

Exercise

Problem 24.1 Prepare the following table incorporating the `\toprule[]`, `\midrule[]`, `\bottomrule[]`, and `\addlinespace[]` commands. It shows the Romberg's integration procedure.

Interval (n)	Step size	$O(h^2)$	$O(h^4)$	$O(h^6)$	$O(h^8)$	$O(h^{10})$
1	h	$I_{1,1}$				
2	$\frac{h}{2}$	$I_{2,1}$	$I_{1,2}$	$I_{1,3}$		
4	$\frac{h}{4}$	$I_{3,1}$	$I_{2,2}$	$I_{2,3}$	$I_{1,4}$	
8	$\frac{h}{8}$	$I_{4,1}$	$I_{3,2}$	$I_{3,3}$	$I_{2,4}$	$I_{1,5}$
16	$\frac{h}{16}$	$I_{5,1}$	$I_{4,2}$			

Problem 24.2 Write the following pseudocode incorporating the `\vline` command. It is the formation of a random permutation of n .

```

subroutine permutation( $n, P$ )
  for ( $i = 1$  to  $n$ ) do
    |  $Q[i] := i$  //  $Q$  is a temporary permutation
  end for
   $q := n$ 
  for ( $i = 1$  to  $n$ ) do // Loop of the positions
    |  $z := \text{rint}(1, q)$  //  $z$  is a random position in  $(1, q)$ 
    |  $P[i] := Q[z]$  // Generate an element of the permutation
    if ( $z < q$ ) then
      | for ( $j = z$  to  $q - 1$ ) do
        | |  $Q[j] := Q[j + 1]$  // Update the temporary permutation
      | end for
      |  $q := q - 1$  // Update the size of the temporary permutation
    endif
  end for
end subroutine

```

Problem 24.3 Prepare the following table incorporating `\tabcolsep`, `\rule{0pt}{}`, and `\noindent`, if required. It shows the weekly lecture schedule of an academic Institute.

	08.00	09.00	10.00	11.00	12.00	14.00	15.00	16.00
M O N	MTH102NBT PHY103NAT PHY102ST PHY103RT	MTH102NA PHY103NB MTH101S MTH101R ESO-II MTH203R	D0 ESO-I(T) CHM201RT	ESC101NT ESC102NT HSS-I	MTH012NB PHY103NA PHY102S PHY102R ESO-I CHM201R	CHM101LabT D2/OE	ESC101N ESC102N	MTH102NAT PHY103NBT MTH101ST MTH101RT ESO-II MTH203RT
T U E		CHM101Lab2 PHY101Lab1 ESC101NLab3 PHY102Lab4 ESO210Lab1		ESC101N ESC102N HSS-I	D2/OE		ESC101NLab5 ESO214Lab1	
W E D		ESC102NLab5 ESO210Lab2		D0 ESO-I CHM201R	MTH102NA PHY103NB MTH101S MTH101R D2/OE	D3/OE	ESO-II MTH203R	HSS-I
T H U		CHM101Lab3 ESC101NLab1 ESC102NLab2 ESO214Lab2		D0 HSS-I	MTH102NB PHY103NA PHY102S PHY102R D3/OE		ESO210Lab3	
F R I		CHM101Lab1 PHY101Lab2 ESC101NLab4 ESC102NLab3 ESO214Lab2		MTH102NBT PHY103NAT PHY102ST PHY102RT D2/OE	ESC101N ESC102N D3/OE	MTH102NA PHY103NB MTH101S MTH101R ESO-I CHM201R	MTH102NB PHY103NA PHY102S PHY102R ESO-I(T) CHM201RT	MTH102NAT PHY103NBT MTH101ST MTH101RT ESO-II MTH203R

Problem 24.4 Prepare the following table incorporating `\tabcolsep`, `\rule{0pt}{}`, `\noindent`, and `\rowcolor{}` as per requirement. It shows the programme and instructor-wise weekly lecture schedule of another academic Institute.

