Khulna University of Engineering & Technology
Department of Industrial Engineering and Management
B.Sc. Engineering 4th Year Special Backlog Examination, 2018

IPE 3217
Operations Research

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 operations research? Discuss about the structure and applications of mathematical models.   10

    (b) A certain final product consists of three parts. The three parts can be produced in four different departments with each department having a limited number of production hours. The table below gives the production rates of the three parts. The objective is to determine the number of hours of each department to be assigned to each part so as to maximize the number of completed units of the final product. Formulate the problem as a linear programming model.   10

Department	Capacity (hours)	Production rate per hour		
		Part 1	Part 2	Part 3
1	100	10	15	5
2	150	15	10	5
3	80	20	5	10
4	200	10	15	20

    (c) Determine the solution space graphically for the following inequalities.   15

   $x_1 + x_2 \le 4$
   $4x_1 + 3x_2 \le 12$
   $-x_1 + x_2 \ge 1$
   $x_1 + x_2 \le 6$
   $x_1, x_2 \ge 0$

   Which constraints are redundant? Reduce the system to the smallest number of constraints that will define the same solution space and determine the optimal solution if the objective function is "Maximize, $z = 6x_1 + 2x_2$".

2. (a) Solve the following problem by simplex method.   15

   Maximize, $z = 3x_1 + 5x_2 - 2x_3$
   Subject to,
   $x_1 + 2x_2 + 2x_3 \le 10$
   $2x_1 + 4x_2 + 3x_3 \le 15$
   $x_1, x_2, x_3 \ge 0$

    (b) Solve the following LP problem by dual simplex method.   20

   Minimize, $z = 5x_1 + 6x_2$
   Subject to,
   $x_1 + x_2 \ge 2$
   $4x_1 + x_2 \ge 4$
   $x_1, x_2 \ge 0$

3. (a) While solving a linear programming problem by simplex method what indicates by each of the following solutions? Explain with example.
    i) Degeneracy; iii) Alternative optima;
    ii) Unbounded solutions; iv) Infeasible solution.

15

(b) Consider the following LP allocation model.

Maximize, $z = 2x_1 + 4x_2$ (profit)

Subject to,

$$x_1 + 2x_2 \leq 5 \text{ (resource 1)}$$
$$x_1 + x_2 \leq 4 \text{ (resource 2)}$$
$$x_1, x_2 \geq 0$$

The optimum tableau is given by

Basic	x_1	x_2	x_3	x_4	Solution
z	0	0	2	0	10
x_2	1/2	1	1/2	0	5/2
x_4	1/2	0	-1/2	1	3/2

i) Classify the two resources as scare or abundant;

ii) Determine the maximum range of change in the availability of each resource that will keep the solution optimal.

4. (a) What are meant by balanced and unbalanced transportation model? Explain briefly. 10
   (b) Solve the following transportation problem. 25

Destination

	1	2	3	4	
Source 1	7	8	11	10	30
2	10	12	5	4	45
3	6	10	11	9	35
	20	28	17	33	

SECTION–B

5. (a) Assign the men to jobs in the best way 15

Cost Matrix (Tk)

		Job		
		Mow	Paint	Wash
Men	John	15	10	9
	Keren	9	15	10
	Terri	10	12	8

(b) Consider the following integer linear programming problem.

Maximize, $z = 3x_1 + 12x_2$

Subject to,

$$x_1 + 3x_2 \leq 9$$
$$7x_1 - x_2 \leq 11$$
$$x_1, x_2 \geq 0$$

20

Basic	x_1	x_2	S_1	S_2	Solution
z	0	0	87/20	21/20	507/10
x_1	0	1	7/20	1/20	37/10
x_2	1	0	1/20	3/20	21/10

The optimal simplex tableau is given above. Now find out the optimal integer solution.

6. (a) Write down the characteristics of dynamic programming. 10

   (b) Consider the following capital budgeting. Develop the forward dynamic programming model and find the optimum solution. Assume that the total available capital is \$8 million. 25

Proposal	Plant-1		Plant-2		Plant-3	
	C_1	R_1	C_2	R_2	C_3	R_3
1	3	5	3	4	0	0
2	4	6	4	5	2	3
3	-	-	5	8	3	5
4	-	-	-	-	6	9

7. (a) What is queue? Describe the necessity of studying queue. 07

   (b) Find the saddle point of the following game. 10

B

		i	ii	iii	iv
	i	4	-4	-5	6
	ii	-3	-4	-9	-2
A	iii	6	7	-8	-9
	iv	7	3	-9	5

   (c) Solve the following game graphically. 18

B

		i	ii
	i	2	4
	ii	2	3
A	iii	3	2
	iv	-2	6

8. (a) Initial condition, $\infty^{(0)} = (1, 0, 0)$ 12
   Transition matrix,

		1	2	3
	1	0.3	0.6	0.1
$P =$	2	0.1	0.6	0.3
	3	0.05	0.4	0.55

   Find the condition at the step 4.

