Khulna University of Engineering & Technology
Department of Industrial Engineering and Management
B.Sc. Engineering 3rd Year 1st Term Examination, 2015
IPE 3103
(Engineering Metallurgy)

Full Marks: 210   Time: 3 hrs

N.B: *i) Answer any THREE questions from each section in separate scripts.*
ii) Figures in the right margin indicate full marks.

SECTION–A

1. (a) Write the history of five step metallurgical development in brief. 10
   (b) Compare and contrast: 12
       i)   Metal and non-metal
       ii)   Atomic packing in F.C.C and HCP structures.
   (c) What is crystal imperfection? Explain different types of crystal Imperfections in brief. 13

2. (a) Draw the cooling curve for a pure metal and an alloy. 08
   (b) What information may be obtained from an equilibrium diagram? Describe the lever rule as applied to equilibrium diagram by taking an example. 12
   (c) Bismuth (melting point 520° F) and Cadmium (melting point 610° F) are assumed to be completely soluble in the liquid state and completely insoluble in the solid state. They form a eutectic at 290° F containing 40 percent Cadmium. 15
       i)   Draw the equilibrium diagram on a piece of graph paper labeling all points, lines, and areas.
       ii)   For an alloy containing 70 percent Cadmium give the chemical composition and relative amounts of the phases present at a temperature of 100° F bellow.

3. (a) Draw the Iron-Iron carbide diagram labeling all points, lines, areas, phases and reactions. 11
   (b) Describe completely the changes that take place during the slow cooling of 0.5 percent carbon steel from the austenite range. 09
   (c) Define critical cooling rate. How TT diagram is formed? Explain with neat sketches. 15

4. (a) What is crystallographic plane? Describe the mechanism of crystallization of a pure metal. 14
   (b) Briefly explain with clear sketches the following types of crystal. 15
       i)   BCC
       ii)   FCC
       iii)   CPH
   (c) Define hardness, toughness and ductility. 06

SECTION–B

5. (a) What is heat treatment process of metal? Briefly explain the carburizing, flame hardening and nitriding process. 13
   (b) Why heat treatment of steels is necessary? Explain full annealing process with net sketch. 15
   (c) Write the differences between normalizing and annealing process. 07

6. (a) Write short notes on: 12
       i)   Centrifugal compacting
       ii)   Extrusion
       iii)   Slip casting
   (b) Briefly describe the various finishing operations used in powder metallurgy. 10
   (c) Discuss advantages and limitations of powder metallurgy. 13

7. (a) What is Babbit metal? Explain briefly the Manhe's process for the manufacture of copper.   10

   (b) Write short notes on: 09
   - i) Muntz metal
   - ii) Y-Alloy
   - iii) Gunmetals

   (c) Briefly describe some non-metallic tool materials.   10

   (d) Name the various types of cutting-tool materials. Among them which material is best suited for grinding purpose?   06

8. (a) What is meant by non-destructive testing? Briefly discuss the following NDT testing with neat sketches.   18
   - i) Liquid Penetrant
   - ii) Ultrasonic
   - iii) X-ray

   (b) Write down the advantages and disadvantages of the following NDT method: 12
   - i) Magnetic
   - ii) Eddy current
   - iii) Visual inspection

   (c) Write down some common applications of NDT method   05

Khulna University of Engineering & Technology
Department of Industrial Engineering and Management
B.Sc. Engineering 3rd Year 1st Term Examination, 2015
IPE 3105
(Product Design - I)

Full Marks: 210   Time: 3 hrs

N.B: i) *Answer any THREE questions from each section in separate scripts.*
      ii) *Figures in the right margin indicate full marks.*

SECTION–A

1. (a) What is meant by product development? Write down the major characteristics of successful product development.   10
   (b) What are the challenges in product development of a "Laptop"? Explain.   08
   (c) Describe the activities of concept development process briefly.   17

2. (a) What are the different ways for gathering raw data from customers? Explain them with their key features?   12
   (b) Write down some guidelines to interpret raw data in terms of customer needs. Explain with proper examples.   13
   (c) Prepare a mission statement for office desk.   10

3. (a) What is meant by target values? In how many ways you can set the values of metrics? Explain.   11
   (b) Describe the five step concept generation method briefly.   14
   (c) Draw a concept classification tree with a suitable example.   10

