

This question paper contains 3 printed pages

7018

Your Roll No

M Tech / II Sem.

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

4 J

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
because it uses */ and */ as its starting and ending delimiters */
std  cout<<"Does this compile?" <<std endl,
return 0
}
```
 - c) The average binding energy per nucleon of the nuclei is about 8 MeV Deuteron 2
binding energy is only about 2.224 MeV but it is still stable Give reason for the stability of the deuteron
 - d) Using neutron (n) and proton (p) combination, three bound states nn, np & pp can be 2
formed Out of these only np bound state is stable and exists Why not the other two bound states are stable
 - 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 $^{137}_{56}\text{Ba}$ has spin-parity of $3/2^+$ The first two excited states 4
have spin parity $1/2^+$ & $11/2^-$ According to the shell model, what assignments would be expected for these excited states
- 2)
- a) Write a C++ program that asks the users to enter two numbers and tells the user 3
which number is larger than the other
 - 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

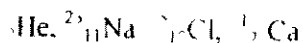
b) Write a C++ program to calculate the relativistic mass and speed of an electron accelerated in an electron gun 8

4)

a) if deuteron 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

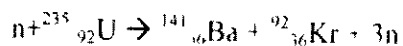
c) Predict the ground state spins, parities and magnetic moments of the following nuclei using the shell model 6



5)

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

b) Consider the reaction 4



calculate the energy released in mev in the reaction

[Atomic masses ${}^{235}_{92}\text{U} = 235.04391\text{u}$, ${}^{141}_{56}\text{Ba} = 140.9139\text{u}$ ${}^{92}_{36}\text{Kr} = 91.8973\text{u}$]

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

moment discrepancy between the theoretical and experimental values

$$\text{Given } \mu_n = -1.913\mu_n \quad \mu_p = 2.793\mu_n$$

$$\mu_d (\text{expt}) = 0.857438$$

6)

a) Are the following definition valid? Why? Why not? 2

```
Const std string exclam = "!",
```

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

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?

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