Formulas for the exam KPP202

Reliability

$$R(t) = e^{-\lambda t}$$

$$MTBF = \frac{1}{\lambda} \qquad MTBF = \frac{\sum t_{Up}}{n_{CM}}$$

$$MTTR = \frac{\sum t_{CM}}{n_{CM}}$$

$$R(t) = e^{-\lambda t_m} = 0.5$$

$$R_s(t) = \prod_{j=1}^{n} R_j(t) = R_1(t) \cdot R_2(t) \cdot \ldots \cdot R_n(t)$$

$$R_p(t) = 1 - \prod_{j=1}^{n} (1 - R_j(t)) = 1 - (1 - R_1(t)) \cdot (1 - R_2(t)) \cdot \ldots \cdot (1 - R_n(t))$$

R(t) = Reliability

λ = The failure rate of components with an exponentially distributed fault distribution

MTBF = Mean time between failure

t = time

t_{UP} = Operable time

t_m = median time

n = number of occasions

$R_S(t)$ = The reliability of serial systems

$R_P(t)$ = The reliability of parallell systems

$$f = \frac{1}{MTBM_{PM}}$$

$$\overline{M} = \frac{\lambda \cdot \overline{M}_{CM} + f \cdot \overline{M}_{PM}}{\lambda + f} \qquad \overline{M} = \frac{\sum (t_{CM} + t_{PM})}{n_{(CM+PM)}}$$

$$MTBM = \frac{1}{\frac{1}{MTBM_{CM}} + \frac{1}{MTBM_{PM}}}$$

$$MLDT = \frac{\lambda \cdot MLDT_{CM} + f \cdot MLDT_{PM}}{\lambda + f}$$

$$MTW(A) = \frac{\lambda \cdot MTW(A)_{CM} + f \cdot MTW(A)_{PM}}{\lambda + f}$$

$$MTW = MLDT + MTW(A)$$

$$MDT = MTW + \overline{M} \qquad MDT = \frac{\sum (t_W + t_{CM} + t_{PM})}{n_{(CM+PM)}}$$

$$MDT = \frac{\lambda \cdot (MTW(A)_{CM} + MLDT_{CM} + \overline{M}_{CM}) + f \cdot (MTW(A)_{PM} + MLDT_{PM} + \overline{M}_{PM})}{\lambda + f}$$

f = Frequency of preventive maintenanced tasks

MTBM = Mean time between maintenance

$\overline{M}$ = Mean maintenance time

MLDT = Mean logistics downtime

MTW(A) = Meantime waiting, administrative

MDT = Mean downtime

PM = Preventive maintenance

CM = Corrective maintenance

Availability:

$$A_i = \frac{MTBF}{MTBF + MTTR}$$

$$A_a = \frac{MTBM}{MTBM + \bar{M}}$$

$$A_o = \frac{MTBM}{MTBM + MDT} \qquad A_o = \frac{\sum t_{Up}}{\sum t}$$

A_i = Inherent availability

A_a = Achieved availability

A_o = Operative availability

MTTR = Mean time to repair

OEE-calculations:

$$\textbf{Planning factor} = \frac{\textbf{Scheduled work time – planning related stop time}}{\textbf{Scheduled production time}}$$

$$\textbf{Availability} = \frac{\textbf{Planned production time – unplanned stop time}}{\textbf{Planned production time}}$$

$$\textbf{Performance rate} = \frac{\textbf{Bought cycle time x items produced}}{\textbf{Available operative time}}$$

$$\textbf{Quality rate} = \frac{\textbf{Items produced – defect items}}{\textbf{Items produced}}$$

$$\textbf{PfOEE = Pf x A x P x Q}$$

$$\textbf{OEE = A x P x Q}$$

Performance rate when producing products with different cycle times:

$$P = \frac{\sum\left(CT_T \times Q_p\right)}{AOT}$$

P = Performance rate
CT_T = Theoretical cycle time
Q_p = Quantity produced items
AOT = Available operative time