Khulna University of Engineering & Technology
Department of Industrial Engineering and Management
B.Sc. Engineering 2nd Year 2nd Term Examination, 2018

IPE 2207

Probability and Statistical Analysis

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) Briefly explain the role of probability in inferential statistics. 07
   (b) A pack contains 4 blue, 2 red and 3 black pens. Three pens are drawn at random from the pack without replacement. What is the probability of drawing 2 blue pens and 1 black pen? 08
   (c) A pair of fair dice is tossed. Find the probability that the total score is a prime number. 12
   (d) The probability that the head of a household is at home when a telemarketing representative calls is 0.40. Given that the head of the house is home, the probability that goods will be bought from the company is 0.30. Find the probability that the head of the house is home and goods are bought from the company. 08

2. (a) Briefly explain the types of random variable with suitable example(s). 07
   (b) Find the probability distribution for the number of Jazz CDs when 4 CDs are selected at random from a collection consisting of 5 Jazz CDs, 3 classical CDs, and 4 rock CDs. 08
   (c) A continuous random variable X that can assume values between $x = 2$ and $x = 5$ has a density function given by, $f(x) = \frac{2(1+x)}{27}$. Find (i) $P(x < 4)$ (ii) $P\ (3 \leq x < 4)$. 10
   (d) Suppose that an antique jewelry dealer is interested in purchasing a gold necklace, for which the probabilities are 0.22, 0.36, 0.28, and 0.14 respectively, that she will be able to sell it for a profit of $250, sell it for a profit of $150, break even, or sell it for a loss of $150. What is her expected profit? 10

3. (a) Briefly explain binomial distribution with example. 06
   (b) Suppose that a system contains a certain type of component whose breakdown is exponential with a mean of 8 years. If 10 of these components are installed in different system, what is the probability that at least 3 of the components are not functioning at the end of 15 years? 12
   (c) Briefly explain the memory less property of exponential distribution. 07
   (d) A life insurance sales man sells on the average of 3 life insurance policies per week. Calculate the probability that in a given week he will sell (i) some policies, (ii) 2 or more policies but less than 5 policies. 10

4. (a) What is meant by system reliability? Explain. 07
   (b) An electric system consists of five components as illustrated in the following figure. Assume that each component work independently and probability of working of each component is also shown in the figure. Find the probability that the entire system works. 10

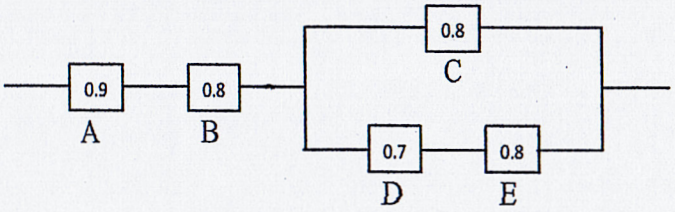

Figure 4(b)

4. (c) Explain the term moment generating function (MGF). 05

(d) Find the MGF of the exponential random variable X with parameter λ and calculate μ and σ^2. 13

SECTION–B

5. (a) What is normal distribution? Mention 5 characteristics of normal distribution. 12

(b) Assuming the normal heat rate is normal healthy individuals is normally distributed with mean= 70 and standard deviation = 10 beats/min, (i) what area under the curve is above 80 beats/ min? (ii) What area of the curve is below 40 beats per min or above 100 beats per min. Give your answer with hand sketch. 15

(c) Mention four applications/uses of normal distribution. 08

6. (a) What are the differences between sample statistics and population parameter? 10

(b) Explain the central limit theorem with example. 10

(c) A manufacturer of light bulbs claims that its light bulbs have a mean life of 1520 hours with an unknown standard deviation. A random sample of 40 such bulbs is selected for testing. If the sample produces a mean value of 1505 hours and a sample standard deviation of 86, is there sufficient evidence to claim that the mean life is significantly less than the manufacturer claimed? Assume that light bulb lifetimes are roughly normally distributed. 15

7. (a) Write down the significance of f-distribution. 05

(b) A consumer product is made at two different plants using similar machines. Dimensions are sampled at both sites with the following results. 20

Plant	A	B
Sample size	15	08
Sample variance, cm^2	0.100	0.115

(i) Are the plants making product with equal variances?

