Name: _____

You are taking this exam under the College of Engineering Honor Code as a graduate engineer. After completing the exam, please write and sign "*I have neither given nor received aid on this exam, nor have I concealed any violation.*"

If you bring me a self addressed, stamped envelope (use two stamps), I will send the exam and course grade to you. **Happy Holidays.**

1. (20%) Identify the following, as they pertain to this course:

equipment ownership expense

modular costing

work breakdown structure

unbilled revenue

cost-capacity exponent

conservatism

prepaid expense

slope constant, *s*

output cost index

straight line depreciation

2. (15%) Bronson Painters has summed its direct costs of performing work in 1994, with the following results. (a) Select the elements and their quantities to make up a **three** element cost index, with 1994 base = 100. (b) Calculate the value of the index in 1999. NA = not available. **SHOW ALL WORK**.

Item	1994 Amount (units)	1994 Price ($/unit)	Total ($)	1999 Price ($/unit)	
Painters	4,000 hr	25/hr	100,000	30/hr	
Exterior latex paint	2,000 gal	12/gal	24,000	18/gal	
Exterior oil paint	1,000 gal	15/gal	15,000	22/gal	
Interior latex paint	3,000 gal	10/gal	30,000	14/gal	
Interior oil paint	1,000 gal	12/gal	12,000	15/gal	
Miscellaneous oil based paint, chemicals	NA	NA	14,000	NA	
Paint thinners, additives (oil based)	NA	NA	6,000	NA	
Miscellaneous materials	NA	NA	5,000	NA	
Miscellaneous tools	NA	NA	4,000	NA	
			210,000		

3. (40%) Primo Developers has contracted excavation of the basement of the Braggo Building to Subbo Construction, at a unit price of \$5.00/CM (meter^3) for an engineer's estimate = 20,000 CM within the basement excavation pay lines. Excavation was scheduled to start day 10 with duration = 34 days and with scheduled completion day 44. **SHOW ALL WORK.**

Subbo estimated it must excavate 27,200 CY (yard^3) to complete the estimated 20,000 CM. Subbo's estimated labor cost was 1088 hr @ \$50.00/hr = \$54,400 and estimated equipment cost was 272 hr @ \$100/hr = \$27,200. Material cost = 0.

Actual start of excavation was day 6. By day 20, excavated quantities are 10,000 CY which results in 8,000 pay CM. The unit price has been decreased by \$0.20/CM to \$4.80/CM. Subbo has used 350 hr labor and 100 hr equipment at labor cost = \$19,000 and equipment cost = \$9,000. Projected excavation required is now 22,000 pay CM.

(a) What is the **percent complete** and what is the **earned value** on the contract and what is Subbo's **revenue earned** on the contract?

(b) Develop formulas and calculate the following **contract variances** (Primo's variances) for work to date (day 20): **cost** variance, **schedule** variance, **cost quantity** variance, **time rate** variance, and **projected cost rate** variance.

(c) Develop formulas and calculate the following **contract control indexes** (Primo's control indexes) for work to date: **cost** control index, **schedule** control index, **quantity** control index, and **time rate** control index.

(d) Develop formulas and calculate the following **contractor cost variances** (Subbo's variances) for work to date: **absolute cost** variance (**$**), **absolute quantity** variance (**equipment hr**), **unit labor productivity rate (hr/CY)** variance, and **projected absolute cost equipment resource** variance (**$**).

(e) Develop formulas and calculate the following **contractor control indexes** (Subbo's control indexes) for work to date: **cost** control index (**$/$**), and **quantity** control index [**(equipment hr)/ (equipment hr)]**.

(f) What are **Subbo's gross income** to date, **gross income variance** to date, and **projected gross income** variance?

4. (25%) Accompanying this exam are spreadsheet input and calculated values (which you may want to tear off for easier use) for purchase of a piece of equipment by a contractor. **SHOW ALL WORK**

(a) Determine the economic life of the equipment using the discounted cash flow method.

(b) How much equipment cost should the contractor charge per hour in estimating costs and submitting a bid for cost reimbursable work, for a life of two years, using the average cost model?

(Extra page to be used for calculations if needed)

	A	B	C	D	E	F	G	H	I
15	**INPUT DATA FOR ALL CASES**								
16	CONSTANTS OVER LIFETIME								
17	First cost					$80,000			
18	Expected rate of return					20%			
19	Insurance, property tax, % value @ start of year					5.0%			
20	Income tax rate					40%			
21	Cost of new tires					$0			
22	Life of tires, hr					10000			
23	Annual tire repair, % of tire wear					0%			
24	Fuel cost, per gallon					$1.50			
25	Oil, lube, per hour					$0.00			
26	Annual hours of use					1000			
27	Crew cost less this equipment (includes operator)					$100.00			
28	Cost of downtime, per hour					$50.00			
29						Year of life			
30	ANNUAL VALUES					0	1	2	3
31	End of year salvage					1.00	0.75	0.60	0.30
32	Fuel use per hour, gallon						4.00	4.00	4.00
33	Output loss, old vs. new						0.00	0.00	0.00
34	Output loss, new vs. replacement						0.00	0.00	0.00
35	Replacement cost multiplier					1.00	1.00	1.00	1.00
36	Repair cost per hour						$0.00	$0.00	$0.00
37	Downtime						0.00	0.00	0.00
38									
39									
40	**CALCULATED VALUES FOR ALL CASES**								
41						Year of life			
42	ANNUAL VALUES					0	1	2	3
43	End of year salvage = (first cost)*(end of yr sal %)					$80,000	$60,000	$48,000	$24,000
44	Value at start of year = (salvage last year)						$80,000	$60,000	$48,000
45	Depreciation = (start of yr value)-(end of yr salvage)						$20,000	$12,000	$24,000
46	Average value for year = ((start of yr val)+(end of yr sal))/2						$70,000	$54,000	$36,000
47	Prop tax, ins = (ins, prop tax %)*(start of yr val)						$4,000	$3,000	$2,400
48	Return on investment = (expected ROR %)*(average value for year)						$14,000	$10,800	$7,200
49	Income tax credit from depreciation = (income tax %)*depreciation						$8,000	$4,800	$9,600
50	Tire wear & repair = (cost/life)*(1 + repair)*hours						$0	$0	$0
51	Fuel = (gal/hr)*($/gal)*hours						$6,000	$6,000	$6,000
52	Oil, lube = ($/hr)*hours						$0	$0	$0
53	Repair = ($/hr)*hours						$0	$0	$0
54	Downtime = (% downtime)*hours*(cost/hr)						$0	$0	$0
55	Output loss = ((1+(vs. new))(1+(vs. rep))-1)								
56	*(hours*(crew cost)+tires+fuel+oil+repairs+downtime)						$0	$0	$0
57	Extra cost of replacement = (first cost)*(replacement cost mult - 1)						$0	$0	$0
58	(P/F,i,n)=1/((1+i)^n)	Note: A & F = continuous A & F				1.00000	0.833333	0.694444	0.5787
59	(P/F,i,n)=i/(((1+i)^n)*ln(1+i))						0.914136	0.76178	0.63482
60	(A/P,i,n)=(((1+i)^n)*ln(1+i))/((1+i)^n-1)						1.093929	0.596689	0.43276