

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

B.Sc. Engineering 2nd Year 2nd Term, 2016

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) Define sample space and event with proper examples. 05
(b) A pair of fair dice is tossed. Find the probability of getting – 10
 i) A total of 8;
 ii) At most a total of 6.
(c) State the bayes' rule. 05
(d) A paint store chain produces and sells latex and semi-gloss paint. Based on long range sales, the probability that a customer will purchase latex paint is 0.75. Of those that purchase latex paint, 60% also purchase rollers. But only 30% of the semigloss paint buyers purchase rollers. A random selected buyer purchases a roller and a can of paint. What is the probability that the paint is latex? 15

2. (a) Define random variable. Briefly explain the types of random variable. 08
(b) What is meant by mutually exclusiveness of two events? Explain with example. 05
(c) A lot containing 15 components is sampled by a quality inspector. The lot contains 3 defective components. A sample of 4 is taken by the inspector. Find the probability distribution for the number of defective components. 12
(d) Consider the density function 10
$$f(x) = \begin{cases} k\sqrt{x}, & 0 < x < 1 \\ 0 & , \text{ elsewhere} \end{cases}$$

 i) Evaluate k;
 ii) Find $P(0.4 < x < 0.8)$

3. (a) Write down the properties of binomial distribution. 05
(b) A company makes electric motors with probability of being defective is 0.10. What is the probability that a sample of 15 electric motors will contain- 15
 i) No defective motor;
 ii) Fewer than 5 defective motors;
 iii) At least 3 defective motors.
(c) The average number of customers arriving at a certain automobile service facility is 30 per hour and follows Poisson probability distribution. Compute the probability that- 15
 i) At least 5 customers will arrive in a 15 minutes periods;
 ii) Fewer than 3 customers will arrive in a 10 minutes period.

4. (a) Find the moment generating function of the exponential random variable X with parameter λ and calculate $E[X]$. 08
(b) Suppose that a system contains a certain type of component whose breakdowns is exponential with mean 10 years. If 12 of those components are installed in different system, what is the probability that at least 3 components are still functioning at the end of 20 years? 15

- (c) A circuit system is given in the following figure. Assume that each component works independently and the probability of working of each component is also given in the figure 4(c). Find the probability that entire system works. 12

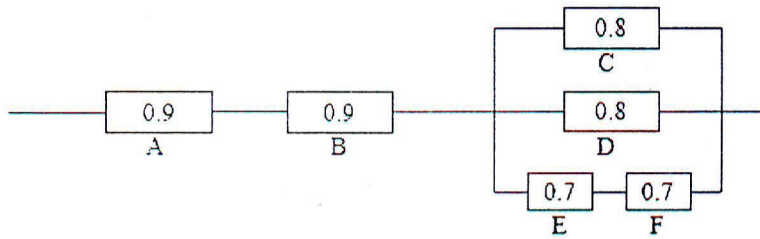


Figure-4 (c)

SECTION-B

5. (a) How to convert normal data to SND? Explain with example. 06
 (b) The monthly sales of mufflers in an area follow the normal distribution with a mean of 1200 and a standard deviation of 225. The manufacturer would like to establish inventory levels such that there is only a 5 percent chance of running out of stock. Where the manufacturer should set the inventory levels? 14
 (c) An engineer has collected historical data from 350 vendors and found an average lead time of 10 days with a standard deviation of 5 days. To determine the current average, he sample 28 vendors and computed a value of 12 days. 15
 i) What are chances that the average lead time will exceed 12 days?
 ii) If the engineer wants 98 percent assurance that the estimate of average lead time is no more than 1 day off, can the sample average of the 28 vendors be relied on?

6. (a) Write down the significance of t and F distribution in statistical analysis. 05
 (b) Carroll has taken six reading from the monthly sales ledger and obtained the following value: \$121,532; \$194,312; \$152,932; \$138,692; \$142,107; \$176,917. If sales have followed a normal distribution in the past with $\mu = \$130,000$. Has the parent claims population changed? 15
 (c) A consumer product is made at two different plants using similar machines. Dimensions are sampled at both sites with the following results: 15

Plant	A	B
Sample size	15	8
Sample variance, cm^2	0.100	0.115

Are the plants making product with equal variances?

