Khulna University of Engineering & Technology
Department of Industrial Engineering and Management
B.Sc. Engineering 3nd Year1st Term Examination, 2017
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) Explain crystallographic plane and space lattice. 10
   (b) Discuss the mechanism of crystallization briefly. 13
   (c) Mention the macrodefects in casting in brief. 12

2. (a) Discuss the deformation by twinning. 11
   (b) Discuss the factors that govern the grain size in annealing. 12
   (c) Define alloy and solid solution. Discuss the cooling curve for pure iron. 12

3. (a) 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 containing 40% cadmium. 20
      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.
   (b) What is the delta region of the iron-iron carbide diagram? Describe it briefly. 15

4. (a) Write down short notes on cementite, austenite, ferrite, and pearlite. 12
   (b) Define heat treatment. Mention spherodizing briefly. 12
   (c) Discuss the mechanism of heat removal during quenching. 11

SECTION–B

5. (a) What is meant by powder metallurgy? Briefly discuss the characteristics of metal powder. 13
   (b) Briefly explain the manufacturing process of metal powders. 15
   (c) Discuss various applications of powder metallurgy. 07

6. (a) What is non-destructive testing? Briefly discuss the following NDT method; 20
      i) Eddy current ii) Magnetic iii) Liquid penetrant
   (b) Write down some common application of NDT method. Also mention the advantages of NDT. 10
   (c) Write down the advantages and disadvantages of X-ray NDT method. 05

7. (a) Write down the basic properties that tool materials must possess. Also write down the properties of different elements used in cutting tool materials. 15
   (b) Write short notes on Babbit metal and White metal. Also mention the properties of bearing materials. 12
   (c) What are the effects of following elements on the mechanical properties of steel; 08
      i) Molybdenum ii) Chromium

8. (a) Write short notes on following metals;i) Muntz metal ii) Gun metal 10
   (b) What is ferrous metals? Briefly describe the raw materials used in production of iron and steel. 10
   (c) How aluminum is produced? Explain every step briefly. 15

Khulna University of Engineering & Technology
Department of Industrial Engineering and Management
B.Sc. Engineering 3nd Year 1st Term Examination, 2017
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.*
iii) *Assume reasonable data if missing any.*

SECTION–A

1. (a) Define matrix organization. Why it is preferable over functional and project organization? 10
   (b) What are the purposes of design process? How do the attributes "creation" and "Team spirit" contribute to make the product development interesting? 12
   (c) Entitle the main functions of core team and extended team in product development process? Also differentiate between alpha and beta prototypes. 13

2. (a) Why product life cycle is look like a bathtub? Mention some extension policies of product life cycle. 10
   (b) Create a product technology roadmap illustrating the availability of technologies for a class of products you understand well, such as personal computers. 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? Do you think the developers deliberately ignored these needs? 15

3. (a) Why functional decomposition is most applicable to technical products? Mention some approaches of problem decomposition. 10
   (b) What do you mean for "Engineering characteristics" in product development? List a set of metrices corresponding to the need that a pen writes smoothly. 10
   (c) How can the concept selection methods be used to benchmark or evaluate existing products? Perform such an evaluation for an automobiles you might consider purchasing. 15

4. (a) Write down the different ways to communicate the concept including their benefits and limitations. 10
   (b) When might it not be advantageous to communicate the product concept to potential customers using a working prototype? Under what circumstances it is better to use some other format? 12
   (c) Is cooking dinner analogous to a market-pull, technology-push platform, process intensive, customization, high risk quick-build or complex system process? Explain your reasons. 13

SECTION–B

5. (a) Define DFM. How can you estimate the manufacturing costs in DFM method? 13
   (b) What is industrial design? Describe the ergonomic needs and aesthetic needs of industrial design. 12
   (c) Mention the differences between technology driven products and user driven products. 10

6. (a) What is prototype? What are prototypes used for? 13
   (b) Clarify the following terms in DFM: i) Black box ii) Keeping score iii) Error proofing. 12
   (c) Explain ' A prototype may expedite other development steps' 10

