(1)

Program: B.Sc.Engg. (IPE)
Semster: 3rd Semester

Date: 30 September 2022
Time: 2:30 PM-4:00 PM

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)

ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF MECHANICAL AND PRODUCTION ENGINEERING

MID SEMESTER EXAMINATION
IPE-4101 Introduction to Industrial & Production Engineering

WINTER SEMESTER: 2021-2022
TIME : 1 HR 30 MIN
FULL MARKS : 75

There are 3 (Three) questions. Answer all Questions. Marks in the Margin indicate full marks

01. (a) Classify the different types of industries and hence specific the different industries based on International Standard Industrial Classifications (ISIC) coding with examples. (12)

(b) What do you mean by manufacturing systems? Classify and explain the different types manufacturing systems. (8)

(c) What is Industrial revolution 4.0? (5)

(CO1), (PO1)

02. (a) Explain with necessary diagram the information process cycles involved in a typical manufacturing firm. (15)

(b) Explain the different rules and types of flow pattern that need to be considered for the design of plant layout in industries. (10)

(CO1), (PO1)

03. (a) A certain part is routed through six machines in a batch production plant. The setup and operation times for each machine are given in the table below. The batch size is 100 and the average nonoperation time per machine is 12 hours.

Determine: (i) manufacturing lead time and (ii) production rate for operation 3.

Machine	Setup time (hr.)	Operation time (min.)
1	4	5.0
2	2	3.5
3	8	10.0
4	3	1.9
5	3	4.1
6	4	2.5

(b) What do you mean by the term "Utilization" and "Availability"? How the "Utilization" and Availability can be calculated and state its effect on production capacity of a plant? (CO2, CO3), (PO1,PO2)

Program: B. Sc. Engg. (ME/IPE)
Semester: 1st Semester

Date: 5 October, 2022 (Afternoon)
Time: 2:30 am – 4:00 pm

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)

ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF MECHANICAL AND PRODUCTION ENGINEERING

Mid Semester Examination
Course Number: Math 4111
Course Title: Modelling with calculus and ODE

Winter Semester: 2021 - 2022
Full Marks: 75
Time : 1.5 Hours

There are **3 (three)** questions. Answer **all** questions. The symbols have their usual meanings. Marks of each question and corresponding CO and PO are written in the brackets.

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1. a) Consider the graph of the function f shown in Fig. Q 1(a). Use this graph to sketch the graphs of the following functions. [10] **CO1 PO1**

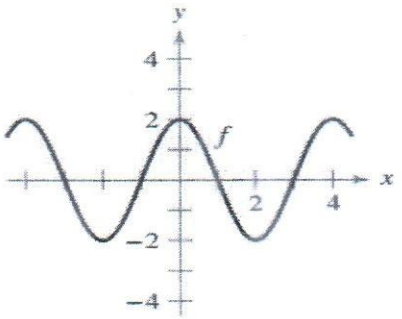


Fig. Q1(a)

$(i)\, f(x+1),\quad (ii)\, f(x)+1,\, (iii)\, 2f(x),\, (iv)\quad -f(x)$

b) Find a value of the constant k, if possible, that will make the function continuous everywhere. [10] **CO1 PO1**

$$f(x)=\begin{cases}7x-2; & x\le 1\\ kx^2; & x>1\end{cases}$$

2 a) In the engine shown in Fig. Q 2(a), a 7-inch connecting rod is fastened to a crank of radius 3 inches. The crankshaft rotates counterclockwise at a constant rate of 200 revolutions per minute. Find the velocity of the piston when $\theta=\frac{\pi}{3}$ [10] **CO1 PO2**

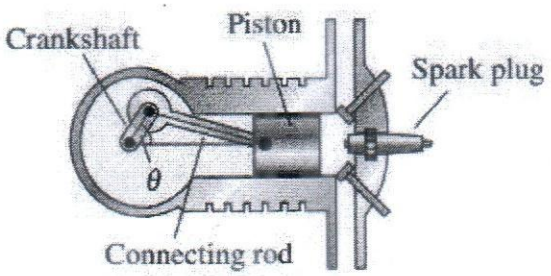


Fig. Q 2(a)

b) Show that the following function, *s(t)* satisfies the hypotheses of the Mean-Value theorem over the interval [0, 2], and find all values of c in the interval (0, 2) at which the tangent line to the graph off is parallel to the secant line joining the points (0, *f*(0)) and (2, *f*(2)). [10] **CO1 PO1**

$$s(t)=\frac{1}{4}t^3+1$$

c) Find the absolute extrema of the following function on the indicated closed interval. [10] **CO1 PO1**

$$g(x)=2x+5\cos x;\ [0,2]$$

3. a) Sketch a graph of $y=f(x)=\dfrac{x^2-1}{x^3}$ and identify the locations of all asymptotes, intercepts, relative extrema, and inflection points. [15] **CO1 PO1**

b) Two posts, one 12 feet high and the other 28 feet high, stand 30 feet apart. They are to be stayed by two wires, attached to a single stake, running from ground level to the top of each post. Where should the stake be placed to use the least amount of wire? [10] **CO1 PO1**

The End

B Sc Eng. ME/IPE/1st Sem. Date: 03 Oct. 2022 (afternoon)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
DEPARTMENT OF MECHANICAL AND PRODUCTION ENGINEERING

Mid Semester Examination **Winter Semester: 2021 - 2022**
Course Number: PHY 4113 **Full Marks: 75**
Course Title: Structure of Matter, Electricity, Magnetism and Modern Physics **Time: 1.5 Hours**

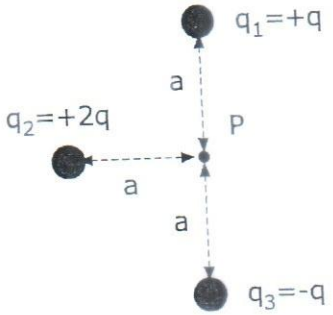
There are **4 (Four)** questions. Answer any 3 **(Three)** questions. The symbols have their usual meanings. Marks of each question and corresponding CO and PO are written in the brackets.

---

1. (a) What do you understand by quantization and conservation of charges? (2.5+2.5) (CO1) (PO1)

(b) Show that the electric field strength E at a distance r from the center of a sphere with a charge q distributed uniformly and of radius R is given by $E = \left(\frac{q}{4\pi\varepsilon_0 R^3}\right) r$. Plot the field strength E as a function of r (*for* $r = 0$ *to* $r >> R$) and explain the points where the value of E will be minimum and maximum. (10+5) (CO2) (PO2)

(c) Consider the charge configuration below. What are the magnitude and direction of the electric field at point P due to this charge configuration? (05) (CO3) (PO2)



2. (a) How do you differentiate between electric potential and potential energy? (05) (CO1) (PO1)

(b) Find the expression of electric potential *(V)* at an arbitrary point *P* which is at a distance *r* from the center of an electric dipole. (15) (CO2) (PO2)

(c) Two-point charges $+q$ and $-2q$ are separated by a distance of $20\ m$ in space. If $q = 10\ nC$, what is the value of electric potential at the midpoint between the charges? (05) (CO3) (PO2)

3. (a) What do you understand by Miller indices? Sketch (201) plane of a cubic crystal. (5) (CO1) (PO1)

(b) Derive Bragg's law for X-ray diffraction. In Bragg's diffraction condition, can λ be greater than twice of interplanar spacing? Support your answer. (15) (CO2) (PO2)

(c) In a tetragonal crystal, the lattice parameters $a = b = 2.42\ \text{Å}$ and $c = 1.74\ \text{Å}$. Determine the interplanar spacing between the consecutive (101) planes. (05) (CO3) (PO2)

4. (a) Classify the crystals on the basis of the nature of the forces acting between the atoms/ions in the crystal. (05) (CO1) (PO1)

(b) Obtain an expression for the lattice energy of an ionic crystal in equilibrium. (15) (CO2) (PO2)

(c) In a NaCl crystal, the equilibrium distance r_0 between ions is $0.281\ nm$ and the binding energy for that crystal is $7.96\ eV$. Calculate the constant n for NaCl. Provided that Madelung constant, $\alpha = 1.748$ for NaCl crystal. (05) (CO3) (PO2)

B.Sc Engg. (ME)/1st Sem 29 September, 2022 (Afternoon)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
DEPARTMENT OF MECHANICAL AND PRODUCTION ENGINEERING

MID Semester Examination
Course No.: Chem- 4115
Course Title: *Physical and Inorganic Chemistry*

Winter Semester: A.Y. 2021-2022
Time: 1.0 Hour 30 Minutes
Full Marks: 75

There are **03 (Three)** Questions. Answer all of them. Marks in the margin indicate full marks. Don't write on this question paper. Symbols carry their usual meanings. Assume reasonable values for any missing data. Programmable calculators are not allowed.

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1. (a) Explain Arrhenius and Lewis concepts of acids and bases. Mention the salient features of the concepts with suitable examples. **[06] CO2 PO2**

(b) What are Ionic Product of water and p^H? Name two acid base indicators giving structure of Phenolphthalein. **[07] CO2 PO2**

(c) Describe buffer solution. Give the types and mode of operation of buffer solution. **[012] CO2 PO2**

2. (a) Define heat of solution and heat of combustion with suitable examples. How can you determine the heat of combustion in a laboratory? **[06] CO3 PO3**

(b) Define chemical,l potential and Gibb's free energy. **[05] CO3 PO3**

(c) Calculate K_p for the reaction N_2 (g) + O_2 (g) $\leftrightarrow$ 2NO (g) at 25^0C, when the value of standard free energy (ΔG^o) is 173 KJ. Comment on the result. **[07] CO3 PO3**

(d) The heat of reaction of $N_2 + 3H_2 \rightarrow 2NH_3$ at 298K was found to be -21.976 kcal. What will be the heat of reaction at 50°C? The heat capacities Cp at 25°C for N_2, H_2 and NH_3 are 6.8, 6.77 and 8.86 cal.mol^{-1}.deg^{-1} respectively. **[07] CO3 PO3**

3. (a) Derive mathematical equation showing the effect of temperature on the heat of reaction at constant volume and at constant pressure. Name the equation. **[12] CO4 PO2**

(b) Derive a mathematical equation relating the free energy change (ΔG) and equilibrium constant (K). Mention the significance of the obtained equation. **[13] CO4 PO2**

Program: BSc IPE 1st Semester
Semester: Winter

Date: October 04, 2022 (Tuesday)
Time: 02:30 pm – 04:00 pm

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
DEPARTMENT OF TECHNICAL AND VOCATIONAL EDUCATION (TVE)

Exam: Mid Semester Examination
Course Number: Hum 4117
Course Title: Islamic Culture & Professional Ethics

Summer Semester: 2021 - 2022
Full Marks: 75
Duration: 90 minutes

There are **4 (four)** questions. Answer 3 (three) questions. **Questions 3 and 4 are compulsory**. The symbols have their usual meaning.

1.	a)	What is Islam? What differentiates Islam from other religions?	05	
	b)	The Dalai Lama said: "**The purpose of our lives is to be happy**". Is this in line with the Islamic view? Support your answers with reference from the Holy Qur'an.	10	CO1
	c)	Write 5 (five) names among the attributes of Allah with their appropriate meaning.	10	
2.	a)	List the names of all the children of Prophet Muhammad (PBUH).	03.5	
	b)	How many wives did Prophet Muhammad (PBUH) during the course of his life? Mention all their names.	06.5	
	c)	Many of the modern anti-Islamic movements accuse Prophet Muhammad (PBUH) of being a womanizer. How would you defend the personality of our beloved Prophet Muhammad (PBUH) against such claims?	15	CO1
3.	a)	Unlike all other religions, Islam is considered as a full package consisting of more than just how to worship the Almighty Allah. Justify this statement?	10	CO1
	b)	With reference to the Islamic Economic System, prepare elaborate measures that can be used to reduce poverty among the Muslim Ummah.	10	
	c)	What is dignity and equality with reference to Human Rights in Islam?	05	CO2
4.	a)	Explain the following with reference to Human Rights in Islam: i. Right to life and safety, ii. Freedom of belief, iii. Right to justice.	15	
	b)	What does Islam say about the presence of pets (cats, dogs) in our homes?	05	CO2
	c)	Ali (the 4th Caliph (r)) once said: "*Do not slaughter sheep in the presence of other sheep, or any animal in the presence of other animals*". Discuss the wisdom behind this statement.	05	

Program: B.Sc. Engg. (IPE)
Semester: 1th Sem.

Date: 28 September 2022
Time: 2:30 pm – 4:00 pm

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF MECHANICAL AND PRODUCTION ENGINEERING

Mid Semester Examination
Course No.: ME 4151
Course Title: Statics and Dynamics

Winter Semester, A. Y. 2021-2022
Time: 1 Hours 30 Min(s)
Full Marks: 75

There are 3 (Three) questions. Answer all the questions.
Marks of each question and corresponding CO and PO are written in the brackets.
Do not write on this question paper.

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1. a) Determine the value of P (as shown in Fig. 1) required to **(15) (CO2) (PO2)**
(*i*) start the block up the incline,
(*ii*) keep it moving up,
(*iii*) prevent it from moving down.

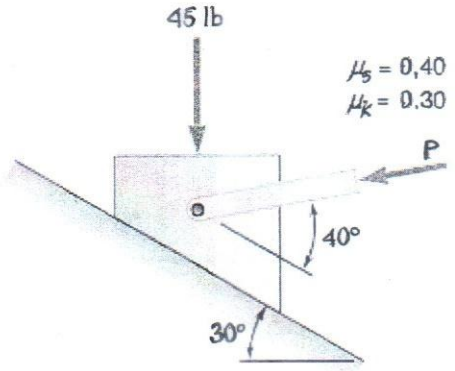

Fig. 1

b) Two parallel 40-N forces are applied to a lever as shown in Fig. 2. Determine the moment of the couple formed by the two forces about point *A*. **(10) (CO1) (PO2)**

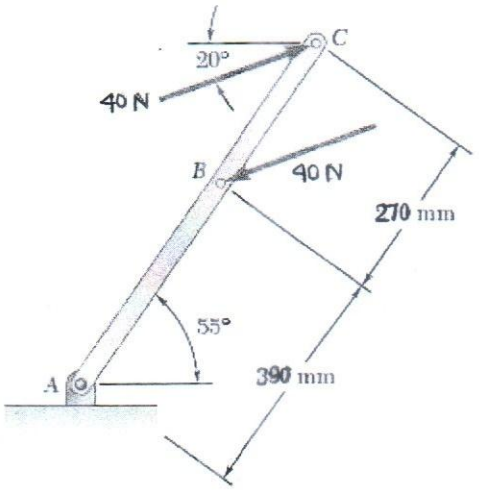

Fig. 2

2. A 10-ft boom is acted upon by a vertical force of 840lb acting on point C as shown in Fig. 3. Determine the tension in each cable T_{BD} and T_{BE} as well as the reaction at the ball-and-socket joint at *A*. **(25) (CO1) (PO3)**

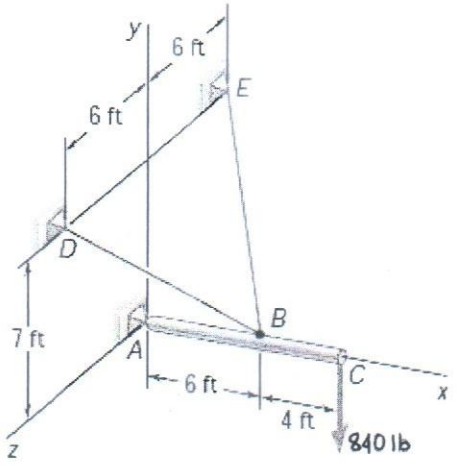

Fig. 3

3. Determine the force in each member of the Pratt bridge truss shown in Fig. 4. State whether each member is in tension or compression. **(25) (CO2) (PO3)**

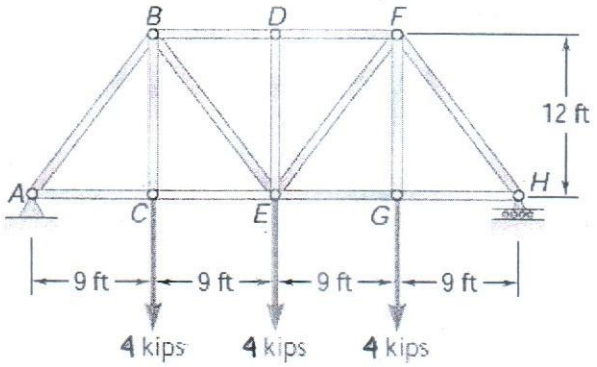

Fig. 4

(11)

Program: B.Sc.Engg. (IPE)
Semster: 3rd Semester

Date: 03 October 2022
Time: 10:30 AM-12:00 Noon

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)

ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF MECHANICAL AND PRODUCTION ENGINEERING

MID SEMESTER EXAMINATION
IPE-4303 Manufacturing Process I

WINTER SEMESTER: 2021-2022
TIME : 1 HR 30 MIN
FULL MARKS : 75

There are 3 (Three) questions. Answer all Questions. Marks in the Margin indicate full marks

01. (a) Explain the fundamentals concept of metal forming processes and hence classify the different metal forming processes with examples. (10)
(b) Write down the differences between hot working and cold working processes. (8)
(c) What do you mean by forging process? List some of the common forging processes. (7)
(CO1), (PO1)

02. (a) Explain with necessary diagram the following rolling processes
(i) Thread Rolling (ii) Ring Rolling. (12)

(b) What do you mean by pattern allowance? The casting shown in Figure 1 is to be made in cast iron using a wooden pattern. Assuming only shrinkage allowance as shown in Table below, calculate the dimension of the pattern. All Dimensions are in Inches (13)
(CO2), (PO1)

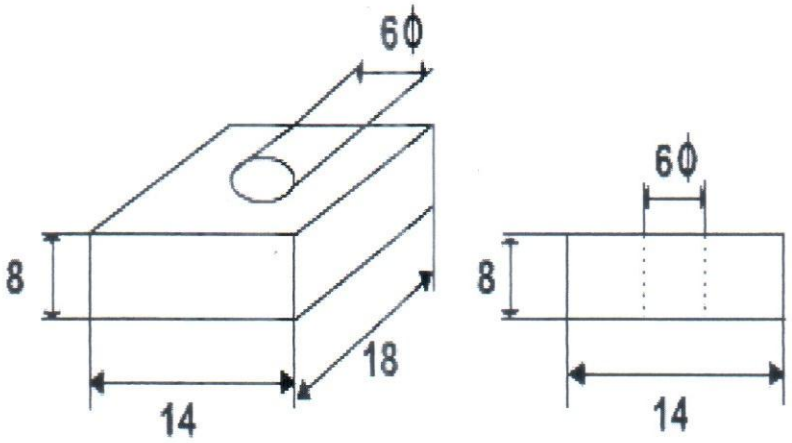

Figure: 1

Table: 1: Shrinkage Allowance

Material	Dimension	Shrinkage allowance (inch/ft)
Grey Cast Iron	Up to 2 feet 2 feet to 4 feet over 4 feet	0.125 0.105 0.083
Cast Steel	Up to 2 feet 2 feet to 6 feet over 6 feet	0.251 0.191 0.155
Aluminum	Up to 4 feet 4 feet to 6 feet over 6 feet	0.155 0.143 0.125

03. (a) Explain with necessary diagram the working principle of Crucible Furnace and Cupola Furnace. (13)

(b) What is sintering? Explain the different heat treatment cycle in sintering process. What will be the design consideration for the fabrication of defect free powder metallurgy product? (12). (CO1, CO2), (PO1)

(13)

B.Sc. (ME) / 3rd Semester
DTE / 1st Semester

Date: 28th September 2022
(Morning)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)

ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF MECHANICAL AND PRODUCTION ENGINEERING

Mid Semester Examination
Course Number: ME 4305
Course Title: Basic Thermodynamics

Winter Semester: 2021 – 2022
Full Marks: 75
Time: 1.5 Hours

There are **3 (Three)** questions. Answer **all** the questions. Marks of each question and corresponding COs/POs are written inside the square brackets. The symbols have their usual meanings. Assume any missing data if necessary.

