channel filled with a hyper porous medium soaked with a rarefied gas. The entropy generation due to heat transfer, fluid friction and magnetic field is evaluated numerically for different values of governing parameters.

Figure 2 shows the effect of magnetic field and velocity slip parameter on the velocity field. It is depicted that due to the intensity of the magnetic field, the fluid velocity is declining gradually. While slip parameter upsurges velocity field. This is quite visible that the fluid has its high velocity in the centre of the circular tube.

It is observed from Figure 3 that an increase in Forchheimer number F reduces the fluid velocity. But this demotion is comparatively large near the centre line. The dimensionless temperature profiles are plotted against r in Figure from 4 to 7. From Figure 4 it is observed that an increment in the temperature slip parameter β supports the magnitude of the temperature while reverse effect is seen due to the enhancement in velocity slip parameter α .

Figure 5 describes that when the Brinkmann number Br and intensity of magnetic field M increase, the fluid temperature rises gradually and this effect is more in the centre line of the channel. From Figure 6 it is predicted that with the increasing of Forchheimer number F, the temperature of the fluid is declining. The effect of radiation parameter on temperature fluid can be seen clearly from Figure 7. The fluid temperature is getting increased due to rise in thermal radiation parameter N. This promotion is comparatively higher on the centre line of the circular channel.

Now Figure 8 to 12 illustrate the effect of various physical parameter on entropy generation rate. From Figure 8 we observed that the entropy generation rate is declining due to increase in the Forchheimer number. While Figure 9 to 11 predict that an increase value of temperature slip parameter β, Brinkmann number Br and Hartmann number M upsurging the entropy generation rate. Figure 12 shows that effect of radiation parameter on entropy generation rate. This is getting increased due to increase of the thermal radiation in the presence of uniform magnetic field.

Figure 13 to 16 reflect the effect of various physical parameter on Bejan number Be . The Bejan number attains its maximum value (i.e., 1) for all value of r . Figure 13 illustrate that Bejan number increases due to an increment in the Brinkmann number. Figure 14 and 15 depict that an increment in the Forchheimer number and Hartmann number raise the value of Bejan number. Figure 16 shows that an increment in the thermal radiation parameter N support the Bejan number.

Table 1 describes that the rate of heat transfers in terms of the Nusselt number rises with an increase of temperature slip parameter β, Brinkmann number Br , Forchheimer number F, viscosity ratio $\mu_{1,}$ Hartmann number M, and radiation parameter N. While it reduces with the increase value of velocity slip parameter α .

