

Table of Contents

Part - 1: Introduction: Unveiling the Metaverse.....	1
1. Exploring the Metaverse Origin.....	3
Introduction.....	3
Structure.....	3
Objectives	4
Industrial revolutions and the origin of digital web.....	4
<i>Pre-industrial era</i>	<i>4</i>
<i>First industrial revolution.....</i>	<i>5</i>
<i>The second industrial revolution.....</i>	<i>6</i>
<i>The third industrial revolution</i>	<i>6</i>
<i>The fourth industrial revolution and the future.....</i>	<i>7</i>
The digital web and human interactions	7
<i>Pre web era</i>	<i>8</i>
<i>Web 1.0.....</i>	<i>9</i>
<i>Web 2.0.....</i>	<i>10</i>
<i>Web 3.0 and later.....</i>	<i>11</i>
Metaverse: the origin	13
Conclusion.....	15
Points to remember	15
References.....	15
2. Metaverse: Various Forms and Interpretations	17
Introduction.....	17
Structure.....	17
Objectives	18
Metaverse: a game.....	18
Metaverse: a virtual world.....	19
Metaverse: an extended real world	20

Metaverse: a social collaboration platform	21
Metaverse: as defined by the experts	22
<i>The virtual universe and open digital space</i>	22
<i>Seamless integration of physical and digital realities</i>	23
<i>Immersive and interactive experience</i>	23
Defining the metaverse.....	23
<i>Metadata and people network</i>	24
<i>Metaverse and its characteristics</i>	24
Metaverse: the next internet	25
Metaverse: myths vs reality	26
Navigating the evolving metaverse landscape.....	30
Conclusion.....	31
Points to remember	31
References.....	32
Part - 2: Metaverse: A Result of Technological Evolutions.....	33
3. Understanding XR: Metaverse Foundation.....	35
Introduction.....	35
Structure.....	35
Objectives	36
The reality.....	36
Augmenting the reality	37
Virtual Reality	38
eXtended Reality	39
Evolution in XR technologies and tools	40
<i>Head Mounted Display</i>	40
<i>Smart glasses</i>	43
<i>Mobile XR</i>	44
<i>WebXR</i>	46
<i>3D displays</i>	47
<i>See-through glass and mirrors</i>	48
<i>Peripherals</i>	49

XR enabling the metaverse	50
Conclusion.....	51
Points to remember	51
References.....	52
4. AI Empowering the Metaverse.....	55
Introduction.....	55
Structure.....	55
Objectives	56
Artificial Intelligence.....	56
Importance of AI.....	56
Evolution in AI.....	57
<i>Identity definition and recognition</i>	<i>57</i>
<i>Environment definition and recognition - the spatial computing.....</i>	<i>59</i>
<i>Human machine interactions</i>	<i>61</i>
<i>Generative AI</i>	<i>63</i>
<i>AI beyond reality.....</i>	<i>64</i>
AI enabling metaverse	65
Conclusion.....	66
Points to remember	66
References	67
5. IoT, Cloud, and Next-gen Networks.....	69
Introduction.....	69
Structure.....	69
Objectives	70
Internet of Things	70
<i>The integration of IoT and XR: A closer human-machine relationship.....</i>	<i>71</i>
<i>Digital twins and simulations</i>	<i>72</i>
<i>Drone swarming and 3D displays</i>	<i>73</i>
<i>Cybernetics: Enhancing the user experience in the metaverse.....</i>	<i>74</i>
<i>IoT and metaverse: Bridging the physical and virtual worlds.....</i>	<i>75</i>
Scaling the metaverse with cloud-based solutions.....	76

Live streaming	76
Cloud rendering	77
Cloud anchors for shared XR content	78
Geospatial services.....	79
Cloud-based metaverse solutions in nutshell	80
Accelerating the metaverse with next-generation networks	80
5G/6G network.....	81
Quantum computing.....	81
Network security	82
Conclusion.....	84
Points to remember	84
References	85
6. Decentralization and the Role of Blockchain.....	87
Introduction.....	87
Structure.....	87
Objectives	88
Rise of decentralization	88
Understanding blockchain.....	90
<i>The book analogy</i>	90
<i>Working of a blockchain</i>	91
<i>Smart contracts as the executable web</i>	93
The evolution of blockchain.....	94
Understanding tokens and NFTs	95
Rise of creator economy	96
A path to decentralized metaverse	98
Conclusion.....	98
Points to remember	98
References	99
Part - 3: Metaverse: An Opportunity to Extend the Beliefs.....	101
7. Gaming Redefined: The Metaverse Revolution.....	103
Introduction.....	103