7. (a) Define DOE. Describe the steps that are followed to design a robust product through DOE. 15
   (b) What is intellectual property? Mention the types of intellectual property with their use. 10
   (c) Write short notes on; i) Concurrent Engineering ii) Value Engineering 10

8. (a) Why should economic analysis be performed? 10
   (b) Why does Kano model use? How can the product feature be developed depending on the customer satisfactions? Explain graphically. 15
   (c) How is project interrelated with the macro environment? Explain. 10

Khulna University of Engineering & Technology
Department of Industrial Engineering and Management
B.Sc. Engineering 3rd Year1st Term Examination, 2017
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 engineering economy. List the four essential elements involved in decision making in engineering economic analysis. 08

    (b) Explain the following terms; i) Economic Equivalence ii) Opportunity cost iii) MARR iv) Compound interest 12

    (c) Transportation costs of a medium size appliance distributor have been increasing by 9% per year. The company expects this year's cost to be $ 25,000. Find the equivalent present and annual worths of the costs for years 1 through 10 at an interest rate of 12% per year. 15

2. (a) What are meant by Arithmetic and Geometric gradient? 05

    (b) Use the cash flow diagram to determine the single amount of money Q$_4$in year 4 that is equivalent to the cash flows shown in figure 2(b). Use i= 10% per year. 15
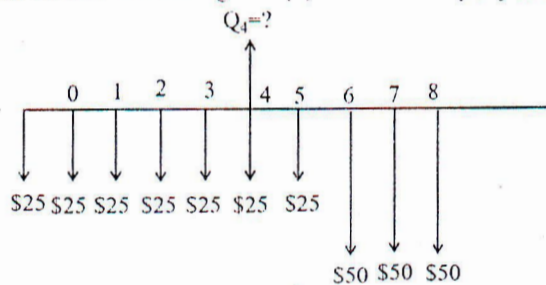

Fig. 2 (b)

    (c) Find i) The present worth p and ii) The equivalent uniform annual worth A for the cash flow shown in figure 2(c). 15
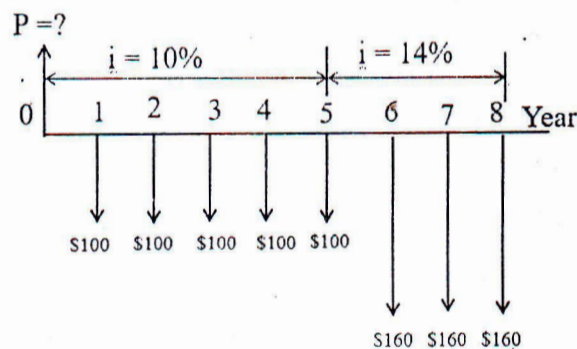

Fig. 2 (c)

3. (a) For an interest rate 1% per 2 months, determine the number of times interest would be compounded in i) 2 month ii) two semiannual periods iii) 3 years. 10

    (b) Equivalent maintenance costs for manufacturing explosion-proof pressure switches are projected to be $ 100,000 in year 1 and increase by 4% each year through year 5. What is the present worth of the maintenance costs at an interest rate of 10% per year, compounded quarterly? 10

    (c) Income from recycling paper and cardboard at the U.S Army's Fort Benning Maneuver Center has averaged $3000 per month for 2.5 years. What is the future worth of income (after 2.5 years) at an interest rate of 6% per year, compounded quarterly? Assume there is no interperiod compounding. 15

4. (a) Compare two alternatives for a security system surrounding a power distributor substation 15 using annual worth analysis and an interest rate of 10% per year.

	Candi	Torro
First Cost, $	-25,000	-130,000
Annual cost, per year, $	-9,000	-2,500
Salvage value, $	3,000	150,000
Life, years	3	∞

(b) Consider a system that has an installed cost of $ 170,000 and an additional cost of $ 60,000 20 after 11 years. The annual software maintenance contract cost is $ 6,000 for the first 7 years and $ 9,000 thereafter. In addition, there is expected to be a recurring major upgrade cost of 17,000 every 15 years. Assume that i = 5 % per year for county funds.