   (b) At a one man barbar shop, customers arrive according to Poisson distribution at a mean arrival rate of 5 customers per hour, and his hair cutting time is exponentially distributed with an average cut taking 10 minutes. It is assumed that because of his excellent reputation, customers were always willing to wait. Calculate the following: 23
   i) Average number of customers in the shop;
   ii) Average number of customers waiting for hair cut;
   iii) Percentage of idle time of the barber;
   iv) The percentage of customers who have to wait.

Khulna University of Engineering & Technology
Department of Industrial Engineering and Management
B.Sc. Engineering Special Back Log Examination, 2018
IPE 4027
Computer Integrated Manufacturing

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 product and manufacturing system. Explain the components of a manufacturing system.

   (b) What is manning level? Differentiate between single station manned cell and single station automated cell.

   (c) In an aircraft assembly plant, it took 54 9min to assemble the 7th central panel. It took 49 min to assemble 12th panel. If you develop a learning curve to predict assembly times for the operation,

      i) What would be the percentage learning and

      ii) How long it take to assemble the 25th panel?

2. (a) Discuss the prerequisites for unattended cell operation.

   (b) What is machine cluster? State the conditions for machine cluster?

   (c) A stamping plant must be designed to supply an automotive engine plant with sheet metal stampings. The plant will operate one 8 hour shift for 250 day/yr and must produce 15,000,000 good quality stampings annually. Batch size=10,000 good stampings produce per batch. Scrap rate = 5%. On average, it takes 3.0 sec to produce each stampings when presses are running. Before each batch, the press must be setup and its takes 4 hrs to accomplish each setup. Press are 90% reliable during production and 100% reliable during setup. How many presses are required?

3. (a) Discuss briefly bar code readers and bar code printers.

   (b) The CNC grinding section has a large number of machines devoted to grinding of shafts for the automotive industry. The grinding machine cycle takes 3.6 min. At the end of the cycle, an operator must be present to unload and load parts, which takes 40 sec. Determine, (i) How many grinding machines the worker can service if it takes 20 sec to walk between the machine and no machine idle time is allowed. (ii) How many seconds during the work cycle is the worker idle? (iii) What is the hourly production rate of this machine cluster?

   (c) What is code 39? Explain with example.

4. (a) What is cellular manufacturing? Discuss the feature of parts classification and coding system.

   (b) What is automated inspection? Discuss off-line and on-line inspection.

   (c) Five machine will constitute a GT cell. The Form-To data for the machines are shown in the table below. Determine the most logical sequence of machines for this data

according to Hollier method 1, and construct the flow diagram for the data, showing where and how many parts enter and exit the system.

From	To				
	1	2	3	4	5
1	0	10	80	0	0
2	0	0	0	85	0
3	0	0	0	0	0
4	70	0	20	0	0
5	0	75	0	20	0

SECTION-B

5. (a) Define FMS. Write down the importance of FMS in material handling and storage system. **10**

(b) Why is computer control required in FMS? Describe the functions performed by the computer control system in FMS. **12**

(c) What is meant by automated storage retrieval system? Describe the unit load AS/RS and Deep-lane AS/RS. **13**

6. (a) Why manually assembly lines are so productive compared with alternative methods? Briefly explain. **10**

(b) What is meant by straving and blocking? Briefly discuss different work transport system in a manual assembly line. **15**

(c) A single assembly line is being planned to produce a consumer appliance at the rate of 200,000 units/year. The line will be operated 8 hr/shift, 2 shift/day, 5 day/week, 50 week/ year, work content time = 35.0 min. For planning purpose, it is anticipated that the proportion uptime on the line will be 95%. Determine, (i) Average hourly production rate R_p (ii) Cycle time T_c (iii) Theoretical minimum number of worker required on the line. **10**

7. (a) Describe the different types of automated assembly systems. **12**

(b) Prepare the rank order clustering technique for the following data: **13**

Parts

Machines	A	B	C	D	E	F	G	H	I
1	1	1		1				1	
2					1				1
3			1		1				1
4		1		1		1			
5	1							1	
6			1						1
7		1				1	1		

(c) Explain the terms: **10**
  i) Line efficiency
  ii) Proportion down time
  Average cost of a work piece produced

