B. Evaluation

When S has the equation $\phi(x,y,z)=0$ defining $x=x(x,z),\ y=y(z,x),\ z=z(x,y)$ the surface integral (1) is the sum in

$$\int\int_{S_{yz}} P(x(y,z),y,z)\overline{dydz}$$

$$+\int\int_{S_{zx}} P(x,y(z,x),z)\overline{dzdx}$$

$$+\int\int_{S_{xy}} P(x,y,z(x,y))\overline{dxdy} \quad (2)$$

of three double integrals, where S_{yz} for instance is the projection of S onto yz-plane.

When $\phi(x,y,z)=0$ defines z, for instance, as a function of x, y not uniquely, say z_1 and z_2, one evauates surface integral for both surfaces(lower and upper surface).

When the equation of S is given parametrically as

$$x=x(u,v), y=y(u,v), z=z(u,v)$$

,
then by the usual transformations (change of variables) from yz-, zx-, xy-planes to uv-plane, (1) becomes

$$\int\int_{S_1} P(x(u,v),y(u,v),z(u,v))\left|\frac{\partial(y,z)}{\partial(u,v)}\right|\overline{dudv}$$

$$+\int\int_{S_2} Q(x(u,v),y(u,v),z(u,v))\left|\frac{\partial(z,x)}{\partial(u,v)}\right|\overline{dudv}$$

$$+\int\int_{S_3} R(x(u,v),y(u,v),z(u,v))\left|\frac{\partial(x,y)}{\partial(u,v)}\right|\overline{dudv}$$

where S_1,S_2,S_3 are the images of S_{yz},S_{zx},S_{xy} under the transformation.