1. Choose answer and indicate by writing only the corresponding capital letter (A, B, C, D) as the case may be).

1.1 The manufacturing area of a plat is divided into four quadrants. Four machines have to be located, one in each quadrant. The total number of possible layouts is:

(a) 4 (b) 8 (c) 16 (d) 2

1.2 The function $f(x) = |x+1|$ on the interval $[-2, 0]$ is:

(a) continuous and differentiable
(b) continuous on the integral but not differentiable at all points
(c) neither continuous nor differentiable
(d) differentiable but not continuous

1.3 If $\vec{V}$ is a differentiable vector function and f is a sufficient differentiable scalar function, then curl $(f\vec{V})$ is equal to

(a) $(grad\ f) \times (\vec{V}) + (f\ curl\ \vec{V})$ (b) $\vec{O}$

(c) f curl $(\vec{V})$ (d) $(\text{grade f}) \times (\vec{V})$

1.4 If the demand for an item is doubled and the ordering cost halved, the economic order quantity

(a) remains unchanged (b) increases by a factor of $\sqrt{2}$
(c) is doubled (d) is halved

1.5 In PERT, the distribution of activity times is assumed to be

(a) Normal (b) Gamma (c) Beta (d) Exponential

1.6 Statistical quality control was developed by

(a) Frederick Taylor (b) Water Shewhart
(c) George Dantzing (d) W.E. Deming

1.7 Among the conventional machining processes, maximum specific energy is consumed in

(a) turning (b) drilling (c) planing (d) grinding

1.8 Cutting power consumption in turning can be significantly reduced by

(a) increasing rake angle of the tool

(b) increasing the cutting angles of the tool
(c) widening the nose radius of the tool
(d) increasing the clearance angle

1.9 Plain milling of mild steel plate produces
(a) irregular shaped discontinuous chips
(b) regular shaped discontinuous chips
(c) continuous chips without built up edge
(d) jointed chips

1.10 A fluid is said to be Newtonian when the shear stress is:
(a) directly proportional to the velocity gradient
(b) inversely proportional to the velocity gradient
(c) independent of the velocity gradient
(d) none of the above

1.11 Consider a refrigerator and a heat pump working on the reversed Carnot cycle between the same temperature limits. Which of the following is correct?
(a) COP refrigerator = COP of heat pump
(b) COP refrigerator = COP of heat pump + 1
(c) COP refrigerator = COP of heat pump - 1
(d) COP refrigerator = inverse COP of heat pump

1.12 Constant pressure lines in the superheated region of the Mollier diagram will have
(a) a positive slope (b) a negative slope
(c) zero slope
(d) both positive and negative slope

1.13 A test specimen is stressed slightly beyond the yield point and then unloaded. Its yield strength will
(a) decrease (b) increase (c) remains same
(d) becomes equal to ultimate tensile strength

1.14 A key connecting a flange coupling to a shaft is likely to fail in
(a) shear (b) tension (c) torsion (d) bending

1.15 A frere bar of length l uniformly heated from 0°C to a temperature t°C. α is the coefficient of linear expansion and E is the modulus of elasticity. The stress in the bar is:

(a) α tE (b) α tE/2 (c) zero

(d) None of the above

2. Each blank(.....) is to be suitably filled in using one of the given options. In the answer book write the question number and the answer only. Also, no explanations for the answer are to be given

2.1 The layout with a higher material handling effort is a ..... layout. (product/process)

2.2 Checking the diameter of a hole using GO-NO-GO gauges is an example of inspection by ..... (variables/attributes)

2.3 Machine tool structures are made ..... for high process capability (tough/strong/rigid)

2.4 For planning the procurement or production of dependent demand items, the technique most suitable is..... (MRP/EOQ)

2.5 In fully developed laminar flow in a circular pipe, the head loss due to friction is directly proportional to ..... (mean velocity/square of the mean velocity)

2.6 In adiabatic flow with friction, the stagnation temperature along a streamline ..... (increases/decreases/remains constant)

2.7 In the case of a refrigeration system undergoing an irreversible cycle, $\phi \frac{\delta Q}{T}$ is ..... (<0/=0/>0)

2.8 The shear force in a beam subjected to pure positive bending is ..... (positive/zero/negative)

2.9 In a single degree of freedom vibration system, the undamped natural frequency is ..... to/than the damped natural frequency. (greater than/equal/less)

2.10 An aeroplane makes a half circle towards left. The engine runs clockwise when viewed from the rear. Gyroscopic effect on the aeroplane causes the nose to ..... (lift/dip)

3. State TRUE or FALSE without copying the questions. Give no reason(s) for yo answer.

3.1 The Laplace transform of $\cos \omega t$ is $\frac{w}{\delta^2 + \omega^2}$.

3.2 A differential equation of form $\frac{dy}{dx} = f(x,y)$ is homogeneous if the function $f(x,y)$ depends only on the ration $\frac{y}{x}$ or $\frac{x}{y}$

3.3 Both the live centre and the dead centre of centre lathes are hardened and lubricated for reducing friction and wear.