Structure.....	103
Objectives	104
Importance of gaming and entertainment	104
Types of games.....	105
Transforming gaming studios and amusement parks	107
<i>Integration of XR experiences</i>	107
<i>The fusion of physical and online presence</i>	108
Transforming museums	108
<i>Revolutionize navigation</i>	109
<i>Enhance the museum artifacts</i>	110
<i>Gamify visitor experience</i>	111
<i>Time travel simulation and virtual encounters</i>	112
<i>Zero museum</i>	114
<i>Virtual museum</i>	114
Expanding gaming and entertainment beyond confinement.....	115
Decentralized gaming and world building	116
Transforming the sports viewing experience.....	117
Revolutionizing film making and viewing.....	118
Conclusion.....	119
Points to remember	120
References.....	120
8. Connecting and Engaging in the Metaverse.....	123
Introduction.....	123
Structure.....	124
Objectives	124
Importance of social connection and engagement.....	124
Types of social connections and engagement.....	125
Social identity in the metaverse	126
Direct communication in the metaverse	128
<i>Breaking the communication barriers of physical meetings</i>	128
<i>Teleporting in virtual meetings</i>	129

Indirect communication in the metaverse	130
<i>Social interactions on the recreated scene</i>	130
<i>AI social media organizer</i>	131
<i>Interactions beyond life</i>	131
Travel and tourism scaling the social reach.....	132
Revolutionizing travel and tourism in metaverse.....	133
<i>Travel beyond destinations</i>	133
<i>Redefine location and navigation</i>	134
<i>Group travel and tourism</i>	135
<i>Virtual travel and tourism</i>	136
Conclusion.....	137
Points to remember	137
References.....	138
9. Revolutionizing Fitness and Healthcare	139
Introduction.....	139
Structure.....	140
Objectives	140
Fitness and health consciousness.....	140
Gamify fitness and wellness in the metaverse	142
<i>Fitness and wellness studios</i>	142
<i>Social fitness and wellness</i>	143
<i>Personal fitness buddy</i>	145
<i>Eat, drink, and smell in the metaverse</i>	146
Transforming physical sports in the metaverse	147
<i>Measure and enhance the performance</i>	147
<i>Redefine coaching</i>	148
<i>Immersive safe practices</i>	149
Role of digitalization and internet in healthcare	151
Transforming healthcare in the metaverse	153
<i>Radiology and diagnosis</i>	153
<i>Remote consultation and assistance</i>	155

Medical training and practice	156
3D scan and bio-print organs	157
Mental health and virtual drugs	157
Building equity in the metaverse	158
Conclusion.....	159
Points to remember	160
Reference.....	161
10. Exploring the Metaverse Economy	163
Introduction.....	163
Structure.....	164
Objectives	164
Understanding the property, value and commerce.....	164
Using metaverse technologies in real estate.....	165
Collaborative spatial designing	165
Construction compliance and 3D printing	167
Marketing and trying before buying.....	168
Personalized advertisement and services	168
Assisted maintenance.....	169
Rise of digital commerce	171
Extending the digital commerce in the metaverse	172
Productivity booster	172
Marketing and communal shopping	174
Delivery and fulfilments.....	175
Connected and continuous services	176
Consumption and ratings	177
Digital content as the virtual property.....	179
The content creator economy	180
Content generation and tuning	180
Content distribution and ownership.....	181
Content consumption and monetization	182
Conclusion.....	183

Points to remember	184
References	184
11. Skilling and Reskilling in the Enterprise Metaverse	187
Introduction.....	187
Structure.....	188
Objectives	188
Understanding the dynamics of skill development.....	188
Innovating education in the metaverse.....	190
<i>Immersive learning experiences</i>	<i>191</i>
<i>Interactive learning experiences.....</i>	<i>192</i>
<i>Personalized learning experiences.....</i>	<i>193</i>
<i>Collaborative learning experiences.....</i>	<i>194</i>
<i>Global learning experiences.....</i>	<i>195</i>
Importance of reskilling in the corporate sphere.....	197
Understanding the enterprise metaverse	198
Navigating the landscape of the enterprise metaverse	199
<i>Extending the reality of automotive and manufacturing.....</i>	<i>200</i>
<i>Exploring beyond earth and beneath the seas</i>	<i>201</i>
<i>Revolutionizing scientific discovery and precision services.....</i>	<i>202</i>
<i>Enhancing disaster response and recovery.....</i>	<i>203</i>
<i>Advancing investigations and analysis</i>	<i>204</i>
<i>Empowering security forces and the military</i>	<i>205</i>
Conclusion.....	206
Points to remember	208
References.....	209
Part - 4: Metaverse: The Concerning Part	211
12. Identity Preservation and Privacy Protection.....	213
Introduction.....	213
Structure.....	213
Objectives	214
Importance of identity	214

