In examples, the cell culture cassette receiving area is separate from operational, heating and cooling assemblies of the system.

In examples the cell culture cassette receiving area defines a warm zone that comprises the high velocity warm airflow.

In examples the warm zone comprises substantially homogeneous temperature within the warm zone.

In examples the cell culture cassette receiving area defines a cold zone that comprises the cold airflow, said cold zone positioned beneath the warm zone.

In examples the cold zone comprises a means for reducing or eliminating condensation.

In examples a thermal platform separates the warm zone from the cold zone. In examples, the thermal platform contains seals.

In examples of the disclosure is a method for maintaining a controlled thermal environment for biological processes within a bioreactor module of a cell culture cassette, the method comprising:

directing a first airflow comprising a high velocity warm airflow at and around the bioreactor module, and simultaneously circulating a cold air flow around and through a reagents fluid reservoir operatively connected to the bioreactor module,

wherein said first airflow and said second airflow are separate and cannot intermingle.

According to an example of the disclosure is a cell culture and tissue engineering system comprising a thermal zone architecture for providing a more consistent and controlled environment for facilitating biological processes, wherein the system comprises:

a distinct warm zone compartment that retains a bioreactor module while continuously circulating a high velocity warm airflow path around and directed at and around the bioreactor module; and

a distinct cold zone compartment that retains a reagents fluid reservoir functionally connected to the bioreactor module, while continuously circulating a cold airflow path around and through the reagents fluid reservoir.

In examples, the distinct cold zone compartment further comprises a means for reducing or eliminating condensation.

In examples, the warm zone compartment further comprises a distinct gas environment to that of the cold zone compartment.

According to a further example of the disclosure is an automated system for cell culture and tissue engineering that retains a cell culture cassette in two distinct temperature and gas controlled environments, wherein a biological reactor component of the cassette is

operatively retained in a substantially homogeneous warm airflow zone with controlled gas concentrations, and wherein a reagents fluid reservoir component of the cassette resides in a substantially homogeneous cold airflow zone, wherein the warm airflow zone is distinctly separated from the cold airflow zone, and wherein the cold airflow zone further comprises a means for preventing or eliminating undesirable moisture accumulation therein.

According to a further example of the disclosure is a cell culture and tissue engineering system for receiving and operationally supporting an automated cell culture cassette in a more consistently controlled environment for biological processes, the cell culture cassette comprising a bioreactor module and a reagents fluid reservoir, the system comprising:

a warm zone configured for circulating a warm airflow path surrounding the bioreactor module;

a cold zone configured for circulating a cold airflow path surrounding the reagents fluid reservoir; and

a movable thermal barrier assembly for thermally isolating said warm zone from said cold zone upon installation of the cell culture cassette, and for securing the bioreactor module solely within the warm zone and the reagents fluid reservoir solely within the cold zone.

In another aspect, the present disclosure refers to a cell culture and tissue engineering system for receiving and operationally supporting an automated cell culture cassette for biological processes, the cell culture cassette comprising a bioreactor module and a reagents fluid reservoir, the system comprising:

a warm zone configured to circulate a warm airflow path surrounding the bioreactor module;

a cold zone configured to circulate a cold airflow path surrounding the reagents fluid reservoir; and

a movable thermal barrier assembly having an unlocked, raised position for installing the cell culture cassette, and a locked, lowered position for thermally isolating said warm zone from said cold zone upon installation of the cell culture cassette wherein, when in the locked, lowered position, the movable thermal barrier assembly forms a portion of a lower surface boundary of the warm zone and a portion of an upper surface boundary of the cold zone.

According to a further example of the disclosure is a cell culture cassette comprising:

- a bioreactor module having a bottom part attached with a reagents fluid reservoir;

- the reagents fluid reservoir comprising a fluids bag container having open air ducts located on front and back walls of the reservoir.

In examples, the fluids bag container comprises a roof and floor, the roof comprising baffles extending downwardly.

In examples, the cassette further comprises a layer of thermal insulation positioned in between the bottom of the bioreactor module and the roof of the fluids bag container, said layer of thermal insulation insulating against migration of heat from the bioreactor module.

