Review

1. ***Key concepts***

   - **systems, dynamic systems, linear systems,**
   - **modeling, mathematical model**
   - **analysis, design, synthesis**

2. ***Laplace Transform***

   - **Laplace Transform review**

3. ***Mathematical Model of Dynamic Systems***

   - **Mechanical Systems**
   - **Electrical Systems**
   - **Fluid Systems and Thermal Systems,** Hydraulic Servo System

(3. *Mathematical Model of Dynamic Systems*)

- Newton's laws
- spring, mass, damper, friction
- Energy Method
- Linearization of nonlinear systems

- Kirchhoff's laws
- resistor, inductor, capacitance
- Operational Amplifiers
- Complex Impedance
- DC Servo Motors

4. ***Transfer Function Approach to Modeling Dynamic Systems***

- **Closed Loop Transfer Function**
- **Transient Response Analysis with MATLAB**
- **Step input response, Ramp input, Impulse response**

5. ***Mathematical Modeling of Dynamic System in State Space***

- **states, state space, state equations**
- **matrix exponential**
- **state transition matrix**
- **solution of state equation**
- **state transformation, diagonalization / Jordan Canonical Form**

6. *Linear System Analysis in Time Domain*

- First order systems, time constant
- second order systems, natural frequency, damping ratio
- higher order systems
- characteristic equations, characteristic roots, complex poles
- transient response

7. *Frequency Response*

- definition: Steady State Frequency Response
- unit step response versus frequency response
- Bode Plot
- Vibration Isolation in Rotating Systems
- Transmissibility
- dynamic vibration absorber
- seismograph / accelerometer

System Control (next semester)

1. **System control: Key issues in control systems**

   - **stability**
   - **performance:**
     - **Command tracking**
     - **Disturbance rejection**

   - **robustness**
     - **stability robustness**
     - **performance robustness**

2. **control system representation**
   - **transfer function**
   - **state equations**
   - **graphical representation: block diagram, signal flow graph**

3. **Stability**

   - **equilibrium**
   - **stability definition**
   - **stability of LTI systems**
   - **stability tests**

System Control (next semester)

4. Controller design

- feedback control systems (closed-loop control systems)
- Root Locus method: pole placement
- Frequency Response method : lead/lag compensators
- analysys and design Using MATLAB
- control system simulation using MATLAB/SIMULINK

- PID Control
- state space method