

```

In[24]:=  $\theta_2 = 2;$ 
Q[M_] := Block[{ $\theta_1$ ,  $\theta_2$ , c2, M21, w21},
   $\theta_1 = 5 * \theta_2;$  M21 = M;
  c2 = 2 /  $\theta_2$ ; w21 = 4 M21 /  $\theta_1$ ;

  {{-(w21 + c2), w21, c2, 0, 0, 0, 0},
   {0, -3 * c2, 0, c2, c2, c2, 0},
   {0, 0, -w21, w21, 0, 0, 0},
   {0, 0, 0, -c2, 0, 0, c2},
   {0, 0, 0, 0, -c2, 0, c2},
   {0, 0, 0, 0, 0, -c2, c2},
   {0, 0, 0, 0, 0, 0, 0}}
];

PG1a[ $\tau$ _, M_] := Block[{Esys, U, Evalues, P,  $\theta_1$ ,  $\theta_2$ },
   $\theta_1 = 5 * \theta_2;$ 
  Esys = Eigensystem[Q[M]];
  Evalues = Esys[[1]];
  If[Abs[Evalues[[7]]] > 10-20, Print["eigenvalue 7 is not 0?"]];
  Evalues[[7]] = -1; (* eigenvalues are ordered increasingly, last one is 0. *)
  Evalues = (Exp[Evalues *  $\tau$ ] - 1) / Evalues;
  Evalues[[7]] =  $\tau$ ;
  U = Transpose[Esys[[2]]];
  P = U . DiagonalMatrix[Evalues] . Inverse[U];
  (P[[1, 1]] + P[[1, 2]]) * 2 /  $\theta_2$ 
];

PG1b[ $\tau$ _, M_] := Block[{P},
  P = MatrixExp[Q[M] *  $\tau$ ];
  (P[[1, 1]] + P[[1, 2]]) / 3
];

PG1[ $\tau$ _, M_] := PG1a[ $\tau$ , M] + PG1b[ $\tau$ , M];

```

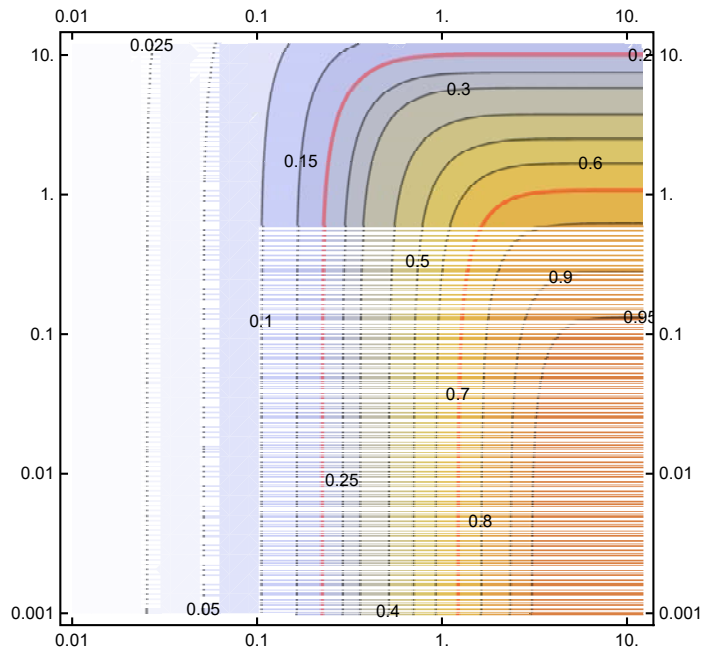
```

In[29]:= b = 10; Mmin = 0.001; Mmax = 12;  $\tau$ min = 0.01;  $\tau$ max = 12;
newStyle[x_] := x /. l_Line  $\Rightarrow$  Sequence[Opacity[.4], Thick, Red, 1]
ContourPlot[(PG1[b^ $\tau$ , b^M] - 1/3) * 3/2,
  { $\tau$ , Log[b,  $\tau$ min], Log[b,  $\tau$ max]}, {M, Log[b, Mmin], Log[b, Mmax]},
  Contours  $\rightarrow$  {0, 0.025, 0.05, 0.1, 0.15, 0.2, 0.25, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 0.95},
  (* ContourStyle  $\rightarrow$  {{Red, Thin}}, *)
  BaseStyle  $\rightarrow$  {FontFamily  $\rightarrow$  "Arial", FontSize  $\rightarrow$  9}, PlotPoints  $\rightarrow$  30,
  ContourLabels  $\rightarrow$  All, ColorFunction  $\rightarrow$  (ColorData[{"BeachColors", "Reverse"}]),
  ContourStyle  $\rightarrow$  Thin, AspectRatio  $\rightarrow$  1,
  (* Frame  $\rightarrow$  False, *)
  FrameTicks  $\rightarrow$  {Table[{ $\tau$ , ToString[Round[b^ $\tau$ ,  $\tau$ min]]}, { $\tau$ , Log[b,  $\tau$ min], Log[b,  $\tau$ max]}],
    Table[{M, ToString[Round[b^M, Mmin]]}, {M, Log[b, Mmin], Log[b, Mmax]}]}
] /. Tooltip[x_, 0.2]  $\Rightarrow$  Tooltip[newStyle[x], 0.2] /.
Tooltip[x_, 0.7]  $\Rightarrow$  Tooltip[newStyle[x], 0.7]

ContourPlot[PG1a[b^ $\tau$ , b^M], { $\tau$ , Log[b,  $\tau$ min], Log[b,  $\tau$ max]}, {M, Log[b, Mmin], Log[b, Mmax]},
  Contours  $\rightarrow$  {0, 0.025, 0.05, 0.1, 0.15, 0.2, 0.25, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 0.95},
  BaseStyle  $\rightarrow$  {FontFamily  $\rightarrow$  "Arial", FontSize  $\rightarrow$  9}, PlotPoints  $\rightarrow$  30,
  ContourLabels  $\rightarrow$  All, ColorFunction  $\rightarrow$  (ColorData[{"BeachColors", "Reverse"}]),
  ContourStyle  $\rightarrow$  Thin, AspectRatio  $\rightarrow$  1,
  (* Frame  $\rightarrow$  False, *)
  FrameTicks  $\rightarrow$  {Table[{ $\tau$ , ToString[Round[b^ $\tau$ ,  $\tau$ min]]}, { $\tau$ , Log[b,  $\tau$ min], Log[b,  $\tau$ max]}],
    Table[{M, ToString[Round[b^M, Mmin]]}, {M, Log[b, Mmin], Log[b, Mmax]}]}
] /. Tooltip[x_, 0.2]  $\Rightarrow$  Tooltip[newStyle[x], 0.2] /.
Tooltip[x_, 0.7]  $\Rightarrow$  Tooltip[newStyle[x], 0.7]

```

Out[31]=



Out[32]=

