Khulna University of Engineering & Technology
Department of Industrial Engineering and Management
B.Sc. Engineering 3rd Year 1st Term Examination, 2019
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.
iii) Assume reasonable data if missing any.

SECTION-A

1. (a) Write down the history of metallurgical development in brief.   10
   (b) What is meant by phase diagram? What are the differences between unary and binary phase diagram?   12
   (c) What are the most important crystal imperfections? With the help of necessary diagram differentiate between edge and screw dislocation.   13

2. (a) What is equilibrium diagram? Explain its importance to develop new alloys.   12
   (b) Show that volume of the H.C.P unit cell is $\frac{3}{2}\sqrt{3}\ a^2c$, where the symbols have their usual meanings.   13
   (c) Discuss the mechanism of crystallization briefly.   10

3. (a) Explain the following microstructures: (i) Pearlite (ii) Ferrite   07
   (b) Bismuth (melting point 520^0 F) and cadmium (melting point 610^0 F) are assumed to be completely soluble in the liquid state and completely insoluble in the solid state. They form a eutectic at 290^0 F containing 40% cadmium.   18
        i) Draw the equilibrium diagram to scale on a piece of graph paper labeling all points, lines and areas.
        ii) For an alloy containing 70% cadmium; give the temperature of initial solidification and give the chemical composition and relative amounts of the phases present at a temperature of 100^0 F.
   (c) What is crystal defect? Write down the differences between point and line defect, with necessary sketch.   10

4. (a) Find the number of atoms by showing the following planes of a b.c.c structure: (i) 100 (ii) 110 (iii) 111 (iv) 221   12
   (b) A metal was to be extracted from an ore. But accidently some iron fillings fell in the crushed ore. How can these iron fillings be separated from the ore?   11
   (c) Define gangue. Explain the peritectic, eutectic and eutectoid reaction with suitable example.   12

SECTION-B

5. (a) What is nondestructive testing? Which nondestructive testing method is best suited to determine the wall thickness at the bottom of a steel tank? How can be determined? Explain.   15
   (b) Briefly explain the Eddy Current NDT method with necessary sketches.   10
   (c) What is a spheroilite? Write down the differences between tempering and annealing.   10

6. (a) Show the relationship between martensite formation and temperature and explain the statement " The Ms temperature seems to be a function of chemical composition"   13
   (b) How does surface condition of a steel affect the cooling rate? Explain with necessary figures.   10
   (c) Discuss the mixing techniques of metal powders and lubricants.   12

7. (a) Write down the basic properties that tool materials must possess. Also write down the 15 properties of different elements used in cutting tool materials.

   (b) Which stainless steel is best suited for surgical instruments? Explain.   10

   (c) Write short notes on following metal: (i) White metal (ii) Gun Meal.   10

8. (a) Write down the effects of the following alloying elements in steel: (i) Chromium (ii) 09 Aluminum (iii) Manganese.

   (b) Define critical cooling rate (CCR). Write down the factors those are influence CCR.   10

   (c) Briefly describe the raw materials used in production of iron and steel.   10

   (d) Write down the advantages and disadvantages of magnetic particle NDT inspection.   06

Khulna University of Engineering & Technology
Department of Industrial Engineering and Management
B.Sc. Engineering 3rd Year 1st Term Examination, 2019

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. 10

   (b) What are the challenges of product development? How do the attributes "Creation" and "Team Spirit" contribute to make the product development interesting? 12

   (c) Define the term "Structured Method". Why structured methods are valuable? Why product development process is called a structured method? 13

2. (a) Why product life cycle is look like a bathtub? Mention some extension policies of product life cycle. 12

   (b) What is a product? Make a comparison among market-pull products, technology-push products and process-intensive products. 10

   (c) Is there an analogy between a University and a product development organization? Is a University a functional or project organization? Explain your answer. 13

3. (a) Define "Mission Statement". What should be the mission statement to launch a new printer? 12

   (b) How are the raw data interpreted in terms of customer needs? 10

   (c) Choose a product that continually annoys you. Identify the needs the developers of this product missed. Why do you think these needs were not met? 13

4. (a) Write down the functions of technical models and cost models of the product in setting the final specifications. 10

   (b) Generate 20 concepts for the sub-problem "prevent opening the cap of a pen" as the part of a new pen development. 12

   (c) Propose a set of selection criteria for the choice of a battery technology for use in a portable computer. Distinguish between Concept Screening and Concept Scoring. 13