3.4 Diamond wheels should not be used for grinding steel components.

3.5 Slip gauges are calibrated by outside micrometers.

3.6 Consider a Rankine cycle with superheat. If the maximum pressure in the cycle is increased without changing the maximum temperature and the minimum pressure, the dryness fraction of stream after the isentropic expansion will increase.

3.7 The specific speed of an impulse hydraulic turbine will be greater than the specific speed of a reaction type hydraulic turbine.

3.8 Self locking in power screw is better achieved by decreasing the helix angle and increasing the coefficient of friction.

3.9 Interference in a pair of gears is avoided, if the addendum circles of both the gears intersect common tangent to the base circles within the points of tangency.

3.10 In a four-stroke engine, the secondary imbalance has a frequency equal to four times engine speed.

4. Match 4 correct pairs between List I and List II for question 4.1 through 4.5

4.1

List I	List II
(A) JIT	(1) CRAFT
(B) Computer assisted layout	(2) PERT
(C) Scheduling	(3) Johnson's rule
(D) Simulation	(4) Kanbans
	(5) EQQ rule
	(6) Monte Carlo

4.2

List I	List II
(A) Finish turning	(1) Backlash eliminator
(B) Forming	(2) Zero rake
(C) Thread cutting	(3) Nose reducing
(D) Down milling	(4) Low speed

4.3

List I	List II
(A) Talysurf	(1) T-Slots
(B) Telescopic gauge	(2) Flatness
(C) Transfer calipers	(3) Internal diameter
(D) Autocollimator	(4) Roughness

4.4

List I (Heat Engines)	List II (Cycles)
(A) Gas Turbine	(1) Constant volume heat addition and constant volume heat rejection
(B) Petrol Engine	(2) Constant pressure heat addition and constant volume heat rejection
(C) Sterling Engine	(3) Constant pressure heat addition and constant pressure heat rejection
(D) Diesel Engine	(4) Heat addition at constant volume followed by heat addition at constant temperature
	(5) Heat rejection at constant volume followed by heat rejection at constant temperature

4.5

List I (Gear types)	List II (Applications)
(A) Worm gears	(1) Parallel shafts
(B) Cross helical gears	(2) Non-parallel, intersecting shafts
(C) Bevel gears	(3) Non-parallel, non-intersecting shafts
(D) Spur gears	(4) Large speed ratios

5. Choose the correct answer and indicate by writing only the corresponding capital letter (A, B, C, D as the case may be)

5.1 $\lim_{x\to\infty} \frac{x^3 - \cos x}{x^2 + (\sin x)^2}$ equal

(a) ∞ (b) 0 (c) 2 (d) does not exist

5.2 Among the following, the pair of vectors orthogonal to each other is

(a) $[3,4,7],[3,4,7]$ (b) $[1,0,0],[1,1,0]$

(c) $[1,0,2],[0,5,0]$ (d) $[1,1,1],[-1,-1,-1]$

5.3 The function $f(x) = x^3 - 6x^2 + 9x + 25$ has

(a) a maxima at x = 1 and a minima at x = 3

(b) a maxima at x = 3 and a minima at x = 1

(c) no maxima, but a minima at x = 3

(d) a maxima at x = 1, but no minima

5.4 The solution to the differential equation $f''(x) + 4f'(x) + 4f(x) = 0$ is:

(a) $f_1(x) = e^{-2x}$ (b) $f_1(x) = e^{2x}, f_2(x) = e^{-2x}$

(c) $f_1(x) = e^{-2x}, f_2(x) = e^{-2x}$ (d) $f_1(x) = e^{-2x}, f_2(x) = e^{-x}$

5.5 In the following FORTRAN statements, what is the value of X at exit?

```
      X = 1
DO 10 I = 1, 3, 2
      X = 2 * X ** 2+1
10 CONTINUE
```

(a) 3 (b) 5 (c) 19 (d) 101

5.6 A stop watch time study on an operator with a performance rating of 120 yields a time of 2 minutes. If allowances of 10% of the total available time are to be given, the standard time of the operation is:

(a) 2 minutes (b) 2.4 minutes (c) 2.64 minutes (d) 2.67 minutes

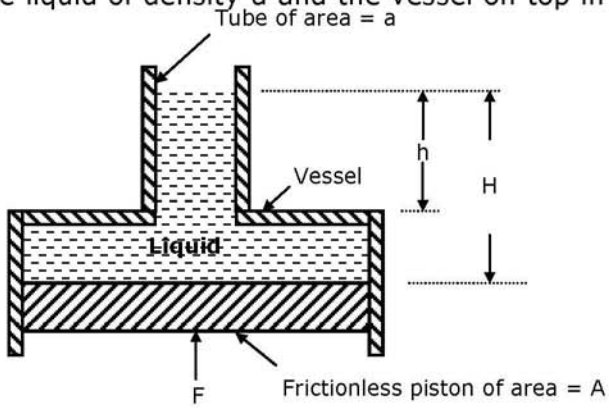
5.7 The force F needed to support the liquid of density d and the vessel on top in the figure below is:

(a) $gd\left[ha-(H-h)A\right]$

(b) gdHA

(c) GdHa

(d) $gd(H-h)A$



5.8 The velocity components in the x and y directions are given by

$$\mu = \lambda xy^3 - x^2 2, v = xy^2 - \frac{3}{4}y^4$$

The value of λ for a possible flow field involving an incompressible fluid is:

(a) $-\frac{3}{4}$ (b) $-\frac{4}{3}$ (c) $\frac{4}{3}$ (d) 3

5.9 One kilomole of an ideal gas is throttled from an initial pressure of 0.5 MPa to 0.1 MPa. The initial temperature is 300 K. The entropy change of the universe is:

(a) 13.38 kJ/K (b) 401.3 kJ/K (c) 0.0446 kJ/K (d) -0.0446 kJ/K

5.10 A heat reservoir at 900 K is brought into contact with the ambient at 300 K for a short time. During this period 9000 kJ of heat is lost by the heat reservoir. The total loss in availability due to this process is:

(a) 18000 kJ (b) 9000 kJ (c) 6000 kJ

(d) None of the above

5.11 In order to burn 1 kilogram of CH_4 completely, the minimum number of kilograms of oxygen needed is (take atomic weights of H, C and O as 1, 12 and 16 respectively).

(a) 3 (b) 4 (c) 5 (d) 6

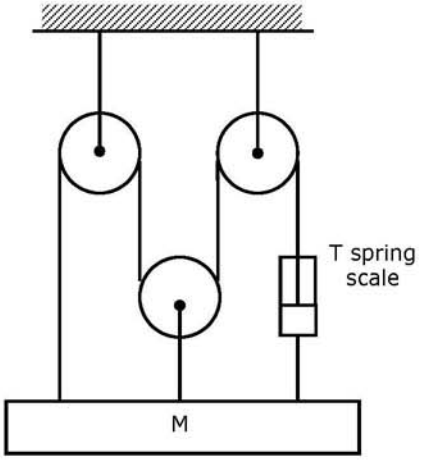
5.12 A spring scale indicates a tension T in the right hand cable of the pulley syste shown in figure below. Neglecting the mass of the pulleys and ignoring friction between the cable and pulley the mass m is:

(a) $\frac{2T}{g}$

(b) $\frac{T\left(1+e^{4\pi}\right)}{g}$

(c) $\frac{4T}{g}$

(d) None of the above



5.13 Figure shows a quick return mechanism. The crank OA rotates clockwise uniformly.

OA = 2 cm

OO = 4 cm

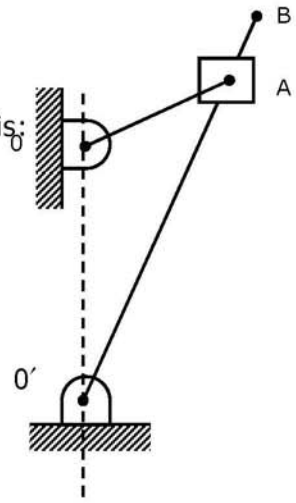
The ratio of time for forward motion to that for return motion is:

(a) 0.5

(b) 2.0

(C) $\sqrt{2}$

(d) 1



5.14 The deflection of a spring with 20 active turns under a load of 1000 N is 10 mm. The spring is made into two pieces each of 10 active coils and placed in parallel under the same load. The deflection of the system is:

(a) 20 mm (b) 10 mm (c) 5 mm (d) 2.5 mm

5.15 The arm OA of an epicyclic gear train shown in figure revolves counter clockwise about O with an angular velocity of 4 rad/sec. Both gears are of same size. The angular velocity of gear C, if the sun gear B is fixed, is:

(a) 4 rad/sec

(b) 8 rad/sec

(c) 10 rad/sec

(d) 12 rad/sec