4. (a) Why is concept selection an integral part of the product development process?   10
   (b) Mention the differences between concept screening and scoring techniques.   10
   (c) In developing a reusable syringe four concepts are screened out from different alternatives. The table (table - 1) shows the selection criteria, their corresponding weights and the ratings for each concept. Now calculate the total score for each concept, rank them and select the concept which should be developed.   15

| | | | Concept | | |
		A(Reference)	B	C	D
Selection Criteria	Weight	Rating	Rating	Rating	Rating
Ease of handling	5%	3	3	4	4
Ease of Use	15%	3	4	4	3
Reiability of setting	10%	3	3	5	5
Metering accuracy	25%	3	3	2	3
Durability	15%	3	3	4	3
Ease of manufacture	20%	3	3	2	2
Probability	10%	3	3	3	3

SECTION–B

5. (a) How can you define the term "Prototype"? Classify prototypes and describe each type with example.   15
   (b) What is meant by the term Industrial Design (ID)? Under what conditions would ID increase or decrease manufacturing cost? Explain.   10
   (c) Describe the different types of modularity of product architectures.   10

6. (a) What is meant by intellectual property? Write down the names of various intellectual properties with their distinguished characteristics.   10
   (b) Among all the principles of mechanical design considerations which seven of them are most essential for DFMA?   07
   (c) Design an experiment to determine a robust process for a seat belt using L8 orthogonal array. Assume all data necessary.   18

7. (a) Why does Kano-model come? How can the product features be developed depending on the customer satisfactions? Explain with suitable graphical arguments. 11

    (b) Explain the interactions between the project and the macro environment. 10

    (c) Build a quantitative model to analyze the development and sale of a bicycle light. Assume that you could sell 20,000 units per year for five years at a sales price of $20 per unit and a manufacturing cost of $10 per unit. Assume that production ramp-up expenses would be $20,000, ongoing marketing and support costs would be $2000 per month, and development would take another 12 months. 14

8. (a) What is meant by the term vertical integration? What types of companies are more likely to become vertically integrated? 07

    (b) What is value engineering? Write down the steps of Value Engineering. 10

    (c) Briefly explain the relationship between product design and process selection. 08

    (d) Identify the two general types of operations. What are their characteristics? 10

Khulna University of Engineering & Technology
Department of Industrial Engineering and Management
B.Sc. Engineering 3rd Year 1st Term Examination, 2015
IPE 3115
(Engineering Economy)

Full Marks: 210   Time: 3 hrs

N.B: i) Answer any THREE questions from each section in separate scripts.
ii) Figures in the right margin indicate full marks.

SECTION–A

1. (a) Define Engineering Economy. Why is engineering economy important to engineers?   10
   (b) If the value of Janes's retirement portfolio increased from $170000 to $ 813000 over a 15 years period, with no deposits made to the account over that period, what annual rate of return did she make?   10
   (c) For the cash flows show below, find EUAW, i = 10% per year.   15
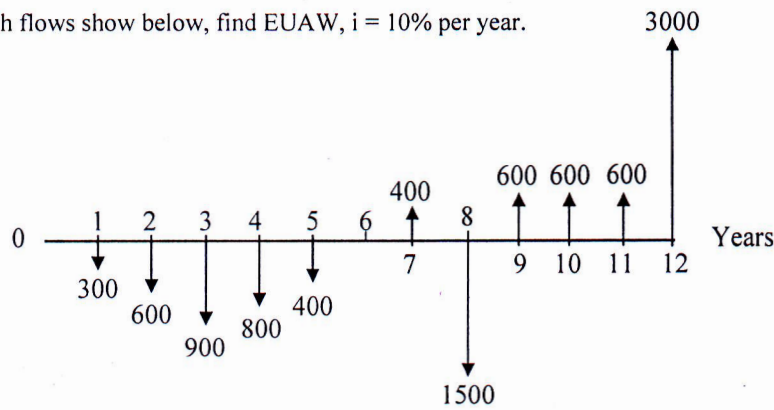
2. (a) Define and explain arithmetic and geometric gradient.   08
   (b) Determine the present worth of a geometric gradient series with a cash flow of $50000 in year 1 and increases of 6% each year through year 8. The interest rate is 10% per year.   12
   (c) For the cash flow shown below, calculate the equivalent uniform annual cost in years 1 through 5 and the present worth of the cash flow. Assume that the interest rate is 12% per year.   15