SN	Subject Code and Title	Room	Lecture Timing	Instructor		
1	ME103	Workshop Practice (CSE)	CW	T3.30, F11.30	Z. Kalita S. Kirtania P. Kalita P.P. Dutta1 P.P. Dutta2	
		Workshop Practice (ECE)	CW	T11.30, Th3.30		
		Workshop Practice (ME)	CW	M11.30, W3.30		
		Workshop Practice (FET+ET)	CW	M3.30, Th11.30		
		Workshop Practice (CE)	CW	W11.30, F3.30		
2	ME201	Solid Mechanics	15/DB	M3.30, T11.30, W11.30(T), Th10.30	Z. Kalita P. Haloi S. Banerjee P. Kalita M. Bardalai S. Kirtania	
3	ME202	Fluid Mechanics-I	15/DB	M9.10, T10.30, Th12.30		
4	ME203	Material Science	15/DB	M11.30, W9.10, Th9.10		
5	ME205	Thermodynamics (ME)	15/DB	M10.30, T9.10, Th10.30, F9.10(T)		
6	ME206	Thermodynamics (FET)	16/DB	M12.30, T11.30, Th11.30, F2.30(T)		
		ME Laboratory I	MEL	T2.30, Th2.30		
7	ME301	Dyn. & Vib. of Machinery	11/DB	T2.30, W9.10, Th2.30	S.K. Singh P. Haloi S. Kashyap T.K. Gogoi P.P. Dutta2 SKS, SK2, TKG	
8	ME302	Measurements & Instrumentation	04/DB	T12.30, W12.30, Th10.30		
9	ME303	Manufacturing Technology II	11/DB	W10.30, Th12.30, F9.10		
10	ME304	Applied Thermodynamics I	11/DB	T11.30, W11.30(T), F10.30		
11	ME305	Mechanical Design	11/DB	T10.30, W3.30(T), Th9.10, F12.30		
12	ME310	ME Laboratory III	MEL	M2.30, F2.30		
13	ME401	Industrial Systems Engineering	04/DB	T9.10, W2.30, F12.30		S. Kashyap -
14	ME471	Industrial Summer Training	-	-		
15	ME534	Mechatronics	04/DB	T12.30, W10.30, F9.10		Z. Kalita P.P. Dutta1 P.P. Dutta2 -
16	ME523	Non-Conventional Energy	04/DB	T10.30, W9.10, F11.30		
17	ME529	Artificial Intelligence in Engg.	04/DB	M2.30, T11.30, F10.30		
18	ME481	Project I	-	-		
19	ME501	Advanced Solid Mechanics	01/ME	M3.30, W10.30, W2.30(T), Th10.30	S. Kirtania S. Banerjee D. Datta T.K. Gogoi P. Kalita PPD1, SKS	
20	ME504	Failure Analysis of Materials	02/ME	M10.30, Th12.30, F10.30		
21	ME539	Optimization Techniques in Engg.	02/ME	M12.30, T11.30, F11.30		
22	ME541	Advanced Fluid Mechanics	01/ME	M11.30, T10.30, Th2.30, F12.30(T)		
23	ME543	Compressible Flow	01/ME	M2.30(T), W12.30, Th12.30, F10.30		
24	ME561	Exp. Methods for Solids & Fluids	01/ME	T12.30, T3.30(P), W11.30, W3.30(P), Th11.30		

Problem 24.5 Prepare the following crossword puzzle table incorporating the `\extrarowheight` and `\cellcolor{}` commands.

