

SAIC4001	INDUSTRY 4.0	L	T	P	Credits	Total Marks
		2	-	2	2	100

UNIT 1 ADVANCED TECHNOLOGY AND ADVANCED MATERIALS**7 Hrs.**

Advanced electro-optical sensing technology-active, passive multi-spectral and hyper spectral imaging; electronic beam steering; vacuum technology, surface and coating technology, health care technology, Nanotechnology- Nanomechanics, Nano optoelectronics; energy storage technology-next generation Li-based Batteries, Hydrogen storage, solar photovoltaic's, Flexible electronics. Intellectual Property Rights - case studies governing/pertaining to Materials/Technology.

UNIT 2 TRANSFORMING TECHNOLOGIES IN BIOENGINEERING**7 Hrs.**

Establishment of smart biotechnology factory, Artificial intelligence in Bioprocess technology, Omics – Big data analysis through automation, 3D bio printing for tissue engineering. Simulation tools, RSM and Box model. Cyber physical system based telemedicine, diagnosis and therapeutics through real time biosensors. Bionanotechnology. Intellectual Property rights (IPR): Case Studies.

UNIT 3 ADVANCEMENTS IN SUSTAINABLE BUILT ENVIRONMENT**7 Hrs.**

Introduction – Technological developments in Architectural, Engineering and Construction (AEC) - Building Information Modelling (BIM) using Cloud computing technology and Internet of things (IoT) – Unmanned Aerial Vehicles, sensors – Additive manufacturing in construction – Concrete 3D printing - Materials used - Lightweight and functionally graded structures - Net Zero Energy buildings, Bioswales, Biofiltration pond, Ecosan systems- Recent developments in Waste water Management, Air pollution control, waste disposal - Integration of energy, water and environmental systems for a sustainable development- Emerging Technologies: Robot Highway- Vertical farming - Intellectual Property rights: Case studies

UNIT 4 SMART MANUFACTURING**8 Hrs.**

Smart factories and interconnection, Smart Manufacturing – automation systems, Additive Manufacturing, Smart grids, Micro Electro Mechanical Systems (MEMS), Stealth technology, Metal Finishing, Self-propelled vehicles, e mobility, Green fuels, drones – unmanned aerial vehicles(UAVs), aerodynamics. Robotic Automation and Collaborative Robots – Augmented reality and haptics, engineering cybernetics and artificial intelligence (AI), Disruptive Technologies – Frugal Innovations – Emerging Technologies - Autonomous Robots, Swam Robot, Modular Robotics, Space craft, Intellectual Property Rights (IPR): Case Studies.

UNIT 5 SMART WORLD**8 Hrs.**

Smart Sensors and IIOT, Smart grid, Hybrid renewable energy systems, Electronics in Smart city, Integration of Sensors in Robots and Artificial Intelligence, 5G Technology, Communication protocols, Human-Machine Interaction, Virtual Reality, Quantum Computing: Changing trends in transistor technology: Processor, Emerging Trends: Deep Space, Swarm Robots, Cyborg, Geofencing, Pervasive Computing, Intellectual Property Rights- Case Studies.

UNIT 6 CYBER PHYSICAL SYSTEMS**8 Hrs.**

Introduction to Cyber Physical Systems (CPS), Architecture of CPS, Data science and technology for CPS, Prototypes of CPS, Emerging applications in CPS including social space, crowd sourcing, healthcare and human computer interactions, Industrial Artificial Intelligence, Deep Learning, Gamification, Networking systems for CPS applications, Wearable cyber physical systems and applications, Domain applications of CPS: Agriculture, Infrastructure, Disaster management, Energy, Transportation, Intellectual Property Rights (IPR) : CaseStudies.