8. (a) Compare concurrent engineering with traditional product development cycle. **08**

(b) Write down the principles of lean manufacturing, Compare mass production with lean production. **12**

(c) How do you reorganized your production system into agility? **15**

Khulna University of Engineering & Technology
Department of Industrial Engineering and Management
B.Sc. Engineering 4th Year Special Backlog Examination, 2018

IPE 4019
Logistics and Supply Chain Management

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 ''Supply Chain? List the supply chain decision phases that have significant impacts on supply chain profitability and explain them in brief.	13
	(b)	Identify the key supply chain decision phases and explain the significance of any two of them.	12
	(c)	Briefly illustrate the cycle view and push-pull of a supply chain.	10
2.	(a)	Describe the integer replenishment policy for a multi echelon supply chain with necessary figures.	10
	(b)	Derive the following expression in case of ordering and delivering the lots jointly $$n^* = \sqrt{\dfrac{\sum hc_i m_i D_i}{2\left(s + \sum \frac{S_i}{m_i}\right)}}$$ where the symbols have their usual meanings.	13
	(c)	How does a coordinated supply chain maximize the profits? Explain.	12
3.	(a)	"Supply chain design is an art of science"- Justify the statement.	10
	(b)	What is meant by implied demand uncertainty? Explain its effect on supply chain uncertainty.	12
	(c)	Demand for the Deskpro Computer at best buy is 1000 units per month. Best buy incurs a fixed order placement, transportation and receiving cost of $4,000 each time an order is placed. Each computer costs best buy $500 and the retailer has a holding cost of 20 percent. Evaluate the number of computers that the store manager should order in each replenishment lot.	13
4.	(a)	Explain optimal cycle service level for seasonal items with a single order in a season.	10
	(b)	Identify the different facilities in a global supply chain network.	10
	(c)	A machine tools retailer, demand for tools is 20,000 per month. Retailer incurs a fixed order placement, transportation and receiving cost of $120 each time an order for tools in placed with the manufacturer. Retailer incurs a holding cost of	15

		20 percent. The manufacturer uses the following marginal unit discount pricing schedule.	

Order Quantity	Marginal Unit Price
0-8,000	$5.00
8,000-13,000	$4.95
Over 13,000	$4.92

Evaluate the number of tools that retailer manager should order in each lot.

SECTION–B

5.	(a)	Write down the name of modes of transportation in supply chain. Discuss about the tailored transportation considering the size of customer.	11
	(b)	What type of points should be considered to trade-off between transportation model and inventory aggregation?	08
	(c)	"TL operations have relatively low fixed costs"– Justify the statement.	08
	(d)	Is cross-docking be considered as the substitution of distribution centre? Express your opinion.	08
6.	(a)	Briefly describe key process under customer relationship management.	12
	(b)	What are the roles of IT is supply chain?	10
	(c)	How can IT manage risks in a supply chain?	13
7.	(a)	Briefly discuss the major factors that effect in supplier scoring and assessment.	15
	(b)	How can design collaboration with suppliers help a PC manufacturer to improve performance? Explain.	10
	(c)	Write short note on Buyback contract.	10
8.	(a)	What is "Bullwhip effect"? Describe with necessary sketches.	10
	(b)	Discuss about the operational obstacles to co-ordination in a supply chain with suitable examples.	15
	(c)	How do the tendencies of local optimization effect the co-ordination of supply chain?	10

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SECTION–A

1. (a) Briefly discuss the basic features of machine tools. What are the design criteria of a machine tool structure? **12**

   (b) What is meant by kinematics of machine tools drive? Name the different types of stepped and stepless drives. **13**

   (c) Drive an expression for percentage of loss of speed in G.P. series. **10**

2. (a) Why arithmetic progression does not permit economical machining at larger diameter? Explain with the help of diagram. **10**

   (b) Discuss sliding key mechanism and Norton gear box with the help of neat sketches. **15**

   (c) Distinguish between ray diagram and speed diagram. What does the speed diagram of a gear box indicate? **10**

3. (a) What are the different types drives employed in machine tool? Explain the hydraulic drive system in machine tools? **12**

   (b) Write down the advantages and disadvantages of hydraulic system in machine tool drive. **13**

   (c) What are the advantages of spool valve over poppet valve? **10**

4. (a) With the help of net sketches discuss the working principle of PIV drive. **15**

   (b) A gear box has to be designed for drilling machine to give speed variation between 120 and 200 rpm in 6 steps. The input shaft runs at 225 rpm. The intermediate shaft has 3 speeds. Select a suitable gear box layout and calculate the gear sizes. **20**