(ii) How much larger or smaller does s_B^2 have to be to alter the decision in (i)?

(c) What are the advantages and disadvantages of using t-distribution? 10

8. (a) You want to estimate the average ages of kids that ride a particular kid's ride at Disneyland. You take a random sample of 8 kids exiting the ride, and find that their ages are 2,3,4,5,6,6,7,7. Assume that ages are roughly normally distributed. 20

(i) Calculate the sample mean, (ii) Calculate the sample standard distribution, (iii) Calculate the standard error of the mean, (iv) Calculate the 99% confidence interval.

(b) A quiz consists of 10 multiple-choice questions. Each question has 5 possible answers, only one of which is correct. Pat plans to guess the answer to each question. Find the probability that Pat gets- 15

(i) One answer correct, (ii) All 10 answer correct, (iii) Find the probability that Pat fails the quiz. A marks is considered a failure if it is less than 50%, (iv) Find the probability that Pat passes the quiz. (v) Find the probability that Pat gets one answer correct.

Khulna University of Engineering & Technology

Department of Industrial Engineering and Management

B.Sc. Engineering 2nd Year 2nd Term Examination, 2018

IPE 2229

Industrial Psychology and Law

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)	Define Industrial Psychology. What are the responsibilities of industrial psychologists?	13
	(b)	Explain G.H. Mead's self-development process in socialization.	12
	(c)	Describe the five stages of socialization in the development of self.	10
2.	(a)	Mention major theories of personality development. Describe the concept of "Culture and Personality".	11
	(b)	What is social loafing? What are the causes and prevention of social loafing?	10
	(c)	What is the importance of mass communication? Differentiate between mass communication and personal communication.	14
3.	(a)	Explain action theory of employee motivation.	11
	(b)	Differentiate between goal setting and control theory of employee motivation.	12
	(c)	Briefly explain different types of leadership style with examples.	12
4.	(a)	Describe different types of prejudice exist in society.	10
	(b)	Discuss the causes, sign and symptoms of excessive workplace stress.	12
	(c)	Define propaganda. Discuss different propaganda techniques.	13

SECTION–B

5.	(a)	Define Industry. What are the main objectives of industrial law?	06
	(b)	Define the following terms according to the Factory Act, 1965. (i) Factory (ii) Worker	06
	(c)	Describe the authorities of a factory inspector as described in the Factory Act, 1965.	08
	(d)	Illustrates the provisions associated with cleanliness, ventilation and temperature and lighting for a factory.	15

6. (a) Write down the provisions for fencing machineries and revolving machineries in a factory. 10

(b) Explicate the provisions for First-aid appliances and canteens for a factory. 10

(c) What are the procedures for issuing Certificate of fitness for young persons working in a factory? 06

(d) State the provisions related to the Annual leave with wages and Festival holidays for the worker. 09

7. (a) Define the following terms according to the Industrial relations Ordinance, 1969: (i) Collective bargaining agent (ii) Trade union 06

(b) Discuss the unfair labor practices on the part of the workmen, according to the Industrial Relations Ordinance, 1969. 12

(c) Write short notes on Participation Committee. What are the functions of participation committee? 10

(d) What are the procedures and power of Labor Court? 07

8. (a) Define the term "go-slow". What are the penalties for taking part in or instigating "go-slow"? 05

(b) Define "ecosystem". State the power and functions of Director General according to the Bangladesh Environment Conservation Act, 1995. 15

(c) What are the procedures for issuing environmental clearance certificate for green, orange A and orange B categories industry? 15

Khulna University of Engineering & Technology

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B.Sc. Engineering 2nd Year 2nd Term Examination, 2018