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1. **(a)** Define the following terms from the context of classical thermodynamics: (i) Principle of corresponding states, (ii) Critical point, (iii) Quality, (iv) The state postulate, (v) Quasi-equilibrium process, (vi) Reference state. **[6]** [CO1] [PO1]

   (b) A fixed mass of an ideal gas is heated from 50°C to 80°C at a constant pressure of (i) 1 atm and (ii) 3 atm. In which case do you think the energy required will be greater? Why? **[2]** [CO1] [PO2]

   (c) Briefly describe the mechanisms of energy transfer to or from an open system; also, write the energy balance equation for the open system. **[5+1]** [CO1] [PO1]

   (d) Is it possible to compress an ideal gas isothermally in an adiabatic piston-cylinder device? Explain. **[2]** [CO1] [PO1]

   (e) On a hot summer day, a student turns his fan on when he leaves his room in the morning. When he returns in the evening, will the room be warmer or cooler than the neighboring rooms? Why? Assume all the doors and windows are kept closed. **[1]** [CO1] [PO1]

   (f) Define turbine efficiency, generator efficiency, and combined turbine-generator efficiency. **[3]** [CO1] [PO1]

   (g) Someone claimed that water vapor could be treated as an ideal gas at all pressures. Do you agree with this claim? Explain your opinion with the necessary figures and examples. **[4]** [CO1] [PO1]

   (h) Draw the T-v and P-T diagrams of a pure substance indicating its different regions. Label essential points on the diagrams properly. **[3+3]** [CO1] [PO1]

2. **(a)** For a saturated liquid-vapor mixture, show that $v_{avg} = v_f + xv_{fg}$. Symbols carry their usual meanings. **[5]** [CO2] [PO2]

(19)

(b) An ideal gas undergoes two processes in a piston-cylinder device as follows: **[2+5+1]**
1-2 → Polytropic compression from T_1 and P_1 with a polytropic exponent n and a compression ratio of $r = V_1 V_2^{-1}$. [CO2] [PO2]
2-3 → Constant pressure expansion at $P_3 = P_2$ until $V_3 = V_1$.
i) Sketch the processes on a single P-V diagram.
ii) Obtain an expression for the ratio of the compression-to-expansion work as a function of n and r.
iii) Find the value of this ratio for values of $n = 1.4$ and $r = 6$.

(c) Show that for a closed system, the boundary work W_b and the change in internal energy ΔU in the first-law relation can be combined into one term, ΔH, for an isobaric process. **[5]** [CO2] [PO2]

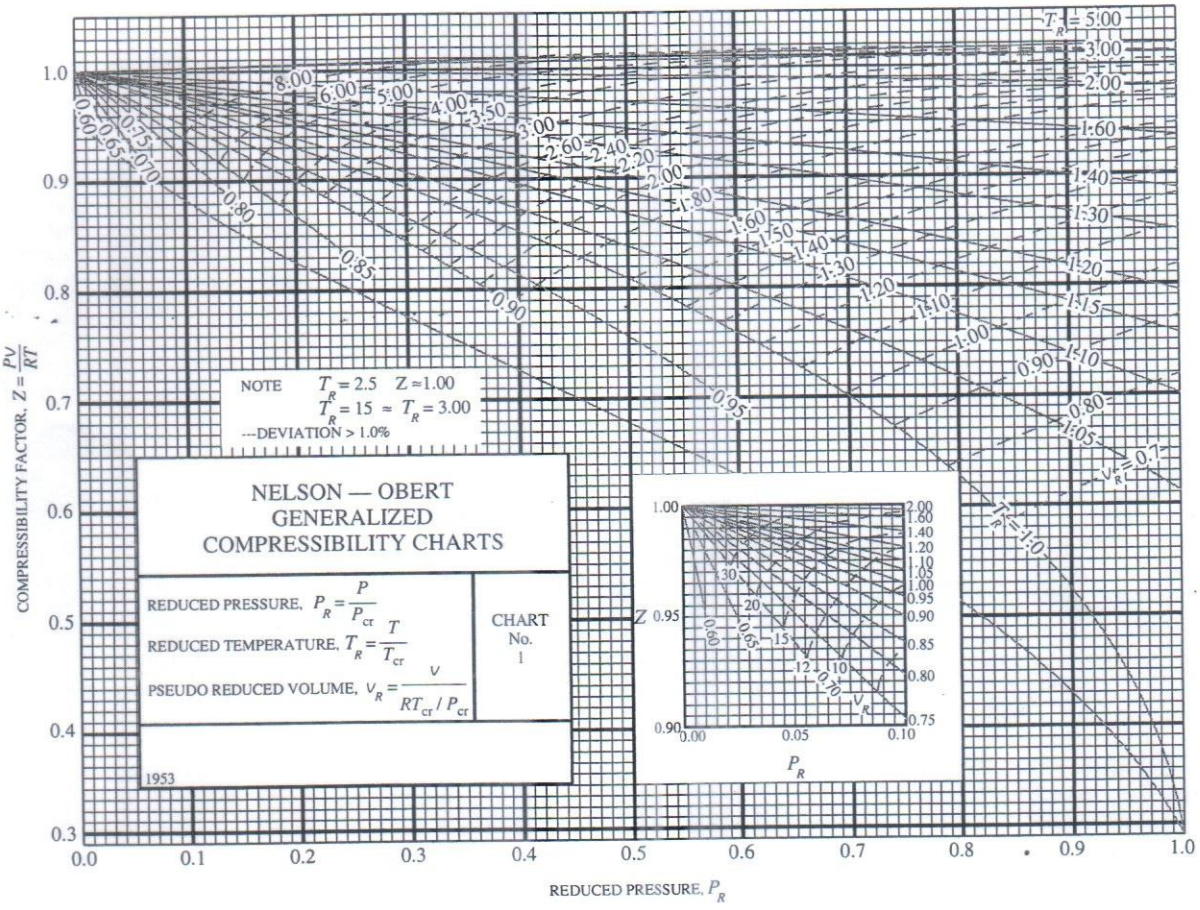
(d) Large wind turbines with blade span diameters of over 100 m are available for electric power generation. Consider a wind turbine with a blade span diameter of 100 m installed at a site subjected to steady winds at 8 m/s. Considering the overall efficiency of the wind turbine to be 32% and the air density to be 1.25 kg/m^3, determine the electric power generated by this wind turbine. Also, assuming steady winds of 8 m/s during a 24-hour period, determine the amount of electric energy and the daily revenue generated for a unit price of \$0.09/kWh for electricity. **[5+1+1]** [CO2] [PO3]

3. **(a)** A 0.016773 m^3 tank contains 1 kg of refrigerant-134a at 110°C. The gas constant, critical pressure, and critical temperature of refrigerant-134a are 0.08149 kPa·m^3/kg·K, 40.59 bar, and 673.56 R, respectively. Determine the pressure of the refrigerant using (i) the ideal-gas equation, (ii) the generalized compressibility chart, and (iii) the refrigerant tables. **[2+4+2]** [CO2] [PO2]

(b) A mass of 12 kg of saturated refrigerant-134a vapor is contained in a piston-cylinder device at 240 kPa. Now 300 kJ of heat is transferred to the refrigerant at constant pressure while a 110 V source supplies current to a resistor within the cylinder for 6 min. Determine the current supplied if the final temperature is 70°C. Also, show the process on a T-v diagram with respect to the saturation lines. **[12]** [CO2] [PO2]

Figure A-15

(a) Low pressures, $0 < P_R < 1.0$



(b) Intermediate pressures, $0 < P_R < 7$

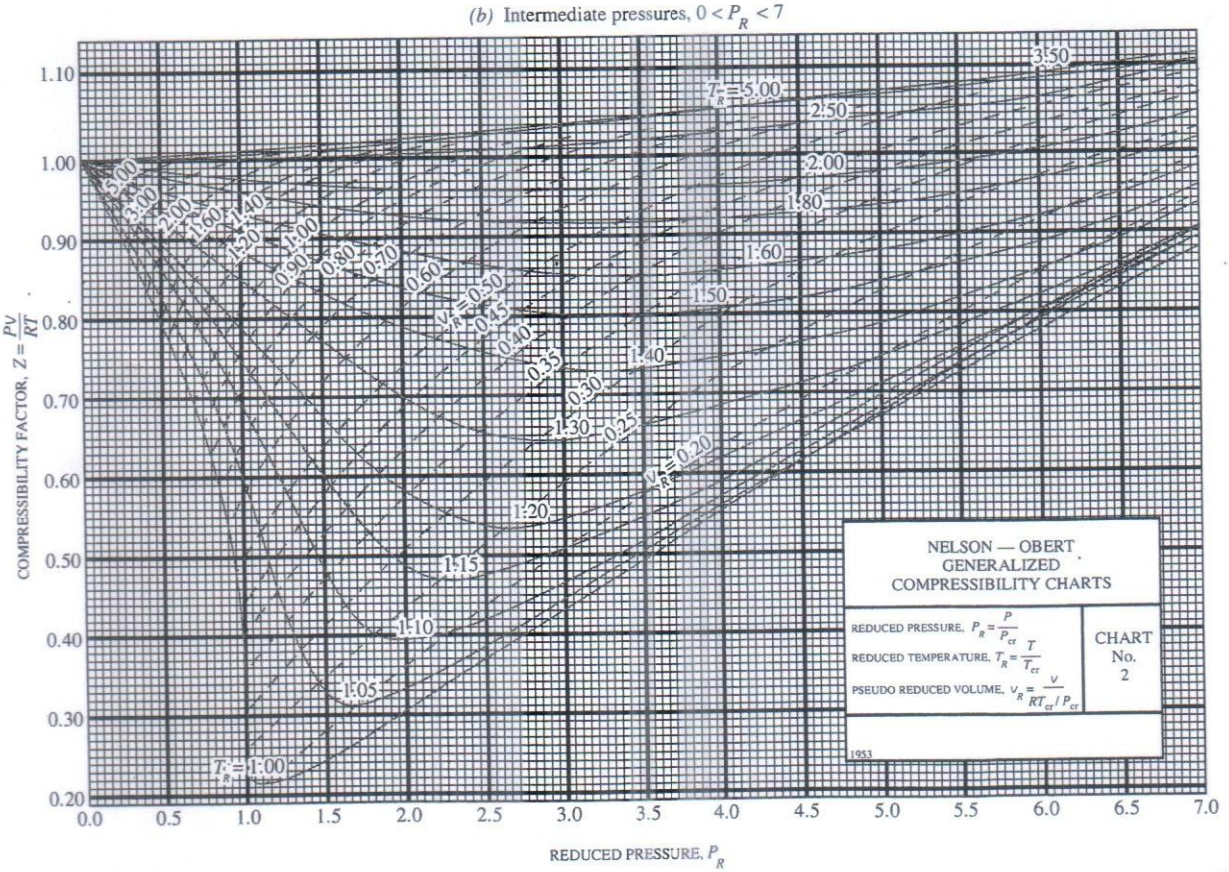


FIGURE A–15

TABLE A–12

Saturated refrigerant-134a—Pressure table

		Specific volume, m^3/kg		*Internal energy,* kJ/kg			*Enthalpy,* kJ/kg			*Entropy,* kJ/kg·K		
Press., P kPa	Sat. temp., T_{sat} °C	Sat. liquid, v_f	Sat. vapor, v_g	Sat. liquid, u_f	Evap., u_{fg}	Sat. vapor, u_g	Sat. liquid, h_f	Evap., h_{fg}	Sat. vapor, h_g	Sat. liquid, s_f	Evap., s_{fg}	Sat. vapor, s_g
60	−36.95	0.0007097	0.31108	3.795	205.34	209.13	3.837	223.96	227.80	0.01633	0.94812	0.96445
70	−33.87	0.0007143	0.26921	7.672	203.23	210.90	7.722	222.02	229.74	0.03264	0.92783	0.96047
80	−31.13	0.0007184	0.23749	11.14	201.33	212.48	11.20	220.27	231.47	0.04707	0.91009	0.95716
90	−28.65	0.0007222	0.21261	14.30	199.60	213.90	14.36	218.67	233.04	0.06003	0.89431	0.95434
100	−26.37	0.0007258	0.19255	17.19	198.01	215.21	17.27	217.19	234.46	0.07182	0.88008	0.95191
120	−22.32	0.0007323	0.16216	22.38	195.15	217.53	22.47	214.52	236.99	0.09269	0.85520	0.94789
140	−18.77	0.0007381	0.14020	26.96	192.60	219.56	27.06	212.13	239.19	0.11080	0.83387	0.94467
160	−15.60	0.0007435	0.12355	31.06	190.31	221.37	31.18	209.96	241.14	0.12686	0.81517	0.94202
180	−12.73	0.0007485	0.11049	34.81	188.20	223.01	34.94	207.95	242.90	0.14131	0.79848	0.93979
200	−10.09	0.0007532	0.099951	38.26	186.25	224.51	38.41	206.09	244.50	0.15449	0.78339	0.93788
240	−5.38	0.0007618	0.083983	44.46	182.71	227.17	44.64	202.68	247.32	0.17786	0.75689	0.93475
280	−1.25	0.0007697	0.072434	49.95	179.54	229.49	50.16	199.61	249.77	0.19822	0.73406	0.93228
320	2.46	0.0007771	0.063681	54.90	176.65	231.55	55.14	196.78	251.93	0.21631	0.71395	0.93026
360	5.82	0.0007840	0.056809	59.42	173.99	233.41	59.70	194.15	253.86	0.23265	0.69591	0.92856
400	8.91	0.0007905	0.051266	63.61	171.49	235.10	63.92	191.68	255.61	0.24757	0.67954	0.92711
450	12.46	0.0007983	0.045677	68.44	168.58	237.03	68.80	188.78	257.58	0.26462	0.66093	0.92555
500	15.71	0.0008058	0.041168	72.92	165.86	238.77	73.32	186.04	259.36	0.28021	0.64399	0.92420
550	18.73	0.0008129	0.037452	77.09	163.29	240.38	77.54	183.44	260.98	0.29460	0.62842	0.92302
600	21.55	0.0008198	0.034335	81.01	160.84	241.86	81.50	180.95	262.46	0.30799	0.61398	0.92196
650	24.20	0.0008265	0.031680	84.72	158.51	243.23	85.26	178.56	263.82	0.32052	0.60048	0.92100
700	26.69	0.0008331	0.029392	88.24	156.27	244.51	88.82	176.26	265.08	0.33232	0.58780	0.92012
750	29.06	0.0008395	0.027398	91.59	154.11	245.70	92.22	174.03	266.25	0.34348	0.57582	0.91930
800	31.31	0.0008457	0.025645	94.80	152.02	246.82	95.48	171.86	267.34	0.35408	0.56445	0.91853
850	33.45	0.0008519	0.024091	97.88	150.00	247.88	98.61	169.75	268.36	0.36417	0.55362	0.91779
900	35.51	0.0008580	0.022703	100.84	148.03	248.88	101.62	167.69	269.31	0.37383	0.54326	0.91709
950	37.48	0.0008640	0.021456	103.70	146.11	249.82	104.52	165.68	270.20	0.38307	0.53333	0.91641
1000	39.37	0.0008700	0.020329	106.47	144.24	250.71	107.34	163.70	271.04	0.39196	0.52378	0.91574
1200	46.29	0.0008935	0.016728	116.72	137.12	253.84	117.79	156.12	273.92	0.42449	0.48870	0.91320
1400	52.40	0.0009167	0.014119	125.96	130.44	256.40	127.25	148.92	276.17	0.45325	0.45742	0.91067
1600	57.88	0.0009400	0.012134	134.45	124.05	258.50	135.96	141.96	277.92	0.47921	0.42881	0.90802
1800	62.87	0.0009639	0.010568	142.36	117.85	260.21	144.09	135.14	279.23	0.50304	0.40213	0.90517
2000	67.45	0.0009887	0.009297	149.81	111.75	261.56	151.78	128.36	280.15	0.52519	0.37684	0.90204
2500	77.54	0.0010567	0.006941	167.02	96.47	263.49	169.66	111.18	280.84	0.57542	0.31701	0.89243
3000	86.16	0.0011410	0.005272	183.09	80.17	263.26	186.51	92.57	279.08	0.62133	0.25759	0.87893

