7018

M Tech / II Sem.

NUCLEAR SCIENCE & TECHNOLOGY
Paper :NST – 609 : Nuclear & Computational Science

Time 3 hours

Maximum Marks 70

(Write your Roll No on the top immediately on receipt of this question paper)
Question No 1 is compulsory Answer any four questions out of the rest

1)

a) Is this a valid programme? Why or why not? 2

```
# include < iostream >
int main () std   cout<<"Hello, world!" <<std  endl,
```

b) Will this programe compile successfully? Why or why not? 2

```
# include < iostream >
int main ()
{
    /* this is a comment that extends over sevseral lines
    becuase it uses */ and */ as its starting and ending delimeters */
    std   cout<<"Does this compile?" <<std  endl,
    return 0
}
```

c) The average binding energy per nucleon of the nuclei is about 8 MeV Deuteron binding energy is only about 2 224 MeV but it is still stable Give reason for the stability of the deuteron 2

d) Using neutron (n) and proton (p) combination, three bound states nn, np & pp can be formed Out of these only np bound state is stable and exists Why not the other two bound states are stable 2

e) Arrange the following operators by precedence from highest to lowest 3

x<<y,   x=y,   x- - ,   x/y,   ++x,   x= = y

f) Determine if actinium – 225 can decay through α as well as β decay or not? 3

g) Write a C++ program to test whether a given number is prime or not 4

h) The ground state of $^{137}_{56}$ Ba has spin-parity of $3/2^+$ The first two excited states have spin parity $1/2^+$ & $11/2^-$ According to the shell model, what assignments would be expected for these excited states 4

2)

a) Write a C++ program that asks the users to enter two numbers and tells the user which number is larger than the other 3

b) Is the following program valid? If so, what does it do? 4

If not, say why not, and rewrite it to be valid

```
#include <iostream>
# include <string>
int main()
std  string s= "a string",
std   string x = s+", really",
std   cout <<s<< std ·endl,
std . cout <<x<< std  endl,
return  0,
```

c) Write a C++ program to find the real root of $(x+1)^5$ using Secant method   5

3)

a) Write a C++ program to generate the product of the number in the range [1,10)   4

b) Write a C++ program to calculate the relativistic mass and speed of an electron accelerated in an electron gun   8

4)

a) if deutron had excited states, then what would be the minimum potential for the first excited state (l = 1)   3

b) What is the significance of scattering length? What information sign of the scattering length provides about the system   3
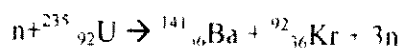
c) Predict the ground state spins, parties and magnetic moments of the following nuclie using the shell model   6

^{4}He. $^{23}_{11}$Na $^{35}_{17}$Cl, $^{41}_{20}$Ca

5)

a) Ground state of deutron is a mixture of S & D state but not a mixture of S & P or F state Why?   3

b) Consider the reaction   4

$n+^{235}_{92}U \rightarrow {}^{141}_{56}Ba + {}^{92}_{36}Kr + 3n$

calculate the energy released in mev in the reaction

[Atomic masses $^{235}_{92}U = 235\ 04391u$, $^{141}_{56}Ba = 140\ 9139u$ $^{92}_{36}kr = 91\ 8973u$]

c) We know that deutron system is an admixture of $^3S_1$ & $^3D_1$ states Calculate the countribuition of $^3D_1$ state to the deuteron ground state on the basis of magnetic dipole   5

moment discupancy between the therotical and experimental values

Given $\mu_n = -1.913\mu_n$ $\mu_p - 2.793\mu_n$

μ_d (expt) = 0.857438

6)

a) Are the following definition valid? Why? Why not?

   Const std string exclam = "!",

   Const std string message = "is this" + "valid" + exclam,

   2

b) In the shell model, a spin orbit interaction splits all energy levels except the s-type levels Why does the s-type levels remains unsplit?

   2

c) Write a C++ program to countdown from 10 to -5

   4

d) Which of the following nucleon - nucleon scattering is easiest to carry out experimentally? Give reasons?

   4

       n - p,   p-n,   n-n,   p-p

How can you use nucleon-nucleon scattering to show that the nuclear forces are charge independent?