

八十八學年度 工科系 系(所) 丙 組碩士班研究生招生考試

科目 核工原理 科號 3402 共 3 頁第 1 頁 \*請在試卷【答案卷】內作答

1. (15%)

Consider the chain-decay  $A \rightarrow B \rightarrow C \rightarrow$

With no atoms of B present at  $t=0$

- Determine the time  $t_m$ , when the activity of B reaches a maximum
- Determine the time  $t_e$ , when the activities of A and B are equal.

2. (15%)

Draw a block diagram showing the major parts of a complete nuclear fuel cycle with fissile nuclides recycled. Clearly label what material is transferred between steps.

3. (20%)

Consider a homogeneous, rectangular parallelepiped, bare reactor of dimensions  $a \times b \times c$ . Assume  $E_R$  is the recoverable energy per fission and  $P$  is total thermal power.

- Solve the reactor equation to get the flux distributions in reactor.
- Find the geometric buckling.
- Find the ratio of maximum flux to average flux.

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4. Explain the following terminology
  - (a) Buildup Factor (3%)
  - (b) Critical Heat Flux (3%)
  - (c) Stochastic Effect of Radiation (3%)
  - (d) Xenon Oscillation (3%)
  - (e) Delayed Neutrons (3%)
  
5. 請說明為何類似車諾比爾災變的核電廠事故，不可能發生於國內核電廠使用之輕水反應器？ (6%)
  
6. Please give the physical meaning of each following terms and its unit in SI System.
  - (a) Source Strength (3%)
  - (b) Absorbed Dose (3%)
  - (c) Dose Equivalent (3%)
  - (d) Relative Biological Effect (3%)

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7. In a pressurized water reactor, power density of fuel rod at the center of the core can be represented by following equation

$$q'' = q''_{\text{MAX}} \cos\left(\frac{\pi z}{H}\right)$$

where  $z$  is in the direction of coolant flow and  $H$  is the height of the core.

- (a) Please derive an equation to calculate the coolant temperature along the coolant channel (5%).

Use following notation in your derivation:

$A_f$ : the cross sectional area of fueled portion of a fuel rod.

$W$ : coolant flow rate through the coolant channel

$C_p$ : specific heat of coolant

$T_o$ : coolant temperature at core entrance

- (b) Please derive an equation to calculate the cladding surface temperature along the direction of coolant flow. (5%)

Use following notations in your derivation:

$P_n$ : the circumference of the fuel rod;

$h$ : heat transfer coefficient at cladding surface.

8. Please name the proper material used in shielding neutrons and gamma rays, respectively. Please also give the reasons for making the choices. (7%)