TABLE A–13

Superheated refrigerant-134a

T °C	v m³/kg	u kJ/kg	h kJ/kg	s kJ/kg·K	v m³/kg	u kJ/kg	h kJ/kg	s kJ/kg·K	v m³/kg	u kJ/kg	h kJ/kg	s kJ/kg·K
	P = 0.06 MPa (T_{sat} = −36.95°C)				P = 0.10 MPa (T_{sat} = −26.37°C)				P = 0.14 MPa (T_{sat} = −18.77°C)			
Sat.	0.31108	209.13	227.80	0.9645	0.19255	215.21	234.46	0.9519	0.14020	219.56	239.19	0.9447
−20	0.33608	220.62	240.78	1.0175	0.19841	219.68	239.52	0.9721				
−10	0.35048	227.57	248.60	1.0478	0.20743	226.77	247.51	1.0031	0.14605	225.93	246.37	0.9724
0	0.36476	234.67	256.56	1.0775	0.21630	233.97	255.60	1.0333	0.15263	233.25	254.61	1.0032
10	0.37893	241.94	264.68	1.1067	0.22506	241.32	263.82	1.0628	0.15908	240.68	262.95	1.0331
20	0.39302	249.37	272.95	1.1354	0.23373	248.81	272.18	1.0919	0.16544	248.24	271.40	1.0625
30	0.40705	256.97	281.39	1.1637	0.24233	256.46	280.69	1.1204	0.17172	255.95	279.99	1.0913
40	0.42102	264.73	289.99	1.1916	0.25088	264.27	289.36	1.1485	0.17794	263.80	288.72	1.1196
50	0.43495	272.66	298.75	1.2192	0.25937	272.24	298.17	1.1762	0.18412	271.81	297.59	1.1475
60	0.44883	280.75	307.68	1.2464	0.26783	280.36	307.15	1.2036	0.19025	279.97	306.61	1.1750
70	0.46269	289.01	316.77	1.2732	0.27626	288.65	316.28	1.2306	0.19635	288.29	315.78	1.2021
80	0.47651	297.43	326.02	1.2998	0.28465	297.10	325.57	1.2573	0.20242	296.77	325.11	1.2289
90	0.49032	306.02	335.43	1.3261	0.29303	305.71	335.01	1.2836	0.20847	305.40	334.59	1.2554
100	0.50410	314.76	345.01	1.3521	0.30138	314.48	344.61	1.3097	0.21449	314.19	344.22	1.2815
	P = 0.18 MPa (T_{sat} = −12.73°C)				P = 0.20 MPa (T_{sat} = −10.09°C)				P = 0.24 MPa (T_{sat} = −5.38°C)			
Sat.	0.11049	223.01	242.90	0.9398	0.09995	224.51	244.50	0.9379	0.08398	227.17	247.32	0.9348
−10	0.11189	225.04	245.18	0.9485	0.09991	224.57	244.56	0.9381				
0	0.11722	232.49	253.59	0.9799	0.10481	232.11	253.07	0.9699	0.08617	231.30	251.98	0.9520
10	0.12240	240.02	262.05	1.0103	0.10955	239.69	261.60	1.0005	0.09026	239.00	260.66	0.9832
20	0.12748	247.66	270.60	1.0400	0.11418	247.36	270.20	1.0304	0.09423	246.76	269.38	1.0134
30	0.13248	255.43	279.27	1.0691	0.11874	255.16	278.91	1.0596	0.09812	254.63	278.17	1.0429
40	0.13741	263.33	288.07	1.0976	0.12322	263.09	287.74	1.0882	0.10193	262.61	287.07	1.0718
50	0.14230	271.38	297.00	1.1257	0.12766	271.16	296.70	1.1164	0.10570	270.73	296.09	1.1002
60	0.14715	279.58	306.07	1.1533	0.13206	279.38	305.79	1.1441	0.10942	278.98	305.24	1.1281
70	0.15196	287.93	315.28	1.1806	0.13641	287.75	315.03	1.1714	0.11310	287.38	314.53	1.1555
80	0.15673	296.43	324.65	1.2075	0.14074	296.27	324.41	1.1984	0.11675	295.93	323.95	1.1826
90	0.16149	305.09	334.16	1.2340	0.14504	304.93	333.94	1.2250	0.12038	304.62	333.51	1.2093
100	0.16622	313.90	343.82	1.2603	0.14933	313.75	343.62	1.2513	0.12398	313.46	343.22	1.2356
	P = 0.28 MPa (T_{sat} = −1.25°C)				P = 0.32 MPa (T_{sat} = 2.46°C)				P = 0.40 MPa (T_{sat} = 8.91°C)			
Sat.	0.07243	229.49	249.77	0.9323	0.06368	231.55	251.93	0.9303	0.051266	235.10	255.61	0.9271
0	0.07282	230.46	250.85	0.9362								
10	0.07646	238.29	259.70	0.9681	0.06609	237.56	258.70	0.9545	0.051506	235.99	256.59	0.9306
20	0.07997	246.15	268.54	0.9987	0.06925	245.51	267.67	0.9856	0.054213	244.19	265.88	0.9628
30	0.08338	254.08	277.42	1.0285	0.07231	253.52	276.66	1.0158	0.056796	252.37	275.09	0.9937
40	0.08672	262.12	286.40	1.0577	0.07530	261.62	285.72	1.0452	0.059292	260.60	284.32	1.0237
50	0.09000	270.28	295.48	1.0862	0.07823	269.83	294.87	1.0739	0.061724	268.92	293.61	1.0529
60	0.09324	278.58	304.69	1.1143	0.08111	278.17	304.12	1.1022	0.064104	277.34	302.98	1.0814
70	0.09644	287.01	314.01	1.1419	0.08395	286.64	313.50	1.1299	0.066443	285.88	312.45	1.1095
80	0.09961	295.59	323.48	1.1690	0.08675	295.24	323.00	1.1572	0.068747	294.54	322.04	1.1370
90	0.10275	304.30	333.07	1.1958	0.08953	303.99	332.64	1.1841	0.071023	303.34	331.75	1.1641
100	0.10587	313.17	342.81	1.2223	0.09229	312.87	342.41	1.2106	0.073274	312.28	341.59	1.1908
110	0.10897	322.18	352.69	1.2484	0.09503	321.91	352.31	1.2368	0.075504	321.35	351.55	1.2172
120	0.11205	331.34	362.72	1.2742	0.09775	331.08	362.36	1.2627	0.077717	330.56	361.65	1.2432
130	0.11512	340.65	372.88	1.2998	0.10045	340.41	372.55	1.2883	0.079913	339.92	371.89	1.2689
140	0.11818	350.11	383.20	1.3251	0.10314	349.88	382.89	1.3136	0.082096	349.42	382.26	1.2943

TABLE A–13

Superheated refrigerant-134a (*Concluded*)

T °C	v m³/kg	u kJ/kg	h kJ/kg	s kJ/kg·K	v m³/kg	u kJ/kg	h kJ/kg	s kJ/kg·K	v m³/kg	u kJ/kg	h kJ/kg	s kJ/kg·K
	P = 0.50 MPa (T_{sat} = 15.71°C)				P = 0.60 MPa (T_{sat} = 21.55°C)				P = 0.70 MPa (T_{sat} = 26.69°C)			
Sat.	0.041168	238.77	259.36	0.9242	0.034335	241.86	262.46	0.9220	0.029392	244.51	265.08	0.9201
20	0.042115	242.42	263.48	0.9384								
30	0.044338	250.86	273.03	0.9704	0.035984	249.24	270.83	0.9500	0.029966	247.49	268.47	0.9314
40	0.046456	259.27	282.50	1.0011	0.037865	257.88	280.60	0.9817	0.031696	256.41	278.59	0.9642
50	0.048499	267.73	291.98	1.0309	0.039659	266.50	290.30	1.0122	0.033322	265.22	288.54	0.9955
60	0.050485	276.27	301.51	1.0600	0.041389	275.17	300.00	1.0417	0.034875	274.03	298.44	1.0257
70	0.052427	284.91	311.12	1.0884	0.043069	283.91	309.75	1.0706	0.036373	282.88	308.34	1.0550
80	0.054331	293.65	320.82	1.1163	0.044710	292.74	319.57	1.0988	0.037829	291.81	318.29	1.0835
90	0.056205	302.52	330.63	1.1436	0.046318	301.69	329.48	1.1265	0.039250	300.84	328.31	1.1115
100	0.058053	311.52	340.55	1.1706	0.047900	310.75	339.49	1.1536	0.040642	309.96	338.41	1.1389
110	0.059880	320.65	350.59	1.1971	0.049458	319.93	349.61	1.1804	0.042010	319.21	348.61	1.1659
120	0.061687	329.91	360.75	1.2233	0.050997	329.24	359.84	1.2068	0.043358	328.57	358.92	1.1925
130	0.063479	339.31	371.05	1.2492	0.052519	338.69	370.20	1.2328	0.044688	338.06	369.34	1.2186
140	0.065256	348.85	381.47	1.2747	0.054027	348.26	380.68	1.2585	0.046004	347.67	379.88	1.2445
150	0.067021	358.52	392.04	1.3000	0.055522	357.98	391.29	1.2838	0.047306	357.42	390.54	1.2700
160	0.068775	368.34	402.73	1.3250	0.057006	367.83	402.03	1.3089	0.048597	367.31	401.32	1.2952
	P = 0.80 MPa (T_{sat} = 31.31°C)				P = 0.90 MPa (T_{sat} = 35.51°C)				P = 1.00 MPa (T_{sat} = 39.37°C)			
Sat.	0.025645	246.82	267.34	0.9185	0.022686	248.82	269.25	0.9169	0.020319	250.71	271.04	0.9157
40	0.027035	254.84	276.46	0.9481	0.023375	253.15	274.19	0.9328	0.020406	251.32	271.73	0.9180
50	0.028547	263.87	286.71	0.9803	0.024809	262.46	284.79	0.9661	0.021796	260.96	282.76	0.9526
60	0.029973	272.85	296.82	1.0111	0.026146	271.62	295.15	0.9977	0.023068	270.33	293.40	0.9851
70	0.031340	281.83	306.90	1.0409	0.027413	280.74	305.41	1.0280	0.024261	279.61	303.87	1.0160
80	0.032659	290.86	316.99	1.0699	0.028630	289.88	315.65	1.0574	0.025398	288.87	314.27	1.0459
90	0.033941	299.97	327.12	1.0982	0.029806	299.08	325.90	1.0861	0.026492	298.17	324.66	1.0749
100	0.035193	309.17	337.32	1.1259	0.030951	308.35	336.21	1.1141	0.027552	307.52	335.08	1.1032
110	0.036420	318.47	347.61	1.1531	0.032068	317.72	346.58	1.1415	0.028584	316.96	345.54	1.1309
120	0.037625	327.89	357.99	1.1798	0.033164	327.19	357.04	1.1684	0.029592	326.49	356.08	1.1580
130	0.038813	337.42	368.47	1.2062	0.034241	336.78	367.59	1.1949	0.030581	336.12	366.70	1.1847
140	0.039985	347.08	379.07	1.2321	0.035302	346.48	378.25	1.2211	0.031554	345.87	377.42	1.2110
150	0.041143	356.86	389.78	1.2577	0.036349	356.30	389.01	1.2468	0.032512	355.73	388.24	1.2369
160	0.042290	366.78	400.61	1.2830	0.037384	366.25	399.89	1.2722	0.033457	365.71	399.17	1.2624
170	0.043427	376.83	411.57	1.3081	0.038408	376.33	410.89	1.2973	0.034392	375.82	410.22	1.2876
180	0.044554	387.01	422.65	1.3328	0.039423	386.54	422.02	1.3221	0.035317	386.06	421.38	1.3125
	P = 1.20 MPa (T_{sat} = 46.29°C)				P = 1.40 MPa (T_{sat} = 52.40°C)				P = 1.60 MPa (T_{sat} = 57.88°C)			
Sat.	0.016728	253.84	273.92	0.9132	0.014119	256.40	276.17	0.9107	0.012134	258.50	277.92	0.9080
50	0.017201	257.64	278.28	0.9268								
60	0.018404	267.57	289.66	0.9615	0.015005	264.46	285.47	0.9389	0.012372	260.91	280.71	0.9164
70	0.019502	277.23	300.63	0.9939	0.016060	274.62	297.10	0.9733	0.013430	271.78	293.27	0.9536
80	0.020529	286.77	311.40	1.0249	0.017023	284.51	308.34	1.0056	0.014362	282.11	305.09	0.9875
90	0.021506	296.28	322.09	1.0547	0.017923	294.28	319.37	1.0364	0.015215	292.19	316.53	1.0195
100	0.022442	305.81	332.74	1.0836	0.018778	304.01	330.30	1.0661	0.016014	302.16	327.78	1.0501
110	0.023348	315.40	343.41	1.1119	0.019597	313.76	341.19	1.0949	0.016773	312.09	338.93	1.0795
120	0.024228	325.05	354.12	1.1395	0.020388	323.55	352.09	1.1230	0.017500	322.03	350.03	1.1081
130	0.025086	334.79	364.90	1.1665	0.021155	333.41	363.02	1.1504	0.018201	332.02	361.14	1.1360
140	0.025927	344.63	375.74	1.1931	0.021904	343.34	374.01	1.1773	0.018882	342.06	372.27	1.1633
150	0.026753	354.57	386.68	1.2192	0.022636	353.37	385.07	1.2038	0.019545	352.19	383.46	1.1901
160	0.027566	364.63	397.71	1.2450	0.023355	363.51	396.20	1.2298	0.020194	362.40	394.71	1.2164
170	0.028367	374.80	408.84	1.2704	0.024061	373.75	407.43	1.2554	0.020830	372.71	406.04	1.2422
180	0.029158	385.10	420.09	1.2955	0.024757	384.12	418.78	1.2808	0.021456	383.13	417.46	1.2677

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Program: B. Sc. Engg. (ME/IPE/BSc TE) **Date: 5 October, 2022**
Semester: 3rd /2 Y 1st Semester **Time: 10:30 am – 12:00 noon**

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)

ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF MECHANICAL AND PRODUCTION ENGINEERING

Mid Semester Examination **Winter Semester: 2021 - 2022**
Course Number: math 4311/4599 **Full Marks: 75**
Course Title: Vector Analysis, Multivariable Calculus and Complex Variables **Time : 1.5 Hours**

There are **3 (three)** questions. Answer **all of them**. The symbols have their usual meanings. Marks of each question and corresponding CO and PO are written in the brackets.

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1. (a) Examine whether the vectors $\mathbf{i}-2\mathbf{j}+3\mathbf{k}$, $5\mathbf{i}+6\mathbf{j}-\mathbf{k}$ and $3\mathbf{i}+2\mathbf{j}+\mathbf{k}$ form a linearly dependent set or a linearly independent set. If dependent, find a linear relation among them. [11] [CO1, PO1]

   (b) Find the area of the parallelogram having diagonals $3\mathbf{i}+\mathbf{j}-2\mathbf{k}$ and $\mathbf{i}-3\mathbf{j}+4\mathbf{k}$. [07] [CO1, PO1]

   (c) Give the geometrical interpretation of the cross product of vectors. [07] [CO1, PO1]

2. (a) Find the volume of the parallelepiped whose edges are represented by the vectors $\boldsymbol{c}\times\boldsymbol{a}$, $\boldsymbol{a}\times\boldsymbol{b}$ and $\boldsymbol{b}\times\boldsymbol{c}$. [12] [CO1, PO1]

   (b) If $\mathbf{F}(x,y,z)=x^2yz\,\mathbf{i}-2xz^3\mathbf{j}+xz^2\,\mathbf{k}$ and $\mathbf{G}(x,y,z)=2z\,\mathbf{i}+y\mathbf{j}+x^2\mathbf{k}$, find $\dfrac{\partial^2}{\partial x\,\partial y}(\mathbf{F}\times\mathbf{G})$ at (1, 0, −2). [13] [CO1, PO1]

3. (a) Find the directional derivative of $\phi(x,y,z)=4xz^3-3x^2y^2z$ at (2, −1, 2) in the direction of the vector $2\mathbf{i}-3\mathbf{j}+6\mathbf{k}$. [13] [CO1, PO1]

   (b) Find an equation for the tangent plane to the surface $2xz^2-3xy-4x=7$ at the point $(3,-1,2)$. [12] [CO1, PO1]

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Name of the Program: B.Sc. ME
Semester: Winter semester

Date: October 04, 2022 (Tuesday)
Time: 10:30 am– 12:00 pm

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
DEPARTMENT OF TECHNICAL AND VOCATIONAL EDUCATION (TVE)

Exam: Mid Semester Examination
Course Number: Hum 4317
Course Title: Science Technology and Islam

Summer Semester: 2021 - 2022
Full Marks: 75
Duration: 90 minutes

There are 4 (four) questions. Answer any 3 (three) questions

1.	a) What is Big-Bang Theory? Mention the Quranic evidence about this theory.	10	CO1, CO2	
	b) Describe the view of the Quran about the expansion of the Universe with the scientific opinion.	10		PO9/ PO10
	c) What is your understanding about Big-Crunch? What is the view of the Holy Quran about Big-Crunch? Discuss.	05		
2.	a) Discuss the Fine-tuning and perfect balance of the universe and mention the verse of the Quran in this regard.	10	CO1, CO2	
	b) Describe the creation and formation of the earth.	10		PO10
	c) Discuss about the "Unique rotation of the Universe".	05		
3.	a) Describe the fundamental force in physics with the references from the Holy Quran.	10	CO1, CO2, CO5	PO6/ PO7
	b) "Everything created in pairs"-Explain the statement with reference from the Holy Quran and scientific opinion.	10		
	c) What is dark matter and dark energy?	05		
4.	a) Discuss about the scientific indication about Physics in the Holy Quran.	10	CO1, CO2, CO5	PO6/ PO7
	b) "Allah created every living creature from water"-explain the statement of the Holy Quran with scientific view.	10		
	c) Describe about the embryo development in the Holy Quran.	05		

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Program: BSc. Eng.(ME) / DTE (1st sem)
Semester: 3rd , Winter

Date: 3 October 2022
Time: 10:30 am to 12:00 pm

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
DEPARTMENT OF MECHANICAL AND PRODUCTION ENGINEERING

Mid-Semester Examination — Winter Semester, A.Y. 2021-2022
Course No. ME 4325 — Time : 1½ hours
Course Title: Material Engineering — Full Marks : 75

There are **4** (Four) Questions. Answers to questions 1 and 4 are compulsory. Answer either question 2 or 3. Answer 3 (Three) questions altogether. The symbols have their usual meanings. Marks of each question and corresponding CO and PO are written in the brackets.

1	a)	Two materials can have similar toughness with different stiffness values. From stress-strain curves for such cases choose one for a design where high plastic deformation is preferred. Again, different methods are used to measure the stiffness of different metals and alloys. List the methods used to estimate stiffness from the stress-strain curves where the yield point may or may not be sharp.	12.5 (CO1) (PO1, PO2)
	b)	The same material can be either ductile or brittle based on its operating temperature. With necessary sketches describe how deformation types can be identified from fracture surfaces. Explain how operating temperature controls the mode of fracture.	12.5 (CO2) (PO2, PO3)
2		Sketch the unit cells of SC, BCC, and FCC crystal structures. Calculate packing density for all these three crystal structures and show that FCC can be categorized as the most packed lattice type among all. Also, build a BCC structure from two interpenetrating SC with a neat sketch and explain when to be considered as SC and when as BCC.	25 (CO1, CO2) (PO1, PO2, PO3)
		Q3 is an alternative to Q2 (answer either one)	
3		Using neat sketches calculate the number of atoms per unit cell of SC, BCC, and FCC crystal structures. Also, calculate the number of nearest neighbor and next nearest neighbor for these crystal structures with the relevant distances. Comment on how these factors play a role to build materials' ductile properties.	
4	a)	Distinguish between crystal structure and lattice. Using neat sketches, explain how symmetry limits the total number of crystal structures in 2-D to four and total number of lattice types to five.	12.5 (CO1) (PO1, PO2)
	b)	Distinguish between creep and fatigue failure. Discuss fatigue life and fatigue limit. Explain how a dynamic loading system leads to failure at a much lowers strength than the yield strength of a material.	12.5 (CO1) (PO1, PO2)

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Program: B. Sc. in IPE | **Date: 28 September, 2022**
Semester: Winter semester | **Time: 10:30 am – 12:00 pm**

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)

ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF MECHANICAL AND PRODUCTION ENGINEERING

Mid Semester Examination | **Winter Semester: 2021 - 2022**
Course Number: ME 4353 | **Full Marks: 75**
Course Title: Thermodynamics and Heat Transfer | **Time: 1.5 Hours**

There are **3 (three)** questions. Answer all **3 (three)** questions. The symbols have their usual meanings. Marks of each question and corresponding CO and PO are written in the brackets. (Property tables are attached at page – 3)

---

1. a) i) Distinguish between the SIE and CIE combustion processes with the help of a neat sketch. **(10) (CO2)**
ii) Define piston clearance. Why is it so crucial for an engine? How can you optimize the piston clearance? **(PO1/PO2)**

b) Consider the following specifications for a square engine. **(15) (CO2) (PO1/PO2)**

Configuration: V10	Volume: 4000 cc
Engine speed: 2500 rpm	Cut-off ratio: 1.8
Brake torque: 11.5 Nm	Total clearance volume: 0.2 L
Length of connecting rod: 350 mm	
Fuel consumption rate: 2.22×10^{-4} kg/s	

Calculate:

i. Connecting rod to crank radius ratio.
ii. The air standard efficiency (%) of the engine. (k = 1.4)
iii. The brake power (kW) at the flywheel.
iv. The brake specific fuel consumption rate (g/kW-h)

2. a) Differentiate between a 4-stroke and 2-sroke engine in terms of Power-to-weight ratio. Also, describe why the 2-stroke engine is getting phased out now-a-days. **(6) (CO2) (PO1/PO2)**

b) Compute the higher heating value of 'octane' when the lower heating value is 44.4 MJ/kg. **(9) (CO2) (PO1/PO2)**

3. a) Distinguish between a 'control mass' system and a 'control volume' system with necessary examples. On which condition a 'control mass' system can be approximated as an 'isolated system'? **(6) (CO1) (PO1/PO2)**

b) "Work is a path function"- Explain. **(4) (CO1) (PO1/PO2)**

c) During the combustion of gasoline in a SIE, 200 kW heat is produced which is completely converted into work by the wheels. Does this scenario violate the 2nd law of thermodynamics? Explain in terms of Kelvin-Plank Statement. **(10) (CO1) (PO1/PO2)**

d) A mass of 15 kg of air in a piston-cylinder device is heated from 29°C to 77°C by passing current of 5A through a resistance heater inside the cylinder (as shown in Fig. 1). The pressure inside the cylinder is held constant at 300 kPa during the process, and a heat loss of 60 kJ occurs. Determine the voltage of the resistance heater. **(15) (CO1) (PO1/PO2)**

