SNS COLLEGE OF TECHNOLOGY

(An Autonomous Institution)

COIMBATORE-35

Accredited by NBA-AICTE and Accredited by NAAC – UGC with A++ Grade
Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai

DEPARTMENT OF BIOMEDICAL ENGINEERING

COURSE NAME: 19BMT301/ BIOCONTROL SYSTEMS

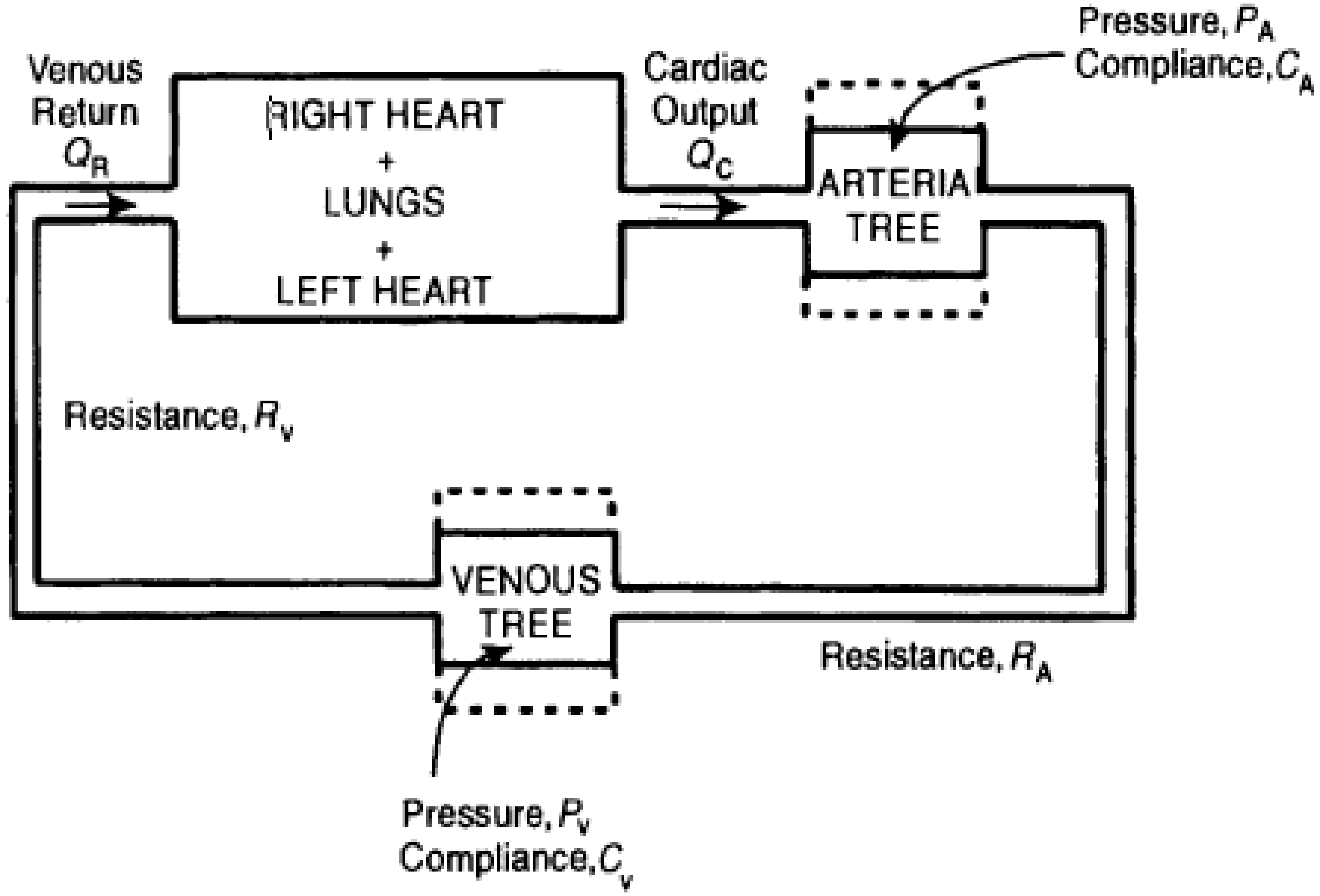
III YEAR / V SEMESTER