EEE 2211

Electronics

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 doping? Why it is necessary in semiconductor materials? 05
   (b) Define p-n junction. Draw and explain the V-I characteristics of p-n junction. What is depletion layer? Why is it so called? 12
   (c) Define ripple factor. Derive the expression for ripple factor of a full wave bridge rectifier. 08
   (d) A crystal diode having an internal resistance $r_f = 200\Omega$ is used for half wave rectification. If the applied voltage $\vartheta = 100\text{Sin}100\pi t$ and load resistance $R_L = 800\Omega$, Find (i) $I_m, I_{dc}, and\ I_{r.m.s}$ (ii) a.c. power output and d.c. power output (iii) d.c. output voltage and (iv) rectification efficiency. 10

2. (a) Define transistor and transistor biasing? Show that, $I_c = \frac{\alpha}{1-\alpha} I_B + \frac{I_{CBO}}{1-\alpha}\ and\ \beta = \frac{\alpha}{1-\alpha}$ 12
   (b) What are the differences between JFET and BJT? Write down the working principle of MOSFET. 13
   (c) Why stabilization is required in transistor? Explain the operation of transistor as an amplifier. 10

3. (a) "CMOS can act as an inverter" –Justify the statement. 08
   (b) Explain the operation of SCR using two transistor model. 10
   (c) How OP-Amp can act as a differentiator and an integrator? What will be the output of this circuits if a square wave is applied at the input. 12
   (d) The intrinsic stand-off ratio for a UJT is 0.6. If the inter base resistance is $R_{BB} = 10K\Omega$, what are the values of $R_{BI}\ and\ R_{BZ}$? 05

4. (a) Write short notes on (i) LED, (ii) Varactor diode, and (iii) Solar cell 09
   (b) Define resistance welding. Classify it. 07
   (c) What is meant by induction heating and dielectric heating? Deduce the power dissipation equation of dielectric heating. 13
   (d) Design a regulated d.c. power supply to have +12V output. 06

SECTION–B

5. (a) What is duality principle? Write basic theorems and postulates of Boolean algebra and prove them. 10
   (b) Define Minterms and Maxterms. Write the terms for three binary variables. 07
   (c) Name five IC digital logic families and write their application areas and describe them. 10
   (d) Define (i) Fan out, (ii) power dissipation, (iii) propagation delay, and (iv) noise margin. 08

6.	(a)	Define combinational and sequential logic circuits. Prove that a full adder can be represented by two half adder and an OR gate.	12
	(b)	Design a BCD to Excess-3 code converter with logic gates.	13
	(c)	Draw the internal architecture of an 8085 microprocessor and explain its different parts. Draw also its pin diagram.	10
7.	(a)	Define Flip-Flop. Briefly explain J-K Flip-Flop with its characteristic table. What is toggle condition? How can you avoid it?	14
	(b)	What are register and counter? Draw the logic diagram of a binary counter.	07
	(c)	Mention the procedure to transfer data between two registers.	09
	(d)	Define and classify instrumentation.	05
8.	(a)	Derive the equation of electrostatic deflection of CRO.	12
	(b)	What is transducer? How does a thermistor work?	07
	(c)	Define integrated circuit. Mention the advantages, disadvantages, and applications of IC.	10
	(d)	Define modulation. Describe some digital modulation techniques with proper examples.	06

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ME 2213

Mechanics of solids

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) Draw the stress strain diagram for structural steel. Explain various points of the diagram. 08

(b) The rigid bar AB, attached to two vertical rods as shown in the figure 1(b), is horizontal before the load P is applied. Determine the vertical moment of P. If its magnitude is 50 KN. 12