7. (a) What do you mean by level of significance? Explain with example. 05
 (b) The mean life of a battery used in a digital clock is 305 days. The lives of the batteries follow the normal distribution. The battery was recently modified to last longer. A sample of 20 of the modified batteries had a mean life of 311 days with a standard deviation of 12 days. Did the modification increase the mean life of the battery? Use the 0.05 significance level. 15
 (c) A sample of 65 observations is selected from one population with a population standard deviation of 0.75. The sample mean is 2.67. A sample of 50 observations is selected from a second population with a standard deviation of 0.66. The sample mean is 2.59. Conduct the following test of hypothesis using the 0.08 significance level. 15

$$H_0: \mu_1 \leq \mu_2$$

$$H_1: \mu_1 > \mu_2$$

8. (a) The number of flaws per $100m^2$ of cloth is to be checked by a quality control chart which assumes an underlying Poisson population. For the last 75 samples the number of flaws have been recorded: 15

Number of flaws	0	1	2	3	4	5	≥ 6
Frequency	20	30	15	7	2	1	0

If $1-\alpha=0.95$, is the Poisson population assumption a reasonable one?

- (b) Mr. Alim manages a regional financial center. He wishes to compare the productivity, as measured by the number of customers served, among three employees. Four days are randomly selected and the number of customers served by each employee is recorded. The results are:

Rakib	Mamun	Rob
55	66	47
54	76	51
59	67	46
56	71	48

Is there a difference in the mean number of customer served? Use the 0.05 significance level.

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IPE 2229

Industrial Psychology and Law

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 psychology and I-O psychology. "The scope of I-O psychology is the entire process of management dealing with people at work", justify the statement. 13
- (b) What is socialization? Discuss the importance of android games on the socialization of child in Bangladesh. 10
- (c) What is team commitment? How does formal group differ from informal group? 12
2. (a) What type of leader is the queen of Great Britain? Discuss the importance of this leadership. 10
- (b) Discuss the effects of job satisfaction on job performance and turnover. 13
- (c) Most of the adventurous clip in National Geographic channel are western. Discuss their motivation. 12
3. (a) Discuss the techniques of propaganda. 09
- (b) What is motivation? Discuss two factor theory and expectancy theory. 13
- (c) Explain David McClelland's motivational needs theory with suitable examples. 13
4. (a) What is the relation between pride and prejudice? 07
- (b) What is cognitive psychology? Briefly describe the Albert Ellis' Rational Emotive Behavior Therapy (REBT). 13
- (c) Write short notes on: 15
 - i) Managerial grid approach of leadership;
 - ii) Mass communication;
 - iii) Group formation.

SECTION-B

5. (a) State the provisions of power and functions of certifying surgeons. 13
- (b) Mention the provisions of cleanliness for worker in a factory. 10
- (c) State the provisions for precautions against dangerous fumes. 12
6. (a) What are the requirements for orange and red category of issuing environmental clearance certificate? 06
- (b) What are the penalties for violating the restrictions of regarding vehicles emitting smoke? 10
- (c) Define the following terms: 09
 - i) Collective bargaining agents;
 - ii) Arbitrator;
 - iii) Industrial dispute.
- (d) If you want to establish a trade union, what are the requirements necessary for the application? 10
7. (a) State the provisions for strike and lockout. 10
- (b) What are the power and functions of the Director general, as described in Environment conservation Act, 1995? 10
- (c) Write down the penalty for unfair labor practices and illegal strike or lockout. 08
- (d) Write down the importance of Environmental conservation Rule, 1997. 07

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|----|-----|--|----|
| 8. | (a) | Briefly explain different types of psychological tests used in industries. | 14 |
| | (b) | Differentiate between reliability and validity of a psychological test. | 06 |
| | (c) | What is instinct? Differentiate between instinct and habit. | 08 |
| | (d) | Why "Habitual fact" is so vital for human beings? | 07 |
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Khulna University of Engineering & Technology
Department of Industrial Engineering and Management

B.Sc. Engineering 2nd Year 2nd Term, 2016

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 do you understand by doping of semiconductor? Explain how depletion layer is formed in a p-n junction. 13
- (b) Define p-n junction. Draw and explain the V-I characteristic of p-n junction. 10
- (c) Discuss the operation of Zener diode as a voltage regulator. Draw the output wave shape for the following Fig. 1(c), if the input voltage is $V_i = 5000 \sin \omega t$ milli-volt. 12