SECTION–B

5. (a) Differentiate between sunk costs and marginal costs. A construction company bought a 17 180,000 metric ton earth sifter at a cost of $ 65,000. The company expects to keep the equipment a maximum of 7 years. The operating cost is expected to follow the series described by 40,000+10,000 K, where K is the number of years since it was purchased (K= 1,2, ...,7). The salvage value is estimated to be $ 30,000 for years 1 and 2 and $20,000 for years 3 through 7. At an interest rate of 10% per year, determine the economic service life and the associated equivalent annual cost of the sifter.

(b) Define "Payout Period". A waste holding lagoon suited near the main plant receives sludge 18 daily. When the lagoon is full it is necessary to remove the sludge to a site located 8.2 km from the main plant. Currently, when the lagoon is full, the sludge is removed by pump into a tank truck and hauled away. The process requires the use of portable pump that initially costs $800 and has an 8-years life. The company pays a contract individual to operate the pump and oversee environmental and safety factors at a rate of $100 per day, plus the truck and driver must be rented for $200 per day. The company has the option to install a pump and pipeline to the remote site. The pump would have a initial cost of $1600 and a life of 10 years and will cost $3 per day to operate. The company's MARR is 10% per year.

  i) If the pipeline will cost $12 per meter to construct and will have a 10 years life, how many days per year must the lagoon require pumping to justify construction of the pipeline?

  ii) If the company expects to pump the lagoon once per week, every week of the year, how much money can it afford to spend now on the 10 year life pipeline to just breakeven?

6. (a) Define "Capital Recovery". Five years ago an industrial engineer deposited $10,000 into 11 an account and left it undistributed until now. The account is now worth $25,000.

  i) What is the overall ROR during the 5 years?

  ii) If the inflation over the period was 4% per year, what was the real ROR?

  iii) What is the buying power of the $25,000 now compared to the buying power 5 years ago?

(b) Define and explain the following terms with suitable example; 12

  i) Book value   ii) Market value   iii) Salvage value   iv) Depletion

(c) A device has a first cost $25,000 with a $5,000 salvage value after 5 years. Calculate and 12 plot depreciation charge and book value at the end of various years using straight line and double decline balancing method. Also show the differences between them.

7. (a) An engineer collected average cost and revenue data for Arenson's FC1 handheld financial 12 calculator. Fixed cost = $30,000 per year ; cost per unit = $40; revenue per unit = $ 70 ;

  i) What is the range in breakdown quantity if there is possible variation in the fixed cost from $20,000 to $ 40,000 per year? (use $ 50,000 increments).

  ii) What is the incremental change in the breakeven quantity for each $ 50,000 change in the fixed cost?

(b) Why is sensitivity analysis? Why it is important in engineering economy? 10

(c)   Robot X will have a first cost of $ 82,000, an annual maintenance and operation (M &O)   13
      cost of $ 30,000 and salvage value of $ 50,000, $ 42,000 and $ 35,000 after 1, 2 and 3
      years respectively. Robot Y will have a first cost of $ 97,000, an annual M &O cost of $
      27,000 and salvage value of $ 60,000, $ 51,000 and $ 42,000 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 an option?

8. (a)   Show breakeven point graphically. What is the importance of this point?   08
    (b)   What is the difference between disbenefits and costs? Select the better of two proposal to   15
          improve street safety and lighting in a colonia in south central New Mexico. Use a B/C
          analysis and an interest rate of 8% per year.

	Proposal 1	Proposal 2
Initial, $	900.000	1,700, 000
Annual M & O cost, $, per year	120,000	60,000
Annual benefits, $, per year	530,000	650,000
Annual disbenefits, $, per year	300,000	195,000
Life, years	10	20

    (c)   A self –employed chemical engineer is on contract with "M" chemical, currently working   12
          in a relatively high-inflation country in central America. She wishes to calculate a project
          PW with estimated costs of $35,000 now and $ 7000 per year for 5 years beginning 1 year
          from now with increases of 12% per year thereafter for the next 8 years. Use a real interest
          rate of 15% per year to make the calculations (i) Without an adjustment for inflation and
          (ii) Considering inflation at a rate of 11% per year.