Identity preservation challenges in the metaverse.....	215
Significance of privacy in social context	216
Implications of unregulated privacy in the metaverse	218
<i>Infringement of natural people privacy</i>	218
<i>Intrusions into digital and intellectual properties</i>	219
<i>Emotion and sentiment manipulation</i>	220
<i>Social isolation</i>	221
<i>Unforeseen metaverse crimes</i>	223
Prioritizing safety, security, and ethics in the metaverse.....	223
Conclusion.....	225
Points to remember	226
References.....	227
13. Metaverse and Sustainability	229
Introduction.....	229
Structure.....	229
Objectives	230
Understanding sustainable development.....	230
Sustainability challenges in the metaverse.....	231
<i>Economic sustainability in the metaverse</i>	231
<i>Environmental sustainability in the metaverse</i>	233
<i>Social sustainability in the metaverse</i>	234
<i>Sustainability trade-off in the metaverse</i>	235
Sustainability considerations for the metaverse	236
<i>Defining and measuring sustainability index</i>	237
<i>Sustainable product and customer experience</i>	238
<i>Holistic product development process</i>	239
<i>Sustainability as a business</i>	240
Conclusion.....	241
Points to remember	241
References.....	242

Part - 5: Shaping the Metaverse: Standards and Practices.....	243
14. Getting Started with Metaverse Development	245
Introduction.....	245
Structure.....	245
Objectives	246
Understanding the metaverse solution ecosystem.....	246
<i>The metaverse solution stack</i>	<i>247</i>
<i>Categories of metaverse applications.....</i>	<i>248</i>
<i>Building the metaverse using production applications.....</i>	<i>248</i>
<i>Governing the metaverse using management applications</i>	<i>250</i>
<i>Experiencing the metaverse using consumption applications</i>	<i>251</i>
<i>The changing role of people in the metaverse</i>	<i>253</i>
Basics of metaverse application development	254
<i>Scene and environment</i>	<i>255</i>
<i>Interactions and navigation</i>	<i>256</i>
<i>Collaboration and social engagement</i>	<i>258</i>
<i>Real-world integration</i>	<i>259</i>
Metaverse Development Kits	261
<i>Development kits for mobile apps.....</i>	<i>261</i>
<i>Development kits for HMD and smart glasses apps.....</i>	<i>262</i>
<i>Development kits for web apps.....</i>	<i>263</i>
<i>Development kits for peripheral devices</i>	<i>264</i>
Operating system to support the metaverse	265
Modular and configurable metaverse devices	267
Meeting the enterprise metaverse	268
Conclusion.....	270
Points to remember	270
References.....	271
15. Metaverse Practices, Standards, and Initiatives.....	275
Introduction.....	275
Structure.....	275

Objectives	276
Metaverse beyond software horizon	276
Best practices for metaverse development	277
<i>Product definition practices</i>	278
<i>User experience design practices</i>	280
<i>Development practices</i>	284
<i>Testing practices</i>	287
<i>Continuous operations practices</i>	289
Emerging standards and protocols	290
<i>Electromagnetic safety standards</i>	290
<i>Environment specific safety standards</i>	291
<i>Data safety standards</i>	291
<i>Security standards</i>	292
<i>Usability standards</i>	293
<i>Ethical standards</i>	293
Collective initiatives shaping the metaverse	294
<i>Metaverse associations and consortiums</i>	294
<i>Government and academic initiatives</i>	295
<i>Development programs and active investors</i>	296
<i>Conferences, summits, and tech-fairs</i>	297
<i>Communities and social influencers</i>	298
Conclusion	299
Points to remember	300
References	301
16. Metaverse: A Way Forward	305
Introduction	305
Structure	305
Navigating the metaverse: A recap	305
The future	306
A collective action plan	307
Conclusion	308
Index	309-317