Roll No: ----------

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, December 2017

Program: M.TECH. NST — **Semester – III**
Subject (Course): NUCLEAR POWER ENGINEERING — **Max. Marks : 100**
Course Code : NSAT 8005 — **Duration : 3 Hrs**
No. of page/s: 02

SECTION – A (4 x 5M)

Q.1 **Explain categorization of nuclear power plants according to:**
(a) Purpose
(b) Enrichment level

Q.2 **Draw and explain structure of Pressurized Heavy Water Reactor (PHWR).**

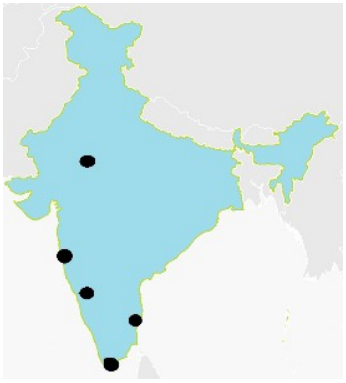
Q.3 **Match the following:**

A. KK-1 & 2	**1. PHWR**
B. MAPS	**2. FBR**
C. PFBR	**3. PWR**

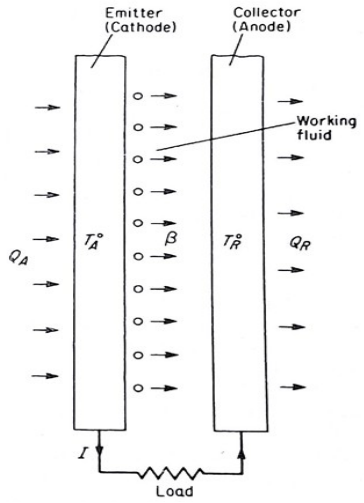
Q.4 **Draw a flowchart describing the complete atomic regulatory framework of India.**

SECTION – B (4 x 10M)

Q.5 **(a) For the map below, name the nuclear sites and give specifications of each site.**



(b) **Identify the type of energy converter as shown below and discuss.**



Q.6 Under direct capital costs, elucidate the following:
(i) Structures and site facilities
(ii) Reactor Equipment

Q.7 Explain chemical shim control and write the formula for Boron worth (W_B).

Q.8 Explain the following:
(a) Doppler effect
(b) Sodium loss reactivity

SECTION – C (2 x 2M)

Q.9 For an open system, chalk down the necessary derivations according to following First law equation:
$PE_1 + KE_1 + IE_1 + FE_1 + \Delta Q = PE_2 + KE_2 + IE_2 + FE_2 + \Delta W_{sf}$
where subscripts 1 & 2 denotes input and output respectively.

Q.10 For the following set of equations, discuss the modifications done for safety calculations by taking reactor power density into account.

$$\frac{dn}{dt} = \frac{\rho - \bar{\beta}}{\Lambda} n + \sum_{i=1}^{6} \lambda_i C_i$$

$$\frac{dC_i}{dt} = \frac{\bar{\beta}_i}{\Lambda} n - \lambda_i C_i \quad (i = 1 \text{ to } 6)$$

where n = neutron density (n/cm^3),
C_i = delayed neutron precursor concentration for the ith group (precursors/cm^3),
$\rho = (k-1)/k = \delta k/k$ = reactivity,
$\bar{\beta}$ = effective delayed neutron fraction,
$\bar{\beta}_i$ = effective delayed neutron fraction for the ith group,
Λ = neutron generation time (s),
λ_i = decay constant for the ith delayed neutron group (s^{-1}).

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SECTION – A (4 x 5M)

Q.1 **Draw and explain structure of a Boiling Water Reactor (BWR).**

Q.2 **Highlight the importance of GDWP (Gravity Driven water pool) in Advanced Heavy Water Reactor (AHWR).**