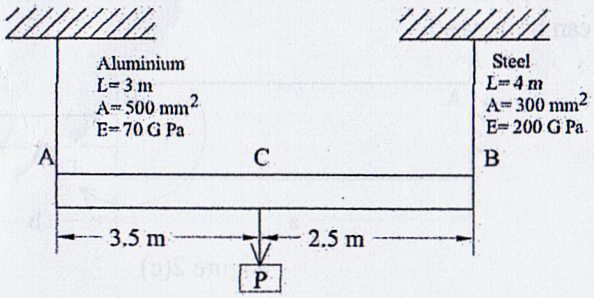

Figure 1(b)

(c) The light rigid bar ABCD shown in figure 1(c) is pinned at B and connected to two vertical rods. Assuming that the bar was initially horizontal and the rods stress free, determine the stress in each rod after the load P=20kips is applied. 15

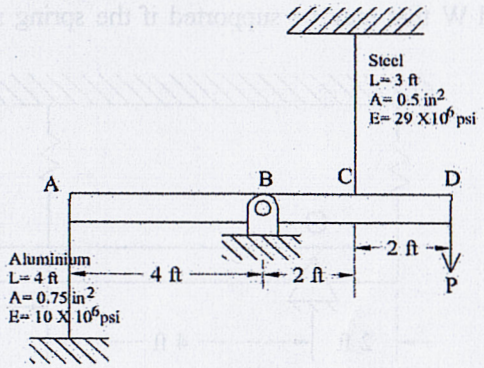

Figure 1(c)

2. (a) A rigid bar of negligible weight is supported as shown in the figure 2(a). If W=80KN. Compute the temperature change that will cause the stress in the steel rod to be 55 MPa. Assume the co-efficient of linear expansion are 11.7 $\mu m/(m.°C)$ for steel and 18.9 $\mu m/(m.°C)$ for bronze. 13

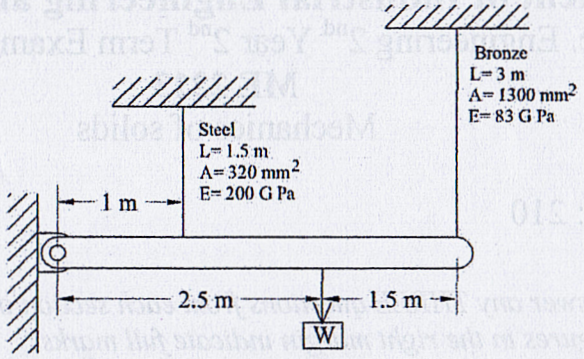

Figure 2(a)

(b) A flexible shaft consists of a 0.20 in diameter steel wire encased in a stationary tube that fits closely enough to impose a frictional torque of 0.5 lb.in/in. Determine the maximum length of the shaft if the shearing stress is not to exceed 20 ksi. What will be the angular deformation of one end relative to the other end? G= 12×10^6psi. 10

(c) The compound shaft shown in figure 2(c) is attached to rigid supports. For the bronze segment AB, the diameter is 75mm, $\tau \leq 60$ MPa and G= 35 GPa. For the steel segment BC, the diameter is 50 mm, $\tau \leq 80$ MPa and G=83 GPa. If a=2m and b=1.5m. Compute the maximum torque T that can be applied. 12

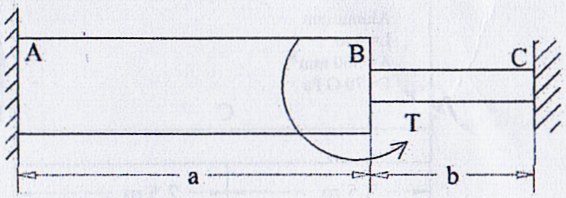

Figure 2(c)

3. (a) What are the different types of loading on a beam? Explain with figures. 08

(b) A rigid bar pinned at point O, is supported by two identical springs as shown in figure 3(b). Each spring consists of 20 turns of $\frac{3}{4}''$ diameter wire having a mean diameter of $6''$. Determine the maximum load W that may be supported if the spring stress in the springs is limited to 20ksi. 12