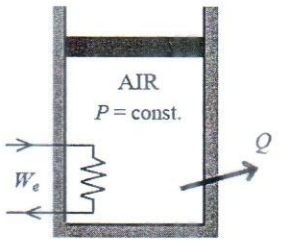


Fig. 1 A piston-cylinder device

TABLE A–2

Ideal-gas specific heats of various common gases (*Continued*)

(*b*) At various temperatures

Temperature, K	c_p kJ/kg·K	c_v kJ/kg·K	k	c_p kJ/kg·K	c_v kJ/kg·K	k	c_p kJ/kg·K	c_v kJ/kg·K	k
	Air			*Carbon dioxide, CO_2*			*Carbon monoxide, CO*		
250	1.003	0.716	1.401	0.791	0.602	1.314	1.039	0.743	1.400
300	1.005	0.718	1.400	0.846	0.657	1.288	1.040	0.744	1.399
350	1.008	0.721	1.398	0.895	0.706	1.268	1.043	0.746	1.398
400	1.013	0.726	1.395	0.939	0.750	1.252	1.047	0.751	1.395
450	1.020	0.733	1.391	0.978	0.790	1.239	1.054	0.757	1.392
500	1.029	0.742	1.387	1.014	0.825	1.229	1.063	0.767	1.387
550	1.040	0.753	1.381	1.046	0.857	1.220	1.075	0.778	1.382
600	1.051	0.764	1.376	1.075	0.886	1.213	1.087	0.790	1.376
650	1.063	0.776	1.370	1.102	0.913	1.207	1.100	0.803	1.370
700	1.075	0.788	1.364	1.126	0.937	1.202	1.113	0.816	1.364
750	1.087	0.800	1.359	1.148	0.959	1.197	1.126	0.829	1.358
800	1.099	0.812	1.354	1.169	0.980	1.193	1.139	0.842	1.353
900	1.121	0.834	1.344	1.204	1.015	1.186	1.163	0.866	1.343
1000	1.142	0.855	1.336	1.234	1.045	1.181	1.185	0.888	1.335

TABLE A–17

Ideal-gas properties of air

T K	h kJ/kg	P_r	u kJ/kg	v_r	$s°$ kJ/kg·K
200	199.97	0.3363	142.56	1707.0	1.29559
210	209.97	0.3987	149.69	1512.0	1.34444
220	219.97	0.4690	156.82	1346.0	1.39105
230	230.02	0.5477	164.00	1205.0	1.43557
240	240.02	0.6355	171.13	1084.0	1.47824
250	250.05	0.7329	178.28	979.0	1.51917
260	260.09	0.8405	185.45	887.8	1.55848
270	270.11	0.9590	192.60	808.0	1.59634
280	280.13	1.0889	199.75	738.0	1.63279
285	285.14	1.1584	203.33	706.1	1.65055
290	290.16	1.2311	206.91	676.1	1.66802
295	295.17	1.3068	210.49	647.9	1.68515
298	298.18	1.3543	212.64	631.9	1.69528
300	300.19	1.3860	214.07	621.2	1.70203
305	305.22	1.4686	217.67	596.0	1.71865
310	310.24	1.5546	221.25	572.3	1.73498
315	315.27	1.6442	224.85	549.8	1.75106
320	320.29	1.7375	228.42	528.6	1.76690
325	325.31	1.8345	232.02	508.4	1.78249
330	330.34	1.9352	235.61	489.4	1.79783
340	340.42	2.149	242.82	454.1	1.82790
350	350.49	2.379	250.02	422.2	1.85708
360	360.58	2.626	257.24	393.4	1.88543
370	370.67	2.892	264.46	367.2	1.91313
380	380.77	3.176	271.69	343.4	1.94001

B.Sc. Engg. ME 3rd Semester 29 September 2022 (Morning)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
Department of Computer Science and Engineering (CSE)

MID SEMESTER EXAMINATION **WINTER SEMESTER, 2021-2022**

DURATION: 1 HOUR 30 MINUTES **FULL MARKS: 75**

CSE 4373: Computer Programming and Applications

Programmable calculators are not allowed. Do not write anything on the question paper.

Answer **all 3 (three)** questions. Marks of each question and corresponding CO and PO are written in the right margin with brackets.

1. a) What are the rules for naming identifiers? Distinguish between the following pair of data types (including their format specifiers for I/O) supported in C Programming Language: 3+4 (CO1) (PO1)
   i. float and double
   ii. short and long

   b) How can you compute the quotient and remainder between two integers in C? What is the purpose of unsigned type modifier? Write a C program to find the largest of three numbers without using any relational operators. 3+2+5 (CO2) (PO1)

   c) What is the purpose of "const" keyword? Why should you use comment in a programming language? Distinguish between logical and relational operators in C. 2+3+3 (CO2) (PO1)

2. a) Distinguish between the nested if-else and if-else ladder in C. Write a 'C' program using simple if-else statements (without using any loop) that tries to guess a secret number in 3 attempts. In the first step the computer will set a random (secret) number from 0 to 9. Then a user (via input) will try to guess that secret number in 3 attempts; the user will win the game if any of the guesses is correct, and will lose otherwise. 3+10 (CO3) (PO2)

   b) How does the switch statement work? What are the valid places where the programmer can apply Break and Continue control statement? Write a program in C that will sum all the numbers from 1 to 1000 while ignoring all numbers divisible by 3. 3+3+6 (CO3) (PO2)

3. a) What are the advantages of user-defined function? Explain the syntax of function prototype. Write a program in C to swap two numbers using a function. 3+2+4 (CO2) (PO2)

   b) Explain the advantages and disadvantages of recursion. Write a program in C to Print Fibonacci Series using recursion. 4+6 (CO1) (PO1, PO2)

   c) What is the output of the following program? 6 (CO2) (PO2)

```
void main()
{
    int n=10;
    int f(int n);
    printf("%d",f(n));
}
int f(int n)
{
    if(n>0)
        return(n+f(n-2));
}
```

Figure 1: Code snippet for Question 3.(c)

Justify your answer with a flow chart.

Formulas: Hum 4721: All notations carry their usual meanings.

Time Value of money

$$i_{effective} = \left(1 + \frac{r}{m}\right)^m - 1 \qquad i_{con/effective} = e^r - 1 \qquad i = \sqrt[n]{\frac{F}{P}} - 1$$

$$Estimated \quad n = \frac{72}{RoR\%} = \frac{72}{i}$$

$$F = P\left(1 + \frac{1}{k}\right)^{rkn} = P\left[\left(1 + \frac{1}{k}\right)^k\right]^{rn} \qquad F = Pe^{rn} = p(factor). \qquad r = ln(1 + i)$$

Factor by which to multiply the "Given"	Factor functional symbol
$(1+i)^n$	$(F/P, i\%, n)$
$(1+i)^{-n}$	$(P/F, i\%, n)$
$[(1+i)^n - 1]/i$	$(F/A, i\%, n)$
$[(1+i)^n - 1] \Big/ i(1+i)^n$	$(P/A, i\%, n)$
$\frac{i}{(1+i)^n - 1}$	$(A/F, i\%, n)$
$\frac{i(1+i)^n}{(1+i)^n - 1}$	$(A/P, i\%, n)$
$\frac{e^{rn} - 1}{r}$	$(F/\bar{A}, r\%, n)$
$\frac{e^{rn} - 1}{re^{rn}}$	$(P/\bar{A}, r\%, n)$
$\frac{r}{e^{rn} - 1}$	$(\bar{A}/F, r\%, n)$
$\frac{re^{rn}}{e^{rn} - 1}$	$(\bar{A}/P, r\%, n)$

$$F = \frac{G}{i}\left[\frac{(1+i)^n - 1}{i}\right] - \frac{nG}{i} = \frac{G}{i}(F/G, i\%, n) - \frac{nG}{i}$$

$$A = \frac{G}{i} - \frac{nG}{i}\left[\frac{i}{(1+i)^n - 1}\right] = G\left[\frac{1}{i} - \frac{n}{(1+i)^n - 1}\right] = G\left(\frac{A}{G}, i\%, n\right)$$

$$P = A\left(\frac{P}{A}, i\%, n\right) = G\left[\frac{1}{i} - \frac{n}{(1+i)^n - 1}\right]\left[\frac{(1+i)^n - 1}{i(1+i)^n}\right]$$

$$= G\left\{\frac{1}{i}\left[\frac{(1+i)^n - 1}{i(1+i)^n} - \frac{n}{(1+i)^n}\right]\right\} = G\frac{1}{i}\left(\frac{P}{G}, i\%, n\right)$$

$$= G\frac{1}{i}\left[\left(\frac{P}{A}, i\%, n\right) - n\left(\frac{P}{F}, i\%, n\right)\right]$$

TABLE D-15
10% compound interest factors

	Single Payment		*Uniform Series*				*Uniform Gradient*		
n	Compound amount factor *F/P*	Present worth factor *P/F*	Sinking fund factor *A/F*	Capital recovery factor *A/P*	Compound amount factor *F/A*	Present worth factor *P/A*	Gradient conversion factor *A/G*	Present worth factor *P/G*	*n*
1	1.1000	0.9091	1.000 00	1.100 00	1.000	0.909	0.000	0.000	1
2	1.2100	0.8264	0.476 19	0.576 19	2.100	1.736	0.476	0.826	2
3	1.3310	0.7513	0.302 11	0.402 11	3.310	2.487	0.937	2.329	3
4	1.4641	0.6830	0.215 47	0.315 47	4.641	3.170	1.381	4.378	4
5	1.6105	0.6209	0.163 80	0.263 80	6.105	3.791	1.810	6.862	5
6	1.7716	0.5645	0.129 61	0.229 61	7.716	4.355	2.224	9.684	6
7	1.9487	0.5132	0.105 41	0.205 41	9.487	4.868	2.622	12.763	7
8	2.1436	0.4665	0.087 44	0.187 44	11.436	5.335	3.004	16.029	8
9	2.3579	0.4241	0.073 64	0.173 64	13.579	5.759	3.372	19.421	9
10	2.5937	0.3855	0.062 75	0.162 75	15.937	6.144	3.725	22.891	10
11	2.8531	0.3505	0.053 96	0.153 96	18.531	6.495	4.064	26.396	11
12	3.1384	0.3186	0.046 76	0.146 76	21.384	6.814	4.388	29.901	12
13	3.4523	0.2897	0.040 78	0.140 78	24.523	7.103	4.699	33.377	13
14	3.7975	0.2633	0.035 75	0.135 75	27.975	7.367	4.996	36.800	14
15	4.1772	0.2394	0.031 47	0.131 47	31.772	7.606	5.279	40.152	15
16	4.5950	0.2176	0.027 82	0.127 82	35.950	7.824	5.549	43.416	16
17	5.0545	0.1978	0.024 66	0.124 66	40.545	8.022	5.807	46.582	17
18	5.5599	0.1799	0.021 93	0.121 93	45.599	8.201	6.053	49.640	18
19	6.1159	0.1635	0.019 55	0.119 55	51.159	8.365	6.286	52.583	19
20	6.7275	0.1486	0.017 46	0.117 46	57.275	8.514	6.508	55.407	20
21	7.4002	0.1351	0.015 62	0.115 62	64.002	8.649	6.719	58.110	21
22	8.1403	0.1228	0.014 01	0.114 01	71.403	8.772	6.919	60.689	22
23	8.9543	0.1117	0.012 57	0.112 57	79.543	8.883	7.108	63.146	23
24	9.8497	0.1015	0.011 30	0.111 30	88.497	8.985	7.288	65.481	24
25	10.8347	0.0923	0.010 17	0.110 17	98.347	9.077	7.458	67.696	25
26	11.9182	0.0839	0.009 16	0.109 16	109.182	9.161	7.619	69.794	26
27	13.1100	0.0763	0.008 26	0.108 26	121.100	9.237	7.770	71.777	27
28	14.4210	0.0693	0.007 45	0.107 45	134.210	9.307	7.914	73.650	28
29	15.8631	0.0630	0.006 73	0.106 73	148.631	9.370	8.049	75.415	29
30	17.4494	0.0573	0.006 08	0.106 08	164.494	9.427	8.176	77.077	30
31	19.1943	0.0521	0.005 50	0.105 50	181.943	9.479	8.296	78.640	31
32	21.1138	0.0474	0.004 97	0.104 97	201.138	9.526	8.409	80.108	32
33	23.2252	0.0431	0.004 50	0.104 50	222.252	9.569	8.515	81.486	33
34	25.5477	0.0391	0.004 07	0.104 07	245.477	9.609	8.615	82.777	34
35	28.1024	0.0356	0.003 69	0.103 69	271.024	9.644	8.709	83.987	35
40	45.2593	0.0221	0.002 26	0.102 26	442.593	9.779	9.096	88.953	40
45	72.8905	0.0137	0.001 39	0.101 39	718.905	9.863	9.374	92.454	45
50	117.3909	0.0085	0.000 86	0.100 86	1 163.909	9.915	9.570	94.889	50
55	189.0591	0.0053	0.000 53	0.100 53	1 880.591	9.947	9.708	96.562	55
60	304.4816	0.0033	0.000 33	0.100 33	3 034.816	9.967	9.802	97.701	60
65	490.3707	0.0020	0.000 20	0.100 20	4 893.707	9.980	9.867	98.471	65
70	789.7470	0.0013	0.000 13	0.100 13	7 887.470	9.987	9.911	98.987	70
75	1 271.8952	0.0008	0.000 08	0.100 08	12 708.954	9.992	9.941	99.332	75
80	2 048.4002	0.0005	0.000 05	0.100 05	20 474.002	9.995	9.961	99.561	80
85	3 298.9690	0.0003	0.000 03	0.100 03	32 979.690	9.997	9.974	99.712	85
90	5 313.0226	0.0002	0.000 02	0.100 02	53 120.226	9.998	9.983	99.812	90
95	8 556.6760	0.0001	0.000 01	0.100 01	85 556.760	9.999	9.989	99.877	95
100	13 780.6123	0.0001	0.000 01	0.100 01	137 796.123	9.999	9.993	99.920	100

B.Sc. Engg. IPE 3rd Semester — 29 September 2022 (Morning)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
Department of Computer Science and Engineering (CSE)

MID SEMESTER EXAMINATION — **WINTER SEMESTER, 2021-2022**

DURATION: 1 HOUR 30 MINUTES — **FULL MARKS: 75**

CSE 4373: Computer Programming and Applications

Programmable calculators are not allowed. Do not write anything on the question paper.

Answer **all 3 (three)** questions. Marks of each question and corresponding CO and PO are written in the right margin with brackets.

---

1. a) Evaluate the expression assigned to the variable 'ans' in Figure 1. Show the intermediate steps as well. — 7 (CO4) (PO2)

```
int a=1, b=2, c=3, d=5, ans;
ans = a%5-a/b+c++*++d;
```

Figure 1: Code Snippet for 1(a)

b) Write a program that will take three integers, **n**, **m**, and **k** as input. Then, it will take **two** regular matrices **A** and **B** of size (**n** × **m**) .Finally, it will evaluate the following expression. — 11 (CO2) (PO2)

$$C = A - k * B$$

c) Outline a step-by-step process describing how a computer reads, compiles, and executes a C program. Use appropriate diagrams, if necessary. — 7 (CO1) (PO2)

2. a) Suppose for a game development project, you have to draw hollow triangular shapes of different sizes. Write a program that takes a number **n** as input and print the patterns as shown in Figure 2. — 10 (CO3) (PO3)

```
2        3          4

 *        *          *
***      * *        * *
        *****      *   *
                  *******
```

Figure 2: Output form the program in Question 2(a) for n=2, n=3 and n=4

b) What would be the output of the code snippet in Figure 3? — 7 (CO4) (PO2)

```
int i;
for(i=1; i<100; i++)
{
        if(i%5==0 && i%3==0) continue;
        else if(i%3==0) printf("desh\n");
        else if(i%5==0) printf("bangla\n");
        if(i>21) break;
}
```

Figure 3: C program for snippet for Question 2(b)

c) Answer the following Questions: 4+4
   i. What are the two major criteria to evaluate algorithms? (CO1)
   ii. ii. What are the advantages of modular programming? Which features in C Programming Language help to write modular programs? (PO1)

3. a) Following is a buggy C program to convert Celsius into Fahrenheit. Briefly explain each bug in the program and debug it. 6 (CO4) (PO2)

```
$include{stdio.h}
int main()
{
int celsius, fahrenheit, 1_f;
1_f = fahrenheit - 32
celcius = 1_f*9/5
      printf("%f", &celcius);
      return 0;
}
```

Figure 4: C program for Question 3(a)

b) Suppose you are developing a word processing software. As a part of that, you have to write a program that takes in a stream of characters as input and output the count of the numeric digits, upper-case letters, and lower-case letters as shown below. The program first takes an integer, **n** as input. Then, it takes a stream of **n** characters which are either digits upper-case or lower-case letters. The ASCII value of '0', 'A', 'a' is respectively 48, 65, and 97. 12 (CO3) (PO2)

Input

15

sBc103Ghf456kJk

Output

Numeric Digits: 6

Upper-case Letters: 3

Lower-case Letters: 6

c) Write a program that approximates the sum of the first n terms of the first n terms of the following series. Here, n is an integer input by the user. 7 (CO2) (PO2)

$$1+\frac{1}{1!}+\frac{1}{2!}+\frac{1}{3!}+\frac{1}{4!}+\ldots\ldots\ldots$$

30

B.Sc. Engg. (ME/IPE), 3rd Sem. Date: September 30, 2022 (Morning)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid-Semester Examination — Winter Semester, A. Y. 2021-2022
Course No.: EEE 4381 — Time: 90 minutes
Course Title: Electronics and Digitization Techniques — Full Marks: 75

There are **4 (four)** questions. **Question 1 is compulsory.** Answer **any 2 (two)** questions from the other 03 (three). Marks in the margin indicate full marks. Do not write on this question paper.

