Full Marks: 70

REV-00 MSP/52/57

## M.Sc. PHYSICS FOURTH SEMESTER HIGH ENERGY PHYSICS & ASTRO PHYSICS

**MSP-402** 

(Use separate answer scripts for Objective & Descriptive)

Duration: 3 hrs.

( <u>PART-A : Objective</u> )						
Tir	ne: 20 min.		Marks: 20			
Choose the correct answer from the following:						
1.	The SI unit of time is <i>sec</i> . But in particle phys <b>a.</b> GeV <b>c.</b> GeV <sup>-1</sup>	ics, time is measured in: b. GeV <sup>2</sup> d. GeV <sup>-2</sup>				
2.	<ul> <li>Asymptotic freedom in QCD signifies that strong force between quarks:</li> <li>a. remains constant.</li> <li>b. becomes weaker at smaller distance and stronger as the quarks move apart.</li> <li>c. becomes extremely strong as the quarks are close to each other.</li> <li>d. depends on the mass of the quarks.</li> </ul>					
3.	The electron anti-neutrino $(\overline{v_e})$ is assigned we a. 0 c. +1	ith a lepton number: b1 d. +2				
4.	In the weak interaction involving charged cu a. quarks flavour changes c. quarks colour changes	urrent vertex: b. a quark changes to a lepton d. none of the above				
5.	Which of the following gauge boson is exchange a. Z <sup>0</sup> boson c. W <sup>-</sup> boson	nged in the weak decay of $u \rightarrow d$ b. photon ( $\gamma$ ) d. $W^+$ boson	?			
6.	The de Broglie wavelength associated with a a. $2\pi$ GeV <sup>-1</sup> c. 1 fermi	1 GeV photon is: b. 1 GeV <sup>-1</sup> d. 3.95 GeV <sup>-1</sup>				
7.	The fundamental gauge boson which mediat quarks is: <b>a.</b> photon ( $\gamma$ ) <b>c.</b> muon neutrino ( $\nu_{\mu}$ )	tes the strong interaction betweer b. pion ( $\pi^+$ ) d. gluon (g)	two			
8.	Which of the following particle has a strange <b>a</b> . nutrino ( $\nu$ ) <b>c</b> . pion ( $\pi^+$ )	eness $\neq 0$ ? b. neutral kaon ( $K^0$ ) d. Higgs boson ( $H$ )				
9.	The Dirac equation describes the relativistic a. spin 1/2 particles c. spin-1 gauge boson	motion of: b. spin 0 particles d. none of these				

10.	The flowing decay is forbidden: $\pi^- + \nu \rightarrow \pi^- + \Sigma^+$		( DADT P. Descriptive )	
	The conservation law violated here is:		( <u>PARI-D.Descriptive</u> )	
	a. conservation of parity	b. conservation of strangeness	Time: 2 hrs. 40min.	Marks: 50
	c. conservation of charge	d. conservation of lepton number	[Answer question no.1 & any four (4) from the rest ]	
11.	The quark content of the $\Omega^-$ particle is:		1. a. What do you mean by elementary or fundamental particle? List all the	
	a. uds	D. QSS	fundamental entities of the standard model of particle physics.	
	c, ddd	u. 555	b. Construct the baryon octet putting the symbols of the baryons in	
12.	At $q^2 \rightarrow 0$ the value of the proton form fac	ctor $F(q)$ becomes:	appropriate places in the octet according to their charge and strangeness	•
	a. 1	b. 0	<b>2. a.</b> Explain briefly the CP violation in the neutral kaon system.	5+5=10
10	c. q <sup>2</sup> /2	d. $\sqrt{q}$	<b>b.</b> Calculate the color factor for the interaction between a red and a blue	
13.	The parallax ( $\theta$ ) of a distant star, 'd' AU away from the sun is given by:		(K-D) quark.	
	$d \cdot \sigma = \frac{1}{d} A U$	$\theta = \frac{d}{d}AU$	3. a. Discuss elaborately the deep inelastic scattering process of neutrino	8+2=10
	c. $\theta = \frac{\pi}{d} A U$	d. $\theta = \frac{d}{\pi} A U$	and quark.	
14	The selection end elliptic error in alig		<b>b.</b> Express Dirac equation for spin ½ particles in covariant form. What are	
14.	a co	ed at about:	the eigen values of the Dirac traceless matrices $\alpha_i$ and $\beta$ ?	
	a. 5" c. 23 5°	d. 43.5°	4. a. Show that the scattering cross section for an extended object (say a	8+2=10
	. 20.0		hadron) can be expressed as:	
15.	The solar system moves around the center	of the Milky Way Galaxy with a velocity:	$d\sigma(\theta) = d\sigma_{vt}  F(Q^2) ^2$	
	a. c/2	b. 600 km/s	where $F(\Omega^2)$ is the hadron form factor	
	c. 250 km/s	<b>a.</b> 11.2 km/s		
16.	Identify the process that dominates the end	ergy liberation in Sun.	<b>b.</b> Write a short note on quark confinement.	
	a. Nuclear fusion	b. Nuclear fission	5. a. Find the neutrinos involved in the following decays:	2+2+2+4=10
	c. Gravitational contraction	d. Gravitational differentiation	(i) $\pi^- \rightarrow \mu^- + ?$	
17.	The super-cluster present in Pisces constel	lation, containing 43 galaxies, has been	(ii) $\mu^- \rightarrow e^- + ? + ?$	
	discovered by Indian scientists in 2017, na	med as:	b. Draw the Feynmann diagram for charged current vertex of leptons for	
	a. Lakshmi	b. Durga	weak interaction. Give an example.	
	c. Swaraswati	d. Parvati	c. Analyze the following reactions in terms of constituent quarks:	
18.	Acceleration due to gravity (g <sub>ns</sub> ) of a neutr	on star of mass 1.44Mo and radius 10 km is:	(i) $\pi^- + p \rightarrow K^0 + \Lambda^0$	
	a. 9.8 m/s <sup>2</sup>	b. 1.86×10 <sup>12</sup> m/s <sup>2</sup>	(ii) $K^- + p \rightarrow K^+ + K^0 + \Omega$	
	c. $11.2 \times 10^{12} \text{ m/s}^2$	d. 250 m/s <sup>2</sup>	<b>d.</b> A photon with energy $E_y = 2.09$ GeV creates a proton-antiproton pair	
10	Escape velocity of a neutron star of mass 1 44Ma and radius 10 km is:		in which the proton has a kinetic energy of 95 MeV. Calculate the kinetic	
17.	a. 1.93×10 <sup>8</sup> m/s	b. 2.99×10 <sup>8</sup> m/s	energy of the antiproton.	
	c. $11.2 \times 10^3 \text{ m/s}$	d. 299 m/s	6. Explain the Apparent and Absolute magnitudes of a star.	4+6=10
20	The link of all starts and the starts		Draw the H-R diagram and discuss its three main regions.	
20.	The lightest elements are built up in:	h the main sequence stars	7 Calculate the amount of energy released when H fuses to produce He in	2+4+4=10
	c. the white dwarfs	d, the neutron stars	stars.	2.1.1-10
		and the recurrent starts	Discuss the steps of the fusion reactions below:	
			(a) Proton-Proton chain reaction.	
			(b) Carbon-Nitrogen-Oxygen reaction.	
			8. Explain briefly how white dwarf forms	5+5=10
			What role does electron degeneracy plays in the interior of a white dwarf?	

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