SECTION-B

5. (a) Write short notes on soft models and hard models. 08

   (b) Describe any two methods of reducing the cost of components. 12

   (c) What is industrial design? How can the importance of industrial design be assessed to a particular product? Explain with relevant examples. 15

6. (a) What is meant by design for manufacturing? Demonstrate the flow diagram of DFM method. 12

   (b) Write down the ideal characteristics of a part for an assembly. 10

   (c) What is meant by DFMA? Explain various manufacturing costs. 13

7. (a) Define prototype and prototyping. Why prototypes are used? Explain. ·12

(b) Devise a prototyping plan for investigating the comfort of different types of 11
handles for kitchen knives.

(c) Write short notes on: 12
i) Robust design, ii) Concurrent engineering and iii) Value engineering.

8. (a) Discuss control factor, noise factor and performance metric with examples. 12

(b) What is IP? Discuss its necessity for the development of a country. 10

(c) Why and how sensitivity analysis is performed in economic analysis of product 13
development project? Discuss with examples.

Khulna University of Engineering & Technology
Department of Industrial Engineering and Management
B.Sc. Engineering 3rd Year 1st Term Examination, 2019
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.
iii) Assume reasonable data if missing any.

SECTION-A

1. (a) Define specific weight, the mass density, specific volume and specific gravity. 10
   (b) What is absolute pressure? For positive gage pressure draw the relationship among absolute, atmospheric and gage pressure. 12
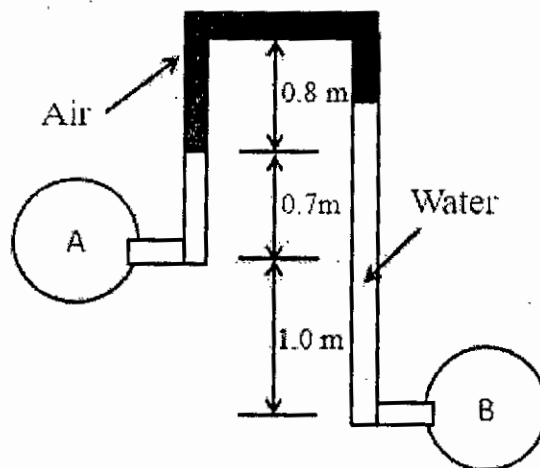   (c) For the manometer shown in figure 1 (c) find the pressure difference between points A and B. 13

Figure 1 (c).

2. (a) How pressure can be measured by single column manometer? Explain with necessary illustration. 13
   (b) Define center of pressure. Derive an expression for the total pressure on an inclined surface. 12
   (c) A circular plate 2.5 m diameter is immersed in a water, its greatest and least depth below the free surface being 3 m and 1 m respectively. Find, 10
      (i) The total pressure on one face of the plate.
      (ii) The position of the center of pressure.

3. (a) What is pitot tube? Explain the principle of pitot tube with net sketch. 10
   (b) Differentiate between notch and weir. How discharge can be measured by using trapezoidal notch. 13
   (c) A venturimeter is to be fitted in a pipe 0.25 m diameter where the pressure head is 7.6 m of flowing liquid and the maximum flow is 8.1 m^3 per minute. Find the least diameter of the throat to ensure that the pressure head does not become negative. Take k = 0.96. 12

4. (a) Derive an expression for time for emptying the reservoir of an orifice. 12
   (b) Write short notes on: 10
      (i) Renolds number (ii) Nusselt number (iii) Mac number (iv) Froude number
   (c) State and derive Bernoulli's equation for real fluid. 13

SECTION-B

5. (a) What is fluid machine? What are the basic differences between pump and turbine? 06

    (b) Why reciprocating pump is called positive displacement pump? Show that for a double acting reciprocating pump, the power required to drive the pump can be expressed as $P = \frac{2\rho g(ALN)(H_s+H_d)}{60,000}$ kW, where symbols have their usual meanings. 15

    (c) Define slip of reciprocating pump. A double acting reciprocating pump has a stroke of 300 mm and a piston diameter 150 mm. the delivery and suction head are 26 m and 4 m respectively including friction heads. If the pump is working at 60 rpm, find the power required to drive the pump with 80% efficiency. 14

6. (a) What is vortex chamber? Why vortex chamber is introduced in a centrifugal pump? 10

