

Khulna University of Engineering & Technology
Department of Industrial Engineering and Management

B.Sc. Engineering 3rd Year 1st Term Examination, 2018

IPE 3103

Engineering Metallurgy

Full Marks: 210

Time: 03 hrs

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

SECTION-A

1. (a) What is meant by phase diagram? What are the differences between unary and binary phase diagram? Explain Gibbs Phase Rule. 15
- (b) Explain the physical significance of Lever Rule with an example. 12
- (c) Discuss why Lever Rule is not used in single phase region? 08

2. (a) What is the difference between brittle fracture and ductile fracture? 10
- (b) Define a solid. Why glass is not considered a true solid? 10
- (c) Produce clear sketches to show the arrangements of atoms in the following types of crystal: (i) BCC (ii) FCC (iii) CPH 09
- (d) Differentiate between a crystal, a dendrite, and a grain. 06

3. (a) Lead melts at 620⁰F and tin melts at 450⁰F. They form a eutectic containing 62% tin at 620⁰F. The maximum solid solubility of tin in lead at this temperature is 19%; of lead in tin, 3%. Assume the solubility of each at room temperature is 1%. 18
- (i) Draw the equilibrium diagram to scale on a piece of graph paper labeling all points, lines, and areas.
- (ii) Describe the solidification of a 40% tin alloy. Sketch its microstructure at room temperature, giving the chemical composition and relative amounts of phases present.
- (iii) Draw the cooling curve for the above alloy.
- (b) What is meant by crystal defect? What are the differences between point and line defect? 09
- (c) Describe the stages involved in ductile fracture. 08

4. (a) With the aid of an iron-iron carbide equilibrium diagram describe the upper and lower critical lines. 12
- (b) Explain the significance of eutectic, eutectoid, and peritectic transformation in iron-iron carbide equilibrium diagram. 13
- (c) Describe the changes that take place during rapid cooling of 0.8% C steel from austenite range to room temperature. 10

SECTION-B

5. (a) What is heat treatment process of metal? Briefly explain the carburizing, and nitriding process. 10
- (b) What is martensitic transformation? What is the difference between tempering and annealing? 10
- (c) What is TTT diagram? Describe the TTT diagram for 1080 eutectoid steel at 1300⁰F. 15

6. (a) What is powder metallurgy? Briefly discuss the various finishing operation used in powder metallurgy. 08
- (b) Write down the application of powder metallurgy part and briefly discuss the advantages of powder metallurgy process. 12
- (c) Explain the following operations of the powder metal process: (i) compacting (ii) Sintering, and (iii) Hot pressing 15
7. (a) What is NDT? Briefly discuss the following NDT methods: (i) Eddy current test (ii) Ultra sonic inspection, and (iii) X-ray inspection 20
- (b) Briefly discuss the Babbit metal and White metal. 10
- (c) Write down the basic difference between a metal and an alloy. 05
8. (a) What is ferrous metals? Write short notes on Muntt metal and Gun metal. 12
- (b) Briefly discuss about the causes and remedial actions of tool failure. 08
- (c) How aluminum is produced? Explain every step briefly. 15

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IPE 3105

Product Design-I

Full Marks: 210

Time: 03 hrs

- N.B:** i) Answer any **THREE** questions from each section in separate scripts.
ii) Figures in the right margin indicate full marks.
iii) Assume reasonable data if missing any.

SECTION-A

1. (a) What is meant by Product Development? Describe the characteristics of a successful product development process. 12
- (b) Write down the generic process to develop a product. 10
- (c) What are the different issues to choose an organizational structure for product development? Explain briefly. 13

2. (a) Describe product life cycle with appropriate example. Also mention some extension policies of product life cycle. 13
- (b) What is product plan? How new product platforms are differ from derivatives of existing product platforms and incremental improvements to existing products. 10
- (c) Interpret the following raw data in terms of customer need for a vegetable peeler. 12
 - (i) "I cut myself with this one"
 - (ii) "I am left-handed, I use a knife"
 - (iii) "This one is fast but it takes a lot-off"
 - (iv) "I just leave the skin on"
 - (v) "How do you peel a squash"
 - (vi) "This looked ok in the store"

3. (a) "Focus group discussion are preferable than interviews and observing the product in use"—Explain this statement. 10
- (b) How might a portfolio of development projects differ if the firm believes a particular product technology is currently at position A or B on the technology s-curve shown in figure 3(b)? 13

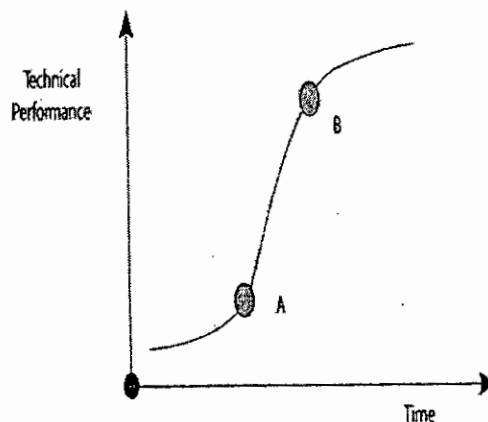


Figure 3(b)