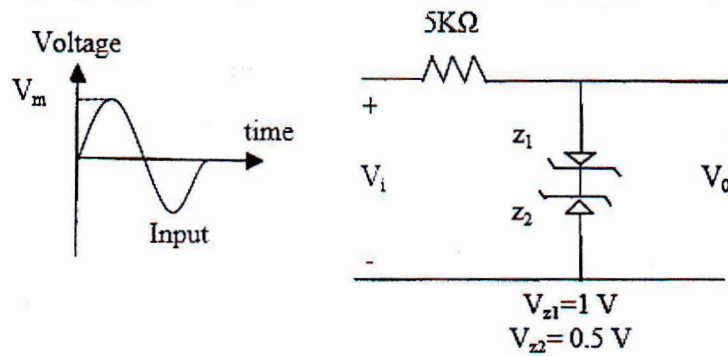


Fig. 1(c)

2. (a) Define load line and operating point. Draw load line for Fig.2 (a). What will be the Q-point if base current $20 \mu A$ and $\beta = 50$? 13

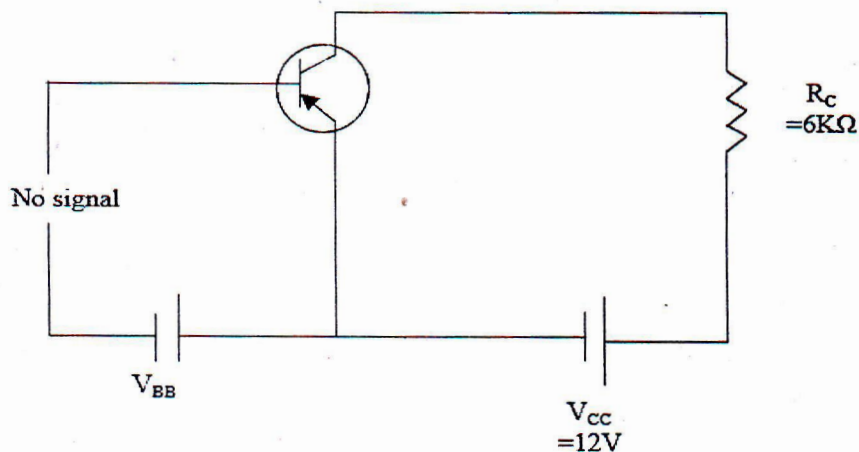


Fig. 2 (a)

- (b) Describe the construction and working principle of MOSFET. 11
 - (c) "In full wave rectification maximum 81.2% of a.c input power can be converted into d.c output power", Justify the statement. 11
3. (a) What is transistor biasing and stabilization? Why biasing of transistor is necessary? 10

(b) Determine I_B , I_C and V_{CE} for the following circuit of Fig. 3(b).

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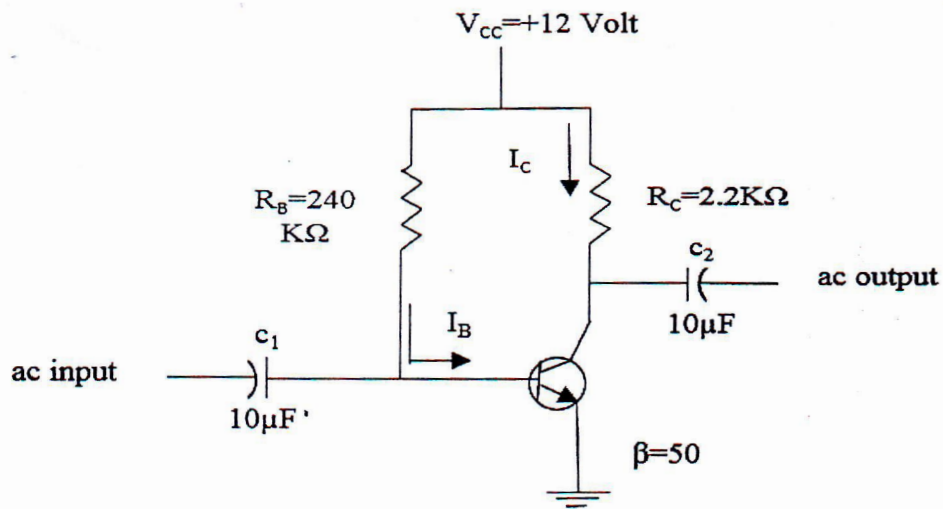


Fig. 3(b)

(c) Draw the two transistor model of SCR. Also find the expression of Anode current.

