



## UNIVERSITY OF PETROLEUM & ENERGY STUDIES

DEHRADUN

Semester End Examination – May, 2018

Program/course: M-TECH (NUCLEAR SCIENCE & TECHNOLOGY)

Subject: PLASMA PHYSICS & NUCLEAR FUSION REACTOR I

Code : NSAT 7005

No. of page/s: 02

Semester: II

Max. Marks: 100

Duration: 3 Hrs

### Section-A (Answer any four questions)

[20]

- What is a Plasma? What are its main characteristics? Explain Debye shielding.
  - List out some important uses & applications of plasma.
- What are gas producing reactions induced by fusion (14 MeV) neutrons in reactor materials?
  - What are its implications on the mechanical integrity of reactor components?
- What is the principle of magnetic confinement? What are magnetic surfaces?
- What is the need to go for modified form of stainless steel in the construction of fusion reactors?
- Discuss important issues of 'Burning Plasmas'.
  - What is the fraction of alpha particle heating in ITER machine ( $f_\alpha$ ).

### Section-B (Answer all questions)

[40]

- What are the magnetic fields required to confine & provide equilibrium to toroidal plasma? What is the relative ordering of various fields?
  - What is the specific role of poloidal field and how is it produced in Tokamaks?
- What are 'banana orbits' in a Tokamak, and what is their significance in the *particle* and *energy* losses from toroidal devices?
- Write short notes on the following (not exceeding 4 line each)
  - Fission-Fusion Hybrid Reactors
  - Magnetic reconnection
  - Self ignited plasma
  - Runaway electrons
- Describe the role of fusion produced alpha particles in a burning plasma. What is helium ash?
- Describe various subsystems of a Tokamak device.

### Section-C (Answer any two questions)

[40]

1. What are the limits of operation of tokamaks? Use Hugill diagram to describe them and what is the effect of wall conditioning on the Tokamak performance?
2. a) Explain with figures how soft x-ray diagnostics gives information about the magnetic surfaces and the dynamic changes taking place due to growth and decay of magnetic islands.  
b) What are sawtooth oscillations? Explain the detailed features present in them.
13. a) Describe the radial build-up of a typical fusion blanket module. What is the role of PbLi in the Test Blanket Module (TBM)?  
b) What is the consequence of close proximity of the blanket module on the burning plasma, and what are the remedial actions?