Khulna University of Engineering & Technology
Department of Industrial Engineering and Management
B.Sc. Engineering 3nd Year 1st Term Examination, 2017
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) Define operations management. Describe the nature of the operation manager's job.   10
   (b) Clarify the statement, "production is a value addition process". Describe lean   15
   production and craft production briefly.
   (c) Contrast the terms strategies and tactics. Why is productivity important?   10

2. (a) What is meant by demand forecasting? What are the main advantages that   12
   quantitative techniques for forecasting have over qualitative techniques?
   (b) Briefly describe the Delphi method. What are its benefits and weaknesses?   10
   (c) A manager uses this equation to predict demand for landscaping services: $F_t = 10 + 5t$.   13
   Over the past eight periods, demand has been as follows:

Period, t:	1	2	3	4	5	6	7	8
Demand:	15	21	23	30	32	38	42	47

3. (a) What is agreement planning? What is its purpose?   05
   (b) Manager T.C Downs of plum engines, a procedure of lawn mowers and leaf blowers,   20
   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.

Month:	1	2	3	4	5	6	7	8	Total
Forecast:	120	135	140	120	125	125	140	135	1040

   i)   Develop a chase plan that matches the forecast and compute the total cost
   of your plan.
   ii)   Compare the costs to a level plan that matches uses inventory to absorb
   fluctuations. Inventory carrying cost is $2 per engine per month. Backlog
   cost is $90 per engine per month.

   (c) Prepare a schedule where the forecast is 90 units for each of the first three periods   10
   and 70 units for each of the next three periods. The starting inventory is 20 units. The
   company uses a chase strategy for determining the production lot size, expect there is
   anupper limit on the lot size of 80 units. Also. The demand safety stock in 10 units.
   Note: The ATP quantities are based on maximum allowable production and do not
   include safety stock. Committed orders are as follows:

Period:	1	2	3	4	5	6
Customer orders:	92	90	70	50	30	30

4. (a) What are the Gantt charts? What are the basic assumptions of the assignment method   05
   of scheduling?

(b) The following table contains information concerning four jobs that are awaiting 15
processing at a work center.

Job	Job Time (days)	Due Date (days)
A	14	20
B	10	16
C	7	15
D	6	17

    i)   Sequence the jobs using FCFS, SPT, EDD andCR. Assume the list is by order of arrival.

    ii)   For each of the methods in part (i), determine, the average job flow time, the average tardiness and the number of jobs at the work center.

    iii)   Is one method superior to the others? Explain.

(c) Given the operation times provided: 15

Job times (minutes)

|	A	B	C	D	E	F
Center 1	20	16	43	60	35	42
Center 2	27	30	51	12	28	24

    i)   Develop a job sequence that minimizes idle time at the two work centers.

    ii)   Construct a chart of the activities at the two centers and determine each one's idle time, assuming no other activities are involved.

SECTION–B

5. (a) Define inventory. Explain briefly how a higher carrying cost can result in a decrease 10
in inventory.

(b) Describe briefly the A-B-C approach to inventory control. 10

(c) The manager of an automobile repair shop hopes to achieve a better allocation of 15
inventory control efforts by adopting an A-B-C approach to inventory control. Given
the monthly usages in the following table, classify the items in A, B and C categories
according to dollar usage:

| Item	Usage	Unit cost ($)
4021	50	1400
9402	300	12
4066	40	700
6500	150	20
9280	10	1020
4050	80	140
6850	2000	15
3010	400	20
4400	7000	5

6. (a) When is MRP appropriate? Briefly define or explain each of these terms: 15

    i)   Master schedule ii) Bill of Materials iii) Net requirements iv) Time phase plan

