Tanta University

Department: Production and Mechanical Design
Total Marks: 85 Marks

Faculty of Engineering

Course Title: (3 مقرر اختياري) CNC Machines
Date: Jan. 23 th 2022 (First term)

Course Code: MPD4130
Allowed time: 3 hrs

Year: 4th
No. of Pages: (4)

Remarks: (answer the following questions... assume any missing data .. answers should be supported by sketches)

Problem number (1):   (15 Marks)

Choose the correct answer:

1. **BLU is**
   a) Smallest programmable move of each axis.
   b) angular slot cut to top right corner.
   c) Error compensation allows for greater positional accuracy (.0001")

2. **Program of instructions**
   a) Closed loop.
   b) 35 mm motion picture film.
   c) Machine tool.

3. **Controller unit**
   a) Limited logic beyond direct input.
   b) inch-wide punched tape.
   c) Open loop.

4. **Basic components of NC system**
   a) Machine tool or other controlled process.
   b) Starting and stopping of machine tool spindle.
   c) Positioning the tool tip at desired location.

5. **Define of Numerical Control**
   a) Punched cards.
   b) A form of programmable automation in which process is controlled by numbers, letters and symbols.
   c) Machine tool or other controlled process.

6. **CNC Machines Advantages**
   a) Usually generates closer tolerances than manual machines.
   b) Computers, programming knowledge required.
   c) Maintenance is difficult.

7. **CNC Machines Disadvantages**
   a) Easy to change a program.
   b) Costly setup and skilled operators.
   c) Easy storage of existing programs.

8. **Steppers motor:**
   a) Move a set amount of rotation (a step) every time the motor receives an electronic pulse.
   b) Are variable – speed motors produce much more power than an electric motor.
   c) They are used on large CNC machinery system attached.

9. **DC and AC servos:**
   a) Widely used variable – speed motors on small & medium continuous path machines.
   b) A servo does not move a set distance when current is applied the motor starts to turn.
   c) They are used on large CNC machinery system attached.

10. **Hydraulic servos:**
    a) A servo does not move a set distance when current is applied the motor starts to turn.
    b) They are used on large CNC machinery system attached.
   c) Widely used variable – speed motors on small & medium continuous path machines.

1

Problem number (2)   (20 Marks)
Write short notes about:
a) Computer Numerical Control (CNC). (5 Marks)

b) Main differences Between CNC and DNC?   (5 Marks)

c) Basic Categories of Motion System?   (5 Marks)

d) The rapid rate is at 394 in/min (10000 mm/min) for each axis. The motion takes place between the coordinate location X2.36 Y0.787 Z0.2 (start point) and X11.812 Y3.54 Z1.0 (end point). Compute the required time for tool travel along each axis. (5 Marks)

Problem number (3)   (20 Marks)

Raw material is 35 mm diameter and 65 mm length. Write a program to produce the workpiece as shown in Figure below using turning operation, Spindle speed is 200 rev/min and feed rate is 0.3 mm/rev.
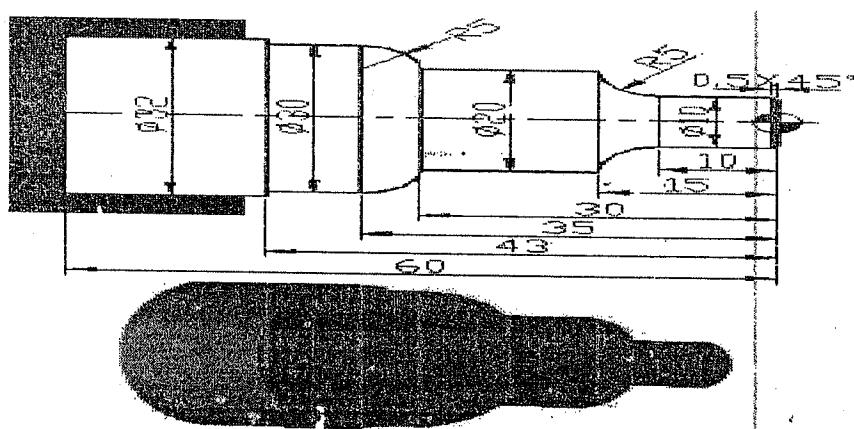
Problem number (4)   (30 Marks)

A raw material dimension is 66X40 mm and 10 mm depth, write a program to produce a workpice as shown below, cutting conditions are speed 180m/min., and feed rate 0.15 mm/rev.

