1) Discuss the problem of the analysis of:
   (i) Solid sample (ii) gas mixture (iii) hydrocarbon liquids
   Describe the radiogauge that can be used and derive the mathematical relation that represents its response.
2) Show how can one design a radiogauge that measures the coating thickness on sheet materials
3) Radiotracers offer an excellent means for solving the problem of particle-size analysis. Explain
4) To measure the density of fluid flowing in a pipe by the gamma ray transmission principle, show how can you optimize both the source energy and the thickness of the fluid.
5) If you continuously divert a fraction of the stream of a fluid through a detection chamber that is overflowed downstream, one can measure the flow rate when a radiotracer is injected in the main stream. Describe this technique and prove the principle behind it.
6) Discuss one of the radiogauging principles that utilizes neutrons as the radiation source.

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Alexandria University	Economics of NPPs	4th year Nucl.
Faculty of Eng.	Final Exam., 2nd Term ,	(2014/ 2015)
Nucl. & Rad.Eng.Dept.	Time : 2 hours	Code : HS 464

Attempt All Questions:

1) a) How the nuclear fuel can be increased for the future sustainability of NPPs ?
   b) Define : Installed Capacity – Stand by Capacity.
   c) A certain NPP has 1000 MW installed capacity, and the average load is 800 MW. Calculate the load factor.
   (9 Marks)

2) a) Compare between , Gas fired energy & Nuclear Energy for:
   i) Health effects ii) Capital cost iii) Environmental waste
   b) Define : Load Factor --- Capacity Factor
   c) Spent nuclear fuel can be an added value for the nuclear fuel supply chain. Explain.
   (9 Marks)

3) a) Compare between ; Nuclear , Solar , Biomass energy sources regarding to the site area.
   b) If the utilization factor for a certain NPP is 0.9 , energy generated = 3300.0 MW, efficiency = 33% , station use = 5 %. Calculate :
   i) Peak Load ii) Net electric power
   (9 Marks)

4) a) What are the main reasons of climate change ?
   b) If 1 gm of U—235 gives energy of 1 MWd . How many Kg needed from natural uranium to get the same energy ?
   c) state the advantages and disadvantages of 4 types of energy sources.
   (9 Marks)

GOOD LUCK prof. M.K.Shaat

Answer the following

Reactor kinetics
June 2015

1-a-In an infinite reactor

$$K_\infty = \frac{\text{fission rate in on generation}}{\text{fission rate in the immediately preceding generation}}$$

using this definition find a formula for the reactor period and comment

b - An infinite thermal reactor consisting of a homogenous mixture of H_2O and ^{235}U in which K_∞ is increased by 0.1 Percent the mean diffusion time in the mixture $t_d = t_{d_M}(1-f)$ where t_{d_M} = mean diffusion time for $H_2O = 2.1 \times 10^{-4}$ sec. $\eta_T = 2.0$ Solve this Case with and without delayed neutrons and explain the importance of delayed neutrons on reactor control. $\sum_{i=1}^{6} \beta_i \bar{t}_i \simeq 0.1$ sec

2- Derive the reactivity equation in detail step by step and explain How to Solve it and use it. Define the stable period

3 - Derive The prompt Jump and Solve the differential equation mathematically and Comment. Define The prompt critical condition

4-a- Show graphically and explain Xenon after shutdown, reactor dead time and burnout after startup.

b - the overall Temperature coefficient of a ^{235}U fueled reactor is α_T Per $^\circ C$ which is Temp. dependent. By how much does The reactivity of the system drop when its Temp is increased from $70^\circ F$ to $550^\circ F$

5 - Discuss The Lifetime prediction for an infinite homogenous thermal reactor

b - Discuss orthogonality and adjointness in detail and show the advantage of adjoint functions.

Alexandria University
Faculty of Engineering
Nuclear and Radiation Eng.
Department
June 2015

جامعة الإسكندرية
كلية الهندسة
قسم الهندسة النووية والاشعاعية

يونيو 2015

Course title Number: Measurments of Nuclear Power Plants

اسم المقرر والرقم الكودى له.....