Year	1	2	3	4	5
Cash flow, $	5000	5400	5800	6200	6600

3. (a) A consulting engineering firm is trying to decide between purchasing and leasing cars. It estimates that medium-sized cars will cost $8300 and will have a probable trade-in value in 4 years of $2800. The annual cost of such items as fuel and repairs is expected to be $950 the first year and to increase by $50 per year. Alternatively, the company can lease the same cars for $3500 per year payable at the beginning of each year. Since some maintenance is included in the rental price, the annual maintenance and operation expenses are expected to be $100 lower if the cars are leased. If the company's minimum rate of return is 20% per year, which alternative should be selected?   18
   (b) Compare the machines below on the basis of their present worth, using an interest rate of 18% per year.   17

	Machine P	Machine Q
First cost	$23000	$37000
Salvage value	4000	5000
Life years	3	5
Annual maintenance cost	3000	3500
Overhaul every 2 years	3700	2000

4. (a) What is meant by capital rationing? Explain.   05
   (b) Compare the alternatives shown on the basis of their capitalized costs using an interest rate of 10% per year.   13

	Alternative M	Alternative N
First cost, $	-150000	-800000
Annual operating cost, $ per year	-50000	-12000
Salvage value, $	8000	100000
Life, years	5	∞

(c) A patriotic group of firefighters is raising money to erect a permanent (i.e., infinite life) monument in 17 New York city to honor those killed in the line of duty. The initial cost of the monument will be $150,000 and the annual maintenance will cost $5000. There will be an additional on-time cost of $20,000 in 2 years to add names of those who were missed initially. At an interest rate of 6% per year, how much money must they raise now in order to construct and maintain the monument forever?

SECTION–B

5. (a) Define depreciation. What is the significance of switching between depreciation models? 08

(b) A company car is purchased for $9000 and is to be depreciated over 8 years and then sold for an 17 estimated $750. (a) Start with DDB depreciation and perform an analysis to determine the maximum depreciation allowed each year if switching to SL is allowed at any time. Let, i = 12% per year. (b) Repeat the analysis above, using the declining-balance method at a rate equal to 150% of the SL rate.

(c) A company pick-up truck has a first cost of $12000, a salvage value of $ 2000, and a recovery period 10 of 8 years. Use the SYD method to tabulate the recovery rate, depreciation amount, and book value for each year.

6. (a) A bank is offering a 10-year certificate of deposit (CD) at an interest rate of 10% per year. Any 17 person who takes the offer will also receive a toaster. If the inflation rate during the next 10 years is expected to be 13% per year, how much money must a person have at the end of 10 years just to be able to buy the same things she can buy now for $10,000? Assume the cost of those things will increase by only 8% per year.

(b) The charley company has been offered an investment opportunity that will require a cash outlay of 18 $30000 now for a cash inflow of $3500 for each year of investment. However, the company must state now the number of years it will retain the investment. If the investment is kept for 6 years, $25000 can be gotten for the company's shame, but after 10 years the resale value will be only $12000. If money is worth 8% per year, is the decision sensitive to the retention period?

7. (a) You and your spouse have to make the decision to keep your present car or purchase a new one. A 20 new car will cost $10000, last you 7 years, have annual maintenance cost of $200 the first year increasing by $100 per year thereafter, and sell for $3000 in 7 years. If you retain the currently owned car, expected trade-in value and annual maintenance are as follows:

Additional years retained	Annual maintenance cost	Trade-in value
1	$1800	$2500
2	1500	2000
3	1500	1500

You will not consider keeping the car for more than an additional 3 years, at which time you anticipate a $1000 sales price. If all other costs are considered equal for the tow cars, use i = 15% to determine when to purchase a new car. (Neglect financing complications in the new car by assuming that you have just own a contest which gives you a sum of $10000 after taxes).

(b) i) Use EUAW analysis to evaluate the alternatives below if the retention years are the maximum life. 15
ii) If a 10% per-year return, payback period analysis is used to evaluate the alternatives, with no EUAW computations, is the decision different? Why?