2
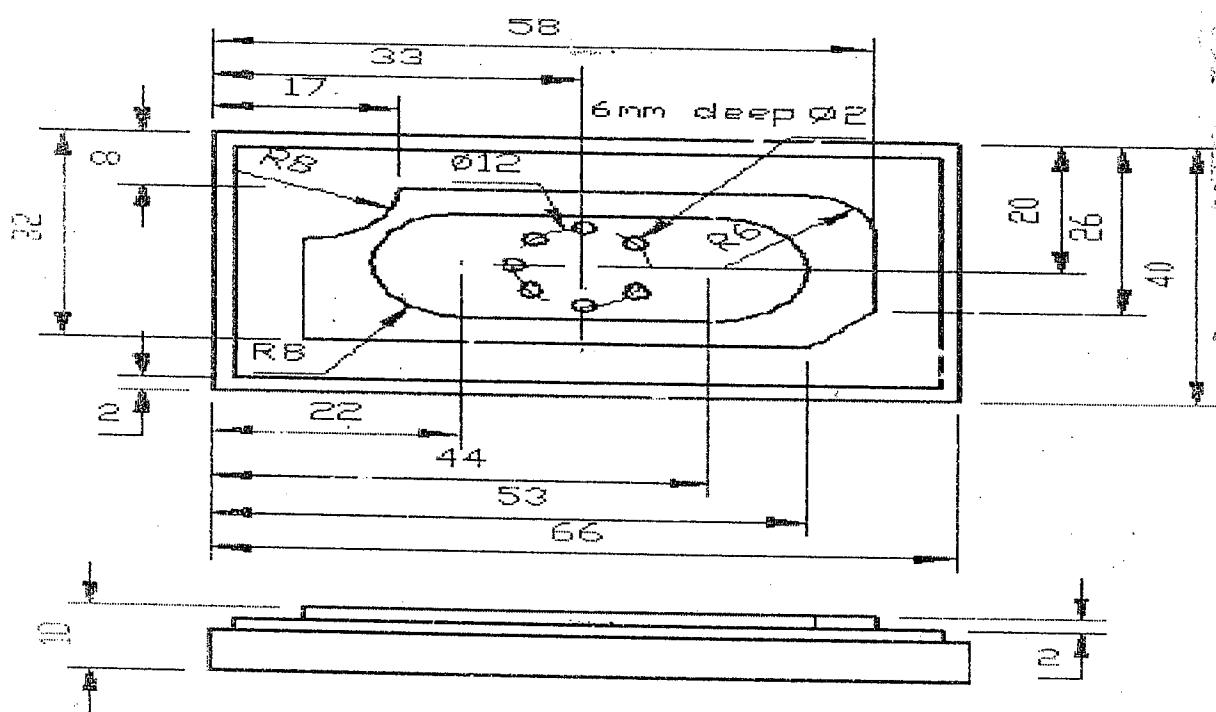
G code list (Lathe)   Description

G code	Description
G00	Rapid traverse
G01	Linear interpolation
G02	Circular interpolation CW
G03	Circular interpolation CCW
G04	Dwell
G09	Exact stop
G10	Programmable data input
G20	Input in inch
G21	Input in mm
G22	Stored stroke check function on
G23	Stored stroke check function off
G27	Reference position return check
G28	Return to reference position
G32	Thread cutting
G40	Tool nose radius compensation cancel
G41	Tool nose radius compensation left
G42	Tool nose radius compensation right
G70	Finish machining cycle
G71	Turning cycle
G72	Facing cycle
G73	Pattern repeating cycle
G74	Peck drilling cycle
G75	Grooving cycle
G76	Threading cycle
G92	Coordinate system setting or max. spindle speed setting
G94	Feed Per Minute
G95	Feed Per Revolution
G96	Constant surface speed control
G97	Constant surface speed control cancel

G code list (Mill)   Description

G code	Description
G00	Rapid traverse
G01	Linear interpolation
G02	Circular interpolation CW
G03	Circular interpolation CCW
G04	Dwell
G17	X Y plane selection
G18	Z X plane selection
G19	Y Z plane selection
G28	Return to reference position
G30	2nd, 3rd and 4th reference position return
G40	Cutter compensation cancel
G41	Cutter compensation left
G42	Cutter compensation right
G43	Tool length compensation + direction
G44	Tool length compensation – direction
G49	Tool length compensation cancel
G53	Machine coordinate system selection
G54	Workpiece coordinate system 1 selection
G55	Workpiece coordinate system 2 selection
G56	Workpiece coordinate system 3 selection
G57	Workpiece coordinate system 4 selection
G58	Workpiece coordinate system 5 selection
G59	Workpiece coordinate system 6 selection
G68	Coordinate rotation
G69	Coordinate rotation cancel
G73	Peck drilling cycle
G74	Left-spiral cutting circle
G76	Fine boring cycle
G80	Canned cycle cancel

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G81	Drilling cycle, spot boring cycle
G82	Drilling cycle or counter boring cycle
G83	Peck drilling cycle
G84	Tapping cycle
G85	Boring cycle
G86	Boring cycle
G87	Back boring cycle
G88	Boring cycle
G89	Boring cycle
G90	Absolute command
G91	Increment command
G92	Setting for work coordinate system or clamp at maximum spindle speed
G98	Return to initial point in canned cycle
G99	Return to R point in canned cycle

M code list(Lathe)	Description
M00	Program stop
M01	Optional program stop
M02	End of program
M03	Spindle start forward CW
M04	Spindle start reverse CCW
M05	Spindle stop
M08	Coolant on
M09	Coolant off
M29	Rigid tap mode
M30	End of program reset
M40	Spindle gear at middle
M41	Low Gear Select
M42	High Gear Select
M68	Hydraulic chuck close
M69	Hydraulic chuck open
M78	Tailstock advancing
M79	Tailstock reversing
M94	Mirrorimage cancel
M95	Mirrorimage of X axis
M98	Subprogram call
M99	End of subprogram

M code List (Mill)	Description
M00	Program stop
M01	Optional program stop
M02	End of program
M03	Spindle start forward CW
M04	Spindle start reverse CCW
M05	Spindle stop
M06	Tool change
M07	Coolant ON – Mist coolant/Coolant thru spindle
M08	Coolant ON – Flood coolant
M09	Coolant OFF
M19	Spindle orientation
M28	Return to origin
M29	Rigid tap
M30	End of program (Reset)
M41	Low gear select
M42	High gear select
M94	Cancel mirror image
M95	Mirror image of X axis
M96	Mirror image of Y axis
M98	Subprogram call
M99	End of subprogram
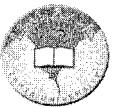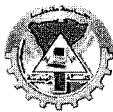
حاول الإجابة على جميع الأسئلة بإختصار وفى نقاط محددة

1. أعقد مقارنة بين كل من طرق انتاج المواد المركبة التالية:
حقن الإسطنبات، كبس الإسطنبات، حقن المتفاعلات، قوالب النقل للمواد الاولية، قوالب النقل للمواد اللاصقة
من حيث: درجة حرارة القالب، ضغط القالب، زمن الانتاج للعينة، ادخال الخامات للقالب، النسبة الطولية، نوع المواد المستخدمة في الإنتاج، استخراج المنتج من القالب، تخريب للألياف، معدل القص عند الكبس.

2. أعقد مقارنة بين كل من اللفلفة الطبقية وسحب الإسطنبات من حيث شكل المنتج، سرعة الإنتاج، قوة شد الألياف، نسبة العامل المساعد، درجة حرارة التصلب، نسبة العيوب في المنتج وسببها، الإستخدام في انتاج المواد المتشبعة، معدل الإنتاج العالمي، عملية الإنتاج مستمرة ام متقطعة.

3. أعقد مقارنة بين كل من المواد المركبة المصنعة من البوليمرات الثابتة حراريا والبوليمرات اللدنة حراريا، **من حيث** سرعة الإنتاج، درجة حرارة الإستخدام، كميات الإنتاج، التكرارية، أقلها ضررا بالبيئة، اقلها تكلفة في إنشاء وحدة الإنتاج، اقلها تكلفة في إنتاج منتج بعينه يمكن إنتاجه بالمادتين، اكثرهما في تحمل الإجهادات، اكثرهما ثباتا مع تغير درجة الحرارة في البعاد، النسبة الطولية، ضغط القالب، مع تأيد اجابتك بطريقة إنتاج والمادة المستخدمة.