(b) Develop a material requirements plan for components H. lead times for the end item 20
and each component expect B are one week. The lead time for B is three weeks.
Sixty units of A are needed at the start of week 8. There are currently 15 units of B
on hand 130 of E on hand, and 50 units of H are in production and will be completed
by the start of week 2.
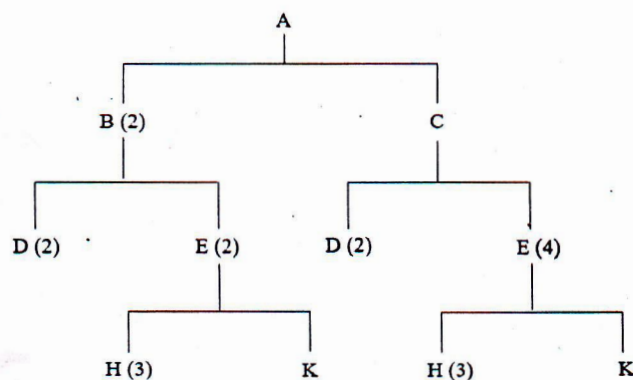
7. (a) What is ERP? What are some unforeseen costs of ERP? 10

(b) Indirect costs for a project are $12000 per week for as long as the project lasts. The project manager has supplied the cost and time information shown. Use the information to 20

     i)   Determine the optimum crashing plan.

     ii)   Group the total costs for the plan.

Activity	Crashing Potential (weeks)	Cost per week to crash($)
a	3	11000
b	3	3000 for 1st week, 4000 for others
c	2	6000
d	1	1000
e	3	6000
f	1	2000
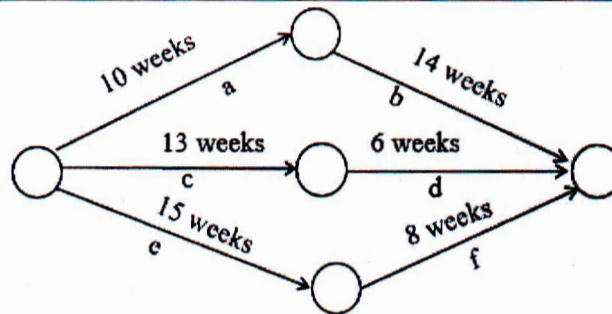
(c) What are the assumptions of flow shop scheduling? 05

8. (a) What is the Kanban aspect of a JIT system? 05

(b) What is meant by service level? How is service level related to the amount of safety stock held? 10

(c) What impact has e-business had on supply chain management? 10

(d) Contrast push and pull methods of moving goods and materials through production systems. 10

Khulna University of Engineering & Technology
Department of Industrial Engineering and Management
B.Sc. Engineering 3rd Year 1st Term Examination, 2017
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) What is fluid? Why fluid is called so continuum? 05
   (b) Define and explain Newton's law of viscosity. How does viscosity of a fluid vary with temperature? 07
   (c) How does pressure in a fluid (in which there is no shearing stress) vary from point to point? For incompressible fluid, deduce the relationship among absolute, atmospheric and gauge pressure. 15
   (d) For an inclined-tube manometer of figure 1 (d), the pressure in pipe A is 8 kPa. The fluid in both pipes A and B is water, and the gage fluid in the manometer has a specific gravity of 2.6. What is the pressure in pipe B corresponding to the differential reading shown? 08
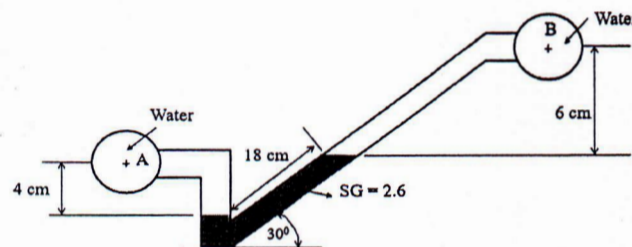

Figure 1 (d)

2. (a) What is pressure diagram and pressure prism? Explain with net sketch. 10
   (b) Derive expression for total pressure and a center of pressure on a vertical plane surface. 15
   (c) Compute the horizontal and vertical components of the total force acting on a curved surface AB, which is in the form of a quadrant of a circle of radius 2 m as shown in figure 2 (c). Take the width of the gate is unity. 10
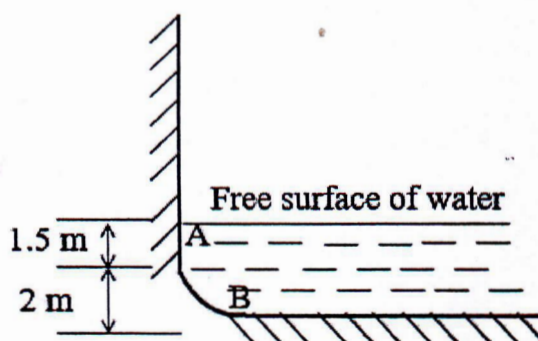