Machine 1	Machine 2
B = $12,000	B = $8,000
Cash flow = $3,000 per year	Cash flow = $1,000 (years 1-5) $3,000 (years 6-15)
Maximum n = 7 years	Maximum n = 15 years

8. (a) Select the best mutually exclusive alternative using the B/C ratio method from the proposals shown 20 below if the MARR is 10% per year and the projects will have a useful life of 15 years. Assume that the cost of the land will be recovered when the project is terminated. Treat maintenance cost as disbenefits.

	Proposal						
	1	2	3	4	5	6	7
Land cost, $	50,000	40,000	70,000	80,000	90,000	65,000	75,000
Instruction cost, $	200,000	150,000	170,000	185,000	165,000	175,000	190,000
Annual maintenance, $	15,000	16,000	14,000	17,000	18,000	13,000	12,000
Annual income,$	52,000	49,000	68,000	50,000	81,000	77,000	45,000

(b) Management if the Hoof cattle company has decided it can invest in any three of four available 15 proposals. Each proposal has an initial investment of $10000 and a specified present worth value at i= 18%. Select the proposals which offer the best investment opportunity.

Proposal	Life years	Proposal present worth at 18%
1	13	$1840
2	5	375
3	10	-1800
4	8	25

Khulna University of Engineering & Technology
Department of Industrial Engineering and Management
B.Sc. Engineering 3rd Year 1st Term Examination, 2015
IPE 3119
(Operations Management)

Full Marks: 210   Time: 3 hrs

N.B: i) Answer any THREE questions from each section in separate scripts.
ii) Figures in the right margin indicate full marks.

SECTION–A

1. (a) Define 'Operation' and 'Operation Management'.   10
    (b) Describe different types of production system.   15
    (c) Briefly describe the functions of operations management.   10

2. (a) Define forecasting. What are factors to be considered for selecting forecasting method? Explain.   10
    (b) Briefly describe the Delphi Technique. What are its main benefits and weakness?   10
    (c) The manager of a travel agency has been using a seasonally adjusted forecast to predict demand for   15
    packaged tours. The actual and predicted values are following table:

Period	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Demand	129	194	156	91	85	132	126	126	95	149	98	85	137	134
Predicted	124	200	150	94	80	140	128	124	100	150	94	80	140	128

   i) Compute MAD for the fifth period, then update it period by period using exponential smoothing with $\alpha = 0.3$.
   ii) Compute a tracking signal for periods 5 through 14 using the initial and updated MADs. If limits of ± 4 are used, what can you conclude?

3. (a) What is meant by aggregate production planning? What are the inputs and outputs of an aggregate   10
    production plans?
    (b) Briefly explain the strategies generally followed for aggregate production planning.   10
    (c) The forecast value of certain goods are shown below: 15

Period	1	2	3	4	5	6	7	8	9	total
Forecast	190	230	260	280	210	170	160	260	180	1940

The department now has 20 full time employees, each of whom can produce 10 units of outputs per period. The manager is considering a plan that would involve hiring two people to start working in period 1, one on a temporary basis who would work only through period 5. Make a production plan for this strategy.

4. (a) Explain the necessity of Gantt Charts in operations management.   05
    (b) A group six jobs is to be processed through a two-machine flow shop. The first operation involves   15
    cleaning and the second involving painting. Determine a sequence that will minimize the total completion time for this group of jobs, idle time for each work center. Processing times are as follows:

	Processing Time (Hours)	
Job	Work Center 1	work Center 2
A	5	5
B	4	3
C	8	9
D	2	7
E	6	8
F	12	15

   (c) Given the following information on job times and due dates, determine the optimal processing   15
   sequence using i) FCFS ii) SPT and iii) EDD. For each method find the average job flow time and the average job tardiness.

| Job	Job Time (hours)	Due Date (hours)
a	3.5	7
b	2.0	6
c	4.5	18
d	5.0	22
e	2.5	4
f	6.0	20

5. (a) Name different kinds of inventories those are carried by a typical manufacturing firm. What are the requirements for effective inventory management? **10**

   (b) Explain the three types of basic costs associated with inventories. **12**

   (c) The Dine corporation is both a producer and a user of brass coupling. The firm operates 220 days a year and uses the couplings at a steady rate of 50 per day. Coupling can be produced at a rate of 200 per day. Annual storage cost is $2 per coupling and machine setup cost is $ 70 per run. **13**

       i) Determine the economic production quantity.

       ii) Approximately how many runs per year will there be?

       iii) Compute the maximum inventory level.