SECTION–B

5. (a) Briefly explain the NC systems of machine tools. **15**

   (b) What are the differences between CNC and DNC system? State the functions of MCU. **10**

   (c) State the basic features of point-to-point and continuous path control system. **10**

6. (a) What is adaptive control machining system? Briefly explain the adaptive control optimization process with suitable sketches. **10**

   (b) Write short notes on the following terms: **12**
      i) Automation ii) transfer machine iii) Robot

   (c) Describe the BTR approach of DNC system with necessary figures. **13**

7. (a) Define "Turret Lathe". Discuss about the role of compound rest in lathe machine.
    (b) Write short note on:
         i)   Face plate ii) Mandrel iii) Follower rest.
    (c) Is interrupted cutting possible in milling machine? Discuss about the differences between 1
         up milling and down milling with necessary sketches.

8. (a) Write down the differences between shaper and planner.   1
    (b) Describe the cutting mechanism of grinding machine with necessary figures.   1
    (c) Name the different types of drill bits. Describe the twist drill with suitable sketches.   1

Khulna University of Engineering & Technology
Department of Industrial Engineering and Management
B.Sc. Engineering 4th Year Special Backlog Examination, 2018
IPE 4225
Tool Engineering

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 meant by radial location? Explain how degrees of freedom are restricted in radial locator? 13
   (b) What are the three basic principles applied to the use of locating pin? Explain. 12
   (c) What are the differences between primary and secondary locator? 10

2. (a) List the name of different types of clamp those are generally used. Write down the principles of clamping. 12
   (b) What are the methods used to speed up the clamping action of a screw clamp? Explain any one of them with suitable sketch. 13
   (c) Discuss the effects of taper angle of wedge clamp on clamping action. Mention suitable range of taper angle of wedge clamp. 10

3. (a) What is drill Jig? What is the difference between a drill jig and a fixture? 10
   (b) Sketch the different vice fixtures with their applications. 15
   (c) Describe in brief the considerations in the design of drill Jigs. 10

4. (a) Why is the collar of knock-off expanding mandrel made of left-hand thread? 10
   (b) Discuss the design principles of lathe fixture. 10
   (c) Describe in brief with sketch (i) Single piloted boring bar (ii) Double piloted boring bar. 15

SECTION-B

5. (a) Briefly explain the following fundamental die cutting operations: (i) Blanking. (ii) Piercing. (iii) Lancing, and (iv) Notching. 12
   (b) What is meant by dis clearance? Discuss the effects of insufficient and excessive die clearance. 10
   (c) Sketch the progressive die and discuss its functions. 13

6. (a) Discuss the methods of reducing cutting force in die cutting operation. 12
   (b) Explain how to determine the drawing force and blank size. 13
   (c) Draw an OBI press and discuss about its major components. 10

7. (a) Discuss the factors that influence the clearance between punch and die. 10
   (b) What are the differences between sheet metal working process and metal forming process? Explain with figures 13
   (c) Differentiate between: (i) Blanking and Piercing, (ii) Perforating and Slitting, (iii) Flanging and Bending. 12

8. (a) Write short note on (i) Wire drawing and (ii) Tube drawing. 10
   (b) Discuss the effect of excessive and insufficient draw radius in drawing operation with suitable sketches. 15
   (c) Explain why it is important not to stop drawing operation once started. 10

Khulna University of Engineering & Technology
Department of Industrial Engineering and Management
B.Sc. Engineering 4th Year Special Backlog Examination, 2018
MATH 2111
Mathematics-III

Full Marks: 210   Time: 3 hrs

N.B: i) *Answer any THREE questions from each section in separate scripts.*
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SECTION–A

1. (a) Define order of a differential equation with example. By eliminating the constants A and B, obtain the differential equation for which $xy = Ae^x + Be^{-x} + x^2$ is a solution. — 11

   (b) Solve $\frac{dy}{dx} = (4x + y + 1)^2; y(0) = 1$. — 11

   (c) Determine the general solution of $ydx - xdy = \sqrt{x^2 + y^2}dx$ — 13

2. (a) Solve $(x^2 + y^2 + x)dx + xydy = 0$ — 12

   (b) Solve $\frac{dy}{dx} + xy = xy^2$ — 11

   (c) Solve $\frac{dy}{dx} + y\cot x = 5e^{\operatorname{cosec} x}$ — 12

3. (a) Solve $\frac{d^2y}{dx^2} + 4\frac{dy}{dx} + 3y = e^{-3x} + \cos 2x$ — 12

   (b) Solve $\frac{\partial u}{\partial t} = 3\frac{\partial^2 u}{\partial x^2}$ by the method of separation of variables. — 10

