COLLEGE OF ENGINEERING, PUNE
DEPRTMENT OF MATHEMATICS

Class: S.Y.B.Tech(Metallurgy) **MA225** **MAX. MARKS:50**

END SEMESTER EXAMINATION **Time: 3Hrs**

N.B. 1. Read the instructions carefully.
2. Use of non-programmable calculators is allowed.
3. Answer Each Section **SEPERATELY.**

SECTION I

Q.1)Attempt the following:

(A) Define unbiased estimator and show that S^2 is an unbiased estimator of the parameter σ^2. (3)

(B) Many cardiac patients were implemented pacemakers to control their heartbeat. A plastic connector module mounts on the top of the pacemaker. Assuming a std. dev. Of 0.0015 and an approximate normal distribution; (1) Find a 95% confidence interval for the mean of all connector modules made by a certain manufacturing company. A random sample of 75 modules has an avg. of 0.310 inch. (2) How large a sample is needed in above example if we wish to be 95% confidence that our sample mean will be within 0.0005 inch of the true mean. (4)

OR

(B) A manufacturer of car batteries claims that his batteries will last on average 3 years with a variance of 1 year. If 5 of these batteries have lifetimes of 1.9, 2.4, 3.0, 3.5 & 4.2 years, construct a 90% confidence interval for σ^2 and decide if the manufacturer's claim that $\sigma^2 =1$ is valid. Assume the population of battery lives to be approximately normally distributed.

SECTION –II

Q.2) Attempt the following:

(A) The specific volume of a superheated steam is listed in steam tables for various temperatures. For example, at a pressure of 2950 lb/in^2, absolute :

T ^{0}F	700	720	740	760	780
V	0.1058	0.1280	0.1462	0.1603	0.1703

Determine V at T = 750^{0}F using Newton's backward difference interpolation method. (4)

(B) The specific heats of silica glass at various temperature are as follows

x ^{0}C	100	200	300	400	500
S cal/^{0}C/gm	0.2372	0.2416	0.2460	0.2504	0.2545

Find the rate of change of specific heat with respect to temperature at 120^{0}C using forward difference interpolation method. (4)

(C) The concentration of pollutant bacteria c in a lake decreases according to $c = 70e^{-1.5t} + 25e^{-0.075t}$. Determine the time required for the bacteria concentration to be reduced to 9 using the Newton-Raphson method, correct up to 4 decimal places. (4)

(D) A civil engineer involved in construction requires 4800, 5810 & 5690 m^3 of sand, fine gravel & coarse gravel respectively for a building project. There are three pits from which these materials can be obtained. The composition of these pits (in $1m^3$)is

	Sand	Fine gravel	Coarse gravel
Pit 1	0.52	0.30	0.18
Pit 2	0.20	0.50	0.30
Pit 3	0.25	0.20	0.55

How many cubic meters must be hauled from each pit in order to meet the engineer's needs? Use Gauss Seidel method (do 5 iterations). (5)

Q.3) Rewrite the following sentences with the correct option: (3)

(A) Given $(x_1, y_1), (x_2, y_2), \ldots\ldots\ldots (x_n, y_n)$, best fitting data to $y = f(x)$ by least square requires minimization of $\sum_{i=1}^{n}[y_i - f(x_i)]$, $\sum_{i=1}^{n}|y_i - f(x_i)|$,

$\sum_{i=1}^{n}[y_i - f(x_i)]^2$, $\sum_{i=1}^{n}[y_i - \bar{y}]^2, \bar{y} = \frac{\sum_{i=1}^{n} y_i}{n}$

(B) To solve the ordinary differential equation $3\frac{dy}{dx} + xy^2 = \sin x, y(0) = 5$,

by Runge-Kutta 4[th] order method, you need to rewrite the equation as

$\frac{dy}{dx} = \sin x - xy^2, y(0) = 5$, $\frac{dy}{dx} = \frac{1}{3}(\sin x - xy^2), y(0) = 5$,

$\frac{dy}{dx} = \frac{1}{3}\left(-\cos x - \frac{xy^3}{3}\right), y(0) = 5$, $\frac{dy}{dx} = \frac{1}{3}\sin x, y(0) = 5$,

(C) The following data of the velocity of a body is given as a function of time.