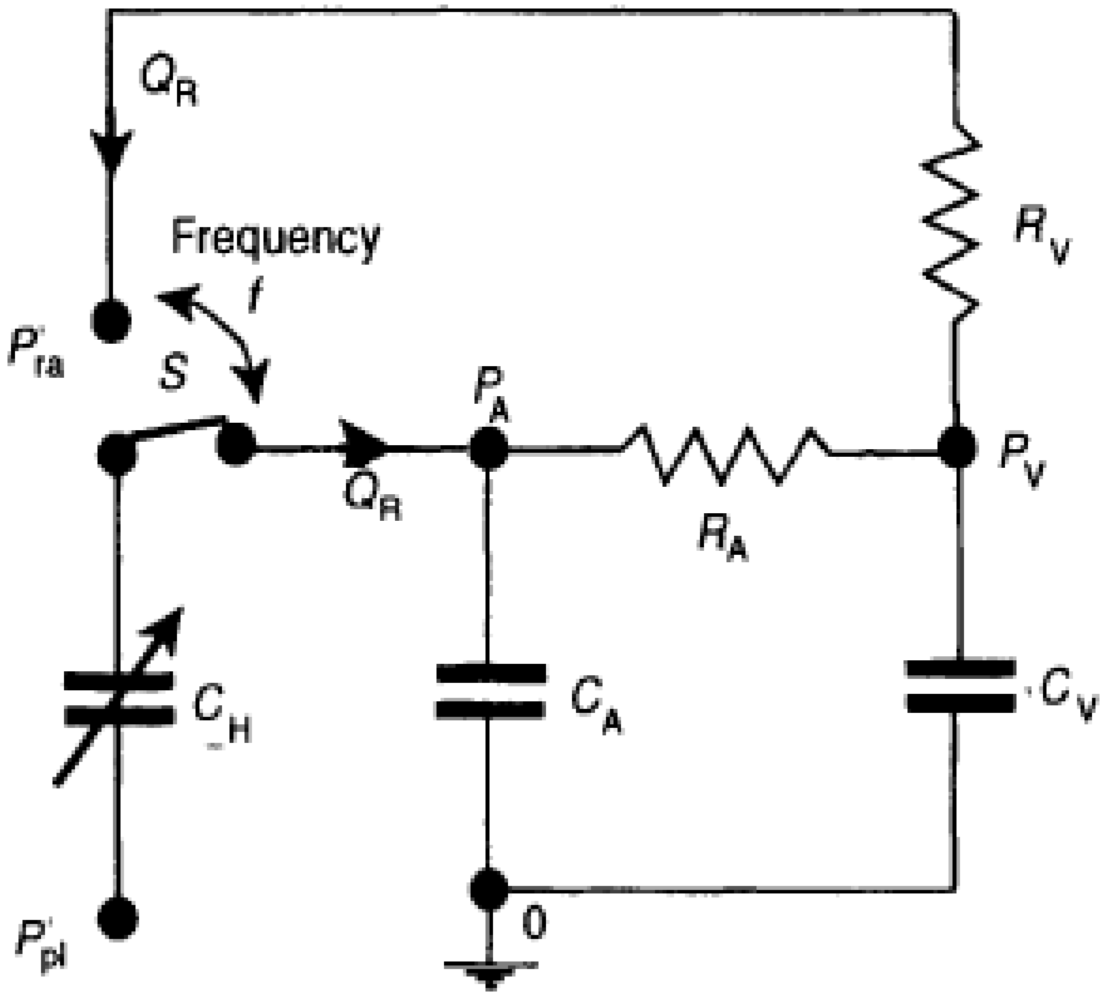
Unit 4 – Modelling of Biological System

Topic 2: Heart Model

Linear Model of Physiological System

•The component that we will label the "heart" actually incorporates the combined functional characteristics of the right heart, the pulmonary circulation, and the left heart.





