# Assignment 4

## EE24Btech11024 - G. Abhimanyu Koushik

1) The function $f(t)$ satisfies the differential equation $\frac{d^2 f}{dt^2} + f = 0$ and the auxillary conditions, $f(0) = 0$, $\frac{df}{dt}(0) = 4$. The Laplace transform of $f(t)$ is given by

(ME 2013)

a) $\frac{2}{s+1}$        b) $\frac{4}{s+1}$        c) $\frac{4}{s^2+1}$        d) $\frac{2}{s^4+1}$

2) Specific enthalpy and velocity of steam at inlet and exit of a steam turbine, running under steady state, are as given below:

| | Specific enthalpy $(kJ/kg)$ | Velocity $(m/s)$ |
|---|---|---|
| Inlet steam condition | 3250 | 180 |
| Exit steam condition | 2360 | 5 |

The rate of heat loss from the turbine per $kg$ of steam flow rate is 5 $kW$. Neglecting changes in potential energy of steam, the power developed in $kW$ by the steam turbine per $kg$ of the steam flow rate is

(ME 2013)

a) 901.2        b) 911.2        c) 17072.5        d) 17082.5

3) A steel ball of diameter 60 $mm$ is initially in thermal equilibrium at $1030°C$ in a furnace. It is suddenly removed from the furnace and cooled in ambient air at $30°C$, with convective heat transfer coefficient $h = 20$ $W/m^2 K$. The thermo-physical properties of steel are: density $\rho = 7800$ $kg/m^3$, conductivity $k = 40$ $W/mK$ and specific heat $c = 600$ $J/kgK$. The time required in seconds to cool the steel ball in air from $1030°C$ to $430°C$ is
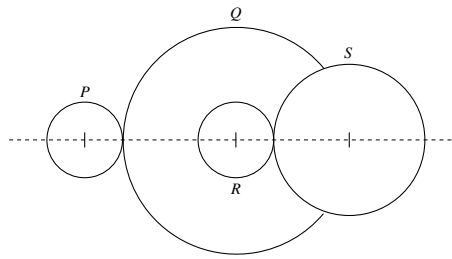
(ME 2013)

a) 519        b) 931        c) 1195        d) 2144

4) A flywheel is connected to a punching machine has a supply energy of 400 $Nm$ while running at mean angular speed of 20 $rad/s$. If the total fluctuation of speed is not to exceed ±2%, the mass moment inertia of the flywheel in $kg - m^2$ is

(ME 2013)

a) 25        b) 50        c) 100        d) 125

5) A compound gear train with gears $P$, $Q$, $R$ and $S$ has number of teeth 20, 40, 15 and 20, respectively. Gears $Q$ and $R$ are mounted on the same shaft as shown in the figure below. The diameter of the gear $Q$ is twice that of the gear $R$. If the module of the gear $R$ is 2 $mm$, the centre distance in $mm$ between the gears $P$ and $S$ is

(ME 2013)

a) 40        b) 80        c) 120        d) 160

6) A pin jointed uniform rigid rod of weight $W$ and length $L$ is supported horizontally by an external force $F$ as shown in the figure below. The force $F$ is suddenly removed. At the instant of force removal, the magnitude of vertical reaction developed at the support is
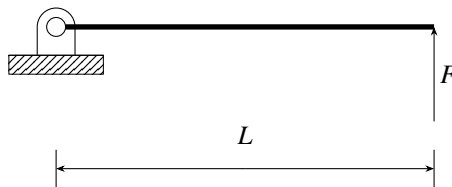


(ME 2013)

a) zero        b) $\frac{W}{4}$        c) $\frac{W}{2}$        d) $W$

7) Two cutting tools are being compared for a machine operation. The tool life equations are:

$$\text{Carbide tool:} \quad VT^{1.6} = 3000$$
$$\text{HSS tool:} \quad VT^{0.6} = 200$$

where $V$ is the cutting speed in $m/min$ and T is the tool life in $min$. The carbide tool will provide higher tool life if the cutting speed in $m/min$ exceeds

(ME 2013)

a) 15.0        b) 39.4        c) 49.3        d) 60.0

8) In a CAD package, mirror image of a 2D point $\mathbf{P}(5, 10)$ is to be obtained about a line which passes through origin and makes an angle $45°$ counterclockwise with the X-axis. The coordinates of transformed point will be

(ME 2013)

a) $(7.5, 5)$        b) $(10, 5)$        c) $(7.5, -5)$        d) $(10, -5)$

9) A linear programming problem is shown below.

$$\text{Maximize} \quad 3x + 7y$$

$$\text{Subject to} \quad \begin{aligned} 3x + 7y &\leq 10 \\ 4x + 6y &\leq 8 \\ x, y &\geq 0 \end{aligned}$$

It has

(ME 2013)

a) an unbounded objective function.

b) exactly one optimal solution.

c) exactly two optimal solutions.

d) infinitely many optimal solutions.

10) Cylindrical pins of $25^{+0.020}_{+0.010}$ *mm* diameter are electroplated in a shop. Thickness of the plate is $30^{\pm2.0}$ *micron*. Neglecting gauge tolerances, the size of the GO gauge in *mm* to inspect the plated components is

(ME 2013)

a) 25.042    b) 25.052    c) 25.074    d) 25.084

11) During the electrochemical machining (ECM) of iron (atomic weight = 56, valency = 2) at current 1000 *A* with 90% current efficiency, the material removal rate was observed to be 0.26 *gm/s*. If the Titanium (atomic weight = 48, valency = 3) is machined by ECM process at the current of 2000 *A* with 90% current efficiency, the expected material removal rate in *gm/s* will be

(ME 2013)

a) 0.11    b) 0.23    c) 0.30    d) 0.52

12) A single degree of freedom system having mass 1 *kg* and stiffness 10 *kN/m* initially at rest is subjected to an impulse force of magnitude 5 *kN* for $10^{-4}$ *seconds*. The amplitude in *mm* if the resulting free vibration is

(ME 2013)

a) 0.5    b) 1.0    c) 5.0    d) 10.0