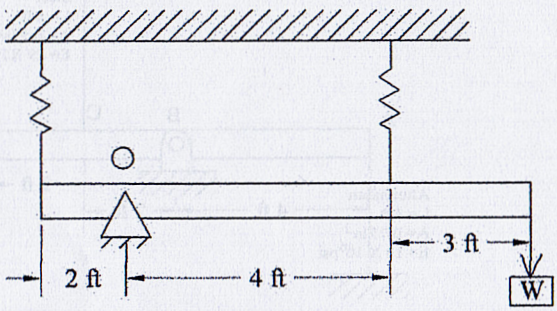

Figure 3(b)

(c) Write shear and moment equations for the beam loaded as shown in figure 3(c) and sketch the shear and moment diagrams. 15

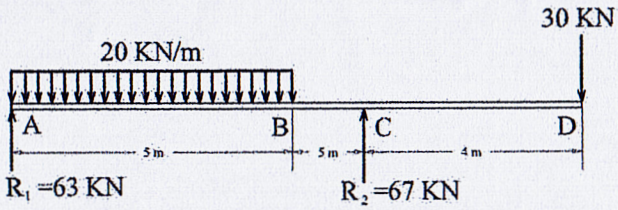

Figure 3(c)

4. (a) Cantilever beam carrying the loads shown in figure 4(a). Draw moment and shear diagrams of the beam. 15

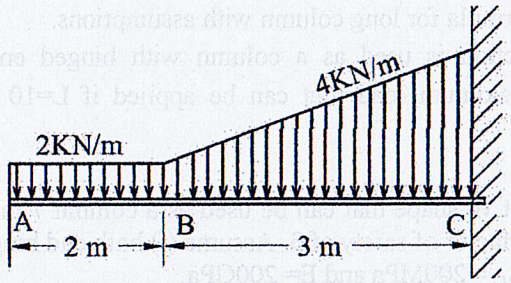

Figure 4(a)

(b) A helical spring is fabricated by wrapping wire 3/4 inch in diameter around a forming cylinder 8 inch in diameter. Compute the number of turns required to permit an elongation of 4 inch without exceeding a shearing stress of 18 ksi. Use G= 12×10^6psi. 10

(c) Derive torsion formula with assumption and hence deduce the relation between maximum shear stress and applied torque. 10

SECTION–B

5. (a) Write down the stress formula corresponding to three basic types of loading. 05

(b) Compute the stresses at A and B on the link loaded as shown in figure 5(b), if P=9000 lb and F=3000 lb. 18

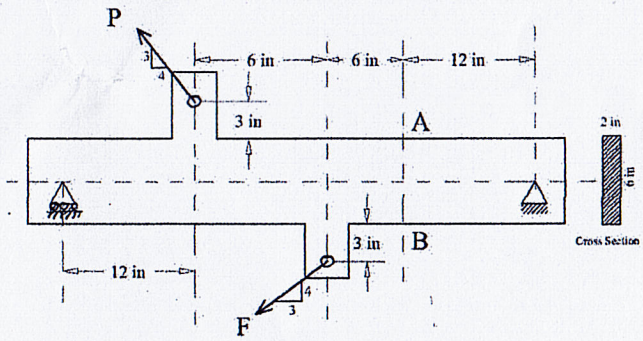

Figure 5(b)

(c) A square steel bar is to support a load of 20 kips on a length of 10 ft. Assume both end hinged, determine the length of each side. Use E= 29×10^6psi . 12

Normal

6. (a) Show that the maximum and minimum ~~shear~~ stresses occur on planes of zero shearing stress. 16

(b) If an element is subjected to the state of stress shown in figure 6(b). Determine the normal and shearing stress on (i) the principle planes, (ii) the planes of maximum in-plane shearing stress, and (iii) the planes whose normal are at +33° and +123° with the x axis. Show the results on complete sketches of differential elements. 19