4. اذكر بالتفصيل ثلاث طرق لتقسيم المواد المركبة

5. اذكر خمسة طرق يمكن بها إنتاج مواد مركبة ذات ألياف مستمرة.

6. وضح مع الرسم تأثير إضافة مواد تقوية على قاعدة من البوليمرات والمعادن والسراميك

7. قارن مع الرسم بين كل من TMC & SMC من حيث الإنتاج ، شكل الماكينة ، التكلفة للمنتج، التخريب في الألياف، النسبة الطولية، اقصى اجهاد تتحمله المادة، التكرارية، نسبة الحشو، اللزوجة، طول الماكينة، مع ذكر مميزات وعيوب كل منهما

8. اذكر مميزات وعيوب الارتباط الشبكي

9. وضح مع الرسم الفرق بن كل من الدهان اليدوي والرش بالمسدس للقالب المفتوح ومميزات وعيوب كل منهما

10. اقترح طرقة أو اكثر لتصنيع ما يلي بإستخدام المواد المركبة:

قضيب مقطعة مربع	خزان وقود(بنزين) لسيارة	حمام سباحة صغير وآخر كبير
الطائرة الشبح	غطاء مروحة التبريد في السيارة	خزان ماء علوي كبير الحجم
قارب صغير	عربة الغسيل في الفنادق	الغطاء الأمامي للسيارة (الكبوت)
غطاء الريداتير	خزان وقود لسيارة غاز	مواسير ماء ذات القطر الكبير
رفرف السيارة	خزان ماء علوي صغير	عمود إنارة طوله 12متر وقطره 25سم
البنيو	خزان زيت الفرامل	كراسي مترو الأنفاق والمطارات
شاسية كوبري	قضيب على شكل حرف I	غطاء مروحة في مصنع كبيرة قطر 5متر
مواسير البترول	قارب كبير الحجم	الطبقة الداخلية لباب سيارة

مع تمنياتي لكم بالتوفيق أد/عزت شعيب
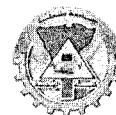
Course Title: Factory planning	Course Code:	Year: 4th
Date: Jan 2022	Allowed time: 3 hrs	No. of Pages: (1)

Remarks: (answer the following four questions… assume any missing data… answers should be supported by sketches…etc)

Problem number (1)   (85 Marks)

Machinery factory produce a special product by using multi machines. The sequence of operations in the production of parts is introduced in Table 1.

Therefore,

a. Use From to Chart to make arrangement of machines inside facility. (**30 Marks**)
b. Make three trials to modify the arrangement and extract MIN total torque. (**30 Marks**)
c. Describe the types of layouts (**10 Marks**)
d. Describe types of charts that makes a control of parts and product production (**15 Marks**)

Table 1

Part No.	Rough stores	L1	L2	L3	M11	M2	M3	G1	G2	D1	D2	SH1	SH2	P SH1	P SH2	FIN
1	5	10		20	40		30	80		50		60				70
2	5		20	10	40		30	60		70	50		90		80	100
3	5	20		40	10	30	90	50	80			60		100	70	110
4	5	60	10		20		80	30		70	40	90	50		100	110
5	5	10		40		30				50			20		60	70
6	5			40	30			20		10						50
7	5		50		40			30		60		20		10	70	80
8	5		40		70	30	60		80	20		10		50		90
9	5		10	50		20		40		30	70			60		80
10	5		20			10			40			50		30		60
11	5			20		30			10	50	70	40			60	80
12	5		60		50		40	10			30	70		80	20	90
13	5	20	10		80	40			70		50		90	60	30	100
14	5	90	30		100	80	20	10		70	40	110	60		50	120
15	5	10		50		30	60			70		20		80	40	90
16	5		50		20			10			40					30

With best wishes

A.M.Elkassas

Tanta University

Department: Production Engineering and design
Total Marks: Marks

Faculty of Engineering
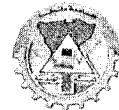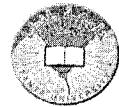
| Course Title: industrial organization | Course Code: | Year: prod 4th |
| Date:Jan 2022 | Allowed time: 3 hrs | No. of Pages: (2) |

Remarks: (answer the following four questions... assume any missing data... answers should be supported by sketches...etc)

Q1: a- In the assembly line, the presented precedence diagram is presented.