In examples, the reagents fluid reservoir is attached via port connections positioned on the roof of said fluids bag container and unobstructed by said layer of thermal insulation.

In examples, the reagents fluid reservoir further comprises snap tabs for attaching to the bioreactor module.

According to a further example of the disclosure is a reagents fluid reservoir for connection to a bioreactor module, the reagents fluid reservoir comprising a fluids bag container having open air ducts located on front and back walls of the reservoir.

In examples, the fluids bag container comprises a roof and floor, the roof comprising baffles extending downwardly.

According to an example of the disclosure is an automated cell culture and tissue engineering system for receiving and operationally supporting an automated cell culture cassette in a more consistently controlled environment for biological processes, the cell culture cassette comprising a bioreactor module and a reagents fluid reservoir, the system comprising:

a warm zone configured for circulating a tangential warm airflow path surrounding the bioreactor module;

a cold zone configured for circulating a tangential cold airflow path surrounding the reagents fluid reservoir; and

a movable thermal barrier assembly for thermally isolating said warm zone from said cold zone upon installation of the cell culture cassette, and for securing the bioreactor module solely within the warm zone and the reagents fluid reservoir solely within the cold zone.

In another aspect, the present disclosure refers to an automated cell culture and tissue engineering system for receiving and operationally supporting an automated cell culture cassette for biological processes, the cell culture cassette comprising a bioreactor module and a reagents fluid reservoir, the system comprising:

a housing comprising an outer shell cover and an inner shell body, wherein the outer shell cover encloses a front opening of the inner shell body in an enveloped manner when the system is closed;

a warm zone including a heating assembly configured to circulate a tangential warm airflow path surrounding the bioreactor module;

a cold zone including a cold thermal assembly configured to circulate a tangential cold airflow path surrounding the reagents fluid reservoir; and

a movable thermal barrier assembly having an unlocked, raised position for installing the cell culture cassette, and a locked, lowered position for thermally isolating said warm zone from said cold zone upon installation of the cell culture cassette wherein, when in the locked, lowered position, the movable thermal barrier assembly forms a portion of a lower surface boundary of the warm zone and a portion of an upper surface boundary of the cold zone.

In any of the aforementioned examples, the system and method may comprise one or more controllers and associated software, sensors, and user interface.

Non-limiting examples are as follows:

1A. A cell culture and tissue engineering system comprising two distinct independent thermal airflows, a first airflow comprising a high velocity warm airflow for directing at and around a bioreactor module of a cell culture cassette, and a second airflow comprising a cold airflow for circulating around and through a reagents fluid reservoir operatively connected to the bioreactor module,

wherein said first airflow and said second airflow are separate and cannot intermingle.

1B. The system of item 1A, wherein said first airflow and said second airflow are contained within a cell culture cassette receiving area of said system.

1C. The system of item 1B, wherein said cell culture cassette receiving area defines a warm zone that comprises the high velocity warm airflow.

1D. The system of item 1C, wherein said warm zone comprises substantially homogeneous temperature within the warm zone.

1E. The system of item 1B, 1C or 1D, wherein said cell culture cassette receiving area defines a cold zone that comprises the cold airflow, said cold zone positioned beneath the warm zone.

1F. The system of item 1E, wherein said cold zone comprises a means for reducing or eliminating condensation.

1G. The system of item 1F, wherein a thermal platform separates the warm zone from the cold zone.

Claims:

1. A cell culture and tissue engineering system for receiving and operationally supporting an automated cell culture cassette for biological processes, the cell culture cassette comprising a bioreactor module and a reagents fluid reservoir, the system comprising:

a warm zone configured to circulate a warm airflow path surrounding the bioreactor module;

a cold zone configured to circulate a cold airflow path surrounding the reagents fluid reservoir; and

a movable thermal barrier assembly having an unlocked, raised position for installing the cell culture cassette, and a locked, lowered position for thermally isolating said warm zone from said cold zone upon installation of the cell culture cassette wherein, when in the locked, lowered position, the movable thermal barrier assembly forms a portion of a lower surface boundary of the warm zone and a portion of an upper surface boundary of the cold zone.

2. The cell culture and tissue engineering system of claim 1, wherein said cold zone further comprises a condensation control for minimizing and eliminating undesirable moisture accumulation therein.