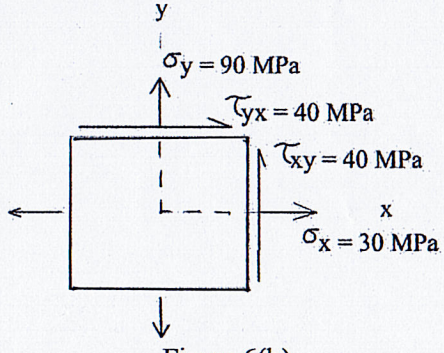

Figure 6(b)

7. (a) Define slenderness ratio? How the slenderness ratio affect Euler's long column formula? Explain. 06

(b) Derive Euler's formula for long column with assumptions. 15

(c) A W310X52 section is used as a column with hinged ends. Using AISC specifications, determine the maximum load that can be applied if L=10 m. Use σ_{yp} =250MPa and E= 200GPa. 14

8. (a) Select the lightest W shape that can be used as a column 7 m long to support an axial load of 450 KN with the factor of safety of 3. Assume (i) both end hinged and (ii) one end hinged other end fixed. Use σ_{PL} =200MPa and E= 200GPa. 19

(b) A double row riveted lap joint forms the grith seam of a boiler 5 ft in diameter. Pitch of the rivets is 3.25 in, diameter of the rivet holes is 11/16 in, thickness of the plate is 7/16 in. Find the strength of a repeating section, the efficiency, and maximum internal pressure. Use $T = 8800$ Psi, $\sigma_b = 19$ ksi and $\sigma_t = 11$ ksi 16

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ME 2215

Thermal Engineering and Heat Transfer

Full Marks: 210 Time: 03 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) What is meant by Renewable Energy? Explain briefly the different terms of renewable energy. 10
   (b) What is meant by "quasi-static process"? Show that the heat and work are path function. 10
   (c) Write down the limitations of 1st law of thermodynamics. Explain the perpetual motion machine of 1st kind. 10
   (d) State Kelvin-Plank and Clausius statements for the second law of thermodynamics. 05

2. (a) Define IC engine. Explain with the help of suitable sketches, the working of a four stroke diesel engine. 15
   (b) Write down the functions of the followings: 06
   i) Carburettor ii) Spark plug iii) Fuel pump
   (c) An oil engine operates on ideal dual combustion cycle as follows: 14
   pressure at the beginning of the compression $= 0.97\ bar$; temperature at the beginning of compression $= 55°C$; pressure ratio $= 1.5$; cut off ratio $= 1.6$; compression ratio $= 11$; ratio of specific heats, $r = 1.4$. Determine the temperature at the end of each operation and efficiency of the engine.

3. (a) What is steam boiler? What are the differentiating features between a water tube and a fire tube boiler? 10
   (b) Define and function of the followings: 10
   i) Economiser ii) Air preheater iii) Blow off cock iv) Fusible plug
   (c) In an oil-gas turbine installation, it is taken at pressure of 1 bar, temperature 27°C and compressed to a pressure of 4 bar. The oil with a calorific value of 42000 KJ/kg is burnt in the combustion chamber to raise the temperature of air to 550°C. If the air flows at the rate of 1.2 kg/s; find the net power of the installation. Also find air fuel ratio. Take $c_p = 1.5$ KJ/kgK. 15

4. (a) Explain briefly otto cycle with the help of P-V and T-S diagrams. Derive an expression for the ideal efficiency of otto cycle. 12

(b) Define coefficient of performance (C.O.P) and Tonne of the refrigeration. What are the factors affect comfort air conditioning? 10

(c) The following observations were made on a boiler plant during one hour test: steam pressure $= 20\ bar$; steam temperature $= 260°C$; steam generated $= 37500\ kg$; temperature of water entering the economizer $= 15°C$; temperature of water leaving the economizer $= 90°C$; fuel used $= 4400$ kg; energy consumption of fuel $=$ 30000 KJ/kg. Calculate i) the equivalent evaporation/kg of fuel ii) the thermal efficiency of the plant. 13