1		2		3		4		5
6				7				
8					9	10		
				11				
12		13				14		15
16				17				

Problem 24.6 Write the following conditional expression using the `cases` environment.

$$\bar{\delta} = \begin{cases} \left[2r + (1 - 2r) \left(\frac{p_i^{\max} - p_{it}}{p_i^{\max} - p_i^{\min}} \right)^{\eta+1} \right]^{\frac{1}{\eta+1}} - 1, & \text{if } r < 0.5 \\ 1 - \left[2(1 - r) + (2r - 1) \left(\frac{p_{it} - p_i^{\min}}{p_i^{\max} - p_i^{\min}} \right)^{\eta+1} \right]^{\frac{1}{\eta+1}}, & \text{otherwise.} \end{cases}$$

Problem 24.7 Write the following conditional expression using the `array` environment.

$$\left. \begin{array}{l} \text{Necessary condition : } v_j \in T ; \quad \text{if, } X_{ij} = 1 ; Y_{il} = 1 ; Y_{jl} = 0 \\ \quad T \subseteq P_m \\ \quad i, j = 1, 2, \dots, |V| ; i \neq j \\ \quad l, m \in \{1, 2, \dots, K\} ; l \neq m \\ \\ \text{Sufficient condition : } \exists r : X_{ir} = 1 ; \text{ where, } v_i, v_r \in T \\ \quad i = 1, 2, \dots, |V| \\ \quad r \in \{1, 2, \dots, |V|\} ; r \neq i \end{array} \right\}$$

Problem 24.8 Write the following expression using the `array` environment.

$$\left[\begin{array}{ccc|ccc} \text{Coefficients of} & & & \text{Coefficients of} & & \\ \text{Non-basic variables} & & & \text{Basic variables} & & \\ a_{11} & a_{12} & \cdots & a_{1,n-m} & 1 & 0 & \cdots & 0 \\ a_{21} & a_{22} & \cdots & a_{2,n-m} & 0 & 1 & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots & \vdots & \vdots & \ddots & \vdots \\ a_{m1} & a_{m2} & \cdots & a_{m,n-m} & 0 & 0 & \cdots & 1 \end{array} \right] = \left[\begin{array}{c} \text{Resource} \\ \text{limits} \\ b_1 \\ b_2 \\ \vdots \\ b_m \end{array} \right]$$

Problem 24.9 Write the following expression using the `\frac{}` command.

$$a = \frac{b}{1 + \frac{c}{1 + \frac{e}{1 + \frac{f}{1+h}}}} + \frac{1 + \frac{c}{1 + \frac{d}{1 + \frac{e}{1+h}}}}{b}$$

Problem 24.10 Prepare the following problem solving procedure incorporating the **tabbing** environment, and nested **flalign** and **array** environments. You can also use `@{}` for adjusting blank space between two columns.

Given:	$D = 150 \text{ mm},$	$F = 7.5 \text{ kN},$	$K = 75 \text{ N/mm},$
	$G = 81370 \text{ N/mm}^2,$	$\sigma_u = 1250 \text{ N/mm}^2,$	$\tau = 30\% \text{ of } \sigma_u = 375 \text{ N/mm}^2.$

Now, spring index, $C = \frac{D}{d} = \frac{150}{d} \Rightarrow d = \frac{150}{C}$

shear stress, $\tau = K_w \frac{8FC}{\pi d^2} = K_w \frac{8FC}{\pi \left(\frac{150}{C}\right)^2}$

$$\Rightarrow K_w C^3 = \frac{150^2 \pi \tau}{8F} = 441.79$$

$$\Rightarrow \left(\frac{4C-1}{4C-4} + \frac{0.615}{C}\right) C^3 = 441.79$$

$$\Rightarrow C \simeq 7.2$$

$\therefore d = \frac{150}{C} \simeq 21 \text{ mm}$

Also, $K = \frac{Gd^4}{8D^3 N_a}$

$\therefore N_a = 7.81 \simeq 8$

Problem 24.11 Prepare the following page incorporating `\vskip`. Note that the figure is not inserted here as a watermark as discussed in §18.7 on page 177.

