R & D

Research and Development

R & D CENTER MATHEMATICS:

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Mathematical modeling of Peristaltic Flows through Porous Medium with Heat Transfer

1. The study of peristalsis has received significant attention in the last five decades mainly because of its potential application to the physiological systems. It is a mechanism for fluid transport which is achieved by the passage of progressive waves of area contraction and expansion over flexible walls of a tube containing fluid. Peristalsis appears to be the major mechanism for urine transport in ureter, food mixing and chyme movement in intestines, transport of spermatozoa in the ductus efferentes of the male reproductive organs, movement of egg in female fallopian tubes, motion of spermatozoa in cervical canal and transport of bile in bile duct. Biomedical instruments such as heart lung machine and other mechanical devices like finger pumps and roller pumps use peristalsis to pump blood and slurries etc., the anatomical organization and physiology of ureters, digestive system, male reproductive system and female reproductive system because peristalsis is known to play a very significant role in the transport of physiological fluids in these systems.

2. Peristaltic pumping is a series of coordinated, rhythmic muscle contractions. It is a routine and an imperative process that moves food through the digestive tract, urine from the kidneys through the ureters into the bladder, and bile from the gallbladder into the duodenum. The transport phenomenon created by peristalsis is an interesting problem because of its application in understanding many physiological transport processes through vessels under peristaltic motion. Roller and finger pumps using viscous fluids also operate on this principle. Here the tube is passive but is compressed by rotating rollers, by a series of mechanical fingers or by a nutating plate.

3. The study of the mechanism of peristalsis in both mechanical and physiological situations has recently become the object of scientific research. Several theoretical and experimental attempts have been made to understand peristaltic action in different situations. A summary of most of the experimental and theoretical investigations reported with details of the geometry, fluid Reynolds number, wavelength parameter wave amplitude parameter and wave shape has been given. Many researchers considered the fluid to behave like a Newtonian fluid for physiological peristalsis including the flow of blood in arterioles.

4. Flow through a porous medium has been of considerable interest in recent years particularly among geophysical fluid dynamicists. Examples of natural porous media are

beach sand, standstone, limestone, rye bread, wood, the human lung, bileduct, gall bladder with stones and in small blood vessels. The magnetohydrodynamic (MHD) flow of a fluid in a channel with peristalsis is of interest in connection with certain flow problems of the movement of conductive physiological fluids, (e.g., the blood flow in arteries). Much attention has been limited to symmetric channels or tubes, but there exist also flow situations where the channel flow may not be symmetric, for instance the sagittal cross section of the uterus.

5. Heat transfer analysis can be used to obtain information about the properties of tissues. For example, the flow of blood can be evaluated using a dilution technique. In this procedure, heat is either injected or generated locally and the thermal clearance is monitored. With knowledge of initial thermal conditions and the thermal clearance rate, it is possible to estimate blood flow rates.