    (b) Show that the manometric efficiency of a centrifugal pump is $\eta_{mano} = \frac{gH}{V_{w2}u_2}$, where symbols have their usual meanings. 13

    (c) A centrifugal pump 1.3 m in diameter delivers 3.5 m³/min of water at a tip speed of 10 m/s and a flow velocity of 1.6 m/s. The outer blade angle 30^0 to the tangent at the impeller periphery. Calculate the torque delivered by the impeller. 12

7. (a) Write down the differences between Reaction and Impulse turbine. 08

    (b) Prove that for in case of Pelton wheel, for maximum efficiency $^u/_v = 0.5$ where u = bucket center line velocity and v = velocity of jet. 15

    (c) Calculate the number of jet required for a pelton wheel to develop 9196.875 kW (12,500 hp) under a head of 300 m at a speed of 500 rpm. Assume that the jet diameter not to exceed one-tenth of the wheel diameter, C_v=0,98, peripheral velocity of wheel/jet speed = 0.46 and efficiency 85%. 12

8. (a) What is draft tube? Derive an expression for the efficiency of a draft tube. 13

    (b) Draw the velocity diagram of a radial flow inward reaction turbine and labelling its all components. 09

    (c) What is compressor? Derive an expression for the work done of a reciprocating compressor with clearance volume. 13

Khulna University of Engineering & Technology
Department of Industrial Engineering and Management
B.Sc. Engineering 3rd Year 1st Term Examination, 2019
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.
iii) Assume reasonable data if missing any.

SECTION–A

1. (a) Define the term "Engineering Economy". Discuss the four essential elements involved in decision making in engineering economic analysis.   10

   (b) Differentiate between simple and compound interest. Assume an engineering company borrows Tk100,000 at 10% per year compound interest and will pay the principle and all the interest after 3 years. Compute the annual interest and total amount due after 3 years. Graph the interest and total owed for each year and compare with the same problem that involved simple interest.   12

   (c) Define "Time value of money" with proper example. Moms glass company has decided to invest funds for the next 5 years so that development of "smart" glass is well funded in the future. This type of new technology glass uses electrochrome coating to allow rapid adjustment to sun and dark in building glass, as well as assisting with internal heating and cooling cost reduction. The financial plan is to invest first, allow appreciation to occur, and then use the available funds in the future. All cash flow estimates are in Tk1000 units, and the interest rate expectation is 8% per year.   13
   Years 1 through 5: Invest Tk7000 in year 1, decreasing by Tk1000 per year through year 5.
   Years 6 through 10: No new investments and no withdrawals.
   Years 11 through 15: Withdraw Tk20,000 in year 11, decreasing 20% per year through year 15.
   Determine, if the anticipated withdrawals will be covered by the investment and appreciation plans. If the withdrawals series is over or underfunded, what is the exact amount available in year 11, provided all other estimates remain the same?

2. (a) For the cash flows shown in figure 2(a), determine the value of x that will make the future worth in year 8 equal to Tk-70,000.   10
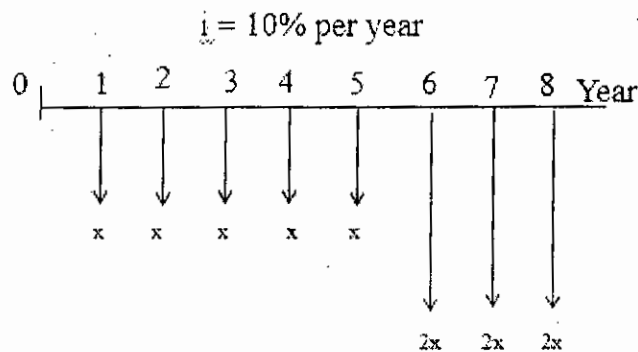
Figure 2 (a)

   (b) Austin utilities is planning to install solar panels to provide some of the electricity for its groundwater desalting plant. The project would be done in two phases. The first phases will cost Tk 4 million in year 1 and Tk 5 million in year 2. This investment will result in energy saving (phase2) of Tk540,000 in year 3, Tk546,000 in year 4 and amounts increasing by Tk6,000 each year through year 10. Let $i = 10\%$ per year.   15
   (i) What is the future worth of the savings?
   (ii) Is the cost of the solar project justified by the savings?