Heart Model

•The "heart" is modelled by assuming its capacitance, C_H, to vary between two levels. During diastole (the phase of ventricular relaxation), $C_H = C_D$, while during systole (ventricular contraction), C_H = Cs, where C_D is about an order of magnitude larger than Cs.

•During diastole, the heart model is connected to the venous side of the circuit, so that C_H (= C_D) *is "charged up" by the filling pressure, which is equal to the right atrial pressure* (referenced to atmospheric pressure), P_{ra}' *minus the pleural pressure,* P_{pl}

Heart Model

- At the end of diastole, the volume of blood in the heart would be

$$V_{HD} = C_D(P_{ra} - P_{pl})$$

- At the end of systole, the volume of blood in the heart becomes

$$V_{HS} = C_S(P_A - P_{pl}) \approx C_S P_A$$

- The difference between the end-diastolic volume and the end-systolic volume is the amount of blood ejected in one beat, i.e., the stroke volume, *SV:*

$$SV = V_{HD} - V_{HS} = C_D(P_{ra} - P_{pl}) - C_S P_A$$

- But the volume of blood pumped out in each beat multiplied by the number of beats that occurs per unit time (f), i.e., the heart rate, must equal the cardiac output, *Qc*

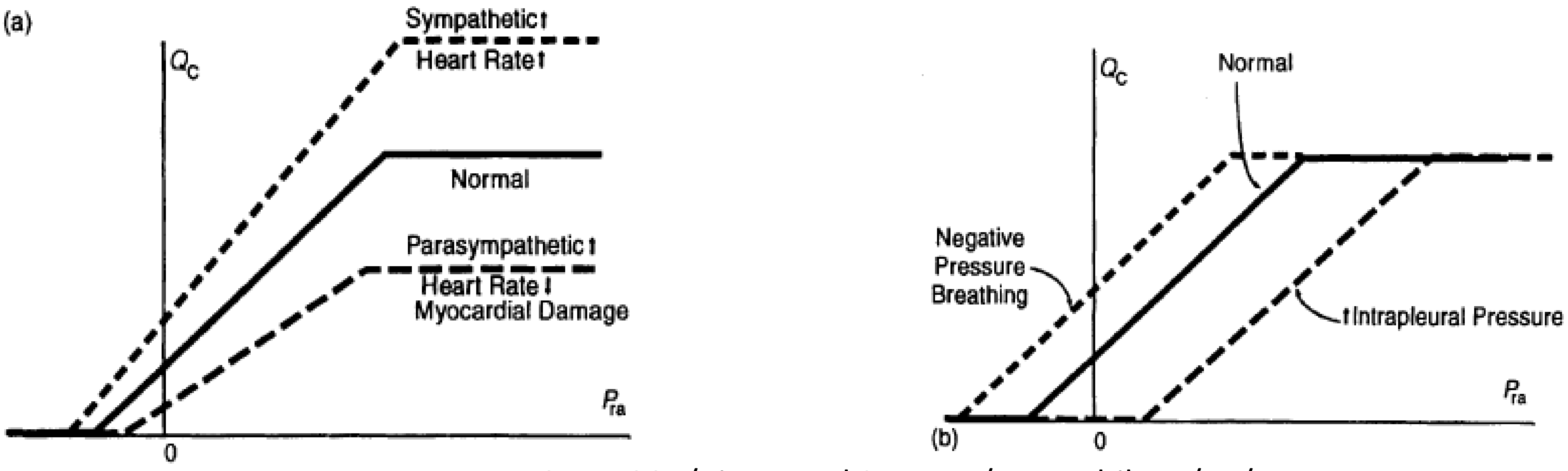
$$Q_C = SV \cdot f \qquad Q_C = f C_D\left(P_{ra} - \frac{C_S P_A}{C_D} - P_{pl}\right)$$

Heart Model

- The threshold limitation on *Qc is given by*

$$Q_C \le Q_{C_{max}} = f C_D \left(P^*_{ra} - \frac{C_S P_A}{C_D} - P_{pl} \right)$$

- P^*_{ra} is the value of P_{ra} above which Qc cannot increase any further.



KEEP

LEARNING..

Thank u

SEE YOU IN NEXT CLASS