- (c) List a set of metrics corresponding to the need that a pen write smoothly. 12

4. (a) What would be the relative advantages and disadvantages of involving actual customers in the concept generation process? 10
- (b) Perform concept screening for the four pencil holder concepts as shown in figure 4(b). 10

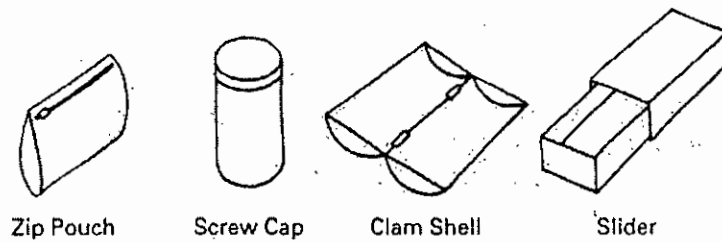


Figure 4(b)

- (c) What are some different ways you could communicate a concept for a new user interface for an automotive audio system? What are the strengths and weaknesses of each approach? 15

SECTION-B

5. (a) Define 'Product Architecture'. Do service products such as bank accounts or insurance policies, have architectures? 10
- (b) Discuss about the impact of ergonomic needs on the product development process. 12
- (c) What is meant by "Industrial Design"? Under what conditions would industrial design increase or decrease manufacturing costs? Explain. 13
6. (a) List 10 reasons why reducing the number of parts in a product might reduce production costs. Also list some reasons why costs might increase. 10
- (b) Devise a prototyping plan for investigating the comfort of different types of handles for kitchen knives. 12
- (c) Is a drawing a physical or analytical prototype? Why (or why not)? What are prototypes used for? 13
7. (a) Design an experiment to determine a robust process for making coffee. 13
- (b) Is it possible to determine what a product really costs once it is put into production? If so, how might you do this? 12
- (c) Write short notes on – 10
- (i) Black Box component procurement (ii) Error proofing
8. (a) Define House of Quality (HoQ). Why it is important in product development? Explain with suitable examples. 12
- (b) List some firms that you feel have a strong corporate identity. What aspects of their products helped to develop this identity? 13
- (c) Write short notes on – 10
- (i) Concurrent Engineering (ii) The Bill of Materials

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IPE 3115

Engineering Economy

Full Marks: 210

Time: 3 hrs

N.B: i) Answer any **THREE** questions from each section in separate scripts.
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 iii) Assume reasonable data if missing any.

SECTION-A

1. (a) Define engineering economy. Why is engineering economy important to engineers? 13
- (b) Classify strategic engineering economic decisions. Discuss any one of them. 12
- (c) A new pickup truck has a first cost of Tk.8000 and is expected to last 6 years with a Tk. 1,300 salvage value. The operating cost of the vehicle is expected to be Tk.1700 the first year, increasing by 11% per year thereafter. Determine the equivalent present cost of the truck if the interest rate is 8% per year. 10

2. (a) Apple computer wants to have \$2.1 billion available 5 years from now to finance production of a handheld "electronic brain" that based on your behavior, will learn how to control nearly all the electronics device in your home, such as the thermostat, coffee pot, TV etc.. The company expects to set aside uniformly increasing amounts of money each year to meet the goal. If the amount set aside at the end of year 1 is \$ 50 million, how much will the constant increase G have to be each year? Assume the investment account grows at a rate of 18% per year. 10
- (b) For the cash flows shown in figure 2 (b), determine the value of x that will make the future worth in year 8 equal to \$70,000. 13

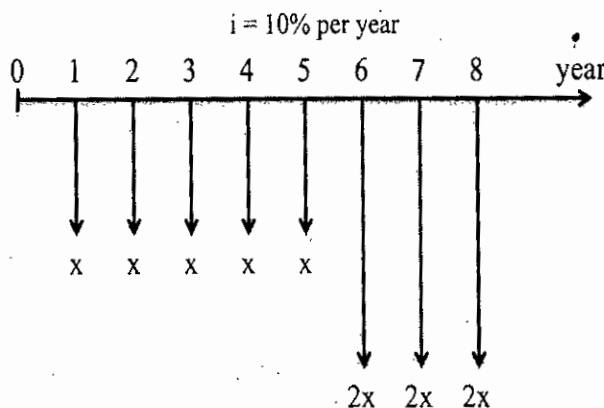


Fig. 2 (b)

- (c) For the cash flows shown in figure 2 (c), determine the present worth in year 0, future worth in year 8 and equivalent uniform annual worth at an interest rate of 10% per year, 12