   (c) Define Laplace transform. Find the Laplace transform of $e^{-2t}(3\cos 6t - 5\sin 6t)$ — 13

4. (a) Evaluate $L^{-1}\left\{\frac{1}{s^2(s+1)^2}\right\}$ — 10

   (b) State convolution theorem. Using convolution theorem, find the inverse Laplace transform of $\left\{\frac{1}{s^2(s+1)^2}\right\}$ — 13

   (c) solve $\frac{d^2Y}{dt^2} + Y = t; Y(0) = 1, Y'(0) = -2$ — 12

SECTION–B

5. (a) If Z_1 and Z_2 are two complex numbers, then prove that $|Z_1 + Z_2| \le |Z_1| + |Z_2|$ — 12

   (b) Represent graphically the set of values of Z for which $|Z + i| - |Z - i| = 3$. — 12

   (c) Find all the roots of the equation $e^Z - \frac{1}{e^Z} = 2i$. — 11

6. (a) Test whether $u = e^{-x}(x \sin y - y \cos y)$ is harmonic or not. If possible, find v such that $f(Z) = u + iv$ is analytic.

   (b) Obtain the expression of $\frac{Z-1}{Z^2}$ in a Taylor's series about $Z = 1$.   10

   (c) Expand $f(Z) = \frac{2Z+3}{(Z-1)(Z-2)}$ in a Laurent series in the region   12

      (i) $1 < |Z| < 2$ and

      (ii) $0 < |Z - 1| < 1$

7. (a) Determine the poles and residues of $f(Z) = \frac{Z^2 - 2Z}{(Z+1)^2(Z^2+4)}$.   11

   (b) Evaluate any two of the following by contour integration: 24

      i) $\int_0^{2\pi} \frac{d\theta}{5+4\cos\theta}$

      ii) $\int_0^{\infty} \frac{x \sin x}{x^2+a^2} dx$

      iii) $\int_{-\infty}^{\infty} \frac{x^2}{(x^2+4)(x^2+9)} dx$

8. (a) State Green's theorem and use this theorem to evaluate $\int_C (3x - 8y^2)dx +$ 11
$(4y - 6xy)dy$, where C is the boundary of the region bounded by $x = 0, y = 0$ and $x + y = 1$.

   (b) Prove that the function $f(Z)$ defined by   18

$$f(Z) = \begin{cases} \dfrac{(x^3 - y^3) + (x^3 + y^3)}{(x^2 + y^2)}; & Z \neq 0 \\ 0 & ; \ Z = 0 \end{cases}$$

Is continuous and Cauchy-Riemann equations are satisfied at the origin. Does $f'(0)$ exist?

   (c) Define limit point and branch point with example.   06

Khulna University of Engineering & Technology
Department of Industrial Engineering and Management
B.Sc. Engineering 4th Year Special Backlog Examination, 2018
ME 2213
Mechanics of Solids

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

   (b) A bronze bar 3m long with a cross sectional area of 320 mm^2 is placed between two rigid walls   14
   as shown in figure 1(b), at a temperature of −20°C, the gap Δ= 2.5mm. Find the temperature
   at which the compressive stress in the bar will be 35 MP. Use $\alpha = 18.0 \times 10^{-6} m/m°C$ and
   E=80 GPa.
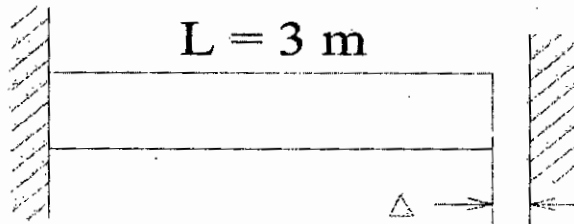
Figure 1(b)

   (c) The rigid bars AB and CD shown in the figure 1(c) are supported by pins at A and C and the   13
   two rods. Determine the maximum force P that can be applied as shown. If its vertical
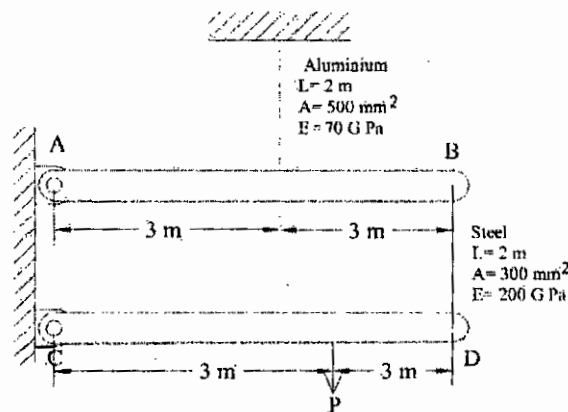   movement is limited to 5 mm. Neglect the weights of all members.

