# NPTEL Syllabus

## Virtual Reality - Video course

### COURSE OUTLINE

Fundamentals of virtual reality systems, including geometric modeling, transformations, graphical rendering, optics, the human vision, auditory, and vestibular systems, interface design, human factors, developer recommendations, and technological issues.

### COURSE DETAIL

<table>
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<tr>
<th>Module No:</th>
<th>Topic</th>
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| **Module I:** Introduction | 1. Course mechanics  
2. Goals and VR definitions  
3. Historical perspective  
4. Birds-eye view (general)  
5. Birds-eye view (general), contd  
6. Birds-eye view (hardware)  
7. Birds-eye view (software)  
8. Birds-eye view (sensation and perception) |
| **Module II:** Geometry of Virtual Worlds | 9. Geometric modeling  
10. Transforming models  
11. Matrix algebra and 2D rotations  
12. 3D rotations and yaw, pitch, and roll  
13. 3D rotations and yaw, pitch, and roll, contd  
14. Axis-angle representations  
15. Quaternions  
16. Converting and multiplying rotations  
17. Converting and multiplying rotations, contd  
18. Homogeneous transforms  
19. The chain of viewing transforms  
20. Eye transforms  
21. Eye transforms, contd  
22. Canonical view transform  
23. Viewport transform  
24. Viewport transform, contd |
| **Module III:** Light and Optics | 25. Three interpretations of light  
26. Refraction  
27. Simple lenses  
28. Diopeters  
29. Imaging properties of lenses |

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Pre-requisites:
Basic maths and exposure to engineering

Additional Reading:
- Doug A. Bowman, Ernst Kruijff, Joseph J. LaViola, and Ivan Poupyrev, 3D User Interfaces, Addison-Wesley, 2005.

Coordinators:
Prof Steven LaValle  
IITM & UIUC
| Module IV: Visual Physiology | 30. Lens aberrations  
31. Optical system of eyes |
|----------------------------|------------------------|
| Module V: Visual Perception | 32. Photoreceptors  
33. Sufficient resolution for VR  
34. Light intensity  
35. Eye movements  
36. Eye movements, contd  
37. Eye movement issues for VR  
38. Neuroscience of vision |
|----------------------------|------------------------|
| Module VI: Tracking Systems | 39. Depth perception  
40. Depth perception, contd  
41. Motion perception  
42. Frame rates and displays  
43. Frame rates and displays contd |
|----------------------------|------------------------|
| Module VII: Visual Rendering | 44. Overview  
45. Orientation tracking  
46. Tilt drift correction  
47. Yaw drift correction  
48. Tracking with a camera  
49. Perspective n-point problem  
50. Filtering  
51. Lighthouse approach |
|----------------------------|------------------------|
| Module VIII: Audio | 52. Visual Rendering-Overview  
53. Visual Rendering-overview, contd  
54. Shading models  
55. Rasterization  
56. Pixel shading  
57. VR-specific problems  
58. Distortion shading  
59. Post-rendering image warp |
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| Module VII: Visual Rendering | 60. Physics and physiology  
61. Auditory perception  
62. Auditory localization  
63. Rendering  
64. Spatialization and display  
65. Combining other senses |
Module IX: Interfaces

66. Interfaces - overview
67. Locomotion
68. Manipulation
69. System control
70. Social interaction
71. Evaluation of VR Systems

References: