B.Tech. SEM -VII Mechanical 2014 Course (CBCS) : SUMMER - 2019

SUBJECT : ELECTIVE – II : EXPERIMENTAL METHODS IN MECHANICAL ENGINEERING

Day : Wednesday
Date : 15/05/2019

S-2019-2842

Time : 02.30 PM TO 05.30 PM
Max. Marks : 60

N. B. :

1) Solve Q.1 or Q.2, Q.3 or Q.4., Q.5 or Q.6, Q.7 or Q.8., Q.9 or Q.10, Q.11 or Q.12.
2) Figures to the right indicate **FULL** marks.
3) Draw neat and labeled diagrams **WHEREVER** necessary.
4) Assume suitable data, if necessary.

Q. 1 **a)** Name any two first order systems and formulate the governing equation for any one of such system. **(07)**

b) A thermometer immersed in an insulated beaker of fluid is read independently by 24 students. The thermometer has a least scale division of 0.1°C. The mean of the sample of 24 measurements is $\bar{T} = 97.22°C$ and the standard deviation of the sample is $S_T = 0.085°E$. Determine the interval within which we expect, with 95 % confidence (20:10 odds), the mean value of μ_T of the parent population to fall. **(03)**
(Take $t_{95} = 2.069$ at $N = 24$)

OR

Q. 2 **a)** Specify the time domain parameters for the response of step input to second order systems. **(05)**
A second order control system was subjected to step input and the measurements indicated that the system had an overshoot of 10% in a rise time of 0.2 seconds. Make calculations for the effective damping ratio and the undamped natural frequency of the system.

b) Twelve values of the calibration constant of an oxygen bomb calorimeter were determined (in kJ/°C): 1385, 1381, 1376, 1393, 1387, 1400, 1391, 1384, 1394, 1387, 1343 and 1382. Using these data, determine the best estimate of the mean calibration constant with 95% confidence. (Take $t_{95} = 2.201$ at $N = 12$) **(05)**

Q. 3 Use least square regression to fit a straight line to the following experimental data : **(10)**

x	0	2	4	6	9	11	12	15	17	19
y	5	6	7	6	9	8	7	10	12	12

Along with the slop and intercept, compute the standard error of the estimate and the correlation coefficient.

OR

Q. 4 Fit an exponential model to the following experimental data. Also compute the standard error of the estimate and the correlation coefficient: **(10)**

x	0.4	0.8	1.2	1.6	2	2.3
y	800	975	1500	1950	2900	3600

P. T. O.

Q. 5 **a)** Why planning of experiments is necessary before actually performing them? **(05)**

b) What is Taguchi method for Design of Experiments (DOE)? **(05)**

OR

Q. 6 **a)** What are the barriers in successful application of DOE? **(05)**

b) What are the phases in implementation of a practical methodology for DOE? **(05)**

Q. 7 While conducting an experiment *viz.* flow through pipe, following data were obtained: **(10)**

	Parameter	Value	Measurement Uncertainty
i)	Diameter of pipe (d)	0.2 m	± 0.001 m
ii)	Discharge (Q)	0.1 m^3/s	± 0.001 m^3/s
iii)	Density (ρ)	998 kg/m^3	± 2 kg/m^3
iv)	Viscosity (μ)	8.9×10^{-4} kgm^{-1}/s^{-1}	± 0.001×10^{-4} kgm^{-1}/s^{-1}

Following relationship was used while calculating Reynolds number :

$$Re = \frac{4\rho Q}{\pi \mu d}$$

Using partial differentiation method, calculate overall uncertainty in measurement of Reynolds number.

OR

Q. 8 Following data refers to an experimental results for efficiency and power output of LPG stove **(10)**

Experiment No.	Efficiency (%)	Power output (kW)
1	54 %	2.46
2	61 %	2.38
3	57 %	2.40
4	59 %	2.52

Using student's t-test method, find standard deviation in efficiency and power output of the stove at 95 % confidence level.
Use the extract of following t table for t values:

Degree of freedom	t – value at 95 % confidence level
1	6.314
2	2.920
3	2.353
4	2.132
5	2.015

Q. 9 With the help of a neat sketch, explain 'Schlieren Technique' for flow visualization. Give applications of this technique. **(10)**

OR

Q.10 With the help of a neat sketch explain construction, working and applications of a 'Smoke Meter'. **(10)**

Q.11 Name software tools used for making of Data Acquisition System (DAS). Explain how is interfacing of hardware and software done in a typical DAS? **(10)**

OR

Q.12 To develop an experimental set up for trial on a single cylinder petrol engine, suggest instruments for measurement of various quantities. **(10)**
If this experimental setup is to be computerized, what parameters will you consider while selection of DAS?

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