Use Ranked positional weight technique to design the assembly line with its work stations

b- Estimate balance delay and

c- Change the cycle time to estimate the number of stations to get the Min balance delay.
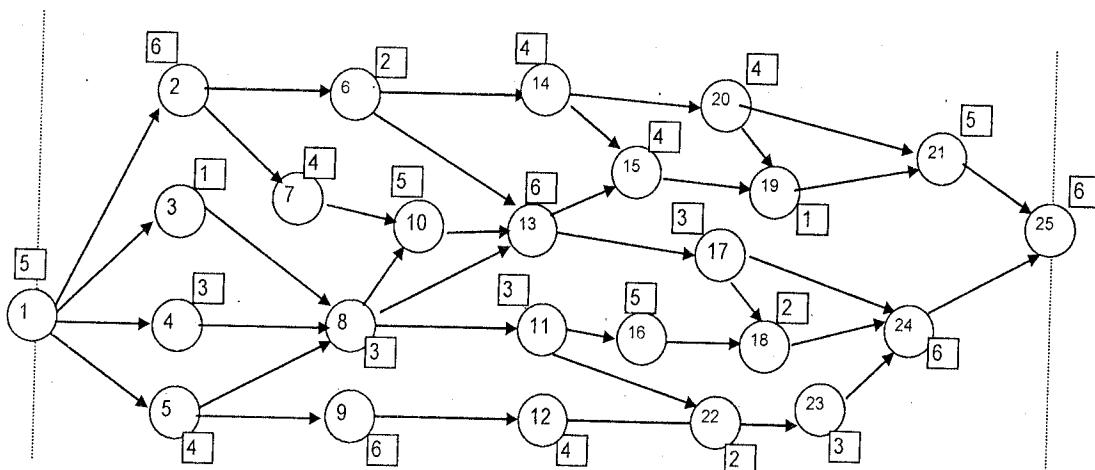
Precedence diagram of an assemply line

Q2: The mobile company is constructing an aggregate plan for the next 12 months. Although several types of mobiles are brewed at the plan and several container sizes are countered, management has decided to use one mobile as the aggregate measure of capacity. The demand for mobile over the next 12 months is forecast to follow the pattern in table -1. Notice how this demand usually peaks in the summer months and is decidedly lower in the winter. The management of the hefty brewery would like to consider three aggregate plans (*Level work force, Level work force plus overtime* and *Chase strategy*). Evaluate these strategies where management has collected the following cost and resource data;

a- Each worker can produce 800 mobile per month on regular time. On overtime, the same production rate is assumed; but overtime can be used for only three months during the year.

1	2
Month	sales forecast (demand)
Jan	200,000
Feb	210,000
Mar	280,000
Apr	400,000
May	300,000
Jun	500,000
Jul	260,000
Aug	400,000
Sep	350,000
Oct	400,000
Nov	250,000
Dec	230,000

b- Each worker is paid 2000 $ per month on regular time. Overtime is paid at 130 percent of regular time. A maximum of 30 percent overtime can be used in any of the four months.

c- It costs 400 $ to hire a worker, including screening costs, paperwork, and training costs. It costs 300 $ to fire a worker, including all severance and benefit costs.

d- For inventory valuation purposes, mobile costs 1.25$ to produce. The cost of carrying inventory is assumed to be 2.7 percent month (or 2.7 cents per mobile per month)

e- Assume the starting inventory is 100,000. The desired ending inventory, a year from now, is also 100,000. all forecasts demand must be met no stock outs are allowed.