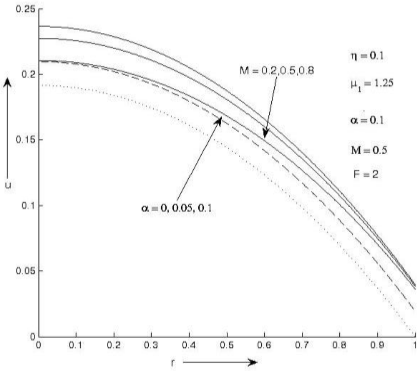

Figure 2. Velocity versus r

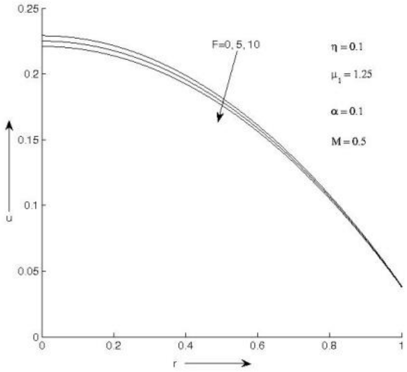

Figure 3. Velocity versus r

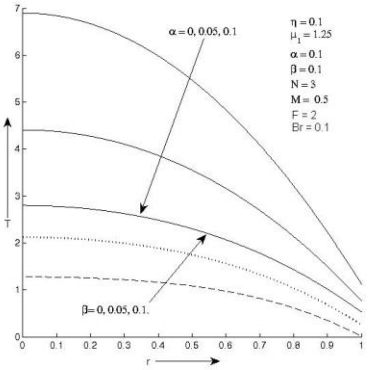

Figure 4. Temperature versus r

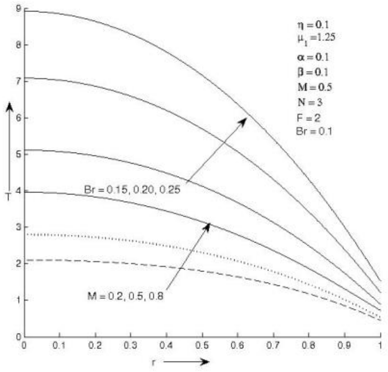

Figure 5. Temperature versus r

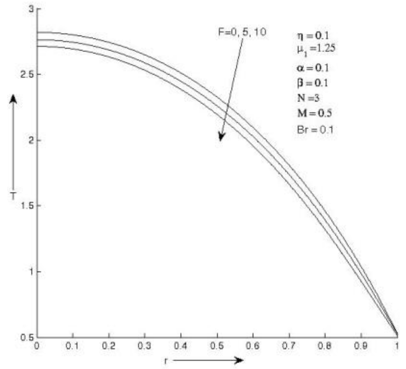

Figure 6. Temperature versus r

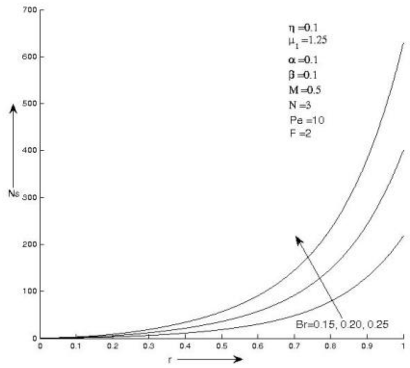

Figure 10. Ns versus r

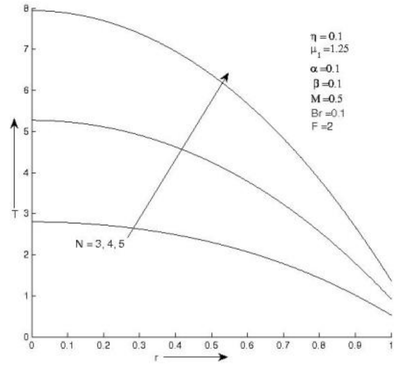

Figure 7. Temperature versus r

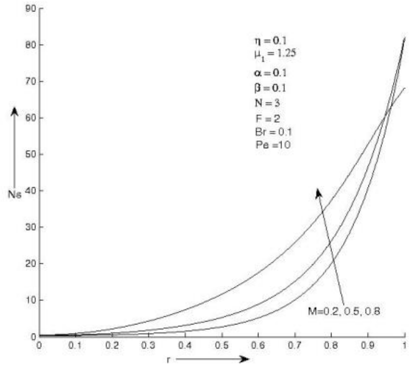

Figure 11. Ns versus r

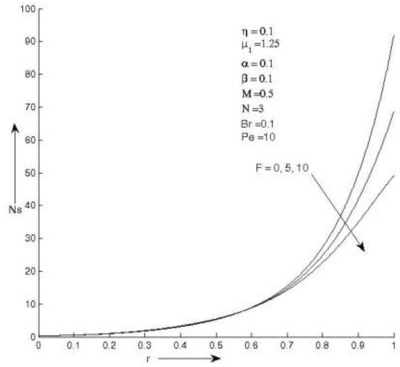

Figure 8. Ns versus r

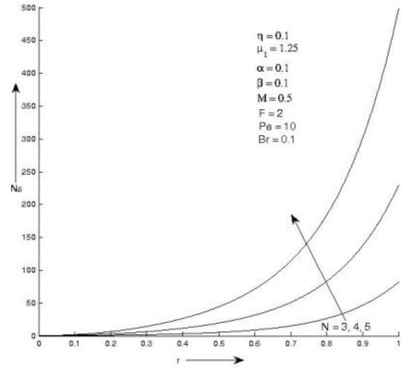

Figure 12. Ns versus r

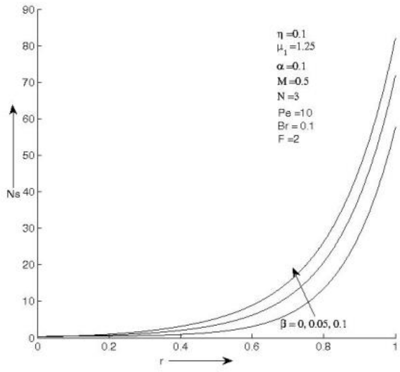

Figure 9. Ns versus r

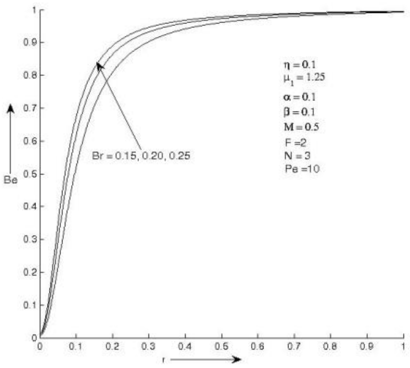

Figure 13. Be versus r

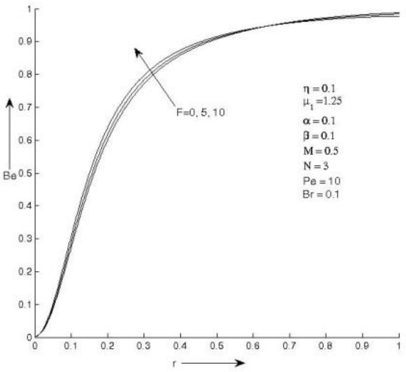

Figure 14. Be versus r

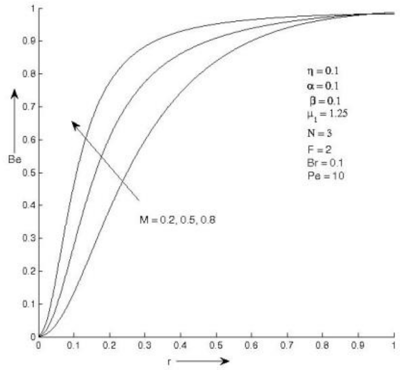

Figure 15. Be versus r

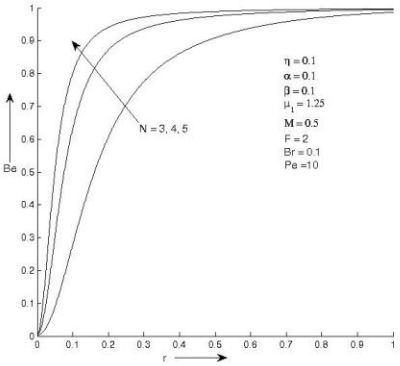

Figure 16. Be versus r

Table 1. Nusselt number (Nu) at wall when $\eta = 0.1$

α	β	Br	F	μ_1	M	N	Nu
0.05	0.05	0.1	2	1.25	0.4	3	0.4023
0.1	0.05	0.1	2	1.25	0.4	3	0.1532
0.05	0.1	0.1	2	1.25	0.4	3	0.4844
0.05	0.05	0.2	2	1.25	0.4	3	1.1044
0.05	0.05	0.1	5	1.25	0.4	3	0.4047
0.05	0.05	0.1	2	2	0.4	3	0.8267
0.05	0.05	0.1	2	1.25	0.5	3	0.4428
0.05	0.05	0.1	2	1.25	0.4	4	0.5295
0.05	0.05	0.1	2	1.25	0.4	5	0.5556

6. CONCLUSIONS

An investigation has been carried out to analyze the entropy generation on forced convective flow of viscous incompressible fluid flow through a circular channel filled with a hyper porous medium in the presence of transverse magnetic field and thermal radiation. The study concludes that