---

1. a) Define majority and minority carriers? Describe the differences between n-type and p-type semiconductor materials. 5 (CO1) (PO1)

b) Sketch the input and output voltage wave shapes for the circuits in Fig. 1(b). Consider $V_{in} = 10V_{peak}$, R = 1 kΩ, V = 4 V. 5 (CO2) (PO2)

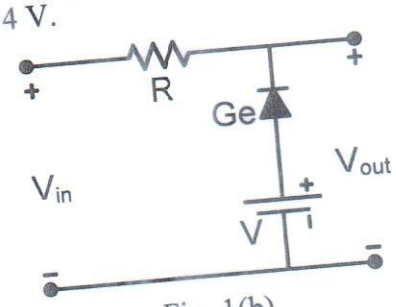


Fig. 1(b)

c) Design a rectifier to convert 220 V AC to 10 V DC. Briefly explain each step of your design with necessary circuit diagram(s). 15 (CO3) (PO3)

2 a) Sketch the equivalent circuits and the forward characteristics for the equivalent models available for p-n junction diode. 7.5 (CO1) (PO1)

b) Distinguish between a bipolar and unipolar device? Identify what kind of device a BJT is and justify your answer. 5 (CO1) (PO1)

c) For the diode networks of Fig. 2(c), determine V_o, I_1, and I_2. 12.5 (CO2) (PO2)

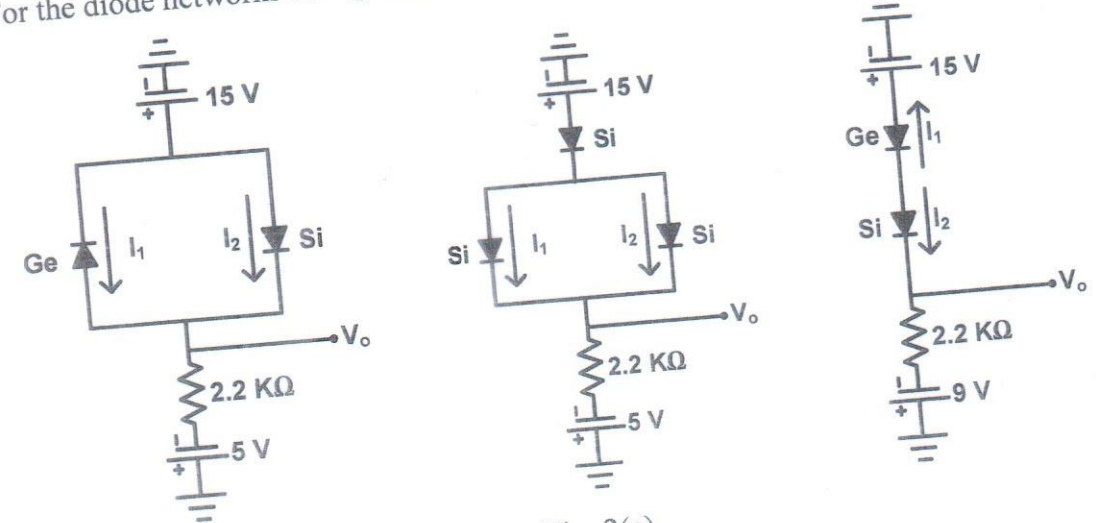


Fig. 2(c)

3. a) Sketch the input and output voltage wave shapes for the circuits in Fig. 3(a). Consider $V_{in} = 20V_{peak}$, R = 1 kΩ, V = 7 V, C = 100 μF. 12.5 (CO2) (PO2)

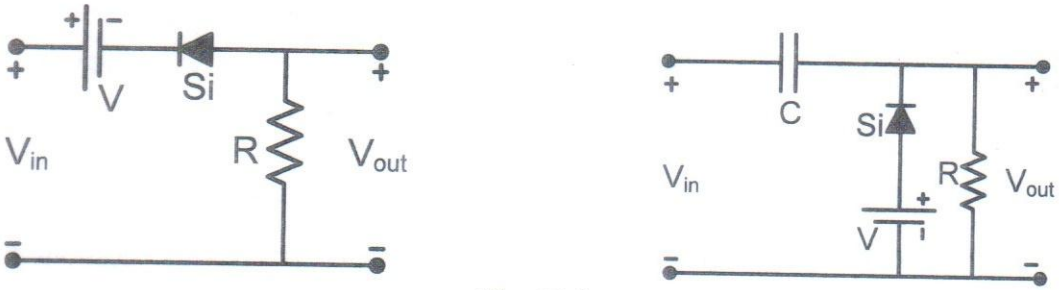


Fig: 3(a)

b) Sketch the common-emitter BJT configuration (for both npn and pnp) and indicate the polarity of the applied bias and resulting current directions. Also draw the collector characteristics and base characteristics. 12.5 (CO1) (PO1)

4. a) Describe the transistor amplifying action with example. 5 (CO1) (PO1)

b) Explain the significances of common base and common emitter amplification factors in BJT amplifiers? Derive the relationship between them. 7.5 (CO1) (PO1)

c) Determine the levels of I_{CQ} and V_{CEQ} for the voltage-divider configuration of Fig. 4(c) using the exact and approximate techniques and compare solutions. 12.5 (CO2) PO2)

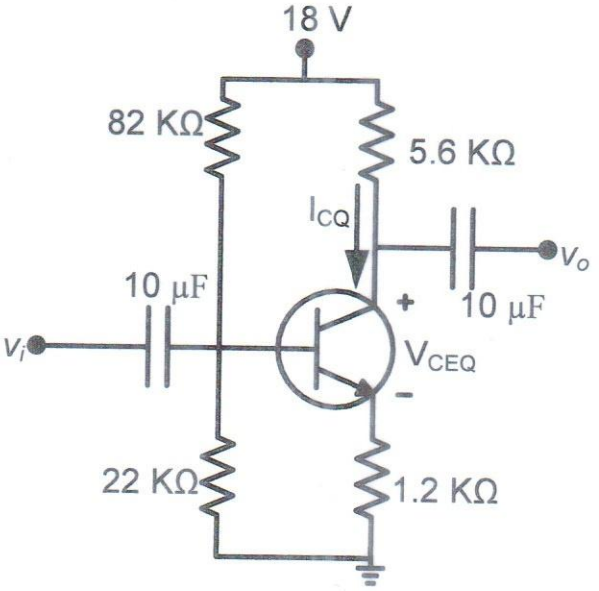


Fig. 4(c)

(32)

Program: B. Sc. in Industrial Production Engineering **Date: 29 September , 2022**
Time: 10:30 a.m.– 12:00 p.m.

Semester: Winter

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
DEPARTMENT OF MECHANICAL AND PRODUCTION ENGINEERING

Mid-Semester Examination **Winter Semester: 2021 - 2022**
Course Number: ME 4503 **Full Marks:75**
Course Title: Mechanics of Machines **Time : 1.5 Hours**

There are 3 (**Three**) questions. Answer **all** of them.
The symbols have their usual meanings. Marks of each question and corresponding CO and PO are written in the brackets. Assume reasonable value for missing data.

---

1. a. Figure 1 is showing the kinematic diagram of a *front loader*. Determine the *mobility* of the mechanism using *kutzbach* equation. **(8) (CO1) (PO2)**

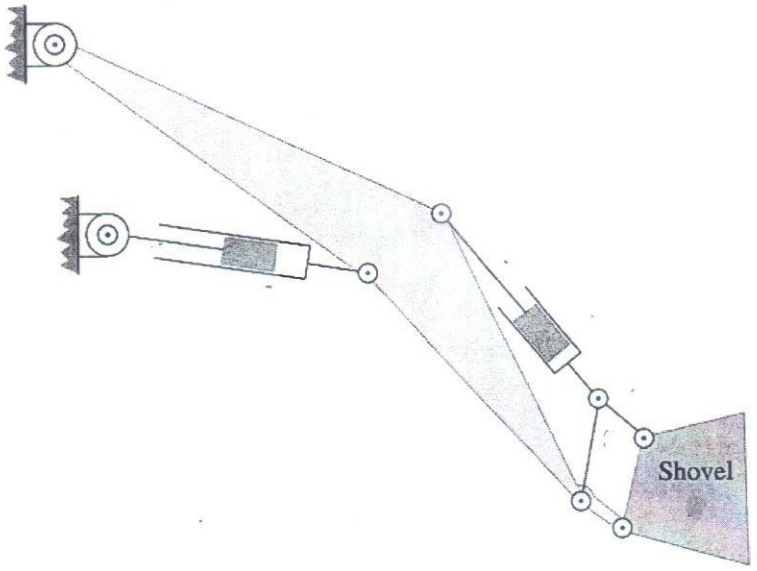


Figure. 1

b. A 4-tooth/in diametral pitch, 24-tooth pinion is to drive a 36-tooth gear. The gears are cut on the 20° full-depth involute system. Find and tabulate the addendum, dedendum, clearance, circular pitch, base pitch, tooth thickness, pitch circle radii, base circle radii, lengths of paths of approach and recess, and contact ratio. **(17) (CO2) (PO3)**

2. In Figure 2 axis y-y is fixed while axis x-x and z-z move with the arm. Gear 7 is fixed to the carrier. Gears 3 and 4, 5 and 6, and 8 and 9 are fixed together, respectively. Gears 3 and 4 move with planetary motion. If the tooth numbers are $N_2 = 16T$, $N_3 = 20T$, $N_4 = 22T$, $N_5 = 14T$, $N_6 = 15T$, $N_7 = 36T$, $N_8 = 20T$, $N_9 = 41T$, and $N_{10} = 97T$, determine the speed and direction of the output shaft. **(25) (CO2) (PO3)**

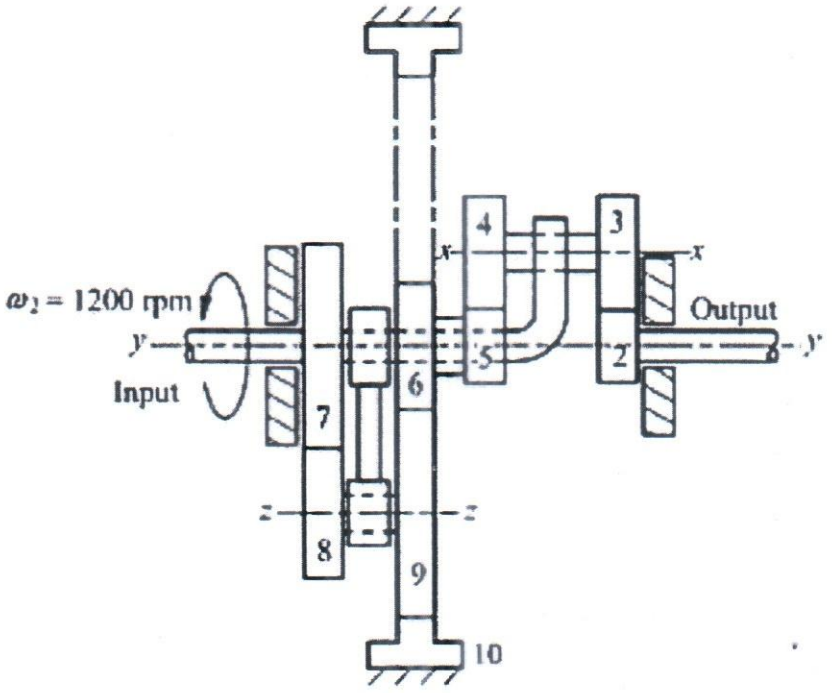


Figure. 2

3. Design a parabolic cam follower-displacement program to provide a dwell with zero lift for the first 120° of the motion cycle, and a dwell at 0.8 in lift for cam angles from 180° to 210°. Assume that the cam rotates with constant angular velocity. **(25) (CO3) (PO3)**

-END-

(39)

Program: B. Sc. in ME
B.Sc. in IPE
Semester: 5th

Date: 05 October, 2022

Time: 10:30 am – 12:00 pm

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)

ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF MECHANICAL AND PRODUCTION ENGINEERING

Mid Semester Examination — **Winter Semester: 2021 - 2022**
Course Number: Math 4511 — **Full Marks:75**
Course Title: Numerical Analysis — **Time : 1.5 HRS**

There are **3 (Three)** questions. Answer all questions. The symbols have their usual meanings. Marks of each question and corresponding CO and PO are written in the brackets. Assume reasonable value for missing data

---

1. Figure 1 shows a uniform beam subject to a linearly increasing distributed load. The equation for the resulting elastic curve is (see Figure 2) **(25) (CO1) (PO2)**

$$y = \frac{w_0}{120EIL}(-x^5 + 2L^2x^3 - L^4x)$$

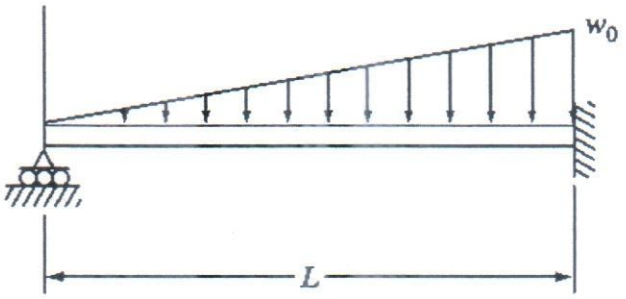


Figure 1

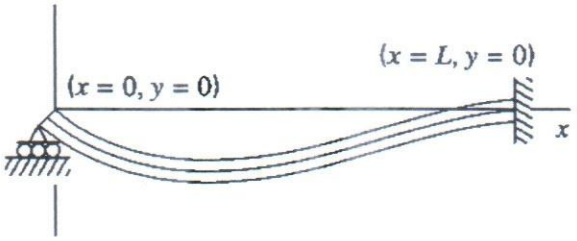


Figure 2

Use *bisection* to determine the point of maximum deflection (that is, the value of x where $dy/dx = 0$). Then substitute this value into the above equation to determine the value of the maximum deflection. Use the following parameter values in your computation: L =600 cm, E =50,000 kN/cm^2 , I = 30,000 cm^4, and w_0 = 2.5 kN/cm

2. a) The power generated by a windmill varies with the wind speed. In an experiment, the following five measurements were obtained: **(15) (CO1) (PO2)**

Wind speed(mph)	14	22	30	38	46
Electric Power (W)	320	490	540	500	480

Determine the *fourth-order* polynomial in the *Lagrange* form that passes through the points. Use the polynomial to calculate the power at a wind speed of 26 mph.
No need to expand the polynomial.

b) Use zero- through third-order Taylor series expansions to predict $f(3)$ for **(10) (CO1) (PO1)**

$$f(x) = 25x^3 - 6x^2 + 7x - 88$$

using a base point at $x = 1$. Compute the true percent relative error for each approximation.
Use forward and backward difference approximations of $O(h)$ and a centered difference approximation of $O(h^2)$ to estimate the first derivative of the function. Evaluate the derivative at $x = 2$ using a step size of $h = 0.2$. Compare your results with the true value of the derivative

3. Solve the following system of four equations using the *Gauss elimination* with *partial pivoting* **(25) (CO1) (PO2)**

$$\begin{aligned} 4x_1 - 2x_2 - 3x_3 + 6x_4 &= 12 \\ -6x_1 + 7x_2 + 6.5x_3 - 6x_4 &= -6.5 \\ x_1 + 7.5x_2 + 6.25x_3 + 5.5x_4 &= 16 \\ -12x_1 + 22x_2 + 15.5x_3 - x_4 &= 17 \end{aligned}$$

(36)

Program: B. Sc. in Mechanical Engineering
Semester: 5th

Date: 03 October, 2022
Time: 10:30 am – 12:00 pm

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)

ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF MECHANICAL AND PRODUCTION ENGINEERING

Semester Mid Examination
Course Number: ME 4511
Course Title: Fluid Mechanics 2

Winter Semester: 2021 - 2022
Full Marks: 75
Time : 1.5 Hours

There are **03 (three)** questions. Answer **all** questions (choose option from question 1). The symbols have their usual meanings. Marks of each question and corresponding CO and PO are written in the brackets. Assume reasonable data for any missing values.

---

1. (a) Derive expression for force, torque and power of the Conical bearing. **(10+15)**
(b) "To achieve supersonic flow from a subsonic state in a duct, a converging-diverging area variation is necessary"- describe elaborately with all appropriate diagrams. **(CO1) (PO1)**

OR

(a) Derive an expression for force, torque and power of the collar bearing.
(b) "For supersonic flow through a duct, the area-velocity relationship is proportional"- describe the statement through mathematical proof and expression with appropriate diagrams.

2. A shaft is supported by Journal, thrust and collar bearing as shown in Figure 1. The external and internal radii of a collar are 60 mm and 50 mm, respectively. An oil film of thickness 0.26 mm and viscosity of 0.1 N-s/m^2 is maintained for collar and thrust bearing. Journal bearing has film thickness half of the collar bearing with viscosity of 0.15 N-s/m^2. If the speed of the shaft is 700 rpm. Find the total force, total torque and total power absorbed in overcoming the viscous resistance. **(25) (CO2) (PO2)**

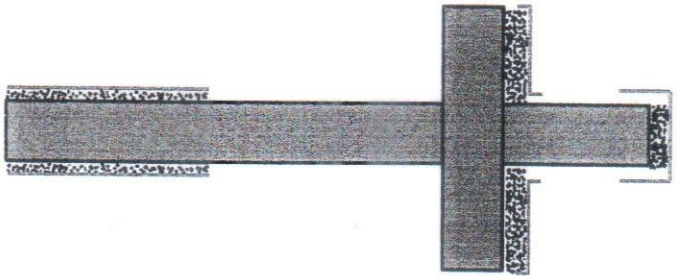


Figure 1

3. An open cylindrical tank having a diameter D is supported around its bottom circumference and is filled to a depth h with a liquid having a specific weight γ. The vertical deflection, d, of the center of the bottom is a function of D, h, t, γ, and E where t is the thickness of the bottom and E is the modulus of elasticity of the bottom material. Form the dimensionless groups describing this relationship. **(25) (CO4) (PO5)**

B.Sc Engg. (ME)/5th Sem, B Sc. TE (2 Yr) (TVE)/ 1st Sem — 28 September, 2022

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
DEPARTMENT OF MECHANICAL AND PRODUCTION ENGINEERING

MID Semester Examination — Winter Semester: A.Y. 2021-2022
Course No.: ME 4513 — Time: 1.0 Hour 30 Minutes
Course Title: *Principle of Heat and Mass Transfer* — Full Marks: 75

There are **03 (Three)** Questions. Answer all of them. Marks in the margin indicate full marks. Don't write on this question paper. Symbols carry their usual meanings. Assume reasonable values for any missing data. Programmable calculators are not allowed.

---

1. (a) (i). *Explain* Thermal conductivity.
(ii). *Write* five characteristics of thermal conductivity-its variation for different materials and under different conditions. **[05] [CO2] [PO2]**

(b) Heat is generated in a long wire of radius r_0 at a constant rate of g_0 per unit volume. The wire is covered with a plastic insulation layer. *Express* the heat flux boundary condition at the interface in terms of the heat generated. **[05] [CO2] [PO2]**

(c) Consider steady 1D heat conduction in a plane wall with variable heat generation and constant thermal conductivity. The nodal network of the medium consists of nodes 0, 1, 2, 3, and 4 with a uniform nodal spacing of Δx. Using the finite difference form of the first derivative, *state* the finite difference formulation of the boundary nodes for the case of uniform heat flux q_0 at the left boundary (node 0) and convection at the right boundary (node 4) with a convection coefficient of h and an ambient temperature of T_α. **[05] [CO2] [PO2]**

2. (a) Starting with an energy balance on a cylindrical shell volume element, *develop* a correlation of the steady one-dimensional heat conduction equation for a long cylinder with constant thermal conductivity in which heat is generated at a rate of g. **[10] [CO4] [PO4]**

(b) Consider a sphere of radius r_1 whose surface temperature T_1 is maintained constant. The sphere is now insulated with a material whose thermal conductivity is k and outer radius is r_2. Heat is lost from the sphere to the surrounding medium at temperature Tα, with a convection heat transfer coefficient h. *Verify* that the critical radius of insulation for sphere is, $r_{cr}=2k/h$. **[10] [CO4] [PO4]**

(c) *Design* a temperature distribution profile and heat flow due to conduction in a circular conical rod with diameter as shown in **Fig. 1** at any section given by D=cx where x is the distance measured from the apex of the cone and c is a certain numerical constant. Assume that lateral surface is well insulated, there is no internal heat generation and heat flow takes place under steady state conditions. **[10] [CO4] [PO4]**

3. (a) A 150 mm steam pipe (**Fig. 2**) has inner diameter of 120 mm and outside diameter of 160 mm. It is insulated at the outside with asbestos. The steam temperature is 150°C and the air temperature is 20°C. h(steam side)=100 W/m^2°C, h(air side)= 30 W/m^2°C, k(asbestos)=0.8 W/m°C and k(steel)= 42 W/m°C. *Calculate* how thick the asbestos should be provided in order to limit the heat loses to 2.1 kW/m^2. **[10] [CO3] [PO3]**

(b) A long cylindrical bar (k=17.4 W/m°C, α=0.019 m^2/h) of radius 80 mm comes out of oven at 830°C throughout and is cooled by quenching it in a large bath of 40°C coolant. The surface coefficient of heat transfer between the bar surface and the coolant is 180 W/m^2°C. *Determine*:
(i). The time taken by the shaft centre to reach 120°C.
(ii). The surface temperature of the shaft when its centre temperature is 120°C. Also calculate the temperature gradient at the outside surface at the same instant of time. **[10] [CO3] [PO3]**