With best wishes

Prof. A.M.Elkassas

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تعليمات الامتحان (1):
يجب الإجابة في الأماكن المخصصة فقط مع التقيد بزمن الامتحان (٣) ثلاث ساعات سؤال (١) تجيب عن جميع الأسئلة
من نقطة رقم ١

Question 1: [40 × 1.25 Marks = 50 Marks]

(إجابة سؤال (١) (٤٠) نقطة رقم (٢) (إجابة صحيحة) كل سؤال فردي وورقة الإجابة

1- The highest level of metrology is the .... metrology.
A- scientific   B- legal   C- industrial   D- primary

2- The .... value is the value that would be obtained by perfect measurement.
A- output   B- correct   C- true   D- precise

3- A .... is simply a measure of some attribute of sampled data.
A- point estimate   B- interval estimate   C- confidence interval   D- statistic

4- The uncertainty of a calibrated measuring instrument is .... the uncertainty of the reference standard that used in the calibration.
A- equal to   B- larger than   C- larger than or equal to   D- less than

5- To obtain a confidence level 99.7 %, the used coverage factor k would equal ...., assuming normal distribution.
A- 1   B- 2   C- 2.58   D- 3

6- If the process capability index $C_p = 1$, this means that the process standard deviation σ_p is equal .... of the tolerance.
A- 1/2   B- 1/4   C- 1/6   D- 1/8

7- The effect of measurement .... on accepting/rejecting a product according to its specification and the result of a measurement is considered in its inspection decision rule.
A- uncertainty   B- repeatability   C- reproducibility   D- resolution

8- .... are the magnitudes of the offsets between the tolerance limits and the gauging limits.
A- Specification intervals   B- Tolerance intervals   C- Guard bands   D- Acceptance bands

9- The .... of a measurement result can be achieved through an unbroken chain of comparisons/calibrations.
A- accuracy   B- precision   C- traceability   D- sensitivity

10- Today, there is .... base units in the SI system.
A- 5   B- 6   C- 7   D- 8

11- .... refers to the degree to which the result of a measurement conforms to the true value.
A- Repeatability   B- Reproducibility   C- Realization   D- Accuracy

12- The standard error of the mean is also known as the experimental .... of the mean.
A- standard deviation   B- variance   C- median   D- mode

13- The variability in measurement due to different operators can be considered as relevant to the .... of the measurement.
A- repeatability   B- reproducibility   C- accuracy   D- precision

14- To calculate the resolution standard uncertainty, the resolution error is usually assigned a .... distribution.
A- normal   B- triangular   C- binomial   D- uniform

15- The combined standard uncertainty provides a confidence level ≈ ...., assuming a normal distribution.
A- 68 %   B- 95 %   C- 99 %   D- 99.7 %

16- By increasing the process capability index C_p, the fraction of nonconforming products ....
A- increase   B- decrease   C- remain constant   D- disappear

17- .... is accepting the product in case of the measurement result lies in the specification zone provided that the measurement uncertainty does not exceed a certain fraction of the specification zone.
A- Simple acceptance   B- Relaxed acceptance   C- Conditional acceptance   D- Stringent acceptance

18- If the guard band multiplier h has a positive value, this means that the decision rule includes ....
A- Simple acceptance   B- Relaxed acceptance   C- Conditional acceptance   D- Stringent acceptance

19- Today, the meter is defined in terms of ....
A- Planck constant   B- Avogadro constant   C- Speed of light in air   D- Speed of light in vacuum

20- The least significant digit in a digital readout represents the .... of the measuring instrument.
A- resolution   B- precision   C- accuracy   D- uncertainty

21- As per ISO 1:2016, the dimensional calibrations should be performed at ....
A- 15 °C   B- 20 °C   C- 25 °C   D- 30 °C

22- If the width of the tolerance zone is 0.2 mm and the combined standard uncertainty is 0.02, then the measurement capability index C_m equals ....
A- 10   B- 0.1   C- 5   D- 0.05

23- A simple acceptance and rejection 4:1 decision rule requires the expanded uncertainty to be no larger than .... of the specification zone.
A- 1/2   B- 1/4   C- 1/6   D- 1/8

24- if $T_U = 25.02$ mm, $T_L = 24.98$ mm, and $g = +0.01$ mm; then the width of the acceptance zone is ....

A- 0.01 mm   B- 0.02 mm   C- 0.03 mm   D- 0.04 mm

25- .... is converting the abstract definition into a physical value.

A- Optimization   B- Realization   C- Idealization   D- Reformulation

26- Systematic measurement error is ....

A- constant   B- predictable   C- constant or predictable   D- variable

27- In .... evaluation method, the uncertainty is quantified statistically from repeated observations.