*****4th Year

السنة الدراسية :.....

Time allowed: 3 hr

الزمن :.....

Answer All Questions:

Question 1******** (25 marks)

a) What are the advantages and disadvantages of the RTDs and Thermocouples found in a NPP?
b) What is meant by nuclear grad RTD? Show where the Thermocouples, narrow-range and wide-range RTDs are typically found in a PWR plant?
c) Descried a procedure for cross calibration test used in NPP for verifying the calibration of the temperature instrumentation.
d) Assuming that the RTD is a first-order system, the equation of RTD temperature is:

$$M\,CdT/dt = UA\,(\theta - T)$$

where, U = overall heat-transfer coefficient at the RTD's sensing element, A = heat-transfer area, T = RTD temperature, θ = temperature of fluid in which the RTD is installed, M = mass of the sensing element, and C = specific heat capacity.

Write the equation to calculate the time constant τ ? Using this equation, explain how the response time increases and decreases with Thermowell and Hollow Annulus Design RTD respectively (see the **Fig 1**).

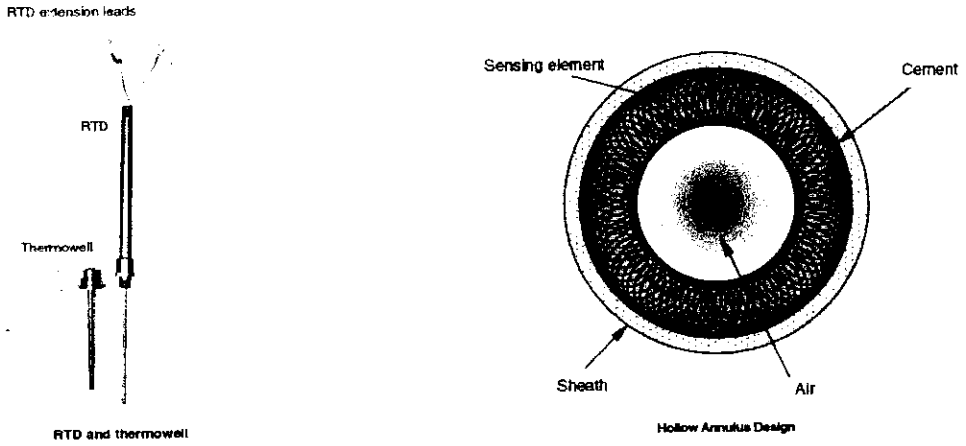


Fig 1

(Hint: The first order instrument dynamic equation is:

$$q_0 = \frac{K q_i}{1 + \tau D}$$

where q_i is the measured quantity, q_o is the output reading, $D = d/dt$, and K is a constant)

e) Suppose that the reference junction of a chromel–constantan thermocouple is maintained at a temperature of 80°C and the output e.m.f. measured is 40.102 mV when the hot junction is immersed in a fluid. What is the fluid temperature?

(Use of Thermocouple tables is allowable)

Question 2******** **(25 marks)**

a) What are the common sensing elements used in pressure transmitters? How the movement of the sensing element is converted into an electrical signal?
b) Mention the most common flow detectors. How a mass flow detection system can be used for steam flow between the boilers and the turbines?
c) Explain the purpose of the square root extractor in flow measurement? A pipe valve when closed the zero flow produces a 10 mA output from the flow transmitter and produces 50 mA when fully open. If due to temperature or other disturbances, the input to square root extractor drifted from 0% to 1% what is the square root extractor output in mA? How this error can be eliminated?
d) What is meant by nuclear grad pressure transmitter? Which transmitter **A** or **B** (see **Fig. 2**) is nuclear grad? Show the locations of the important pressure transmitters in BWR plant. Why the pressure is measured in the dray well?

