UNIVERSITY OF GHANA

BSC.ENGINEERING FIRST SEMESTER EXAMINATIONS: 2015/2016

DEPARTMENT OF FOOD PROCESS ENGINEERING
FPEN 401: FOOD PLANT DESIGN AND ECONOMICS(2 CREDITS)

INSTRUCTION:
ANSWER THREE (3) QUESTIONS

TIME ALLOWED: TWO (2) HOURS

1. (a) Define corporate social responsibility (CSR). Name any two food factories that practice CSR and give an example each of what they do for CSR.
(b) List the different stages involved in the design of a food plant from the beginning to the end.
(c) A rotary dryer is used to dry carrots. Using the given process specification, process data and design variables below calculate:
   (i) the air flow rate ,
   (ii) thermal energy efficiency; and
   (iii) the air heating area required

Process Specifications

F	= 600 kg/h db feed flow
X_o	= 0.75 kg/kgdbmoisture content
X	= 0.15 kg/kg db final moisture content
d	= 0.01m material characteristic size
T_o	= 25°C Ambient temperature
Y_o	= 0.02 Ambient humidity
T_s	= 160°C Heating stream temperature
P	= 1.00 bar

Process Data

Specific heat (kJ/kg K)	*Latent Heat (MJ/kg)*
C_{pL} = 4.2 water	H_o = 2.50 Steam condensation at O°C
C_{pV} = 1.90 water vapour	*Heat transfer coefficient*
C_{PA} = 1.00 air	Heat transfer coefficients (KW/m^{2}K)
C_{PS} = 2.0	U_s = 0.1 air heater
Dry material= 3.73	

Design variables

Y = 0.66 kg/kg db Drying air humidity

T = 85°C Drying air temperature
V = 1.5 m/s drying air velocity
D = 2.0 m Dryer diameter

2. (a)Suppose you expect to receive GH¢ 2,000 per year for the next 22 years except that you will not receive any payment in year 4, 6, 11 and 18. What is the present value of this amount if the interest rate is 24% per year compounded yearly.

(b) Mr.Greg Greedy deposits GH¢ 65,000 into his savings account at Trustworthy Bank which attracts an interest of 17.6% per year compounded quarterly. He then goes for a GH¢ X 20-year loan from Faithful Bank at an effective annual interest rate of 2.5% compounded continuously. If after 14 years of monthly payment of the loan he borrowed from Faithful bank the remaining amount yet to be paid is equal to the total amount of money gained as interest on the money he deposited at Trustworthy Bank at the end of 12 years calculate the amount borrowed, GHX.

3. (a) You expect to receive the following future cash flows at the end of the years indicated: GH¢600 in year 2, GH¢1400 in year 4, GH¢ 900 in year 5, and GH¢1600 in year 6. If the interest rate is 7% per year what is the value of the four flows at year 5.

(b) Eat Well Company is considering investing in a new food product AA. Given the information givenbelow:

Initial fixed capital investment (C_F) = GH¢ 300,000
Working capital (C_W) = 15% C_T (Total fixed capital Investment)
Service life = 5 years
Salvage value at end of service life = GH¢ 50,000
Market Rate (hurdle rate) = 13%
Depreciation = 50,000 GH¢/year

Year	Profit after tax
1	40,000
2	52,000
3	83,000
4	90,000
5	110,000

(i) Determine the return on investment (ROI) and the net present value (NPV)

(ii) Comment on your results.

4. Healthy Foods Company is considering a project proposal for a newly formulated food product BB. The initial fixed capital investment is GH¢ 9,000,000 and the working capital is GH¢ 1,000,000. The plant can process 36,000 kilograms of food in an hour, and will operate 4,000 hours per year. The expected annual expenses (excluding depreciation costs) is GH¢ 3,000,000 per year. The plant is expected to have a service life of 5 years. The depreciation per year is GH¢ 1,800,000. The tax rate is 25%. The salvage value is zero.

(a) If the required annual rate of return after tax is 15%. Calculate the minimum amount that Healthy Foods Company should charge its customer per kilogram of food product BB

(i) using the return on investment (ROI) method

(ii) using the NPV method?

(b) How would your answer in (a) change if the annual expenditure is increased by 20% due to increase in raw materials, and the production rate per year is also reduced by 10% due to power rationing or power outages?