Time (s)	4	7	10	13
Velocity (m/s)	22	24	37	46

The best estimate of the distance in meters covered by the body from $t = 4$ to $t = 13$ using combined Simpson's 3/8 rule would be

282.37, 262.52, 268.30, 278.87

Section III

1. Draw a flow chart for a program that calculates **% carbon** in annealed steel from the **amount of** Phases observed in microstructure.
User should provide information whether the steel is hypo-eutectoid or hyper-eutectoid.
If it is hypo-eutectoid steel, program should ask user to enter amount of **Ferrite** and **Pearlite**.
And if it is hyper-eutectoid steel, program should ask user to enter amount of **Cementite** and **Pearlite**. From above data, Program calculates **% carbon** and prints the output. 4

2. Write a C code for a program that calculates **Yield Strength (σ)** of material having average grain size, **d** and Hall-Petch constant **(k)**.
The Hall-Petch Equation is , $\sigma = \sigma_i + k/\sqrt{d}$, where σ_i is Yield Strength of a Single Crystal. 4

3. If **A** is an integer variable, **A = 13 / 2**; will return a value .... , give reason. 1

4. Explain why following variable are not valid in C,
i) **int** ii) **8_VHN** 1

5. Show the Hierarchy of Operations for expression, **a =12/22*(3.14+2)*3/6;** which evaluates to 2

6. Write the equivalent **if else** statement for the following condition. 2

$$Z > Y ? (G = Z) : (g = Y)$$

7. The expression x = 4 + 2%8 evaluates to......, (Show step by step calculations) 1

8. Write the command line, for SCILAB, to enter following Matrices 3

a. $A = \begin{bmatrix} 1 & 2 & -1 \\ -2 & 7 & 3 \\ 9 & -3 & 4 \end{bmatrix}$ b. $Y = \begin{bmatrix} -1 \\ 3 \\ 4 \end{bmatrix}$ c. $W = \begin{bmatrix} T & T \\ F & F \end{bmatrix}$

9. Write the commands to plot the graphs of following variables, 2
   i) A two dimensional Graph of x and y.
   ii) A three dimensional Graph of A, B and C.

10. In SCILAB, %i stands for 1
%pi stands for ....
%e stands for ....

11. For following command In SCILAB what will be the output 2
   i) For above Matrix A,
   → X=A(5)
   → B=X*3
   ii) → M=zeros(2,2)
   → R=ones(4,4)

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

Table A.5 Critical Values of the Chi-Squared Distribution

v	α									
	0.995	0.99	0.98	0.975	0.95	0.90	0.80	0.75	0.70	0.50
1	0.0^4393	0.0^3157	0.0^3628	0.0^3982	0.00393	0.0158	0.0642	0.102	0.148	0.455
2	0.0100	0.0201	0.0404	0.0506	0.103	0.211	0.446	0.575	0.713	1.386
3	0.0717	0.115	0.185	0.216	0.352	0.584	1.005	1.213	1.424	2.366
4	0.207	0.297	0.429	0.484	0.711	1.064	1.649	1.923	2.195	3.357
5	0.412	0.554	0.752	0.831	1.145	1.610	2.343	2.675	3.000	4.351
6	0.676	0.872	1.134	1.237	1.635	2.204	3.070	3.455	3.828	5.348
7	0.989	1.239	1.564	1.690	2.167	2.833	3.822	4.255	4.671	6.346
8	1.344	1.647	2.032	2.180	2.733	3.490	4.594	5.071	5.527	7.344
9	1.735	2.088	2.532	2.700	3.325	4.168	5.380	5.899	6.393	8.343
10	2.156	2.558	3.059	3.247	3.940	4.865	6.179	6.737	7.267	9.342

Table A.5 (continued) Critical Values of the Chi-Squared Distribution

v	α									
	0.30	0.25	0.20	0.10	0.05	0.025	0.02	0.01	0.005	0.001
1	1.074	1.323	1.642	2.706	3.841	5.024	5.412	6.635	7.879	10.827
2	2.408	2.773	3.219	4.605	5.991	7.378	7.824	9.210	10.597	13.815
3	3.665	4.108	4.642	6.251	7.815	9.348	9.837	11.345	12.838	16.266
4	4.878	5.385	5.989	7.779	9.488	11.143	11.668	13.277	14.860	18.466
5	6.064	6.626	7.289	9.236	11.070	12.832	13.388	15.086	16.750	20.515
6	7.231	7.841	8.558	10.645	12.592	14.449	15.033	16.812	18.548	22.457
7	8.383	9.037	9.803	12.017	14.067	16.013	16.622	18.475	20.278	24.321
8	9.524	10.219	11.030	13.362	15.507	17.535	18.168	20.090	21.955	26.124
9	10.656	11.389	12.242	14.684	16.919	19.023	19.679	21.666	23.589	27.877
10	11.781	12.549	13.442	15.987	18.307	20.483	21.161	23.209	25.188	29.588

Table A.4 (continued) Critical Values of the t-Distribution

v	α					
	0.02	0.015	0.01	0.0075	0.005	0.0025
1	15.894	21.205	31.821	42.433	63.656	127.321
2	4.849	5.643	6.965	8.073	9.925	14.089
3	3.482	3.896	4.541	5.047	5.841	7.453
4	2.999	3.298	3.747	4.088	4.604	5.598
5	2.757	3.003	3.365	3.634	4.032	4.773
6	2.612	2.829	3.143	3.372	3.707	4.317
7	2.517	2.715	2.998	[illegible]	[illegible]	[illegible]