10

(d) Determine the value of I , V_1 , V_2 and V_0 for the circuit of Fig. 3(d).

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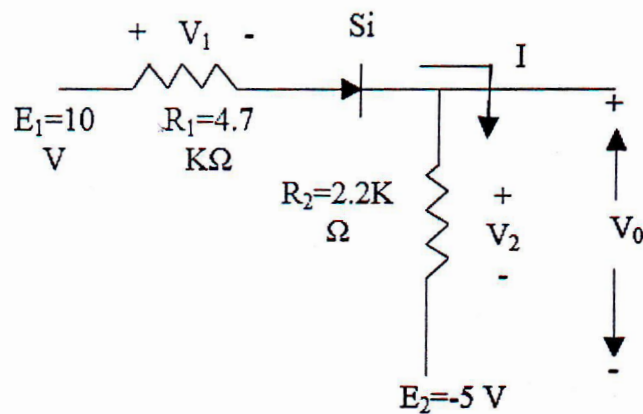


Fig. 3(d)

4. (a) Why JFET is called a voltage control device? Sketch the transfer curve defined by $I_{DSS}=12$ mA and $V_p=-6V$ by applying short hand method only. 10
- (b) Define dielectric heating. Show that the power dissipated per unit volume is represented by, $P=0.555 E^2 f \epsilon_r$ (p.f) $\times 10^{-12}$ watts/c.c in the case of dielectric heating, where the symbols have their usual meaning. 10
- (c) Write short notes on: 15
- Zener diode;
 - Tunnel diode;
 - Varactor diode;
 - LED;
 - Photo diode.

SECTION-B

5. (a) What are the differences between digital and analog electronic? Write down the advantages of digital electronics. 10
- (b) In decimal number system, result of counting some pens is 15. Now convert this decimal 15 to its equivalent binary. From the binary value, convert it into hexadecimal. 12
- (c) In 5-base number system, two numbers are 1324_5 and 2131_5 . Add these two numbers and express the result in 5-base system. [Giving the explanation of each step is a must]. 13
6. (a) By not using truth table, prove that $(A+BC) = (A+B)(A+C)$, when A, B, C are Boolean variable. 12
- (b) Draw the symbol and truth table of basic logic gates. What do you understand by universal logic gate? Prove that NOR gate is an universal logic gate. 13

- (c) Define minterm, maxterm, Boolean function in canonical form, Boolean function in standard form. 10
7. (a) State and prove De Morgan's theorem. 11
- (b) Find the Boolean function of a full adder circuit (in canonical form). Simplify the Boolean function using k-map method. Finally implement the circuit using logic gates. 12
- (c) A Boolean function is given as $F(p, q, r, s) = \sum(0, 2, 3, 5, 7, 8, 10, 11, 13, 15)$, $d = \sum(1, 4)$. Put the function in k-map and find different possible solution of it. Also find the prime implicant and essential prime implicant. 12
8. (a) What is shift register? Design a 4-bit serial transfer shift register. 10
- (b) Define integrated circuit and prime implicant. What are the advantages and limitations of ICs? 10
- (c) Describe J-K, D and T flip flops with net sketches and necessary characteristic tables. 06
- (d) What is counter? Design a 3-bit binary counter using T-flip flops from its excitation table. 09

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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) Define simple stress, shearing stress and bearing stress. 06
 (b) A uniform concrete slab of total weight W is to be attached as shown in Fig. 1(b), to two rods whose lower ends are on the same level. Determine the ration of the areas of the rods so that the slab will remain level. 14

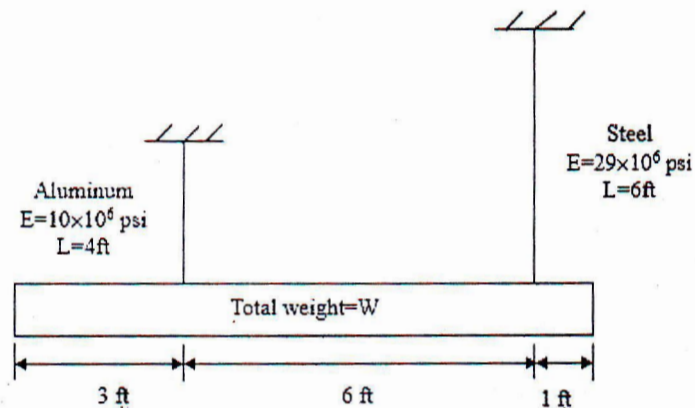


Fig. 1(b)

- (c) The composite rod in Fig. 1(c) is stress free before the axial loads P_1 and P_2 are applied. 15
 Assuming that the walls are rigid. Calculate the stress in each material if $P_1 = 150$ KN and $P_2 = 90$ KN.