3. The cell culture and/or tissue engineering system of claim 1 or 2, wherein said warm zone and said cold zone each comprise a substantially segregated gas environment.

4. The cell culture and tissue engineering system of any one of claims 1-3, said system having a housing comprising an outer shell cover and an inner shell body, wherein the outer shell cover encloses a front opening of the inner shell body in an enveloped manner when the system is closed.

5. The cell culture and tissue engineering system of claim 4, wherein the movable thermal barrier assembly is operationally restrained against an operational robotics interface positioned within the front opening of the inner shell body.

6. The cell culture and tissue engineering system of claim 5, wherein said operational robotics interface is connected to associated internal robotics and comprises valve actuators, peristaltic pumps and related control systems for mating with corresponding connections on the cell culture cassette.

7. The cell culture and tissue engineering system of claims 5 or 6, wherein said movable thermal barrier assembly comprises:

a pair of spaced apart levered arms internally connected at either side of the operational robotics interface that support a central thermal platform with an associated upper handrail.

8. The cell culture and tissue engineering system of claim 7, wherein when in the locked position the central thermal platform comprises part of the lower surface boundary of the warm zone and part of the upper surface boundary of the cold zone.

9. The cell culture and tissue engineering system of any one of claims 4-8, wherein the inner shell body comprises a floor supporting a tray with forward cantilevered ledge that supports part of a bottom surface of the cell culture cassette.

10. The cell culture and tissue engineering system of any one of claims 4-9, wherein a heating assembly is provided in an upper section of the inner shell body, the heating assembly generating warm air directed at the bioreactor module.

11. The cell culture and tissue engineering system of claim 10, wherein the heating assembly comprises a high capacity linear fan operably connected to a heated airflow director to generate and direct a high velocity warm airflow path.

12. The cell culture and tissue engineering system of any one of claims 4-11, wherein a cold thermal assembly in a rear of the inner shell body generates and controls the cold zone airflow path surrounding the reagent fluid reservoir for enhanced reagent stability.

13. The cell culture and tissue engineering system of claim 12, wherein said cold thermal assembly comprises a cold sink array that comprises a plurality of cold sinks compressed with a Peltier device to a hot sink for transfer of heat to the hot sink.

14. The cell culture and tissue engineering system of claim 13, wherein the Peltier device is a Peltier solid-state device comprising an array of spring compression bolts each comprising coil springs, the hot sink acting as a heat conductive path for heat removal.

15. The cell culture and tissue engineering system of claim 14, wherein said Peltier solid-state device functions to pump heat from the plurality of cold sinks to the hot sink for subsequent heat transfer to an ambient environment.

16. The cell culture and tissue engineering system of any one of claims 13-15, wherein each of the plurality of cold sinks of the cold sink array is segmented into functional units comprising a cold sink and associated axial fan.

17. The cell culture and tissue engineering system of any one of claims 13-16, further comprising thermal insulation to inhibit heat from returning to the cold sink from the hot sink.

18. The cell culture and tissue engineering system of claim 2, wherein said condensation control comprises a moisture transport material enclosed within a duct connected to a hot sink, the moisture transport material collecting and moving any condensate that may form and that travels down a cold sink and through to the hot sink where it is evaporated.

19. An automated cell culture and tissue engineering system for receiving and operationally supporting an automated cell culture cassette for biological processes, the cell culture cassette comprising a bioreactor module and a reagents fluid reservoir, the system comprising:

a housing comprising an outer shell cover and an inner shell body, wherein the outer shell cover encloses a front opening of the inner shell body in an enveloped manner when the system is closed;

a warm zone including a heating assembly configured to circulate a tangential warm airflow path surrounding the bioreactor module;

a cold zone including a cold thermal assembly configured to circulate a tangential cold airflow path surrounding the reagents fluid reservoir; and

a movable thermal barrier assembly having an unlocked, raised position for installing the cell culture cassette, and a locked, lowered position for thermally isolating said warm zone from said cold zone upon installation of the cell culture cassette wherein, when in the locked, lowered position, the movable thermal barrier assembly forms a portion of a lower surface boundary of the warm zone and a portion of an upper surface boundary of the cold zone.