(c) Find the present worth in year 0 and future worth in year 8 for the cash flows shown in 10 figure 2 (c). Let i = 10% per year. (All amounts are given in Tk.)
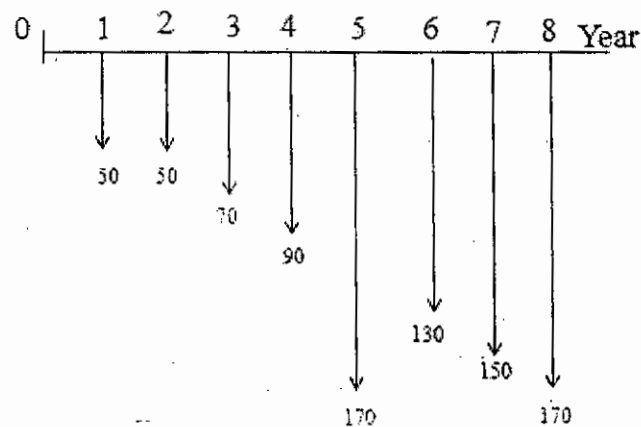
$$i = 10\% \text{ per year}$$

Figure 2 (c).

3. (a) Differentiate between nominal and effective interest rate. For the past 7 years, Excelon 11 Energy has paid Tk. 500 every 6 months for a software maintenance contract. What is the equivalent total amount after the last payment, if these funds are taken from a pool that has been returning 8% per year, compounded quarterly?

(b) A metallurgical engineer is considering two materials for use in a space vehicle. All 12 estimates are made (i) which should be selected on the basis of a present worth comparison at an interest rate 12% per year. (ii) At what first cost for the material not selected above will it become the more economical alternative?

	Material X	Material Y
First Cost, Tk.	-15,000	-35,000
Maintenance cost, Tk.	-9,000	-7,000
Salvage value, Tk.	2,000	20,000
Life, years	5	5

(c) Compare the alternatives shown on the basis of their capitalized costs using an interest rate 12 of 10% per year.

	Alternative M	Alternative N
First Cost, Tk.	-150,000	-800,000
Annual operating cost, Tk./year	-50,000	-12,000
Salvage value, Tk.	8,000	1,000,000
Life, years	5	∞

4. (a) In annual worth method of comparing alternatives that have different lives, why do you 08 calculate the AW of the alternatives over their respective life cycles instead of over the last common multiple of their lives?

(b) Define the term "Capital Recovery" with proper example. 10 years ago, Jacobson Recovery 15 purchased a wrecker for Tk285,000 to move disabled 18-wheelers. He anticipated a salvage value of Tk50,000 after 10 years. During this time his average annual revenue totaled Tk52,000. (i) Did he recover his investment and a 12% per year return? (ii) If the annual M&O cost was Tk10,000 for the first year and increased by a constant Tk1000 per year, was the AW positive or negative at 12% per year? Assume the Tk50,000 salvage was realized.

(c) For the cash flows shown use an annual worth comparison and an interest rate of 10% per 12 year.
   (i) Determine the alternative that is economically best.
   (ii) Determine the first cost required for each of the two alternatives not selected in (i), so the all alternatives are equally acceptable.

	X	Y	Z
First Cost, Tk	-90,000	-400,000	-650,000
Annual cost, Tk/ year	-40,000	-20,000	-13,000
Overhaul every 10 years, Tk	-	-	-80,000
Salvage value, Tk	7,000	25,000	200,000
Life, years	3	10	∞

5. (a) An argon gas processor has a first cost of $ 20,000 with a $5,000 salvage value after 5 17
years. Find (i) D_3 and (ii) BV_3 for year three (iii) Plot book value vs. time.

   (b) A depreciable construction Truck has a first cost of $20,000 with a $4,000 salvage value 18
after 5 years. Fine the (i) Depreciation, and (ii) Book value after 3 years using DDB
depreciation.

6. (a) An engineer invests $15,000 in a savings account that pays interest at a real 8% per year. If 17
the inflation rate is 5% per year, determine (i) the amount of money that will be
accumulated in 10 years (ii) The purchasing power of the accumulated amount (in term of
today's dollars) (iii) the number of future dollars that will have the same purchasing power
as the $15,000 today and (iv) the amount to maintain purchasing power and earn a real 8%
per year return.