A- Type A   B- Type B   C- Type AB   D- Type C

28- In .... evaluation method, the uncertainty is quantified from any form of available knowledge other than repeated observations.

A- Type A   B- Type B   C- Type AB   D- Type C

29- Large values of measurement capability index C_m means .... measurement uncertainty relative to the tolerance width.

A- large   B- low   C- medium   D- constant

30- Stringent acceptance increases confidence in product quality by .... the probability of accepting an out-of-specification product.

A- reducing   B- increasing   C- stabilizing   D- eliminate

31- To assure conformance probability 85 %, the gauging limits should be offset from the tolerance limits by $g = ... \times U$. ٠٠٠ (من جدول معطى في الامتحان)

A- 0.42   B- 0.52   C- 0.64   D- 0.82

32- Gauge blocks are standards used to obtain SI .... in dimensional metrology.

A- quality   B- repeatability   C- conformance   D- traceability

33- Random measurement errors are usually ....

A- corrected   B- eliminated   C- included in the uncertainty budget   D- ignored

34- The calibration certificate of a measuring instrument is considered as a .... uncertainty source.

A- Type A   B- Type B   C- Type AB   D- Type C

35- Acceptance a product does not necessarily mean its conformance to specification due to ....

A- operator error   B- measurement uncertainty   C- instrumentation drift   D- instrumentation bias

36- Typically, the customer who requests .... acceptance from the supplier.

A- stringent   B- relaxed   C- conditional   D- simple

37- .... standards typically used to calibrate commercial and industrial measurement equipment.

A- Primary   B- Secondary   C- Working   D- Industrial

38- .... is the quotient of the change in an indication of a measuring system and the corresponding change in a value of a quantity being measured.

A- Reading   B- Sensitivity   C- Drift error   D- Resolution error

39- A product may be sold in reduced price if its measured feature lies in the .... zone.

A- stringent acceptance   B- relaxed acceptance   C- relaxed rejection   D- transition

40- One-sided guard-band decision rule is used when the measured feature has ....

A- only an upper tolerance limit   B- only a lower tolerance limit   C- A or B   D- one measurement trial

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Question 2: [40 Marks]

A $\Phi 25^{+0.15}_{-0.15}$ mm precision shaft is manufactured on a CNC-lathe machine at an industrial workshop. At the inspection stage, the final turned diameter was measured at the shop floor using a digital caliper to check its compliance with the specified tolerance. The measurement procedure was repeated 10 times, and the readings were as listed below.

Φ (mm)	1	2	3	4	5	6	7	8	9	10
i	25.03	25.02	24.99	25.00	24.97	25.03	24.98	24.97	25.01	24.98

The following data about the measurement process is known:

- The caliper's resolution is 0.01 mm
- The MPE of the caliper is less than 15 μm over its full range when measuring at 20°C.
- The caliper CTE is in the range $(10 \pm 1) \times 10^{-6}$/°C
- The workpiece CTE is within the range: 7×10^{-6}/°C to 13×10^{-6}/°C
- The workshop temperature is within the range: 14°C to 26°C
- The temperature difference between the caliper and the workpiece is within ± 0.5°C.
- Workpiece form error: Negligible
- No correction is applied to the measurement result.

1) **Estimate:**
   - The measurement result. [4 Marks]
   - Type A uncertainty. [4 Marks]
   - The resolution uncertainty of the caliper. [4 Marks]
   - The calibration uncertainty of the caliper. [4 Marks]
   - The uncertainty due to the differential thermal expansion. [4 Marks]
   - The uncertainty due to the temperature difference between the caliper and the workpiece. [4 Marks]
   - The combined standard uncertainty. [4 Marks]
   - The expanded uncertainty. [4 Marks]

2) **Check if the shaft is accepted based on a 4:1 simple acceptance and rejection decision rule.** *Sketch your answer.* [3 Marks]

3) **Write down the traceability demonstration report of the shaft measurement results as per ASME B89.7.5.** [5 Marks]

Conformance Probability, P_c	Guard Band Multiplier, h
0.80	0.42
0.85	0.52
0.90	0.64
0.95	0.82
0.99	1.16
0.999	1.55

مع تمنياتي لكم بالتوفيق .... أ.د/ أحمد بلال الشرقاوي