Figure 1(c)

2. (a) Show that, if the pressure in a cylinder is raised to busting point, failure will occur along   19
   longitudinal section.

2. (b) A rigid horizontal bar of negligible mass is connected to two rods as shown in figure 2(b). If the system is initially stress free. Calculate the temperature change that will cause a tensile stress of 90 MPa in the brass rod. Assume that both rods are subjected to the change in temperature. For Brass $\alpha = 18.7 \, \mu m/(m.°C)$ and for Copper $\alpha = 16.8 \, \mu m/(m.°C)$
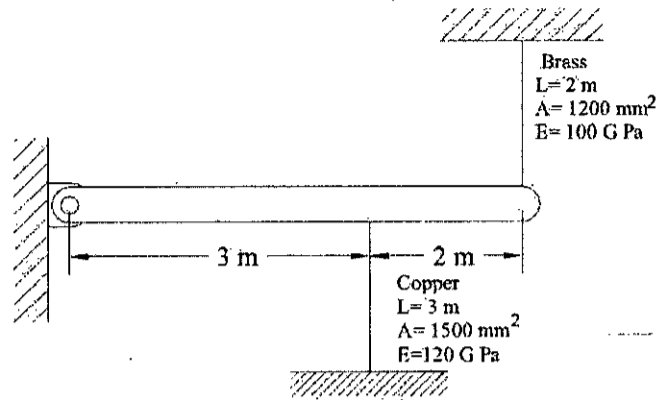
Figure 2(b)

3. (a) The compound shaft shown in figure 3(a) is attached to rigid supports. For the bronze segment   13
AB, the maximum shearing stress is limited to 8000 psi and for the steel segment BC, it is limited to 12 ksi. Determine the diameter of each segment so that each material will be simultaneously stressed to its permissible limit when a torque T=12 kip.ft is applied. For bronze $G = 6 \times 10^6 \, psi$ and for steel $G = 12 \times 10^6 \, psi$.
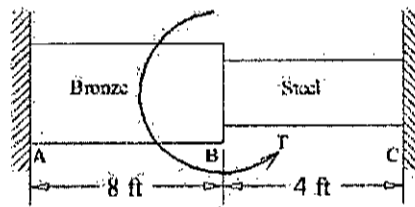

Figure 3(a)

(b) A rigid bar, hinged at one end, is supported by two identical springs as shown in figure 3(b).   12
Each spring consists of 20 turns of 10 mm wire having a mean diameter of 150 mm. Compute the maximum shearing stress in the springs. Neglect the mass of the rigid bar.
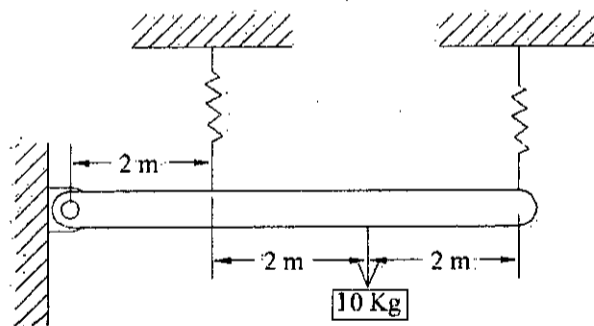

Figure 3(b)

(c) Define the following terms: 10
(i) Bending moment, (ii) Moment of inertia, (iii) Positive bending, (iii) Negative bending.

4. (a) Define flexural stress. Drive the equation of flexural formula and show the condition for   17
maximum flexural stress.

4. (b) Compute the maximum tensile and compressive stress developed in the beam that is loaded and has the cross-sectional properties as shown in figure 4(b).   18
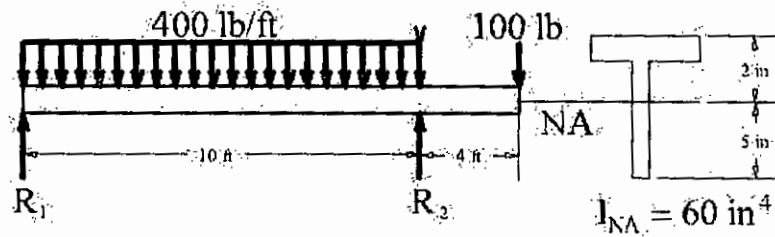
Figure 4(b)