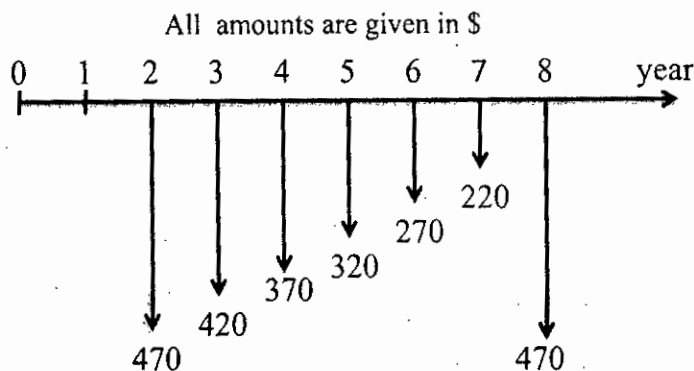


Fig. 2 (c)

3. (a) Differentiate between nominal and effective interest rate. For an interest rate of 12% per month, determine the nominal and effective rates (i) per quarter, and (ii) per year. 10

- (b) An electric switch manufacturing company has to choose one of three different assembly methods. Method A will have first cost of \$40,000, an annual operating cost of 9,000 and a service life of 2 years. Method B will cost \$80,000 to buy and will have an annual operating cost of \$6,000 over its 4-years service life. Method C will cost \$130,000 initially with an annual operating cost of \$4,000 over its 8-years life. Methods A and B will have no salvage value, but Method C will have some equipment worth an estimated \$12,000. Which method should be selected? Use present worth analysis at an interest rate of 10 % per year. 12
- (c) 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, \$	-150,000	-800,000
Annual operating cost, \$/year	-50,000	-12,000
Salvage value,\$	8,000	1,000,000
Life, years	5	∞

4. (a) Two processes can be used for producing a polymer that reduces friction loss in engines. Process T will have a first cost of \$750,000, an operating cost of \$60,000 per year, and a salvage value of \$80,000 after its 2 years life. Process W will have a first cost of \$1,350,000, an operating cost of \$25,000 per year, and a \$120,000 salvage value after its 4 years life. Process W will also require updating at the end of year 2 at a cost of \$90,000. Which process should be selected on the basis of a future worth analysis at an interest rate of 12% per year? 17
- (b) Ten years ago, Jacobson Recovery purchased a wrecker for \$285,000 to move disabled 18-wheelers. He anticipated a salvage value of \$50,000 after 10 years. During this time his average annual revenue totaled \$52,000. (i) Did he recover his investment and a 12% per year return? (ii) If the annual M&O cost was \$ 10,000 for the first year and increased by a constant \$1000 per year, was the AW positive or negative at 12% per year? Assume the \$50,000 salvage was realized. 18

SECTION-B

5. (a) A flood control project will have a first cost of \$14 million with an annual maintenance cost of \$40,000 and a 10 years life. Reduced flood damage is expected to amount to \$175,000 per year. Lost income to farmers is estimated to be \$25,000 per year. At an interest rate of 6% per year, should the project be undertaken? 15
- (b) The effectiveness measure E is the number of graduates from adult training programs. For the CERs shown, determine which independent programs should be selected; b = \$500,000. CER = Cost Effectiveness Ratio. 20

Program	CER, \$/graduate	Program cost, \$
A	1203	305,000
B	752	98,000
C	2010	126,000
D	1830	365,000
E	1050	150,000

6. (a) Define the terms (i) Defender (ii) Challenger (iii) Market value (iv) Economic service life (v) Sunk cost (vi) Opportunity cost (vii) Defender and challenger first cost. 15
- (b) Determine the economic service life of an asset which has the costs shown below. Let $i = 10\%$. 20

Year	Cost, \$/year	Salvage value,-\$
0	-20,000	-
1	-5,000	10,000
2	-6,500	8,000
3	-9,000	5,000
4	-11,000	5,000
5	-15,000	3,000

7. (a) Define ROR and MARR on the basis of engineering economy. Also define Descarte's rule and Norstrom's criteria for solving rate of return equation. 10

- (b) For the cash flows shown, determine the rate of return.

12

Year	0	1	2	3	4	5
Expense,\$	-17,000	-2,500	-2,500	-2,500	-2,500	-2,500
Revenue,\$	0	5,000	6,000	7,000	8,000	12,000

- (c) The five mutually exclusive alternatives shown below are under consideration for improving visitor safety and access to additional areas of a national park. If all alternatives are considered to last indefinitely, determine which should be selected on the basis of a rate of return analysis using an interest rate of 10%.

13

Alternatives	A	B	C	D	E
First cost, \$ millions	-20	-40	-35	-90	-70
Annual M&O cost,\$ millions	-2	-1.5	-1.9	-1.1	-1.3

8. (a) Define inflation. A honing machine will have a cost of \$25,000 (future cost) six years from now. Find the pw of the machine, if the real interest rate is 10% per year and the inflation rate is 5% per year using (i) constant value dollars, and (ii) future dollars
- (b) Define Book value, Recovery period and Depreciation rate (d_i). An asset has a first cost of \$45,000, a recovery period of 5 years, and a \$3,000 salvage value. Use the switching procedure from DDB to SL depreciation, and calculate the present worth of depreciation at $i = 18\%$ per year.
- DDB, Double Decline Balance Depreciation
- SL, Straight Line Depreciation.

15

20