6. (a) What is meant by service level? Explain how does service level affect on safety stock? **10**

   (b) A restaurant uses an average of 50 jars of a special sauce each week. Weekly usage of sauce has a standard deviation of 3 jars. The manager is willing to accept no more than a 10 percent risk of stock out during lead time, which is two weeks. Assume the distribution of usage is normal. **10**

       i) How safety stock should be held?

       ii) Determine the ROP.

   (c) Prepare a MPS for the following situation. The forecast per period is 70 units. The starting inventory is zero. The MPS rule is to schedule production is the projected inventory on hand is negative. The production lot size is 100 units. The following table shows committed orders. **15**

 | Period | 1 | 2 | 3 | 4 |
   |---|---|---|---|---|
   | Customer Orders | 80 | 50 | 30 | 10 |

7. (a) What is MRP II? Show overview of MRP II. **07**

   (b) Write short notes on the followings: **08**

       i) BOM   ii) Product Structure Tree

       iii) Planned-order receipts   iv) Planned-order releases

   (c) Given the following product structure, BOM, MPS and inventory status. Develop MRP tables for item A and D using EOQ method. **20**
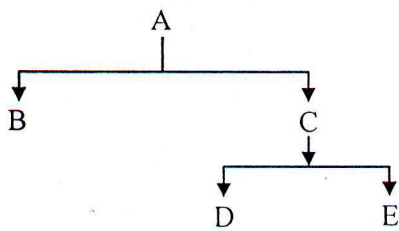
	Master Production Schedule					
Month	1	2	3	4	5	6
Projected Requirement	-	100	-	80	150	200

	Bill of Materials		
Item	No. of Units Required	Initial Stock	Lead Time
A	1	125	1
B	1	20	2
C	1	30	1
D	1	50	1
E	1	100	1

8. (a) What do you mean by project? Write down the responsibilities of a project manager. **09**

   (b) Using the computation algorithm determine the slack time for the following AOA diagram. Identify the activities that are on the critical path. **16**
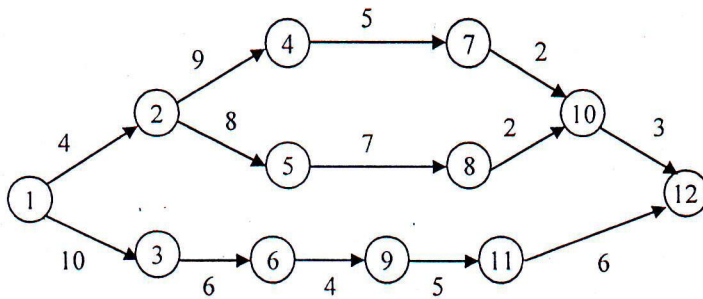
   (c) What is JIT? Make a comparison between JIT and traditional production philosophies. **10**

Khulna University of Engineering & Technology
Department of Industrial Engineering and Management
B.Sc. Engineering 3rd Year 1st Term Examination, 2015
ME 3111
(Fluid Mechanics and Machinery)

Full Marks: 210   Time: 3 hrs

N.B: i) *Answer any THREE questions from each section in separate scripts.*
ii) *Figures in the right margin indicate full marks.*

SECTION–A

1. (a) What is fluid? Describe the characteristics of fluid.   10
    (b) What is viscosity? State and prove Newton's law of viscosity.   13
    (c) For the micro manometer shown in figure 1(c) find the pressure difference between points A and B.   12
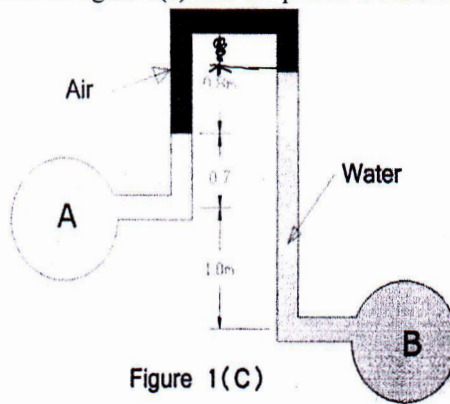

Figure 1(C)