SECTION-B

5. (a) Write down the three basic loading type with their corresponding stress formula.   05

(b) A square steel bar is to support a load of 20 kips on a length of 10 ft. Assume both ends hinged, determine the length of each side. Use $E = 29 \times 10^6$ psi.   13

(c) Determine the largest load P that can be supported by the circular steel bracket shown in the figure 5 (c), if the normal stress on section A-B is limited to 80 MPa.   17
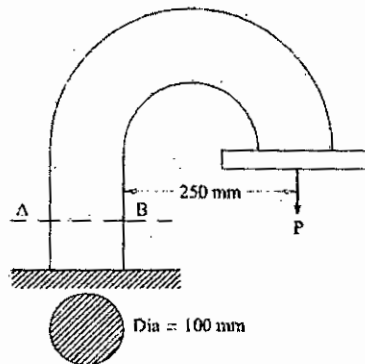
Figure 5(c)

6. (a) Show that maximum and minimum normal stress occur on plane of zero sharing stress.   17

(b) A state of stress is specified in figure 6(b). Determine the normal and shearing stress on (i) the principle planes, (ii) the plane of maximum in plane sharing stress and (iii) the planes whose normal are at $+36.8°$ and $+126.8°$ with the axis. Also show the results of the part (i) and part (ii) on complete sketches of differential elements.   18
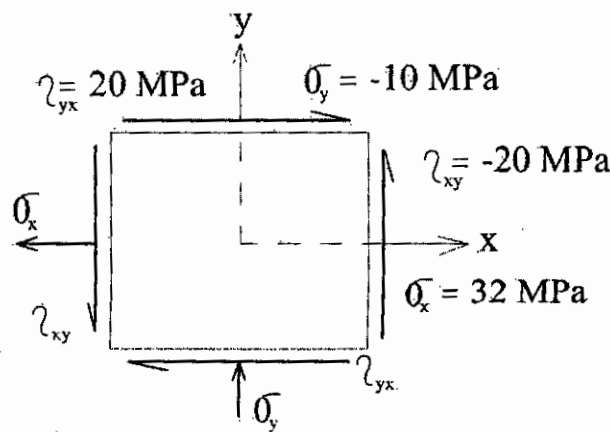
Figure 6(b)

7. (a) Explain critical load. Drive Euler's formula for long column. Write down the limitations of Euler's formula.   17

7. (b) Write down the equations of stress for eccentrically loaded column. A $W360 \times 134$ section is used as a column whose effective length is 6 m. The column carries an axial load of 260 KN and an eccentric load of 220 KN applied on minor axis. Determine e, the maximum shearing load, using $\sigma_{yp} = 250\ MPa$ and E= $200\ GPa$.

8. (a) A $W310 \times 52$ section is used as a column with hinged ends Use AISC specifications, determine the maximum load that can be applied if L= $10\ m$. Use $\sigma_{pl} = 200\ MPa$ and E= $200\ GPa$.   17

(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 pressure. Use $q = 8800\ ps$; $\sigma_b = 19\ ksi$, $\sigma_t = 11\ ksi$.   18

Khulna University of Engineering & Technology
Department of Industrial Engineering and Management
B.Sc. Engineering Special Back Log Examination, 2018
MATH 1111
Mathematics-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 continuity of a function. A function $f(x)$ is defined as follows;   14
    $$f(x) = 3 + 2x \quad \text{for} \quad -3/2 < x \le 0$$
    $$= 3 - 2x \quad \text{for } 0 < x < 3/2$$
    Discuss the continuity and differentiability of $f(x)$ at x = 0.

    (b) Differentiate $\cos^{-1}\left(\frac{1-x^2}{1+x^2}\right)$ with respect to $\tan^{-1}\left(\frac{2x}{1-x^2}\right)$.   11

    (c) Find $\frac{dy}{dx}$, if $e^{xy} - 4xy = 2$.   10

2. (a) Expand $f(x) = \cos x$ in power of $(x - \pi/2)$ in a finite series with the form of   12
    Lagrange's remainder.

    (b) If $u = e^{xyz}$, then find the value of $\frac{\partial^3 u}{\partial x \partial y \partial z}$.   11

    (c) Define maximum function. Find the maximum value of the function $x/\log_e x$ 12

3. (a) Evaluate, $Lt_{x \to \frac{\pi}{2}}(1 - sinx).tanx$.   10

    (b) If $\ln y = \tan^{-1} x$ then using Leibnitz theorem show that $(1 + x^2)y_{n+2} +$ 13
    $\{2x(n + 1) - 1\}y_{n+1} + n(n + 1)y_n = 0$

    (c) Find the tangent and the normal to the curve $y(x - 2)(x - 3) - x + 6 = 0$ at the   12
    point where it cuts the x axis.