'L^AT_EX Learners Team' is a pseudo-name used in this book for illustrative purpose only. The picture used here as the logo of L^AT_EX Learners Team is also fake. Existence of the name or the logo somewhere will be just a coincidence. Such a name and a logo were required while citing some examples in this book, such as the watermarking in §18.7 and the slide preparation in §21.3. It is not fare to use some existing name or logo due to copyright issue. So the author felt better to give a pseudo name along with a fake logo. This is to declare again that 'L^AT_EX Learners Team' is a pseudo-name used in this book for illustrative purpose only. The picture used here as the logo of L^AT_EX Learners Team is also fake. Existence of the name or the logo somewhere will be just a coincidence. Such a name and a logo were required while citing some examples in this book, such as the watermarking in §18.7 and the slide preparation in §21.3. It is not fare to use some existing name or logo due to copyright issue. So the author felt better to give a pseudo name along with a fake logo.

Problem 24.12 Prepare the following two pages with **twocolumn** and **landscape** options incorporating `\hfill`, `\clearpage`, `\newpage`, etc. The value of `enumi` may also be changed. It is a template for two-sided question paper. Upon printing on both side of a page, it will give a two-sided question paper on a half of the page. If reprinted by turning the page, another copy of the question paper can be obtained on the other half of the page.

TEZPUR UNIVERSITY

TU/ME

Spring Semester End Examination :: 2016
ME.537: COMPUTATIONAL METHODS

Full Marks: 60

Time: 2 hours

Answer all questions.

Assume suitable value for any missing data.

1. Answer the following questions in short: [2×6]
- (a) 1(b)–1(e) below show how the heading of a question paper is to be prepared.
 - (b) 1st line: Replace 'ME' by the short name of your department in two or three capital letters.
 - (c) 3rd line: Replace 'Spring' by 'Autumn' if it is Autumn semester, and '2016' by applicable year.
 - (d) 4th line: Replace 'ME537' by your course code, and 'COMPUTATIONAL METHODS' by your course title.
 - (e) 7th line: Delete if not required in your course.
 - (f) While preparing a paper, your questions are to be typed in 1(a)–1(f).

Please turn over...

2. Answer the following questions: [4×3]
- (a) Q. No. 1 and Q. No. 2 show how multiple sub-questions of equal marks are to be prepared under a single main question.
 - (b) Q. No. 3 below shows how multiple sub-questions of unequal marks are to be prepared under a single main question.
 - (c) While preparing a paper, your questions are to be typed in 2(a)–2(c).
- 3.
- (a) Q. No. 4 and Q. No. 5 below show how a single question is to be prepared under an individual number. [1]
 - (b) This is a template for preparing a question paper on the half of an A4-size paper. [1]
 - (c) If your paper needs both side of a page, as shown in this template, print the two pages either in both-side mode or manually on two sides of a single page. [3]
 - (d) Repeat the process described in 3(c) by turning the page. Now cut the page into two parts to get two copies of your question paper. [3]
 - (e) While preparing a paper, your questions are to be typed in 3(a)–3(e). [4]
4. Type your question here [12]
5. Type your question here [12]

~~~~~ Best of Luck ~~~~~

**Problem 24.13** Prepare the following office letter incorporating the `tabularx` environment and `\rule{ }{ }` command.

To  
The Senior Manager  
HRD Division, Regional Steel Pvt. Ltd.

Date: May 10, 2016

**Subject: Report of the committee constituted to enquire the genuineness of the grievances lodged by some employees.**

Ref.: Your Office Letter No. RSPL/HRD/2016/Griv/07, dated April 13, 2016.

Dear Sir

With the reference cited above, this is to inform you that after interacting with various personnel and verifying relevant official records, the Committee could complete the said enquiry well within the stipulated time period of 40 days.

The enquiry steps, findings therein, and recommendation of the committee are summarized in the enclosed report for your kind perusal and subsequent action.

*Copy to:* 1. CMD, RSPL, for information.  
2. Enquiry Cell, RSPL, for record.

*Encl:* As above.

With regards,

---

(Biplab Rana)  
Member

---

(Prabin Singh)  
Member

---

(Rakesh Pratap)  
Coordinator