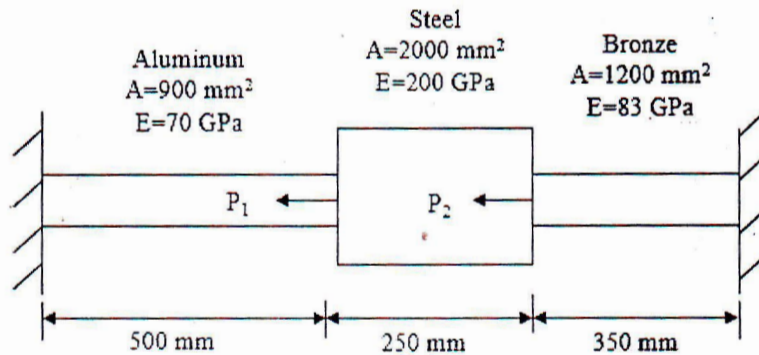


Fig. 1(c)

2. (a) Draw a stress-strain diagram for structured steel and briefly describe its each point. 10
 (b) A torque T is applied, as shown in Fig. 2(b), to a solid shaft with built in ends. Prove that 12
 the resisting torques at the walls are $T_1 = \frac{Tb}{L}$ and $T_2 = \frac{Ta}{L}$. How would these values be changed if the shaft were hollow?

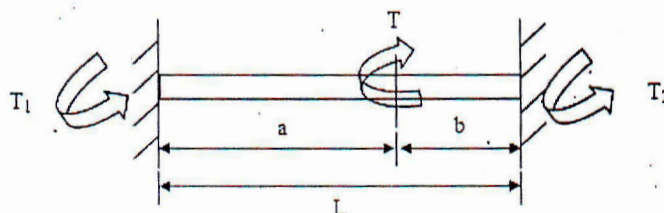


Fig. 2(b)

- (c) A rigid bar, pinned at point O, is supported by two identical springs as shown in Fig. 2(c). 13
 Each spring consists of 20 turns of $\frac{3}{4}$ inch diameter wire having a mean diameter of 6 inch.
 Determine the maximum load w that may be supported if the shearing stress in the springs is limited to 20 ksi.

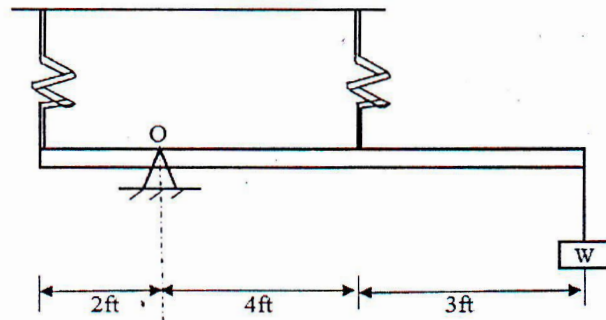


Fig. 2(c)

3. (a) Define bending moment and moment of inertia. 05
 (b) Draw the load and moment diagrams corresponding to the given shear diagram Fig. 3(b). 15
 Specify values at all change of load positions and at all points of zero shear.

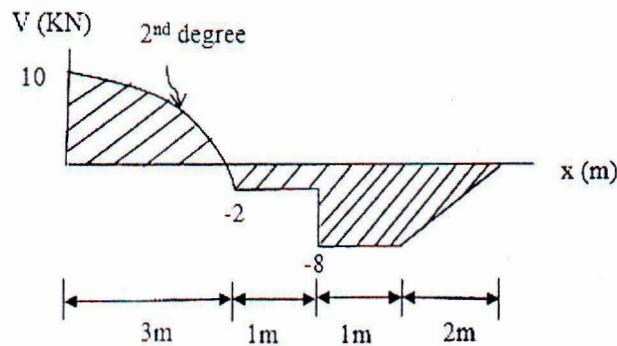


Fig. 3(b)

- (c) Determine the minimum height h of the beam shown in Fig.3(c), if the flexural stress is not exceeded 20 MPa. 15

