Assignment 4

EE24Btech11024 - G. Abhimanyu Koushik

1) The function $f(t)$ satisfies the differential equation $\frac{d^2f}{dt^2} + f = 0$ 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 $1030^{\circ}C$ in a furnace. It is suddenly removed from the furnace and cooled in ambient air at $30^{\circ}C$, with convective heat transfer coefficient $h = 20\ W/m^2K$. 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 $1030^{\circ}C$ to $430^{\circ}C$ is

(ME 2013)

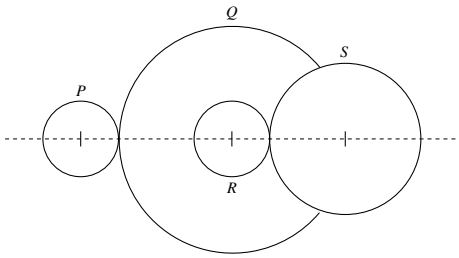
a) 519 b) 931 c) 1195 d) 2144

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 $\pm 2\%$, the mass moment inertia of the flywheel in $kg - m^2$ is

(ME 2013)

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

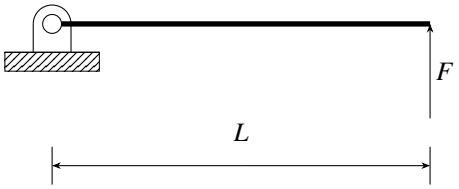
5) A compound gear train with gears P, Q, R and S has number of teeth 20, 40, 15 and 20, respectively. Gears Q and R are mounted on the same shaft as shown in the figure below. The diameter of the gear Q is twice that of the gear R. If the module of the gear R is 2 mm, the centre distance in mm between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

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

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.

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

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 $30^{\pm 2.0}$ *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