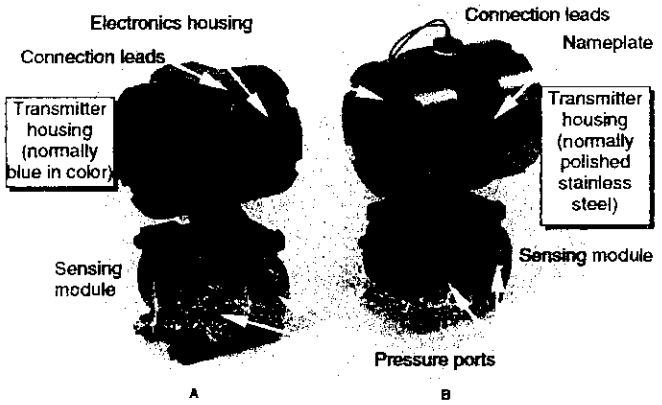


Fig. 2

e) If the fluid in the tank changes temperature, and therefore density, some means of density compensation must be incorporated in order to have an accurate indication of tank level. Show how this problem can be compensated when measuring water level of:
   - Pressurizer,
   - BWR reactor vessel?

Question 3******** **(20 marks)**

a) For the nuclear instrumentation systems used for initial and normal start up and power operation of CANDU reactor, define the **flux** and **power range**, the **neutron detector** used, and the **typical location** of each instrumentation system.
b) In CANDU reactor approaching to criticality is done by rising the moderator level, discuss how existing of some voids in the sensing line produces error in the measured moderator level?
c) At the beginning of approaching to criticality, the nuclear start up instrumentation reading is 5 count /sec. Show why, when the reading is 50000 count /sec, it may be considered that the reactor is critical? **(Assume Keff = 0.9 at the beginning)**

Alexandria University
Faculty of Engineering
Department of Electrical Engineering

Electric Power Systems
Forth Year Nuclear Engineering
Final Exam, June 2015.
Time allowed for this part: 90 minutes.

Electric Power Systems
Electrical Distribution

Answer the following questions:

1) Write **short notes** on the following:
   (a) Insulators for low voltage and medium voltage cables.
   (b) Dry type and Oil-immersed transformers.
   (c) Typical low voltage ring distribution system.
   (d) Types of low voltage circuit breakers.
   (e) Circuit breakers breaking capacity. **(15 points)**

2) A residential building has 20 floors with 6 flats in each floor. The connected load of each flat is assumed to be 16 KVA. The demand factor is 0.6 and the diversity factor is 1.2.
   (a) Select a suitable distribution transformer for this building. Available transformers are: 500, 800, 1000, 1250, 1600, and 2000 KVA all are dry type.
   (b) For the chosen transformer in (a), If the load factor of the building is 0.8, find the capacity factor and utilization factor. **(10 points)**

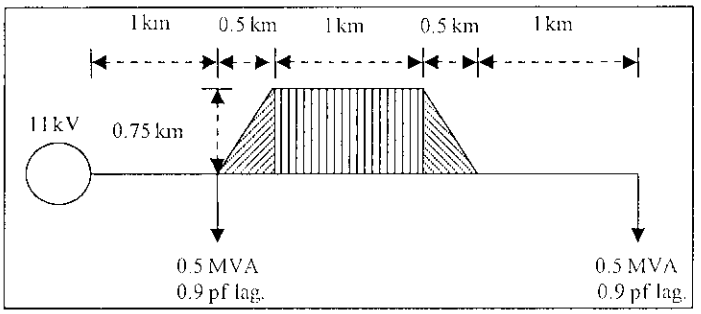


Figure 1

3) For the Medium voltage distribution system shown in figure 1, the load density in the hatched area is 2 MVA/km^2 with 0.9 lagging power factor. Calculate the voltage at the end of the feeder if the cable used is aluminum conductors, XLPE insulated, 240 mm^2 whose voltage drop constant is 0.153 % VD/MVA/km at 11 kV and 0.9 power factor lag. **(10 points)**