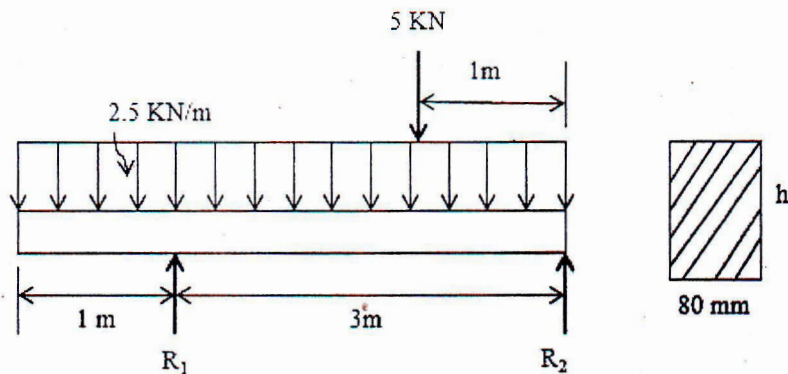


Fig.3(c)

4. (a) Define flexural stress. Determine the maximum tensile stress and compressive stress 17
 developed in the overhanging beam shown in Fig. 4(a). The cross section T with the given
 properties.

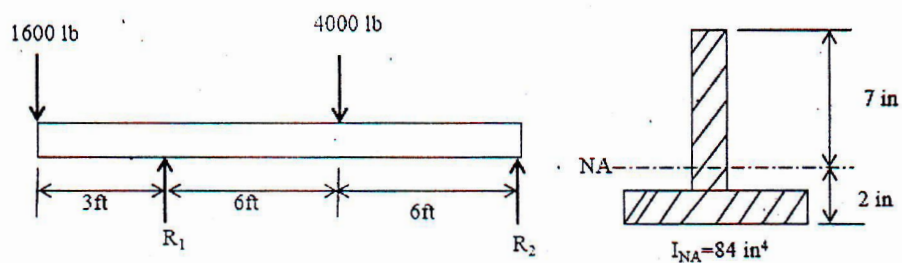


Fig. 4(a)

- (b) Determine the equation of the elastic curve of a cantilever beam supporting a uniformly distributed load of intensity W_0 over part of its length as shown in Fig. 4(b). 18

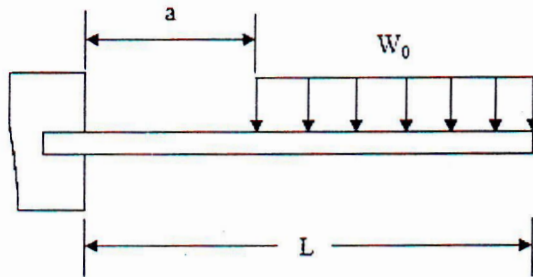


Fig. 4(b).

SECTION-B

5. (a) Write down the three basic types of loading and their corresponding stress formulas. 06
 (b) Compute the stresses at A and B on the link loaded as shown in Fig. 5(b), if $P=9000$ lb and $F=3000$ lb. 16

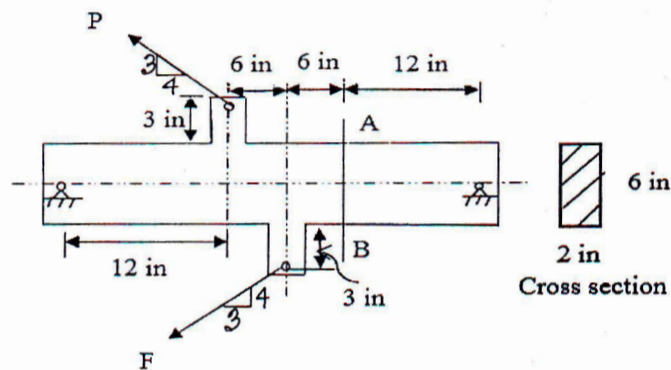


Fig. 5(b)

- (c) A 50 mm by 100 mm timber is used as a column with fixed ends. Determine the maximum length at which Euler's formula can be used if $E=10$ GPa and the proportional limit is 30 MPa. What central load can be carried with a factor of safety of 2 if the length is 2.5 m? 13
6. (a) Show that maximum and minimum normal stress occur on planes of zero shearing stress. 15
 (b) A state of stress is specified in Fig. 6(b). Determine the normal and shearing stresses on 20
 i) The principle planes
 ii) The planes of maximum in planer shearing stress and
 iii) The planes whose normal are at $+32.5^\circ$ and $+122.5^\circ$ with the x axis.
 Show the results of parts (i) and (iii) on complete sketches of differential elements.