SECTION–B

5. (a) What is the basic difference between heat transfer and thermodynamics? State Fourier's law of heat conduction. 08

(b) Derive the three dimensional heat conduction equation in rectangles coordinate for constant thermal conductivity. 12

(c) Consider an aluminum hollow sphere of inside radius $r_1 = 2\ cm$, outside radius $r_2 = 6\ cm$ and thermal conductivity $K = 200\ W/(m.°C)$. The inside radius surface is kept at an uniform temperature $T_i = 100°C$ and outside surface dissipates heat by convection with a heat transfer co-efficient $h_\alpha = 80\ W/(m^2.°C)$ into the ambient air at temperature $T_\alpha = 20°C$. Determine the outside surface temperature of the sphere and the rate of heat transfer from the sphere. 15

6. (a) Considering mixed boundary condition, prove that $\theta(t) = \theta_0 e^{-mt} + (1 - e^{-mt})\ q/h$ the parameters are with their usual meanings. 12

(b) A solid iron rod $[\alpha = 2 \times 10^{-5}\ m^2/s$ and $K = 60\ W/(m.°C)]$ of diameter $D = 6cm$, initially at temperature $T_i = 800°C$, is suddenly dropped into an oil bath at $T_\alpha = 50°C$. The heat transfer co-efficient between the fluid and the surface is $h = 400\ W/(m^2.°C)$. 15

(i) Using the transient temperature charts, determine the centerline temperature 10 min after immersion in the fluid.

(ii) How long will it take the centerline temperature to reach 100°C?

(c) Define the following terms 08

(i) Fourier number (ii) Nusselt number

(iii) Stanton number (iv) Reynolds number

7. (a) Define thermal boundary. Derive the expression of Reynolds-Colburn analogy. 12

(b) An approximate expression for the velocity profile $u(x,y)$ for laminar boundary layer flow along a flat plate is given by 16

$$\frac{U(x,y)}{U\alpha} = 2\frac{y}{\delta(x)} - 2\left[\frac{y}{\delta(x)}\right]^3 + \left[\frac{y}{\delta(x)}\right]^4$$

where the boundary layer thickness $\delta(x)$ is

$$\frac{\delta(x)}{x} = \frac{5.83}{Re_x^{1/2}}$$

(i) Develop an expression for the local drag co-efficient C_x

(ii) Develop an expression for the average drag co-efficient C_m over a distance $x = L$ from the leading edge of the plate

(iii) Determine the drag force F acting on a plate 2m by 2m for the flow of air at atmospheric pressure and at $T_\alpha = 350K$ with a velocity of $U_\alpha = 4m/s$

(c) What is black body? Describe the Kirchhoff's law of radiation. 07

8. (a) Derive an expression for view factor between two elemental surfaces. 10

(b) The configuration of a furnace can be approximated as an equilateral triangular duct which is sufficiently long that the end effects are negligible. The hot wall is maintained at $T_1 = 900K$ and has emissivity $\varepsilon_1 = 0.8$. The cold is maintained at $T_2 = 400K$ and has emissivity $\varepsilon_2 = 0.8$. the third wall is reradiating zone, $q_3 = 0$. The accompanying sketch illustrates the configuration. Calculate the neat radiation heat flux leaving the hot wall. 13

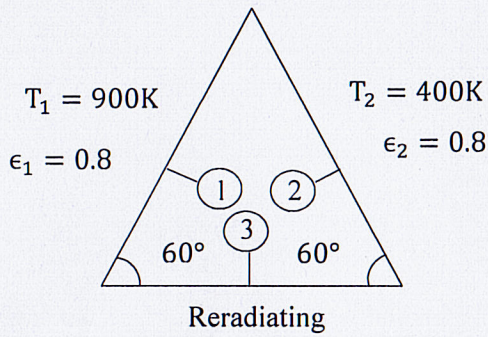

Figure 8 (b)

(c) What is emissive power? Prove that the spectral emissive power of a black body is π-times of its spectral radiation intensity. 12