(1) Entropy generation rate is rising due to increase in temperature slip parameter, viscosity ratio, Hartmann number and radiation parameter.

(2) Entropy generation rate is declining due to the presence of velocity slip coefficient, Brinkmann number and Forchheimer number.

(3) The value of the Bejan number is increasing due to the effect of Brinkmann number, Forchheimer number, Hartmann number and radiation parameter.

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NOMENCLATURE

Br	brinkmann number
Be	bejan number
C_p	specific heat, J. kg-1. K-1
Da	darcy number
F	forchheimer number
κ	thermal conductivity, W.m-1. K-1
$\overline{K}$	permeability
M	hartman number
N	radiation parameter
Ns	entropy generation coefficient
Nu	nusselt number
P	negative of applied pressure gradient in $\overline{x}$ direction
Pe	peclet number
q_r	rediative heat flux
R	radius of circular channel
$\overline{r}$	radial coordinate of cylinder
T	dimensionless temperature
$\overline{T}_{mean}$	bulk mean temperature
T_w	temperature at wall
$\overline{u}$	fluid velocity
$\overline{U}_{mean}$	mean velocity

Greek symbols

α	dimensionless velocity slip coefficient
$\overline{\alpha}$	velocity slip coefficient
β	dimensioless temperature slip coefficient
$\overline{\beta}$	temperature slip coefficient
μ	dynamic viscosity, kg. m-1.s-1
μ_{eff}	effective viscosity
μ_1	viscosity ratio
σ	coefficient of electrical consuctivity
ρ	Fluid density
η	porous media shape parameter
ϕ	mean absorption coefficient

Subscripts

w	wall
p	pressure
eff	effective