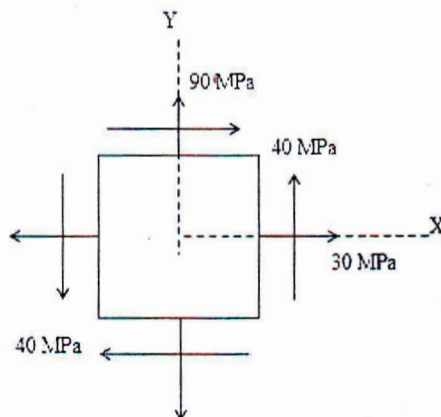


Fig. 6(b)

7. (a) What is critical load? Derive the Euler's formula for long column. 13
 (b) Define slenderness ratio. How the slenderness ratio affect the column formula? Explain. 09
- (c) Select the lightest W shape that can be used as a column 7m long to support an axial load of 450 kN with the factor of safety 3. Assume one end fixed and other hinged. Use $\sigma_{pl} = 200$ MPa and $E=200$ GPa. 13

8. (a) A W 360×134 section is used as a column whose effective length is 6m. The column carries an axial load of 260 kN and an eccentric load of 220 kN applied on the minor axis. Determine the e , the maximum eccentricity of the load. Use AISC specification with $\sigma_{yp}=250$ MPa and $E=200$ GPa. 17
- (b) Find the safe load on the lap connection shown in Fig.8 (b), if the rivets are of 19 mm diameter and the plates are 8 mm thick. Use allowable stress of $\tau=95$ MPa, $\sigma_t=140$ MPa and $\sigma_b=220$ MPa. 18

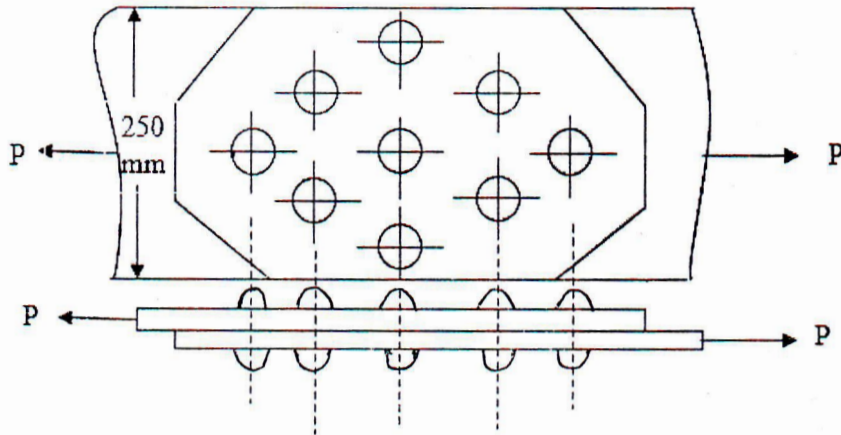


Fig.8 (b)

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B.Sc. Engineering 2nd Year 2nd Term, 2016

ME 2215

Thermal Engineering and Heat Transfer

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) Distinguish between the following: 12
 - i) Intensive and extensive properties;
 - ii) Source and sink;
 - iii) Point function and path function.
- (b) Explain the causes of entropy increase in a closed system. Prove that an isentropic process need not be adiabatic or reversible. 13
- (c) State 'Zeroth law of thermodynamics'. What are the limitations of first law of thermodynamics? 10

2. (a) What is a thermodynamic cycle? Distinguish between a four stroke cycle and a two stroke cycle. 8
- (b) Differentiate between two stroke petrol engine and four stroke petrol engine. 12
- (c) A diesel engine has a bore 250 mm and a stroke of 400 mm. The cut-off takes place at 5 percent of the stroke. Estimate- 15
 - i) Air standard efficiency;
 - ii) Mean effective pressure if the clearance volume and the pressure at the end of suction stroke are 1.2 litres and 1 bar respectively.