(c) Consider a long concrete dam (k= 0.6 W/m·°C, α=0.7 m^2/s) of triangular cross section (**Fig. 3**) whose exposed surface is subjected to solar heat flux of q_s=800 W/m^2 and to convection and radiation to the environment at 25°C with a combined heat transfer coefficient of 30 W/m^2·°C. The 2-m-high vertical section of the dam is subjected to convection by water at 15°C with a heat transfer coefficient of 150 W/m^2·°C, and heat transfer through the 2-m-long base is considered to be negligible. Using the finite difference method with a mesh size of $\Delta x=\Delta y$= 1 m and assuming steady two-dimensional heat transfer, *determine* the temperature of the top, middle, and bottom of the exposed surface of the dam. **[10] [CO3] [PO3]**

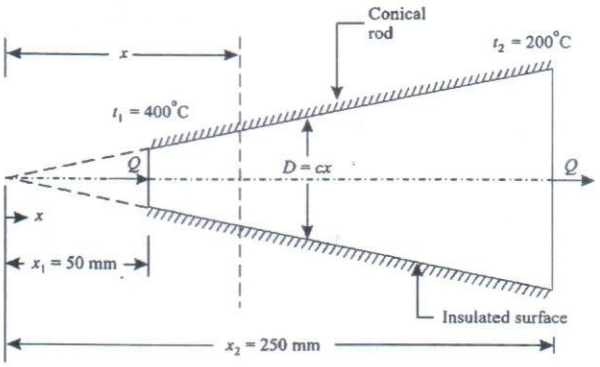


Fig: 1-For Question No 2(c)

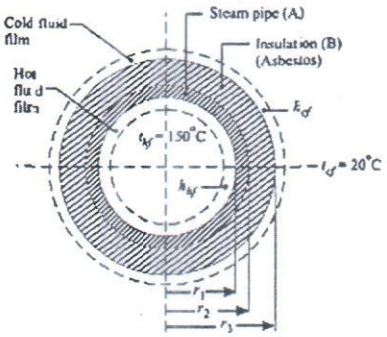


Fig: 2-For Question No 3(a)

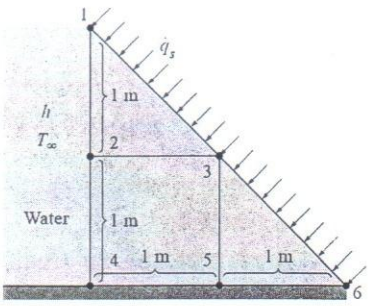
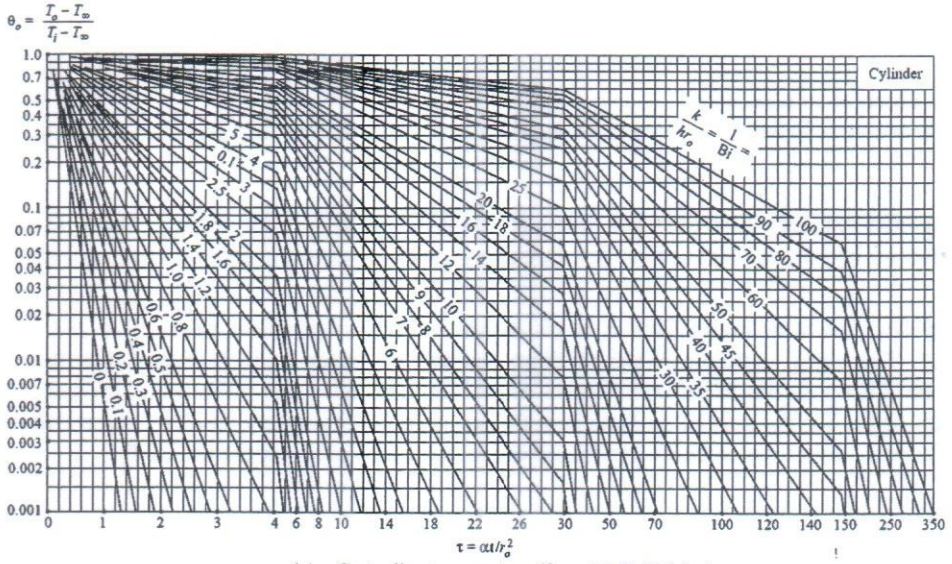
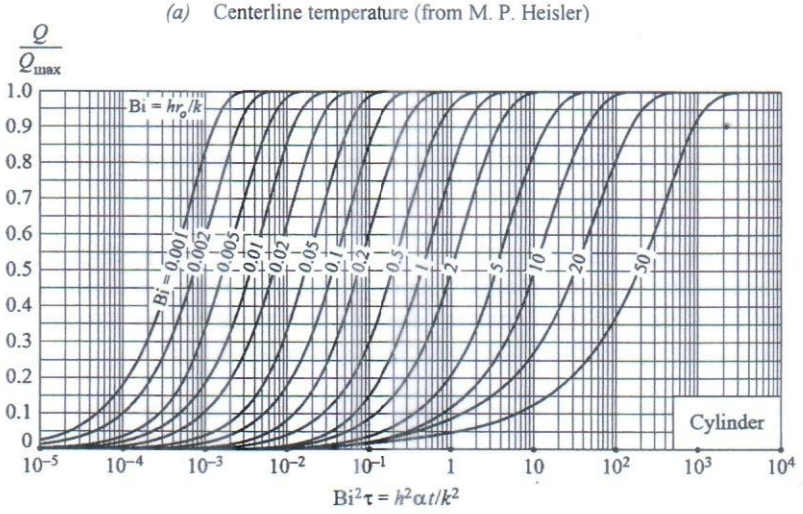


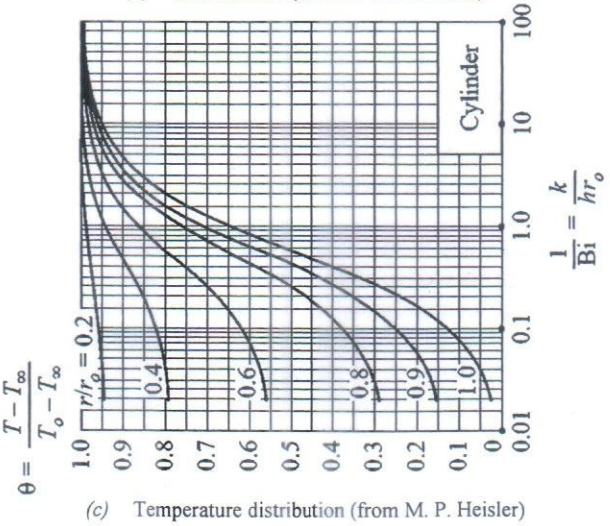
Fig: 3-For Question No 3(c)



(a) Centerline temperature (from M. P. Heisler)



(b) Heat transfer (from H. Gröber et al.)



(c) Temperature distribution (from M. P. Heisler)

(39)

Program: B. Sc. in Mechanical Engineering/ B. Sc. in Technical Education

Date: 30th September, 2022 (Friday)

Semester: 5th

Time: 10:30 am – 12:00 pm (Morning)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)

ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF MECHANICAL AND PRODUCTION ENGINEERING

Mid-Semester Examination | **Winter Semester: 2021 - 2022**
Course Number: IPE 4521 | **Full Marks: 75**
Course Title: Manufacturing Process | **Time : 1 hour 30 Minutes**

There are **4 (four)** questions. Question no. **1** is alternative to question no. **2**. Answer **3 (three)** questions. The symbols have their usual meanings. Marks of each question and corresponding CO and PO are written in the brackets.

---

1. a) Define pattern. Write brief note on the pattern allowances that can be quantitatively specified. **(10) (CO1) (PO1)**

b) Explain some of the moulding material and gas defects of a sand casting with their causes and defects. **(10) (CO1) (PO1)**

c) Mention some advantages and disadvantages of permanent mould casting. **(05) (CO1) (PO1)**

OR

2. a) Briefly discuss about die casting process with its advantages and disadvantages. . **(10) (CO1) (PO1)**

b) Mention the factors responsible for different types of chip formation. **(08) (CO1) (PO1)**

c) What is simple indexing and compound indexing? Explain with examples. **(07) (CO1) (PO1)**

(40)

3.	a)	A sand specimen with a permeability number of 140 takes 45 seconds to pass 2000 cm^3 of air at a pressure of $5g/cm^2$. Calculate the height of the sand specimen.	**(05) (CO2) (PO2)**
	b)	Shear angle can be measured by measuring chip thickness, depth of cut and rake angle of tool. Prove this statement.	**(10) (CO2) (PO2)**
	c)	Is it possible to obtain a casting of a solid bar by centrifugal casting? Give reasons in support of your answer.	**(05) (CO2) (PO2)**
	d)	At what r.p.m. should a lathe be run to give a cutting speed of 60 m/min, when turning a rod of diameter of 42 mm and length 500 mm. Hence, find out machining time for feed of 0.8 mm/min.	**(05) (CO2) (PO2)**
4.	a)	Explain the quick return mechanism of a shaper machine with necessary diagram.	**(10) (CO1) (PO1)**
	b)	Describe with necessary diagram the working principle of a lathe apron. Write a short note on Taper Turning.	**(10) (CO1) (PO1)**
	c)	Explain different types of operations that can be performed on a drilling machine.	**(05) (CO1) (PO1)**

(41)

Program: BSc. Eng. (ME/IPE) Date: 4 October 2022
Semester: 5th Semester Time: 10:30 am – 12:00 pm

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
DEPARTMENT OF MECHANICAL AND PRODUCTION ENGINEERING

Mid-Semester Examination Winter Semester, A.Y. 2021-2022
Course Number: IPE 4531 Full Marks : 75
Course Title: Probability and Statistics Time : 1½ Hours

There are **3 (Three)** questions. Answer all of them. The symbols have their usual meanings. Marks of each question and corresponding CO and PO are written in the right column.
Assume reasonable values if required. Selected formulas and charts are provided at the end of the question.

---

1 Suppose you were working in the quality department of a lubricant company. Which sampling method would you use for quality control? Explain with reasons. Raw data on the weight in gram of a lubricant product collected from that factory is tabled below: — 25, CO1, PO1, PO2

198	147	286
155	236	267
213	224	191
257	193	208
170	181	226

i. Make the data into appropriate classes and then prepare a frequency table.
ii. Determine the Range, Mean, Median, Mode and Standard Deviation from grouped data.
iii. Draw a stem and leaf diagram using the above data set.

2 a) According to Journal of Engineering Progress, approximately 30% of all pipework failures in chemical plants are caused by operator error. — 7, CO2, PO3
(i) Determine the probability that out of the next 10 pipework failures at least 5 are due to operator error.
(ii) Calculate the probability that no more than 4 out of 20 such failures are due to operator error.

b) Potholes on a highway can be a serious problem, and are in constant need of repair. With a particular type of terrain and make of concrete, past experience suggests that there are, on the average 2 potholes per mile after a certain amount of usage. — 6, CO2, PO3
i. Determine the probability that no pothole will appear in a section of 1 mile.
ii. Calculate the probability that no more than one potholes will occur in a given section of 5 miles.
iii. Mention main reason for using a specific probability distribution for solving this problem.

c) Lately five women and eight men applied for a job to a manufacturing company. The personnel manager claimed that the applicants were so equally qualified that he made the selection of the three people hired totally by random process. The selection resulted in three men and no women being selected. The women have filed discrimination charges against the company. Based on probability, what would you conclude about the suit? Discuss. 7 CO2 PO3

d) MPE dept has 120 students at 3rd year. Among them, 30 students took Solar energy and 40 students took Material Handling. There are 10 students who took both Solar energy and Material handling. If a 3rd year MPE student is chosen at random, what is the probability that the student has taken Solar energy? What is the probability that the student has taken solar energy given that Materials handling also taken prior to that. 5 CO2 P03

3 a) Banks affiliated with IUT would like to find out the best estimate of the percentage of IUT students using internet banking. Banks want the estimate to be within .10 of the population proportion, the desired level of confidence is 95 percent, and no estimate is available for the population proportion. Using this information, determine the required sample size. Then using this sample size, how would you find out the best estimate of the percentage of IUT students using internet banking and confidence interval? Explain. 6 CO2 PO3

b) Gauges are used to reject all components for which a certain dimension is not within the specification $1.50 \pm d$. It is known that this measurement is normally distributed with mean1.50 and standard deviation 0.2. Determine the value of d such that the specifications "cover" 95% of the measurements 7 CO2 PO3

c) The average life of a certain type of small motor is 10 years with a standard deviation of 2 years. The Manufacturer replaces free all motors that fail while under guarantee. If she is willing to replace only 3% of The motors that fail, how long a guarantee should be offered? Assume that the life time of a motor follows a normal distribution 6 CO2 PO3

d) The average grade for an exam is 74, and the standard deviation is7. If 15% of The class is given As, and the grades are curved to follow a normal distribution, What is the cutoff mark to get A grade, i.e. you will get A grade when your earned mark is equal or larger than this cutoff mark? 6 CO2 PO3

----OOOO----

Formulas:::

$$n = p(1-p)\left(\frac{z}{E}\right)^2$$

Median:

$$s = \sqrt{\frac{n\sum_i^n (f_i X_i^2) - (\sum_i^n f_i X_i)^2}{n-1}}$$

$$M_d = L + \left(\frac{N/2 - n_b}{n_w}\right) i$$

i = R / (1 + 3.322 logn)

$$b(x; n, P) = {}^{n}C_x * P^x * (1 - P)^{n-x}$$

$$P(x; \mu) = (e^{-\mu}) * (\mu^x) / x!$$

$$h(x; N, n, k) = [\,{}^{k}C_x\,] * [\,{}^{N-k}C_{n-x}\,] / [\,{}^{N}C_n\,]$$

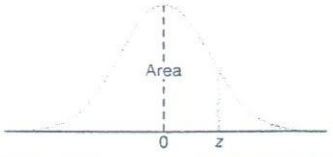


Table A.3 Areas under the Normal Curve

z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
−3.4	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0002
−3.3	0.0005	0.0005	0.0005	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0003
−3.2	0.0007	0.0007	0.0006	0.0006	0.0006	0.0006	0.0006	0.0005	0.0005	0.0005
−3.1	0.0010	0.0009	0.0009	0.0009	0.0008	0.0008	0.0008	0.0008	0.0007	0.0007
−3.0	0.0013	0.0013	0.0013	0.0012	0.0012	0.0011	0.0011	0.0011	0.0010	0.0010
−2.9	0.0019	0.0018	0.0018	0.0017	0.0016	0.0016	0.0015	0.0015	0.0014	0.0014
−2.8	0.0026	0.0025	0.0024	0.0023	0.0023	0.0022	0.0021	0.0021	0.0020	0.0019
−2.7	0.0035	0.0034	0.0033	0.0032	0.0031	0.0030	0.0029	0.0028	0.0027	0.0026
−2.6	0.0047	0.0045	0.0044	0.0043	0.0041	0.0040	0.0039	0.0038	0.0037	0.0036
−2.5	0.0062	0.0060	0.0059	0.0057	0.0055	0.0054	0.0052	0.0051	0.0049	0.0048
−2.4	0.0082	0.0080	0.0078	0.0075	0.0073	0.0071	0.0069	0.0068	0.0066	0.0064
−2.3	0.0107	0.0104	0.0102	0.0099	0.0096	0.0094	0.0091	0.0089	0.0087	0.0084
−2.2	0.0139	0.0136	0.0132	0.0129	0.0125	0.0122	0.0119	0.0116	0.0113	0.0110
−2.1	0.0179	0.0174	0.0170	0.0166	0.0162	0.0158	0.0154	0.0150	0.0146	0.0143
−2.0	0.0228	0.0222	0.0217	0.0212	0.0207	0.0202	0.0197	0.0192	0.0188	0.0183
−1.9	0.0287	0.0281	0.0274	0.0268	0.0262	0.0256	0.0250	0.0244	0.0239	0.0233
−1.8	0.0359	0.0351	0.0344	0.0336	0.0329	0.0322	0.0314	0.0307	0.0301	0.0294
−1.7	0.0446	0.0436	0.0427	0.0418	0.0409	0.0401	0.0392	0.0384	0.0375	0.0367
−1.6	0.0548	0.0537	0.0526	0.0516	0.0505	0.0495	0.0485	0.0475	0.0465	0.0455
−1.5	0.0668	0.0655	0.0643	0.0630	0.0618	0.0606	0.0594	0.0582	0.0571	0.0559
−1.4	0.0808	0.0793	0.0778	0.0764	0.0749	0.0735	0.0721	0.0708	0.0694	0.0681
−1.3	0.0968	0.0951	0.0934	0.0918	0.0901	0.0885	0.0869	0.0853	0.0838	0.0823
−1.2	0.1151	0.1131	0.1112	0.1093	0.1075	0.1056	0.1038	0.1020	0.1003	0.0985
−1.1	0.1357	0.1335	0.1314	0.1292	0.1271	0.1251	0.1230	0.1210	0.1190	0.1170
−1.0	0.1587	0.1562	0.1539	0.1515	0.1492	0.1469	0.1446	0.1423	0.1401	0.1379
−0.9	0.1841	0.1814	0.1788	0.1762	0.1736	0.1711	0.1685	0.1660	0.1635	0.1611
−0.8	0.2119	0.2090	0.2061	0.2033	0.2005	0.1977	0.1949	0.1922	0.1894	0.1867
−0.7	0.2420	0.2389	0.2358	0.2327	0.2296	0.2266	0.2236	0.2206	0.2177	0.2148
−0.6	0.2743	0.2709	0.2676	0.2643	0.2611	0.2578	0.2546	0.2514	0.2483	0.2451
−0.5	0.3085	0.3050	0.3015	0.2981	0.2946	0.2912	0.2877	0.2843	0.2810	0.2776
−0.4	0.3446	0.3409	0.3372	0.3336	0.3300	0.3264	0.3228	0.3192	0.3156	0.3121
−0.3	0.3821	0.3783	0.3745	0.3707	0.3669	0.3632	0.3594	0.3557	0.3520	0.3483
−0.2	0.4207	0.4168	0.4129	0.4090	0.4052	0.4013	0.3974	0.3936	0.3897	0.3859
−0.1	0.4602	0.4562	0.4522	0.4483	0.4443	0.4404	0.4364	0.4325	0.4286	0.4247
−0.0	0.5000	0.4960	0.4920	0.4880	0.4840	0.4801	0.4761	0.4721	0.4681	0.4641