Figure 2 (c)

3. (a) For steady incompressible flow, derive the Euler's equation in differential form and hence show the Bernoulli's equation. 15
   (b) Derive an expression for the discharge through an inclined venturimeter with u-tube differential manometer. 10
   (c) A 30 cm × 15 cm venturimeter is provided in a vertical pipe line carrying oil of specific gravity 0.9, the flow being upwards. The difference in elevation of the throat section and entrance section of the venturimeter is 30 cm. The differential U-tube mercury manometer shows a gauge deflection of 25 cm (shown in figure). Calculate- 10

i) The discharge of the oil and

ii) The pressure difference between the entrance section and the throat section. Take the co-efficient of meter as 0.98 and specific gravity of mercury as 13.6.
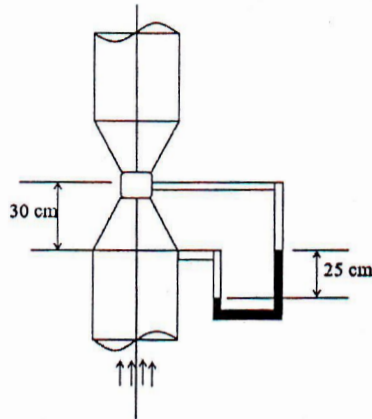

Figure 3 (c)

4. (a) Define co-efficient of contraction and co-efficient of discharge.Obtain an expression for discharge and time for empting the reservoir through an orifice.   15

(b) Define nappe and crest with suitable figure. Find an expression for the discharge over a rectangular weir in term of head of the water over the crest of the weir.   12

(c) Define stream line, streak line, laminar flow and turbulent flow.   08

SECTION–B

5. (a) What is fluid machine? Write down the differences between a pump and a turbine?   05

(b) Why reciprocating pump is called positive displacement pump? Find out the power required to drive a double acting reciprocating pump.   15

(c) Why air vessel is used in reciprocating pump?   05

(d) Water is raised to a height of 20 m above the sump level by a single acting reciprocating pump having a bore of 15 cm and stroke of 30 cm. If the pump has a speed 60 rpm, find the theoretical power and theoretical discharge.   10

6. (a) What is priming? Why priming is so important? Write some applications of centrifugal pump.   08

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

(c) A centrifugal pump 1.3 m in diameter delivers 3.5 m^3/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 a Pelton wheel $(\eta_h)_{max} = \frac{1}{2}(1 + k\cos\theta)$, where the symbols have their usual meanings.   14

(c) A Pelton wheel has a mean bucket speed of 12 m/s and is supplied with water at a rate of 750 liters per second under ahead of 35 m. If the bucket deflect the jet through an angle of 160^0, find the power developed by the turbine and its hydraulic efficiency. Take co-efficient of velocity as 0.98. Neglect the friction in bucket. Also determine the overall efficiency of the turbine if its mechanical efficiency is 80%.   13

8. (a) What is volute casing? Write short notes on draft tube of a Francis turbine.   08

(b) Show that the hydraulic efficiency of a Francis turbine is $\frac{V_{w1}u}{gH}$, where symbol have their usual meanings.   12

(c) Designed a Francis turbine runner with the following data;

Net head (H) = 60 m, Shaft power = 367.875 kW (500 hp), Speed (N) = 600 rpm, Hydraulic efficiency = 85%, Overall efficiency = 80%, Flow ratio (ψ) = 0.15 and Breadth ratio (n) = 0.10. Assume the inner diameter as one half of the outer diameter. The velocity of flow is constant throughout the discharge is radial and neglect the vane thickness.   15