   (b) Light weight wheelchair company has a substantial investment in tubular steel bending 18
equipment. A new piece of equipment costs $5000 and has a life of 3 years. Estimated cash
flows (shown in Table) depend on economic conditions classified as receding, stable or
expanding. A probability is estimated that each of the economic conditions will prevail
during the 3-year period. Apply expected value and PW analysis to determine if the
equipment should be purchased. Use a MARR of 15% per year.

	Economic condition		
	Receding (Prob=0.4)	Stable (Prob=0.4)	Expanding (Prob=0.2)
Year	Annual cash flow estimates, $		
0	-5000	-5000	-5000
1	+2500	+2500	+2000
2	+2000	+2500	+3000
3	+1000	+2500	+3500

7. (a) An IE at a fiber-optic manufacturing company is considered two robots to reduce costs in a 12
production line. Robot X will have a first cost of Tk82,000, an annual M & O cost of
Tk30,000 and salvage values of Tk50,000, Tk42,000 and Tk35,000 after 1, 2 and 3 years
respectively. Robot Y will have a first cost of Tk97,000, an annual M & O cost of
Tk27,000 and salvage values of Tk60,000, Tk51,000 and Tk42,000 after 1, 2 and 3 years
respectively. Which Robot should be selected if a 2-year study period is specified at an
interest rate of 15% per year and replacement after 1 year is not a option?

   (b) Define the term "Breakeven point" with graphical representation. Why Breakeven analysis 10
is so important in decision making?

   (c) Samsung Electronics is trying to reduce supply chain risk by making more responsibly 13
make-buy decision through improved cost estimation. A high-use component (expected
usage is 5000 units per year) can be purchased for Tk 25 per unit with delivery promised
within a week. Alternatively, Samsung can make the component in-house and have it
readily available at a cost of Tk 5 per unit, if equipment costing Tk 150,000 is purchased.
Labor and other operating costs are estimated to be Tk35,000 per year over the study
period of 5 years. Salvage is estimated at 10% of first cost and i=12% per year. Neglect the
element of availability (i) to determine the breakeven quantity and (ii) to recommend
making or buying at the expected usage level.

8. (a) Select projects to maximize PW at i = 15% and b = $70,000. 17

Project	Initial investment, $	Annual NCF, $	Life, years	Salvage value, $
A	-25,000	+6,000	4	+4,000
B	-20,000	+9,000	4	0
C	-50,000	+15,000	4	+20,000

   (b) Determine ESL of an asset which has the costs shown below, let i = 10%. 18

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

Khulna University of Engineering & Technology
Department of Industrial Engineering and Management
B.Sc. Engineering 3rd Year 1st Term Examination, 2019
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.*
iii) *Assume reasonable data if missing any.*

SECTION-A

1. (a) Differentiate between operations management and production management.   05
   (b) Write down the functions of operations management.   10
   (c) Discuss different types of production systems.   20

2. (a) Which type of forecasting approach, qualitative or quantitative is better?   08
   (b) How does the number of periods in a moving average affect the responsiveness of the forecast?   07
   (c) Suppose a software producer is about to release a new version of its popular software. What information do you think it would take into account in forecasting initial sales?   08
   (d) Given below is a series of weekly demand data that the Beta company collected on one of its products and forecast for the corresponding weeks, made by a forecast method which the company is testing.   12

Week	1	2	3	4	5	6
Demand	142	181	144	174	192	176
Forecast	155	157	159	161	163	165

   i) Compute the mean absolute deviation based on all six weeks of data.
   ii) Compute the mean squared error based on the six weeks data.

3. (a) Why is there a need for aggregate planning?   05
   (b) Mention the advantages and disadvantages of chase approach and level approach of aggregate planning.   12
   (c) Manager T.C Downs of plum engines, a procedure of lawn mowers and leaf blowers, must develop an aggregate plan given the forecast for engine demand shown in the table. The department has a normal capacity of 130 engines per month. Normal output has a cost of $60 per engine. The beginning inventory is zero engine. Overtime has a cost of $90 per engine. Develop a chase plan that matches the forecast and compute the total cost of your plan.   18
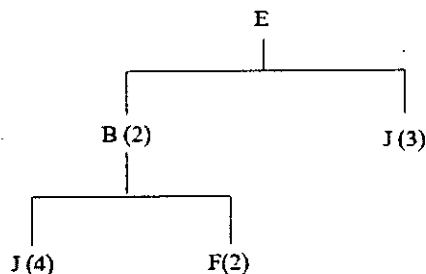
Month:	1	2	3	4	5	6	7	8	Total
Forecast:	120	135	140	120	125	125	140	135	1040