Table A.3 (continued) Areas under the Normal Curve

z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0	0.5000	0.5040	0.5080	0.5120	0.5160	0.5199	0.5239	0.5279	0.5319	0.5359
0.1	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753
0.2	0.5793	0.5832	0.5871	0.5910	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141
0.3	0.6179	0.6217	0.6255	0.6293	0.6331	0.6368	0.6406	0.6443	0.6480	0.6517
0.4	0.6554	0.6591	0.6628	0.6664	0.6700	0.6736	0.6772	0.6808	0.6844	0.6879
0.5	0.6915	0.6950	0.6985	0.7019	0.7054	0.7088	0.7123	0.7157	0.7190	0.7224
0.6	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7517	0.7549
0.7	0.7580	0.7611	0.7642	0.7673	0.7704	0.7734	0.7764	0.7794	0.7823	0.7852
0.8	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8078	0.8106	0.8133
0.9	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365	0.8389
1.0	0.8413	0.8438	0.8461	0.8485	0.8508	0.8531	0.8554	0.8577	0.8599	0.8621
1.1	0.8643	0.8665	0.8686	0.8708	0.8729	0.8749	0.8770	0.8790	0.8810	0.8830
1.2	0.8849	0.8869	0.8888	0.8907	0.8925	0.8944	0.8962	0.8980	0.8997	0.9015
1.3	0.9032	0.9049	0.9066	0.9082	0.9099	0.9115	0.9131	0.9147	0.9162	0.9177
1.4	0.9192	0.9207	0.9222	0.9236	0.9251	0.9265	0.9279	0.9292	0.9306	0.9319
1.5	0.9332	0.9345	0.9357	0.9370	0.9382	0.9394	0.9406	0.9418	0.9429	0.9441
1.6	0.9452	0.9463	0.9474	0.9484	0.9495	0.9505	0.9515	0.9525	0.9535	0.9545
1.7	0.9554	0.9564	0.9573	0.9582	0.9591	0.9599	0.9608	0.9616	0.9625	0.9633
1.8	0.9641	0.9649	0.9656	0.9664	0.9671	0.9678	0.9686	0.9693	0.9699	0.9706
1.9	0.9713	0.9719	0.9726	0.9732	0.9738	0.9744	0.9750	0.9756	0.9761	0.9767
2.0	0.9772	0.9778	0.9783	0.9788	0.9793	0.9798	0.9803	0.9808	0.9812	0.9817
2.1	0.9821	0.9826	0.9830	0.9834	0.9838	0.9842	0.9846	0.9850	0.9854	0.9857
2.2	0.9861	0.9864	0.9868	0.9871	0.9875	0.9878	0.9881	0.9884	0.9887	0.9890
2.3	0.9893	0.9896	0.9898	0.9901	0.9904	0.9906	0.9909	0.9911	0.9913	0.9916
2.4	0.9918	0.9920	0.9922	0.9925	0.9927	0.9929	0.9931	0.9932	0.9934	0.9936
2.5	0.9938	0.9940	0.9941	0.9943	0.9945	0.9946	0.9948	0.9949	0.9951	0.9952
2.6	0.9953	0.9955	0.9956	0.9957	0.9959	0.9960	0.9961	0.9962	0.9963	0.9964
2.7	0.9965	0.9966	0.9967	0.9968	0.9969	0.9970	0.9971	0.9972	0.9973	0.9974
2.8	0.9974	0.9975	0.9976	0.9977	0.9977	0.9978	0.9979	0.9979	0.9980	0.9981
2.9	0.9981	0.9982	0.9982	0.9983	0.9984	0.9984	0.9985	0.9985	0.9986	0.9986
3.0	0.9987	0.9987	0.9987	0.9988	0.9988	0.9989	0.9989	0.9989	0.9990	0.9990
3.1	0.9990	0.9991	0.9991	0.9991	0.9992	0.9992	0.9992	0.9992	0.9993	0.9993
3.2	0.9993	0.9993	0.9994	0.9994	0.9994	0.9994	0.9994	0.9995	0.9995	0.9995
3.3	0.9995	0.9995	0.9995	0.9996	0.9996	0.9996	0.9996	0.9996	0.9996	0.9997
3.4	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9998

(45)

Program: B. Sc. in Industrial and Production Engineering
Semester: Winter

Date: 30 September, 2022
Time: 10:30 am – 12:00pm

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
·· ORGANISATION OF ISLAMIC COOPERATION (OIC)
DEPARTMENT OF MECHANICAL AND PRODUCTION ENGINEERING

Semester Mid Examination — **Winter Semester: 2021 - 2022**
Course Number: IPE 4539 — **Full Marks: 75**
Course Title: Engineering Economy and Finance — **Time : 1.5 Hours**

There are 3 **(THREE)** questions. Answer 3 **(THREE)** questions. The symbols have their usual meanings. Marks of each question and corresponding CO and PO are written in the brackets. Formula sheet and relevant tables are provided.

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1. a. Discuss the benefits of Engineering Economy to engineers. **(10 Marks)**

b. Elaborate on the engineering economy analysis procedures. **(15 Marks)**

(CO 1)
(PO 1)

2. a. Ahmed borrows USD 75,000 from a bank for 1 year at 8% interest for a new industrial machine. **(CO 1)** **(PO 1)**

Solve the:

i. Interest rate **(3 Marks)**

ii. Amount due after1 year **(4 Marks)**

b. A company manger purchases a machine for USD 50,000. The annual operating cost is USD 3,500 including the cost of maintenance. However, the machine needs to be calibrated in year 3 for a cost of USD 5,000 and later be sold at year 10 for an amount of USD 10,000. Construct the cash flow diagram. **(10 Marks)**

c. i. USD 200,000 lent for 4 years at simple $i = 5\%$ per year. **(3 Marks)**
Calculate the simple interest after 3 years.

ii. USD 200,000 lent for 4 years at $i = 5\%$ per year compounded. **(5 Marks)**
Calculate the compound interest rate after 3 years.

3. a. A start-up company made an investment of USD 100 million that is expected to generate USD 50 million per year in revenue for the duration of 6 years. A 10% per year time value of money is applied here. **(CO 2)** **(PO 2)**

i. Solve for the equivalent future worth of the estimated revenues after 6 years at 10% per year. **(5 Marks)**

ii. As result of economic downturn, the company predicted that the earning will drop to 5.5% per year on its money from the previously anticipated 10% per year. **(10 Marks)**
Calculate the revenue per year based on the revised rate of 5.5%.

b. A Petro-chemical plant has upgraded its gas emission control panel with a cost of USD10,000 and is expected to last for 10 years having a salvage value of USD 500. The cost of maintenance is expected to be at USD 1,500 during the first year and increasing by 9% per year thereafter. **(CO 2)** **(PO 2)** **(10 Marks)**
Calculate by hand the equivalent present worth of the modification and maintenance cost at a rate of 6% per year.

5% TABLE 10 Discrete Cash Flow: Compound Interest Factors 5%

n	Single Payments		Uniform Series Payments				Arithmetic Gradients	
	Compound Amount F/P	Present Worth P/F	Sinking Fund A/F	Compound Amount F/A	Capital Recovery A/P	Present Worth P/A	Gradient Present Worth P/G	Gradient Uniform Series A/G
1	1.0500	0.9524	1.00000	1.0000	1.05000	0.9524		
2	1.1025	0.9070	0.48780	2.0500	0.53780	1.8594	0.9070	0.4878
3	1.1576	0.8638	0.31721	3.1525	0.36721	2.7232	2.6347	0.9675
4	1.2155	0.8227	0.23201	4.3101	0.28201	3.5460	5.1028	1.4391
5	1.2763	0.7835	0.18097	5.5256	0.23097	4.3295	8.2369	1.9025
6	1.3401	0.7462	0.14702	6.8019	0.19702	5.0757	11.9680	2.3579
7	1.4071	0.7107	0.12282	8.1420	0.17282	5.7864	16.2321	2.8052
8	1.4775	0.6768	0.10472	9.5491	0.15472	6.4632	20.9700	3.2445
9	1.5513	0.6446	0.09069	11.0266	0.14069	7.1078	26.1268	3.6758
10	1.6289	0.6139	0.07950	12.5779	0.12950	7.7217	31.6520	4.0991
11	1.7103	0.5847	0.07039	14.2068	0.12039	8.3064	37.4988	4.5144
12	1.7959	0.5568	0.06283	15.9171	0.11283	8.8633	43.6241	4.9219

6% TABLE 11 Discrete Cash Flow: Compound Interest Factors 6%

n	Single Payments		Uniform Series Payments				Arithmetic Gradients	
	Compound Amount F/P	Present Worth P/F	Sinking Fund A/F	Compound Amount F/A	Capital Recovery A/P	Present Worth P/A	Gradient Present Worth P/G	Gradient Uniform Series A/G
1	1.0600	0.9434	1.00000	1.0000	1.06000	0.9434		
2	1.1236	0.8900	0.48544	2.0600	0.54544	1.8334	0.8900	0.4854
3	1.1910	0.8396	0.31411	3.1836	0.37411	2.6730	2.5692	0.9612
4	1.2625	0.7921	0.22859	4.3746	0.28859	3.4651	4.9455	1.4272
5	1.3382	0.7473	0.17740	5.6371	0.23740	4.2124	7.9345	1.8836
6	1.4185	0.7050	0.14336	6.9753	0.20336	4.9173	11.4594	2.3304
7	1.5036	0.6651	0.11914	8.3938	0.17914	5.5824	15.4497	2.7676
8	1.5938	0.6274	0.10104	9.8975	0.16104	6.2098	19.8416	3.1952
9	1.6895	0.5919	0.08702	11.4913	0.14702	6.8017	24.5768	3.6133
10	1.7908	0.5584	0.07587	13.1808	0.13587	7.3601	29.6023	4.0220
11	1.8983	0.5268	0.06679	14.9716	0.12679	7.8869	34.8702	4.4213
12	2.0122	0.4970	0.05928	16.8699	0.11928	8.3838	40.3369	4.8113

10% TABLE 15 Discrete Cash Flow: Compound Interest Factors 10%

n	Single Payments		Uniform Series Payments				Arithmetic Gradients	
	Compound Amount F/P	Present Worth P/F	Sinking Fund A/F	Compound Amount F/A	Capital Recovery A/P	Present Worth P/A	Gradient Present Worth P/G	Gradient Uniform Series A/G
1	1.1000	0.9091	1.00000	1.0000	1.10000	0.9091		
2	1.2100	0.8264	0.47619	2.1000	0.57619	1.7355	0.8264	0.4762
3	1.3310	0.7513	0.30211	3.3100	0.40211	2.4869	2.3291	0.9366
4	1.4641	0.6830	0.21547	4.6410	0.31547	3.1699	4.3781	1.3812
5	1.6105	0.6209	0.16380	6.1051	0.26380	3.7908	6.8618	1.8101
6	1.7716	0.5645	0.12961	7.7156	0.22961	4.3553	9.6842	2.2236
7	1.9487	0.5132	0.10541	9.4872	0.20541	4.8684	12.7631	2.6216
8	2.1436	0.4665	0.08744	11.4359	0.18744	5.3349	16.0287	3.0045
9	2.3579	0.4241	0.07364	13.5795	0.17364	5.7590	19.4215	3.3724
10	2.5937	0.3855	0.06275	15.9374	0.16275	6.1446	22.8913	3.7255
11	2.8531	0.3505	0.05396	18.5312	0.15396	6.4951	26.3963	4.0641
12	3.1384	0.3186	0.04676	21.3843	0.14676	6.8137	29.9012	4.3884

FORMULA SHEET

$F = P(1 + i)^n$

$P = F(1 + i)^{-n}$

$$P = A\frac{(1+i)^n - 1}{i(1+i)^n}$$

$$A = P\frac{i(1+i)^n}{(1+i)^n - 1}$$

$$F = A\frac{(1+i)^n - 1}{i}$$

$$A = F\frac{i}{(1+i)^n - 1}$$

$$f = f_1 + \frac{(x - x_1)}{(x_2 - x_1)}(f_2 - f_1)$$

$$P_G = (P/G, i, n) = \frac{(1 + i)^n - in - 1}{i^2(1 + i)^n}$$

$$F_G = G\left[\left(\frac{1}{i}\right)\left(\frac{(1 + i)^n - 1}{i}\right) - n\right]$$

$$A_G = G\left[\frac{1}{i} - \frac{n}{(1+i)^n - 1}\right]$$

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
DEPARTMENT OF MECHANICAL AND PRODUCTION ENGINEERING

MID Semester Examination
Course No.: ME 4555
Course Title: *Fluid Mechanics and Machinery*

Winter Semester: A.Y. 2021-2022
Time: 1.0 Hour 30 Minutes
Full Marks: 75

There are **03 (Three)** Questions. Answer all of them. Marks in the margin indicate full marks. Don't write on this question paper. Symbols carry their usual meanings. Assume reasonable values for any missing data. Programmable calculators are not allowed.

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1. (a) Consider two identical spherical balls submerged in water at different depths. Will the buoyant forces acting on these two balls be the same or different? Again, consider two 5 cm diameter spherical balls, one made of aluminum, the other of iron, submerged in water. Will the buoyant forces acting on these two balls be the same or different? *Explain*. **[05] [CO2] [PO2]**

(b) A typical fluid flow involves a three-dimensional geometry, and the velocity may vary in all three dimensions. Rendering the flow in three-dimensional $V(r, \theta, z)$ in cylindrical coordinates, *explain* that the fully developed flow in a circular pipe is one-dimensional. **[05] [CO2] [PO2]**

(c) *Express* the Bernoulli equation in three different ways using (a) energies, (b) pressures, and (c) heads. **[05] [CO2] [PO2]**

2. (a) *Derive* an expression of viscosity using the principle of Newton's Law of Viscosity. Based on the derivation, differentiate between Newtonian and Non-Newtonian fluid. **[10] [CO3] [PO3]**

(b) A jet of water strikes tangentially on a smooth curved vane moving in the same direction of the jet. If the vane deflects the jet through an angle of 180° in the opposite direction of the jet. *Estimate* the value of maximum efficiency. **[10] [CO3] [PO3]**

(c) *Develop* an equation for the resultant hydrostatic force acting on the surface and the line of action considering a flat plate completely submerged in a liquid. **[10] [CO3] [PO3]**

3. (a) A swimmer having mass of 55 kg is diving in a swimming pool has an effective body area of 0.76 m^2 as shown in **Fig.1**. The tension in the direction of swimmer's leg is 1.5kN when the legs make an inclination of 30° with the vertical direction. If the swimmer's hands bend about 40° with the flow of water and the magnitude of wave is 2.5 m/s. *Calculate* the lift and drag forces and their coefficients. **[10] [CO4] [PO4]**

(b) The pressure of water flowing through a pipe is measured by the arrangement shown in **Fig. 2**. For the values given, *calculate* the pressure in the pipe. All the liquids are incompressible. The effect of air column on pressure is negligible. **[10] [CO4] [PO4]**

(c) A horizontal pipeline is attached to the wall of reservoir (**Fig. 3**). The pipeline has different profiles. The water level in the upper reservoir is in the height H = 1.5 m above the pipeline axis. From the lower end of the pipeline water flows out to the open space. Diameters and lengths of pipeline reaches are: D_1 = 0.24 m, L_1 = 3 m, D_2 = 0.1 m, L_2 = 1 m, D_3 = 0.12 m, L_3 = 2 m. *Calculate* discharge in the pipeline and *verify* the Bernoulli's equation by drawing the course of EGL and HGL. **[10] [CO4] [PO4]**

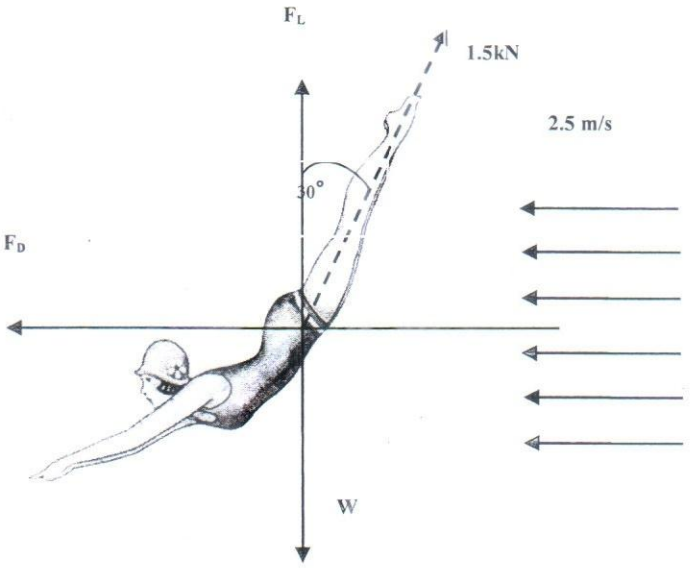

Figure 1: For Question No.3 (a)

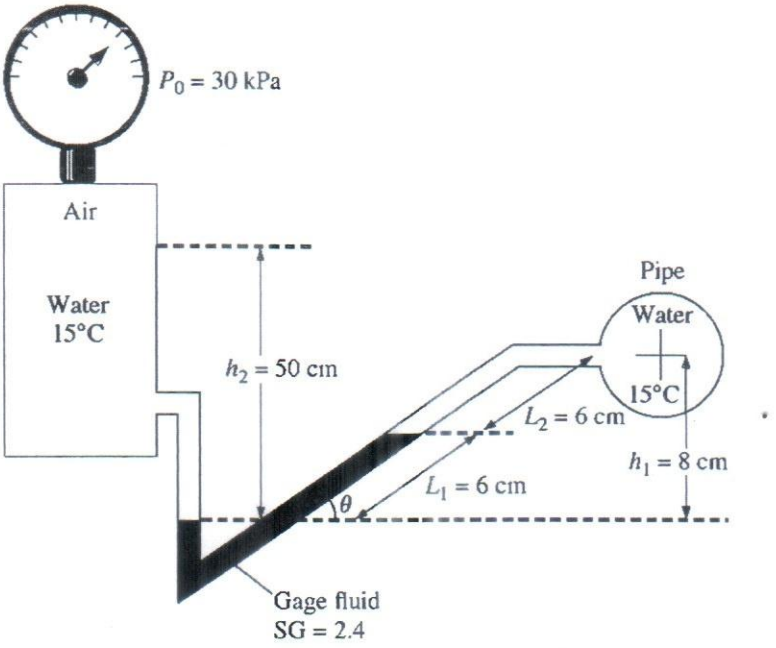

Figure 2: For Question No.3 (b)

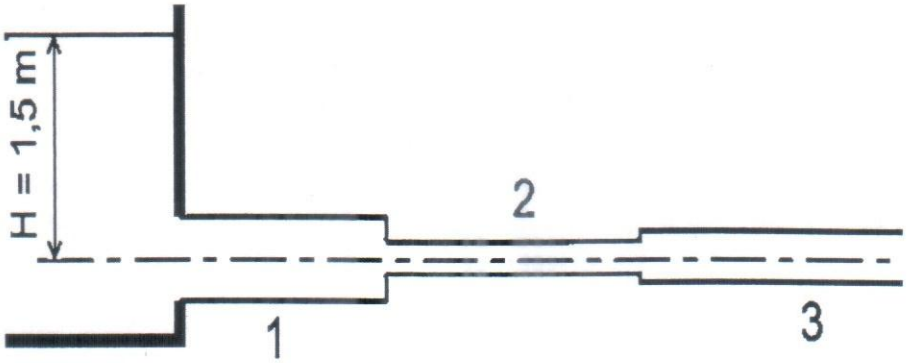

Figure 3: For Question No.3 (c)

Program: B. Sc. in Mechanical Engineering
Semester: 7th

Date: 05 October 2022 (Afternoon)
Time: 2:30 PM – 4:00 PM

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)

ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF MECHANICAL AND PRODUCTION ENGINEERING

Mid Semester Examination — **Winter Semester: 2021 - 2022**
Course Number: MCE 4709 — **Full Marks: 50**
Course Title: Machine Design II — **Time : 1 Hour 30 Minutes**

There are **three** questions. Answer **all** of them. The symbols have their usual meanings. Marks of each question and corresponding CO and PO are written in the brackets. This is an **OPEN BOOK EXAM** (Only Textbook allowed, No notes are allowed). Assume reasonable data if necessary. State all assumptions (if any) clearly. Programmable calculators are not allowed.

