously diagonalized?*

Question 4 (Zee I.3 Q7). *[10 points] Verify (31).*

$$e^{-i\varphi J_3} K_1 e^{i\varphi J_3} = \cos\varphi K_1 + \sin\varphi K_2 \qquad (31)$$

Question 5 (****). *[10 points] Show* $U(1) = SO(2)$

Question 6 (****). *[10 points] Show* $U(n)/SU(n) = U(1)$ *and* $U(n)/U(1) = SU(n)$

Question 7 (****). *[20 points]*
a)Show that $SO(3)$ *is invariant sub group of* $O(3)$
b)Find $O(3)/SO(3)$
c)What about $O(n)/SO(n)$ *?*
d) Is $O(n)/Z_2 = SO(n)$ *?*

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