4. (a) Why are priority rules needed? Briefly describe the following priority rules: (i) FCFS (ii) SPT (iii) EDD (iv) S/O (v) Rush   10
   (b) Differentiate between job-shop scheduling and flow-shop scheduling. Why scheduling is fairly complex for job shops systems?   10
   (c) A group of five jobs is to be processed through a two-machine flow shop. Use Johnson's rule to obtain the optimum sequence that will minimize the total completion time for this group of jobs. Also draw the Gantt chart for this sequence and calculate percentage of idle time for each machine.   15

JOB TIMES (HOURS)

Job	Work Center A	Work Center B
a	2.50	4.20
b	3.80	1.50
c	2.20	3.00
d	5.80	4.00
e	4.50	2.00

5. (a) What are the primary reasons for holding inventory? 10
   (b) List the major assumptions of the EOQ model. 05
   (c) Define EOQ and EPQ. A small manufacturing firm uses roughly 3,400 pounds of chemical 20
       dye a year. Currently the firm purchase 300 pounds per order and pays $3 per pound. The
       supplier has just announced that orders of 1,000 pounds or more will be filled at a price of
       $2 per pound. The manufacturing firms incurs a cost of $100 each time it submits an order
       and assign an annual holding cost of 17% of the purchase price per pound, (i) Determine the
       order size that will minimize total cost (ii) If the supplier offered discount at 1,500 pounds
       instead of 1,000 pounds, what order size would minimize total cost?

6. (a) When is MRP appropriate? Contrast independent and dependent demand. 05
   (b) Define safety stock. The manager of a construction supply house determined from 15
       historical records that demand for sand during lead time averages 50 tons. In addition, the
       manager determined that demand during lead time could be described by a normal
       distribution that has a mean of 50 tons and standard derivation of 5 tons. Answer the
       following questions, where the manager is willing to accept a stock out risk of no more than
       3 percent. (i) What value of z is appropriate? (ii) How much safety stock should be held?
       (iii) What reorder point should be used?
   (c) Eighty units of end items E are needed at the beginning of week 6. Three cases (30 units per 15
       case) of J have been ordered and one case is scheduled to arrive in week 3, one in week 4,
       and one in week 5. Note: J must be ordered by the case, and B must be produced in
       multiples of 120 units. There are 60 units of B and 20 units of J, now on hand. Lead times
       are two week each for E and B, and one week for J. Prepare a material requirements plan for
       component J.

```
                              E
                              |
              ┌───────────────┴───────────────┐
              |                                |
           B (2)                             J (3)
              |
      ┌───────┴───────┐
      |               |
    J (4)           F(2)
```

7. (a) Define project. Distinguish between PERT and CPM. 08
   (b) Using the computing algorithm, determine the slack times for the following AOA diagram. 12
       Identify the activities that are on the critical path.
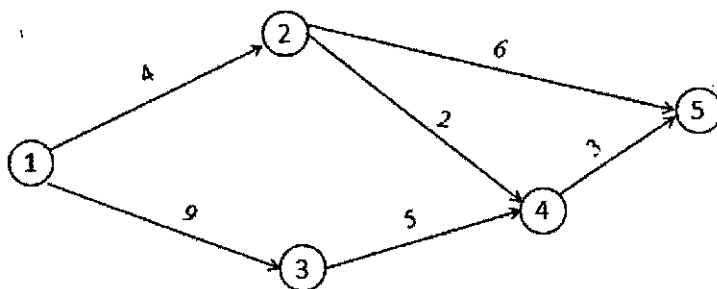
   (c) Consider the following project, with three time estimates for each activity where activity 15
       times are in days. Find the following: (i) The network (ii) All expected activity times,
       variances and slacks. (iii) The critical path and expected completion time. (iv) The
       probability of the project will be done in 23 days. (v) The completion time corresponding to
       95% probability.

Activity	t_0	t_m	t_p	Predecessors
a	1	4	7	-
b	2	2	2	-
c	2	5	8	a
d	3	4	5	a
e	4	6	8	c, b
f	0	0	6	c, b
g	3	6	9	d, c

8. (a) Explain how JIT systems differ from traditional production systems. 10
   (b) How can ERP improve a company's business performance? 10
   (c) What is supply chain? What are the elements of supply chain? 10
   (d) What is Bullwhip effect, why does it occur? 05