4) A four-core low voltage PVC cable is used to feed a 150 kVA load at a distance 200 m from the distribution transformer. The cable is **laid in ground** at a depth of 1 m. the ground temperature is 40° C and the air temperature is 45° C. The ground thermal resistivity is 150° C/cm/Watt. The maximum allowed voltage drop through the cable is 3%. Choose the appropriate cross section for the cable. **(10 points)**

Ground temperature derating factor

Ground temperature °C	25	30	35	40	45	50	55
PVC cables rated 70 °C	1.13	1.07	1.00	0.93	0.85	0.76	0.65
XLPE cables rated 90 °C	1.09	1.04	1.00	0.95	0.90	0.85	0.80

Air temperature derating factor

Air temperature °C	25	30	35	40	45	50	55
PVC cables rated 70 °C	1.22	1.15	1.08	1.00	0.95	0.82	0.71
XLPE cables rated 90 °C	1.14	1.10	1.05	1.00	0.96	0.87	0.84

Burial depth derating factor

Depth of laying (m)	Cables cross section		
	Up to 70 mm²	95 upto 240 mm²	300 mm² & above
0.50	1.00	1.00	1.00
0.60	0.99	0.98	0.97
0.80	0.97	0.96	0.94
1.00	0.95	0.93	0.92
1.25	0.94	0.92	0.89
1.50	0.93	0.90	0.87
1.75	0.92	0.89	0.86
2.00	0.91	0.88	0.85

Soil thermal resistivity derating factor

Soil thermal resistivity in °C Cm/Watt	80	90	100	120	150	200	250
Rating factor	1.17	1.12	1.07	1.0	0.93	0.84	0.75

0.6/1 (1.2) kV

Multicore Cables, with Stranded Copper Conductors PVC Insulated and PVC Sheathed

Description

- Multicore cables of stranded Copper conductors are insulated with PVC compound, assembled together, covered with overall jacket of PVC compound.
- Cables are produced according to IEC 60502 or BS 6346

Application

- For outdoor and indoor installations in damp and wet locations

Type code	Nominal cross sectional area	Max. Conductor resistance		Current rating			Approx. overall diameter	Approx. weight
		DC at 20 °C	AC at 70 °C	Laid direct in ground	Laid in ducts	Laid in free air		
	mm²	Ω/km	Ω/km	A	A	A	mm	kg/km
	Four core cables							
[illegible]	1.5 rm	12.1000	14.700	27	18	15	[illegible]	[illegible]
[illegible]	2.5 rm	7.4100	8.870	32	23	22	12.4	[illegible]
[illegible]	4 rm	4.6100	5.550	[illegible]	[illegible]	31	14.0	[illegible]
[illegible]	6 rm	3.0800	3.699	45	[illegible]	[illegible]	16.0	[illegible]
[illegible]	10 rm	1.8300	2.190	[illegible]	[illegible]	[illegible]	18.5	[illegible]
[illegible]	16 rm	1.1500	1.398	75	[illegible]	72	[illegible]	[illegible]
[illegible]	25 rm	0.7270	0.870	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	35 rm	0.5240	0.630	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	50 rm	0.3870	0.464	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	70 rm	0.2680	0.321	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	95 sm	0.1930	0.232	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	120 sm	0.1530	0.185	247	[illegible]	212	[illegible]	[illegible]
[illegible]	150 sm	0.1240	0.151	[illegible]	220	[illegible]	[illegible]	[illegible]
[illegible]	185 sm	0.0991	0.121	300	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	240 sm	0.0754	0.094	[illegible]	[illegible]	[illegible]	57.9	[illegible]
[illegible]	300 sm	0.0601	0.077	390	330	440	[illegible]	[illegible]

Good Luck

Dr. Karim Hassan

Alexandria University
Faculty of Engineering
Department of Electrical Engineering

Electric Power Systems
4th Year Nuclear Engineering
Final Exam, June 2015
Time allowed for this part: 90 minutes

Electric Power Systems
Part 1: Electric Power Transmission

Attempt ALL the questions:

Q1

A three phase transmission line has a phase impedance of 11 + j38 Ω/phase. The load at the end of the line is 40 MW at 110 kV and 0.7 lagging power factor. Find:

i. Sending end voltage
ii. Line current
iii. Sending end power factor
iv. Transmission efficiency
v. Voltage regulation

Q2

A suspension insulator string comprises four similar units; the self-capacitance of each is four times that between each link-pin and earth. The conductor voltage with respect to earth is 127 kV. Find:

i. The voltage across each unit
ii. String efficiency

In order to have equal voltage across each unit the string units are changed to be of different capacitance except the unit connected to the tower cross-arm (tower end unit).

iii. Which method is used here for equalizing the voltage across the string units?
iv. Calculate the relative capacitance of each string unit with respect.

Q3

11/0.38/0.22 kV, 100 kVA, 10 % Transformer feeds the following loads at low voltage level:

i. Resistive load of 14.52 Ω/phase
ii. Capacitor bank of 4.73 μF/phase

Discuss the probability of resonance occurrence due to supply harmonics at 11 kV busbar.

Q4

1500 kVAR power factor correction capacitors are installed at 380 V busbar. These capacitors are converted to shunt filters to mitigate the 5th harmonic coming from a non-linear load (the only source of distortion). The harmonic current in the capacitors is 5% of the capacitors full load current. Make a complete design for the filter and check that the stresses on the capacitors are within the standardized limits.

Good Luck

Dr. Mostafa Refaey

University of Alexandria
Faculty of Engineering
Nuclear & Radiation Engineering Department

جامعة الاسكندرية
كلية الهندسة
قسم الهندسة النووية والاشعاعية

Course Title & Number: Nuclear Reactor Analysis II NE 435 اسم المقرر والرقم الكودي له: تحليل المفاعلات النووية 2
4th Year السنة الدراسية :الرابعة
Time allowed :3 hours الزمن:3 ساعات

1] Consider a spherical reactor consisting of a core of radius R, surrounded by an infinite reflector. Using the one group theory prove the following (20 Points)

$$BR\cot BR - 1 = -\frac{D_r}{D_c}\left(\frac{R}{L_r}+1\right)$$

2] (10 Points) The hot channel factor is the extent to which q''_{max} exceeds the average heat flux in the core. State the reasons why the hot channel factor differ from unity.

3] (20 Points) A bare cylindrical reactor is to be constructed of a homogeneous mixture of water and U^{235}. The critical mass of the fuel is 4.672 kg. Find the radius of the reactor. $\tau_t = 27\ cm^2$, $L_{tm}^2 = 8.1\ cm^2$, $\eta_t = 2.07$, density of water = 1 gm/cm^3, $\sigma_a(H_2O) = 0.665$ barns, $\sigma_a(U^{235}) = 678$ barns. Assume the reactor is of minimum volume (Optimum Shape).

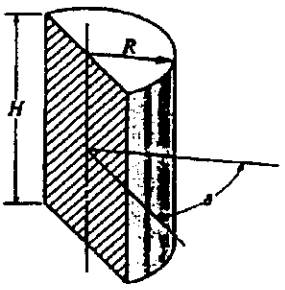
4] (15 Points) State the following:

a) one group equations b) two group equations

c) multigroup equation

5](10 Points)Talk about exponential heat sources.

6](20 Points) Consider the split, finite-cylindrical reactor shown below



(a) With the origin of coordinates at the center of the flat face of the reactor, show that the thermal flux is given by

$$\phi_T(r,\vartheta,z) = AJ_1\left(\frac{x_1 r}{R}\right)\sin(\vartheta)\cos\left(\frac{\pi z}{H}\right)$$

Where $x_1 = 3.84$ is the first zero of $J_1(x)$, that is, $J_1(x_1)=0$. (b) Show that the buckling is:

$$B^2 = \left(\frac{x_1}{R}\right)^2 + \left(\frac{\pi}{H}\right)^2$$

(c) Determine the constant A in terms of the reactor power.

7] What is the boiling crisis? Why should it be avoided?(10 Points)

Good Luck