2. (a) What is Absolute pressure? For positive gauge pressure draw the relationship among absolute,   10
         atmospheric and gauge pressure.
    (b) What is gauge pressure? What are the differences between positive and negative gauge pressure?   13
    (c) A micromanometer, having ratio of basin to limb areas as 40, was used to determine the pressure in a   12
         pipe containing water. Determine the pressure in the pipe for manometer reading shown in figure
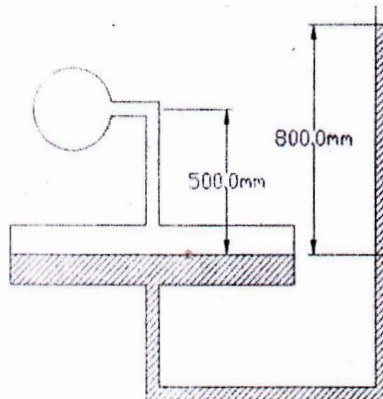   2(c).

Figure 2(C)

3. (a) State and explain the Bernoulli's Equation for real fluid.   12
    (b) With the help of Q net diagram, describe the construction and working of a pitot-static tube.   12
    (c) A horizontal water pipe of diameter 15cm converges to 7.5 cm diameter. If the pressures at the two   11
         sections are 4 Kgf/cm^2 and 1.5 kgf/cm^2 respectively, calculate the flow rate of water.

4. (a) Write down the difference between laminar and turbulent flow.   08
    (b) Explain the following terms: 12
         i)   Vena Contracta,
         ii) Co-efficient of discharge,
         iii) Co-efficient of Velocity and
         iv) Co-efficient of contraction.
    (c) Find the discharge through a drowned orifice of width 3m, if the difference of water levels on both   15
         sides of the orifice is 0.5 m. The heights of the water levels from the top and bottom of the orifice are
         2.5 m and 2.75 m respectively. Take $C_d = 0.6$

5. (a) What is meant by slip of a reciprocating pump? For what purpose an air vessel is connected to reciprocating pump?   10

    (b) Derive an expression for the work done on a double acting reciprocating pump.   13

    (c) Water is raised to a height of 20m above the sump level by a single acting reciprocating pump having a bore of 15cm and a stroke of 30cm. If the pump has a speed of 60 r.p.m., find the theoretical power and the theoretical discharge. If the efficiency of the pump is 70%, calculate the actual power. If the pump has an actual discharge of 0.0052 cumecs, find the percentage of slip.   12

6. (a) What is priming? Why reciprocating pump is called the positive displacement pump?   08

    (b) Derive an expression for Euler's momentum equation for centrifugal pump.   15

    (c) A centrifugal pump has an impeller 50 cm outer diameter and is running 500 r.p.m. and discharging 125 litres/second against a head of 9 m. If the area of flow is constant from inlet to outlet equal to 0.06 m^2 and the vane angles at outlet are set back 45°, determine   12

        i) The manometric efficiency.

        ii) The vane angle at inlet. Assume that the water enters the impellers without shocks. The inner diameter of the impeller is 25 cm.

7. (a) Write down the function of spear, casing and braking jet of a pelton wheel.   06

    (b) Prove that the maximum efficiency of pelton wheel $(\eta_h)_{max} = \frac{1}{2}(1 + k\cos\varphi)$ where the symbols have their usual meanings.   15

    (c) A pelton wheel is required to work under a head of 39.6 m and to develop 74.605 kW (101.4 h.p) at 250 r.p.m. Assuming an efficiency of 80 percent and a co-efficient of velocity of 0.98 find the jet diameter, the diameter of the bucket. The size of the bucket and the number of buckets required.   14

8. (a) What are the differences between Reaction and Impulse turbine?   08

    (b) What is a draft tube? Derive an expression for the efficiency of a draft tube.   15

    (c) A Francis turbine runner is to be designed for the following data: 12

Net head (H) = 60 m, Shaft power = 367.875 kW (500 h.p.), Speed (N) = 600 r.p.m, hydraulic efficiency 85%, Overall efficiency = 80%, flow rate = 0.15 and breath ratio = 0.10. Assume the inner diameter as one-half the outer diameter. The velocity of flow is constant throughout. The discharge is radial. Neglect vane thickness.

Determine the vane angles at the inlet and outlet.