3. (a) Briefly explain the scavenging of F.C engines. What are the types of scavenging? 8
- (b) Write down the working principle of locomotive boiler. Differentiate between lever safety valve and dead weight safety valve. 12
- (c) A steam plant consisting of a boiler, superheater and economizer has the following particulars: Steam pressure = 12.6 bar; temperature of steam leaving superheater = 245°C; fuel used per hour = 1000 kg; feed water per hour = 9000 kg; temperature of feed water entering the economizer = 40°C; temperature of feed water leaving the economizer = 115°C; dryness fraction of steam leaving the boiler = 0.9; calorific value of fuel used = 30240 KJ/Kg. calculate: 15
 - i) Overall efficiency of the plant, and
 - ii) Percent of heat in fuel used in the boiler, economizer and superheater.

4. (a) What is a gas turbine? How does a gas turbine compare with the internal combustion engine power plant? 06
- (b) Name various refrigerants. How a refrigerant is selected? Write important characteristics of refrigerants. 10
- (c) Define comfort. What are the factors which affect comfort air conditioning? 04
- (d) In a refrigerator working on Bell Coleman cycle, the air is drawn into the cylinder of the compressor from cold chamber at a pressure of 1 Kgf/cm² and temperature 10°C. After isentropic compression to 5 Kgf/cm², air is cooled at constant pressure to a temperature of 20°C. The polytropic expansion $p v^{1.25} = \text{constant}$, then follows, and air expanded to 1 Kgf/cm² is passed to cold chamber. Determine: 15
 - i) Work done per Kg of air flow.
 - ii) Refrigerating effect per kg of air flow.
 - iii) COP.
 - iv) Refrigerating capacity of plant in Tons for a mass flow rate of 80 Kg/hr.

SECTION-B

5. (a) What is conduction? Derive the three dimensional general heat conduction equation in rectangular coordinate, considering the case of constant thermal conductivity. 12
- (b) Define fin efficiency. Derive the one dimensional fin equation for fins with negligible heat loss at the tip. 11
- (c) Heat is generated at a constant rate of $g_0=4 \times 10^8 \text{ w/m}^3$ in a copper rod of radius $r=0.5 \text{ cm}$ and the thermal conductivity $k=386 \text{ w/ (m.}^0\text{c)}$. The rod is cooled by convection from its cylindrical surface into an ambient at 30°c with a heat transfer coefficient $h=2000 \text{ w/ (m.}^0\text{c)}$. Determine the surface temperature of the rod. 12
6. (a) Define effectiveness of a heat exchanger. 05
- (b) Derive the effectiveness- NTU relationship for a parallel flow heat exchanger. 15
- (c) Atmospheric air at $T_\infty=350 \text{ K}$ flows with a velocity of $U_\infty=5 \text{ m/s}$ along a flat plate $L=1 \text{ m}$ long. The drag force acting on the plate per 1-m width is $F=4 \times 10^{-2} \text{ N}$. By using the Reynolds- colburn analogy, estimate the corresponding average heat transfer coefficient h_m . 15
7. (a) Define emissive power. Prove that the spectral emissive power of a black body is Π times of its spectral radiation intensity. 10
- (b) Explain specular and diffuse reflection with necessary sketches. 10
- (c) Consider two large parallel plates, one at $T_1=800 \text{ K}$ with emissivity $\epsilon_1=0.9$ and the other at $T_2=300 \text{ K}$ with emissivity $\epsilon_2=0.5$. A radiation shield having an equal emissivity ϵ_3 on both sides is placed between the two plates. Calculate the emissivity of the radiation shield in order to reduce the radiative heat transfer between the two plates to 10 percent of that without the shield. 15
8. (a) Define interface conductance. "*The interface conductance is higher with a softer material than with a harder material*". Justify it with a suitable example. 12
- (b) Define lumped system analysis. Explain the significance of Biot number in the lumped system analysis. 10
- (c) A steel bar [$\rho = 7800 \text{ Kg/m}^3$, $c = 0.5 \text{ KJ/ (Kg.}^0\text{c)}$, $k = 50 \text{ w/ (m.}^0\text{c)}$] of diameter $D=5 \text{ cm}$ is to be annealed by slowly cooling from $T_i=800^\circ\text{c}$ to 120°c in an ambient at $T_\infty=50^\circ\text{c}$. If the heat transfer coefficient between the ambient air and the surface of the bar is $h=45 \text{ w/ (m}^2. ^0\text{c)}$, determine the time required for the annealing process by applying the lumped system analysis. 13