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1. The upside-down steel *A* frame shown in the **Figure 1** is to be bolted to steel beams on the ceiling of a machine room using bolts. This frame is to support the 50 kN vertical load as shown. The total bolt grip is 48 mm, which includes the thickness of the steel beam, the A-frame feet, and the steel washers used. The frame has two drill holes of 20 mm dia for housing the bolts. *Design* the joint by selecting a suitable bolt size. The bolt should be of at least ISO 9.8 grade. Justify your design by *analyzing* the factors of safety guarding against yielding, overload, and joint separation. Also, *Determine* the tightening torque should be used if the connection is permanent and the fasteners are lubricated. **(17) (CO1) (PO2, PO3)**

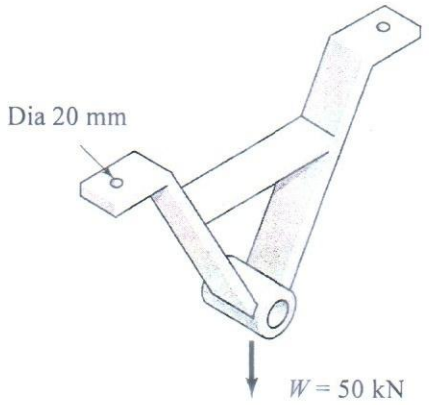

Figure 1

2. A bracket is welded to a wall as shown in **Figure 2** with a fillet weld using an E70 electrode. *Design* the weld size needed between the tube and wall for a static load F = 11 kN and h =1.2*OD, a = 2*OD, l = 2.5*OD. Given that, OD = 89 mm, ID = 78 mm, b = 12.7 mm. The pipe and wall material are made of 1018 HR steel. **(17) (CO1) (PO2, PO3)**

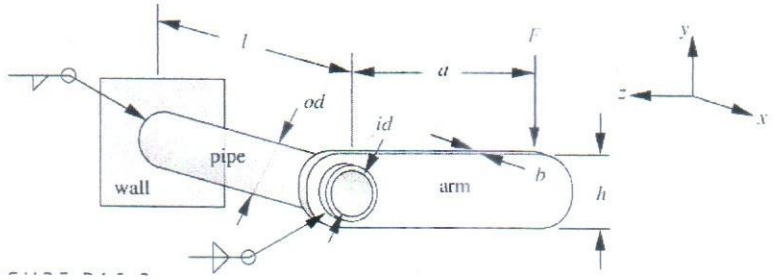

Figure 2

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3. The mean coil diameter of a linear helical compression spring is D = 2.25 inch and the spring index is C = 9. The spring has squared and ground ends and is placed between two flat parallel plates as shown in **Figure 3**. The spring material is music wire A228 and the spring is peened. When the spring is assembled between the plates, the spring at a preload of 45 lbs, the spring length is 5 inches (shown on the left). The spring is then subjected to a fluctuating load. At the maximum working load of 95 lbs, the spring length is 3.75 inches (shown on the right).

Determine:

(i) The number of active coils (round up to the nearest quarter of a coil). **(4) (CO2) (PO2)**

(ii) The free length and the shut (solid) height of the spring. **(4) (CO2) (PO2)**

(iii) The alternating component and the mean component of the shear stress. **(4) (CO2) (PO2)**

(iv) The fatigue factor of safety using the Gerber-Zimmerli failure criterion. **(4) (CO2) (PO3)**

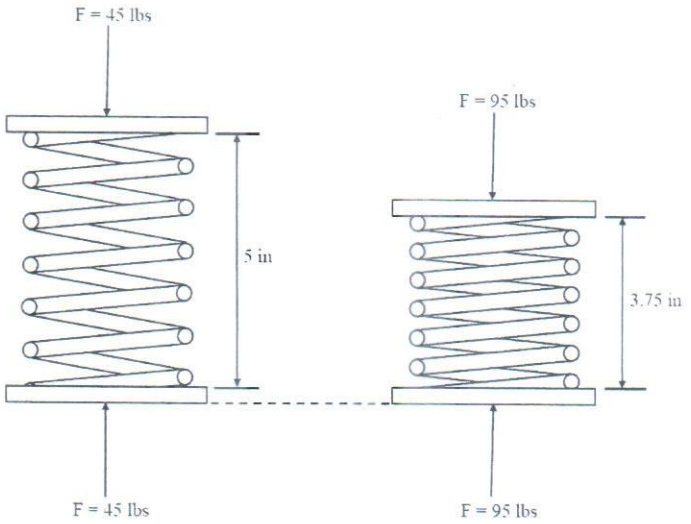

Figure 3

Program: B. Sc. in Mechanical Engineering 29 September 2022 (2:30 – 4:00 pm)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
DEPARTMENT OF MECHANICAL AND PRODUCTION ENGINEERING

Semester Mid-Semester Examination — Winter Semester: 2021 - 2022
Course Number: Hum-4717 — Full Marks: 75
Course Title: Engineering Economy and Finance — Time: 1½ hours

There are 5 **(five)** questions. Answer all of them. Provide cash flow diagram/s whenever applicable. The symbols have their usual meanings. Marks of each question and corresponding CO and PO are written in the brackets. Necessary formulas and interest tables are provided.

1.	Explain the following terms: (a) Product life cycle cost (b) Economic equivalence (c) Minimum Attractive Rate of Return (MARR) (d) Internal Rate of Return (IRR) (e) Discounted payback period	(10) (CO1,2) (PO1)
2.	Panasonic Inc. produces a lithium-ion battery pack that is used in Electric Vehicles (EVs). The fixed cost is BDT1,000,000 per month, and the variable cost is BDT 10,000 per unit. The selling price per unit is p = BDT 20,000 – 2(D). For this situation, (i) determine the optimal volume for maximum revenue and total revenue at this volume (ii) determine the optimal volume for this product for maximum profit; total revenue and profit at this volume (iii) find the volumes at which breakeven occurs (iv) draw demand vs. revenue, fixed cost, and variable cost curve; show volumes for maximum revenue and profit, breakeven points and profit area for this case.	(15) (CO4) (PO2)
3.	Cash flow diagram of a 12-month industrial project (in units of \$1,000,000) is shown in the following figure (Fig Q#3). Assume a nominal interest rate of 12% compounded monthly. Calculate (a) Present equivalent of all investment amounts (cash out flows) (b) Present equivalent of all revenues (cash inflows) (c) Present equivalent of all cash flows	(10) (CO3) (PO3)

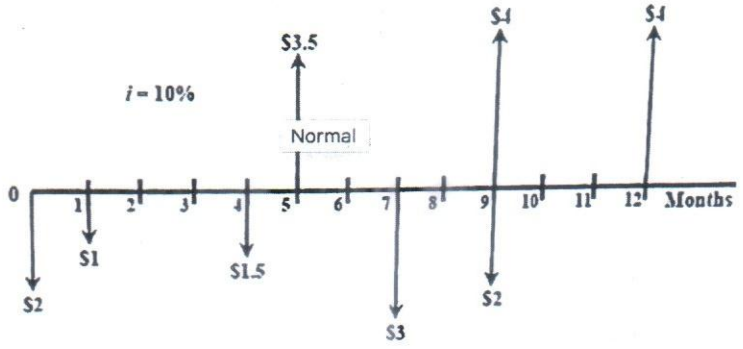

Figure for Q#3

4. (a) Suppose that a $10,000 lump-sum amount is invested for 10 years at a nominal interest rate of 10% compounded quarterly. How much is it worth at the end of the 10th year? (20) (CO4) (PO3)

(b) A mortgage banking company has been evaluating the merits of a 50-year mortgage (in addition to their popular 30-year mortgage). The basic idea is to reduce the monthly payment and make home ownership more affordable. The APR of either mortgage is 10%, and the compounding is monthly. (i) For a mortgage loan of $300,000, what is the difference in the monthly payment for the 30-year mortgage and the 50-year mortgage? (ii) What is the difference in total interest paid between the two mortgages?

5. A company is planning to install a new automated plastic-molding press. Four different presses are available. The initial capital investments and annual expenses for these four mutually exclusive alternatives are as follows: (20) (CO4) (PO3)

	P1	P2	P3	P4
Capital investment	$24,000	$30,400	$49,600	$52,000
Useful life (years)	5	5	10	10
Annual expenses ($):				
Power	2,720	2,720	4,800	5,040
Labor	26,400	24,000	16,800	14,800
Maintenance	1,600	1,800	2,600	2,000
Property taxes	480	608	992	1,040

Assume that each press has the same output capacity (120,000 units per year) and has no market value at the end of its useful life and any additional capital investment is expected to earn at least 10% per year. Which press should be chosen if 120,000 non-defective units per year are produced by each press and all units can be sold? The selling price is $0.5 per unit.

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Program: B. Sc. in Mechanical Engineering | **Date: 30 September, 2022**
Semester: Winter | **Time: 2:30 pm – 4:00 pm**

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
DEPARTMENT OF MECHANICAL AND PRODUCTION ENGINEERING

Semester Mid Examination | **Winter Semester: 2021 - 2022**
Course Number: MCE 4721 | **Full Marks: 75**
Course Title: Manufacturing System and Automation | **Time : 1.5 Hours**

There are 3 **(THREE)** questions. Answer 3 **(THREE)** questions. The symbols have their usual meanings. Marks of each question and corresponding CO and PO are written in the brackets. Answer either Part A or Part B of Question 3. A Formula sheet is provided.

1.	a.	Discuss current realities of manufacturing activities at global perspective.	**(10 Marks)** **(CO 1)** **(PO)**
	b.	Elaborate on significant of Manufacturing System that is a component of Production System to overall performances in production.	**(15 Marks)** **(CO 1)** **(PO)**
2.	a.	As a technical manager of a textile manufacturing company, you are tasked with improving the production efficiency. Suggest and elaborate on FIVE (5) strategies for production improvement via implementation of automation technologies.	**(CO 1)** **(PO 1)** **(15 Marks)**
	b.	Manufacturing companies often attempt to organize its facilities in the most efficient way to serve the particular mission of the plant. Discuss the strategies for production facilities based on product variety and quantity.	**(CO 1)** **(PO 1)** **(10 Marks)**

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3. **ANSWERS EITHER PART A OR PART B**

PART A

a. An automotive part undergoes through six machines in a batch production plant. Table 1 lists the setup and operation times of each machine. Consider a batch size of 200 with average nonoperation time per machine of 6 hours. **(CO 2)** **(PO 2)**

Solve for:

i. Manufacturing lead time. **(10 Marks)**

ii. Production rate for machine 3. **(5 Marks)**

Table 1: Setup time and operation time

Machine	Setup time (hr.)	Operation time (min.)
1	2	5.0
2	4	3.5
3	6	10.0
4	1	1.9
5	2	4.1
6	4	2.5

b. An improvement is made to the previous operation whereby an automated work handling system is used to transfer parts between machines. The transfer time between stations equals 10s while the total time to set up the entire line is 100 hours. Assume that the operation times at the individual machines remain the same. **(CO 2)** **(PO 2)**

Solve for,

i. Manufacturing lead time. **(4 Marks)**

ii. Production rate for machine 3. **(3 Marks)**

iii. Comments on results in (a) and (b). **(3 Marks)**

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PART B

a. A Dhaka Limited Company plans to introduce a new product line. The product line consists of 25 different models. Annual production of each model is expected to be 500 units with each product consists of 100 components. There are an average of 6 processing steps required to produce each component, and each processing step takes 2.0 minute (includes an allowance for setup time and part handling). All processing operations are performed at workstations, each of which includes a production machine and a human worker. Each workstation requires a floor space of 200 m^2, and the factory operates on one shift which is equivalent to 2000 hr/yr. **(CO 2)** **(PO 2)**

Solve for,

i. number of production operations (opt/yr). **(4 Marks)**

ii. number of workers requirement. **(5 Marks)**

iii. floorspace are requirement. **(6 Marks)**

b. A further development on the part design is desired for the production setup in (a). Products are assembled on the single workstations consisting of two workers each. Each final unit of the product will takes 3.0 hours to assemble.

Solve for,

i. number of workers requirement. **(4 Marks)**

ii. floorspace are requirement. **(3 Marks)**

iii. comments on results obtained in (a) and (b) **(3 Marks)**

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FORMULA SHEET

$T_c = T_o + T_h + T_{th}$

$T_b = T_{su} + QT_c$

$R_p = 1/T_p$

$PC_w = n\ S_w\ H_s\ R_p$

$$PC_w = \frac{nS_wH_sR_p}{n_o}$$

$U = Q / PC$

$A = (MTBF - MTTR) / MTBF$

$MLT = n_o\ (T_{su} + QT_c + T_{no})$

(49)

Program: B.Sc. Engg. (ME) 7th Sem / B.Sc.TE 3rd Sem
Semester: Winter semester

Date: 03 October, 2022
(Afternoon)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)

ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF MECHANICAL AND PRODUCTION ENGINEERING

Mid Semester Examination
Course Number: MCE 4729/93
Course Title: Production and Operations Management

Winter Semester: 2021 – 2022
Full Marks: 75
Time: 1.5 Hours

There are **3 (three)** questions. Answer **all** questions. The symbols have their usual meanings. Marks of each question and corresponding CO and PO are written in square brackets. Assume a reasonable value for missing data. Programmable calculators are not allowed.

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1. **(a)** The Instant Paper Clip Office Supply Company sells and delivers office supplies to companies, schools, and agencies within a 50-mile radius of its warehouse. The office supply business is competitive, and the ability to deliver orders promptly is a significant factor in getting new customers and maintaining old ones. (Offices typically order not when they run low on supplies but when they completely run out; as a result, they need their orders immediately.) The company's manager wants to ensure enough drivers and vehicles are available to deliver orders promptly and have adequate inventory in stock. Therefore, the manager wants to be able to forecast the demand for deliveries during the next month. From the records of previous orders, management has accumulated the following data for the past **ten** months: **[10] [CO1] [PO2]**

Month	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.
Orders	120	90	100	75	110	50	75	130	110	90

   i. Compute the monthly demand forecast for April through November using a 3-month moving average.
   ii. Compute the monthly demand forecast for June through November using a 5-month moving average.
   iii. Compute the monthly demand forecast for April through November using a 3-month weighted moving average. Use weights of 0.5, 0.33, and 0.17, with heavier weights in the more recent months.
   iv. Compute the mean absolute deviation for June through October for each method used. Which method would you use to forecast demand for November?

(b) PM Computer Services assembles customized personal computers from generic parts. Formed and operated by part-time UMass Lowell students Paulette Tyler and Maureen Becker, the company has had steady growth since it started. The company assembles computers mostly at night, using part-time students. Paulette and Maureen purchase generic computer parts in volume at a discount from a variety of sources whenever they see a good deal. Thus, they need a good forecast of demand for their computers so that they will know how **[15] [CO1] [PO2]**

many parts to purchase and stock. They have compiled demand data for the last 12 months, as reported below.

Period	Month	Demand	Period	Month	Demand
1	January	37	7	July	43
2	February	40	8	August	47
3	March	41	9	September	56
4	April	37	10	October	52
5	May	45	11	November	55
6	June	50	12	December	54

i. Use exponential smoothing with smoothing parameter $\alpha = 0.3$ to compute the demand forecast for January (Period 13).

ii. Use exponential smoothing with smoothing parameter $\alpha = 0.5$ to compute the demand forecast for January (Period 13).

iii. Paulette believes that there is an upward trend in the demand. Use trend-adjusted exponential smoothing with smoothing parameter $\alpha = 0.5$ and trend parameter $\beta = 0.3$ to compute the demand forecast for January (Period 13).

iv. Compute the mean squared error for each method used and comment on the results.

2. **(a)** An auto parts supplier sells Hardy-brand batteries to car dealers and auto mechanics. The annual demand is approximately 1,200 batteries. The supplier pays \$28 for each battery and estimates that the annual holding cost is 30 percent of the battery's value. It costs approximately \$20 to place an order (managerial and clerical costs). The supplier currently orders 100 batteries per month. **[10] [CO1] [PO2]**

i. Determine the ordering, holding, and total inventory costs for the current order quantity.

ii. Determine the economic order quantity (*EOQ*).

iii. How many orders will be placed per year using the *EOQ*?

iv. Determine the ordering, holding, and total inventory costs for the *EOQ*.

v. How has ordering cost changed? Holding cost? Total inventory cost?

(b) Upon closer inspection, the supplier determines that the demand for batteries is normally distributed with a mean of 4 batteries per day and a standard deviation of 3 batteries per day. (The supplier is open 300 days per year.) It usually takes about 4 days to receive an order from the factory. **[15] [CO1] [PO2]**

i. What is the standard deviation of usage during the lead time?

ii. Determine the reorder point needed to achieve a service level of 95 percent.

iii. What is the safety stock? What is the holding cost associated with this safety stock?

iv. How would your analysis change if the service level changed to 98 percent?

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3. **(a)** An organization is considering two different locations for a new plant. They request a consulting firm to study the sites. In their board meeting, the organization decided that the following five factors may be considered. The consulting firm submitted the result of their study in the table given below. What site will be preferable? **[10] [CO2] [PO3/ PO5]**

Sl. No.	Location Factor	Weight	Score	
			Location 1	Location 2
1.	Facility Utilization	25	3	3
2.	Total load km per month	15	5	5
3.	Average time for delivery	30	4	4
4.	Land and construction costs	20	2	2
5.	Employee preference	10	5	4

(b) You're an analyst for a renowned organization. The organization is considering a new manufacturing plant in Rajshahi, Dhaka, Comilla, or Chittagong. Fixed costs per year are \$30k, \$100k, \$60k, and \$110k, respectively. Variable costs per product are \$45, \$75, & \$35, and \$60, respectively. Identify the range in volume over which each location would be best. If the price per product is \$150, \$120, \$100, and \$90, respectively, and forecast demand per year is 20k, 50k, 30k, and 40k, respectively, then determine the best site. **[15] [CO2] [PO3/ PO5]**

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Program: B.Sc. Engg. (ME)
Semester: 7th Sem.

Date: 30 September 2022
Time: 02:30 pm – 04:00 pm

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF MECHANICAL AND PRODUCTION ENGINEERING

Mid Semester Examination
Course No.: MCE 4787
Course Title: Automobile Engineering

Winter Semester, A. Y. 2021-2022
Time: 1 Hours 30 Min(s)
Full Marks: 75

There are 3 (Three) questions. Answer all the questions.
Marks of each question and corresponding CO and PO are written in the brackets.
Do not write on this question paper.

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1. a) Classify automobile chassis? Briefly explain the different components of an automobile chassis. **(15) (CO1) (PO2)**

   b) Why mixture correction is necessary for a carburetor operation? Explain how you can achieve mixture correction by using an air bleed. **(10) (CO1) (PO2)**

2. a) How a catalytic converter converts the harmful exhaust gases to less toxic mixture of carbon dioxide (CO_2), Nitrogen (N_2) and Water vapors (H_2O) in its different stages. Explain with necessary diagrams and chemical reactions. **(13) (CO1) (PO2)**

   b) It is known that an engine is very powerful for its size if it can produce 100 HP per liter of displacement. However, this efficiency goal is harder to accomplish. To achieve this goal, what are the specific technologies commonly used? Explain any one of them. **(12) (CO1) (PO2)**

3. a) A manual transmission gearbox is shown in Figure 1. Explain the necessary connecting arrangement for achieving different types of speed from this transmission system. **(18) (CO2) (PO2)**

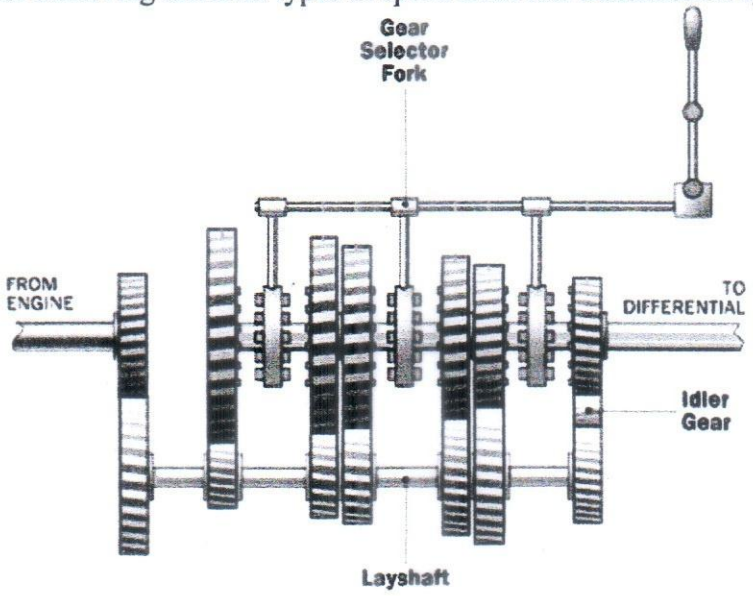

Figure 1

   b) Explain the necessity of synchronizer in the transmission system shown in Figure 1. **(7) (CO2) (PO2)**