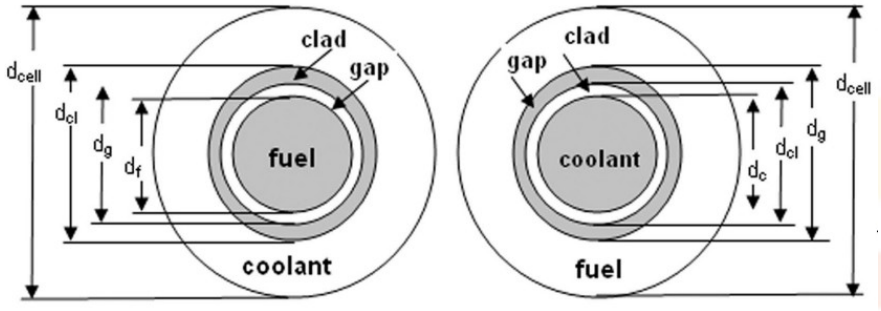
Q.3 **Discuss categorization of nuclear power plants according to:**
(a) Neutron Energy
(b) Moderator

Q.4 **Discuss principle PWR design challenges : reduction in capital, O & M cost, and spent fuel inventory.**

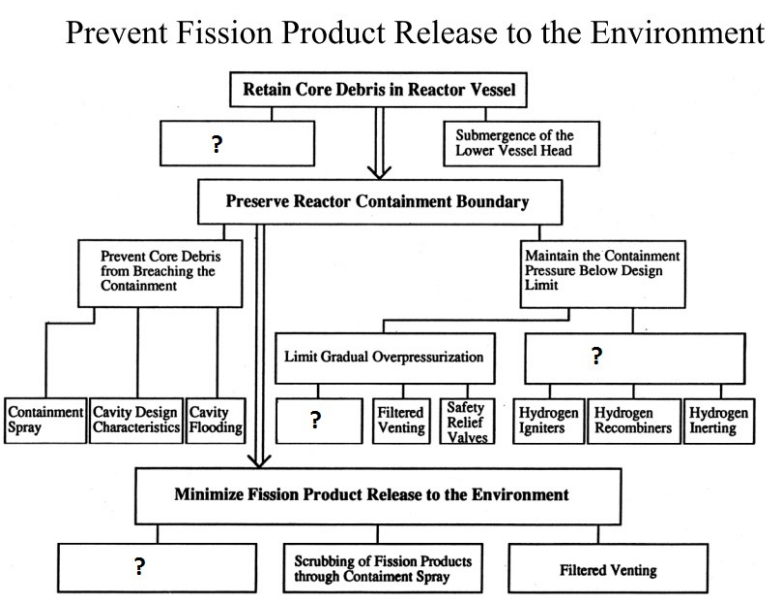
SECTION – B (4 x 10M)

Q.5 **Regarding India's 3 stage nuclear program, discuss the various considerations made for stage-1, stage-2 & stage-3 respectively.**

Q.6 **For the equivalent annulus representation as shown below, name and discuss the cell-A, cell-B.**



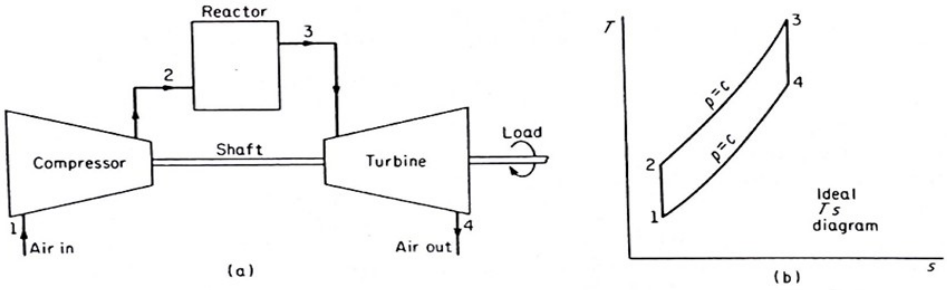
Q.7 **Identify '?' in below flowchart and discuss.**



Q.8 Explain (a) HTGR (b) GCR

SECTION – C (2 x 2M)

Q.9 Discuss the thermodynamic cycle with following T-S diagram and cycle diagram.



Q.10 $PE_1 + KE_1 + IE_1 + FE_1 + \Delta Q = PE_2 + KE_2 + IE_2 + FE_2 + \Delta W_{sf}$

where subscripts 1 & 2 denotes input and output respectively.

For an open system with First law equation above, analyze following systems.

(a) Steam generator
(b) Gas/steam turbine
(c) Water/incompressible fluid pump
(d) Nozzle