Porepared by K. .. (Akhilesh Ranjan)



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DEPARTMENT OF SCIENCES, M. Sc. (Physics) III SEMESTER, END SEMESTER EXAMINATIONS

January 2021 Subject: Particle Physics I (PHY-5005) (REVISED CREDIT SYSTEM - 2017)

Time: 3 Hours	Date: January 2021	MAX. MARKS: 50

Note: (i) Answer all the questions.

(ii) Answer the questions to the point.

1. (i) How many different meson combinations can you make with n quark flavors? [3]

(ii) Examine the following processes, and state for each one whether it is possible or impossible, according to the Standard Model (which does not include GUTs, with their potential violation of the conservation of lepton number and baryon number).

(a)
$$p + \overline{p} \rightarrow \pi^+ + \pi^0$$

(b)
$$\mu^- \rightarrow e^- + \overline{\nu_e}$$

(c)
$$p + p \rightarrow \Sigma^{+} + n + K^{0} + \pi^{+} + \pi^{0}$$
 [3]

(iii) A pion traveling at speed v decays into a muon and a neutrino. If the neutrino emerges at 90° to the original pion direction, at what angle does the muon come off? [4]

2. (i) Why time reversal can not be a perfect symmetry of nature. [3]

(ii) Show that all SU(N) matrices form a group. [3]
(iii) Write all the isospin wavefunctions of masons for

(iii) Write all the isospin wavefunctions of mesons formed by two quark flavors. [4]

3. (i) What are bilinear covariants? Construct all different bilinear covariants for Dirac spinors. [3]

(ii) Using properties of Dirac matrices show that $\phi b + b \phi = 2a \cdot b$. [2]

(iii) Write the Feynman rules for quantum electrodynamics. [5]

4. (i) Calculate the mass of vector meson $K^+(u\overline{s})$ by considering QCD spin - spin coupling. Given $m_u = 310 MeV/c^2, m_s = 483 MeV/c^2$

and $A = (2m_u/\hbar)^2 160 MeV/c^2$. Show detailed calculation. [3] (ii) Mention any experimental evidence which shows that a quark flavor can have three colors. [2] (iii) Mention any experiment which shows existence of gluons. [1]

(iv) Qualitatively show that only 54% momentum of proton is carried by quarks. [4]

5. (i) How many types of weak interaction are there? Give at least one example of each type. Why weak interaction is sometimes called as flavordynamics. [4]

(ii) Draw the Feynman diagram for neutron decay using quark picture. Show the direction of time also. [2]

(iii) Write briefy about the Glashow model of electroweak theory. [4]