4. (a) Define homogeneous function with an example. If $u = 2x^2 + 5xy$ then prove   11
    that $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} = 2u$.

    (b) Define curvature. Find the radius of curvature of the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ at $(0, b)$.   12

    (c) Find the asymptotes of the curve   12
    $x^2(x - y)^2 - 4(x^2 + y^2) = 0$.

5.   Evaluate any three of the followings:

(i) $\int \frac{dx}{3+2\sin x+\cos x}$.

(ii) $\int e^x \frac{x^2+1}{(x+1)^2} dx$

(iii) $\int \log_e(x + \sqrt{x^2 + a^2})\, dx$

(iv) $\int \frac{x^2}{x^4 - x^2 - 12} dx$.

6.   Evaluate any three of the followings: 35

i) $\int_0^1 \frac{x \sin^{-1} x}{\sqrt{1 - x^2}}\, dx$

(ii) $\int_0^{\pi/2} \ln \sin x\, dx$

iii) $\int_0^1 \frac{\log_e(1 + x)}{1 + x^2}\, dx$

(iv) $\int_0^{\pi/2} \sin^m \theta \cos^n \theta\, d\theta$

7.   (a)   If $I_n = \int_0^{\pi/2} e^{2x} \sin^n x\, dx$, $n > 1$, find the reduction formula and hence   18
evaluate I_3.

(b)   Show that $\int_0^\infty \frac{\ln(1+a^2x^2)}{1+b^2x^2} dx = \frac{\pi}{b}\ln(\frac{a+b}{a})$.   17

8.   (a)   Find the area bounded by the astroid $x^{\frac{2}{3}} + y^{\frac{2}{3}} = a^{\frac{2}{3}}$.   11

(b)   Define beta function. Prove that $\Gamma\frac{1}{2} = \sqrt{\pi}$.   12

(c)   Find the volume of the solid generated by revolving the loop of the curve $y^2(x - a) = x^2(x + a)$ about x-axis.   12

Khulna University of Engineering & Technology
Department of Industrial Engineering and Management
B.Sc. Engineering 4th Year Special Backlog Examination, 2018
IPE 3221
Quality Management

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 "quality"? Write down the dimensions of quality.   10
    (b) Justify the statement "zero defect concept is not economically beneficial".   13
    (c) What are the differences between process in control and process out of control?   12

2. (a) Differentiate between Type-I and Type-II errors. Which one is more dangerous for   10
         business? Why?
    (b) What impact does the sample size have on control limit? Explain with examples.   10
    (c) Rajshahi silk mill has often weaving defects in saree. If the number of defect is   15
         more, the saree has to be downgraded to second. Ten saree were taken randomly
         and the number of defects were counted.

Saree	1	2	3	4	5	6	7	8	9	10
Defects	2	6	0	8	4	7	5	2	3	6

Determine whether the process is in control. Setup a control chart.

3. (a) What is meant by process capability? What are the processes of it?   10
    (b) Explain why C_{p_k} value can never be greater than C_p.   10
    (c) Discuss with the help of a diagram, the physical significance of negative value of   15
         C_{p_k}.

4. (a) What is DMAIC? Explain how the process can be improved using DMAIC with   13
         necessary diagram.
    (b) Define "Six Sigma". What are its applications?   10
    (c) Discuss with the help of a diagram why the Six Sigma quality is robust in mean   12
         shift.

5. (a) Define house of quality (HOQ). Construct a HOQ for a new upcoming I-phone to the Asian market. 18
    (b) What is QFD? Discuss the methodology used in QFD. 09
    (c) What is TQM philosophy? Describe any three basic concepts of TQM principles. 08

6. (a) Define common terminology used in acceptance sampling plans. 13
    (b) Write short notes on military and ANSI standards. 05
    (c) A company and its customers agreed to follow a double sampling plan with the following parameters: Lot size $N = 3000$; $n_1 = 40$; $n_2 = 60$; $c_1 = 2$; $c_2 = 3$. Construct a typical OC curve for P values 0.01 and 0.05. 17

7. (a) State and explain the 14 points of Deming in respect of quality management. 18
    (b) What is QMS? State the major clauses of QMS. 12
    (c) What are the limitations of QMS? 05

8. (a) What is FMEA? Perform documentation of FMEA design on a computer mouse. 15
    (b) Briefly state the purpose of ISO 9000. List the requirements for ISO 90001. 10
    (c) Briefly describe the concepts of ISO 14001. 10