Max. 45 Hrs.**TEXT / REFERENCE BOOKS**

1. William D. Callister, Materials Science and Engineering: An Introduction, John Wiley and Sons Inc. Singapore, 2001.
2. Raghavan V., Physical Metallurgy: Principle and Practice, Prentice Hall India Pvt. Ltd., 2006.
3. Flavio Craveiro, Jose Pinto Duarte, Helena Bartolo and Paulo Jorge Bartolo, "Additive manufacturing as an enabling technology for digital construction: A perspective on Construction 4.0", Automation in Construction, Vol. 103, 2019.
3. Klaus Schwab, Fourth Industrial Revolution, Random House USA Inc., New York, USA, 2017.
4. Oliver Grunow, "SMART FACTORY AND INDUSTRY 4.0. The current state of Application Technologies", Studylab Publications, 2016.
5. Alasdair Gilchrist, "INDUSTRY 4.0: Industrial Internet of Things", Apress, 2016.
6. Sang C.Suh, U.John Tanik, John N Carbone, Abdullah Eroglu, "Applied Cyber-Physical Systems", Springer Publications, New York, 2013

END SEMESTER EXAMINATION QUESTION PAPER PATTERN**Max. Marks: 100****Exam Duration: 3 Hrs.****PART A:** 11 Questions of 2 marks each-No choice**22 Marks****PART B:** 2 Questions from each unit with internal choice, each carrying 13 marks**78 Marks**

SBTA4002 Synthetic biology

Course objectives

The course familiarizes students to the rapidly developing field of synthetic biology. The components of synthetic biology are introduced and its commercial applications are elaborated.

Unit I : Introduction to Synthetic biology

Introduction to synthetic biology. Background of Gene Regulatory Mechanisms (Gene Parts- Gene Structure, Promoters, Terminators, Enhancers, Inducers, Repressors, Transcription Factors, Co-factors, transcriptional and post-transcriptional regulation, post-translational modifications). Genetic Engineering and Genome Editing

Unit II : Elements of synthetic biology - Tools

Gene shuffling for large scale pathway assembly and engineering; Choices for microbial hosts for industrial applications– bacteria, yeast, insect. Gene editing methods – CRISPR/ Cas; Gene sequencing – Pyrosequencing, Nanopore sequencing.

Unit III : Bacterial circuits and Biobricks

Bacterial circuits: feedback, feed-forward, toggle switch, signal propagators and band filter, synchronized oscillators. Introduction to Bio Bricks & its applications. Microarrays & systems biology - a basic introduction

Unit IV : Mathematical modeling, simulation & applications

Noise in Gene Expression. Mathematical Modeling and Simulation. Biosensors. Application of software tools for modelling gene expression. Commercial Applications - Biomedicine, Biomaterials, Biofuels and Bioremediation; Global events & competitions- iGEM, synbiobeta.

Unit V : Regulations & ethics

Safety & bioethics, legal & IP elements involved in synthetic biology applications for human, animals and plants.

Course outcome

On completion of the course, the student will be able to;

CO1 : Define synthetic biology and outline its components.

CO2 : Paraphrase the biological mechanisms as circuits.

CO3 : Articulate on the elements of synthetic biology

CO4 : Illustrate bacterial circuits and biobricks

CO5 : Appraise on the applications, regulations and ethics of synthetic biology

CO6 : Design biobricks and novel metabolic pathways.

Text Books/References:

1. Eric Davidson, The Regulatory Genome: Gene Regulatory Networks In Development And Evolution, Academic Press (2006).

2. Hamid Bolouri, Computational Modeling of Gene Regulatory Networks - A Primer, Imperial College Press (1st edition) (2008).
3. Freemont, P.S and Kitney, R.I. (2012). Synthetic Biology – a Primer. World Scientific Publishing Co pte Ltd
4. Singh, V and P.K. Dhar. (2015). Systems and Synthetic Biology. Springer publishing, Netherlands
5. Fu, P and Panke, S (2009). Systems Biology and Synthetic Biology. Wiley Publishing.
6. Covert, M.W. (2014). Fundamentals of Systems Biology: from Synthetic Circuits to Whole Cell Models. CRC Press
7. Konopka, A. K. (2006). Systems Biology: Principles, Methods, and Concepts. CRC Press.
8. Church, G and Regis, E. (2012). Regenesiis: How Synthetic Biology will Reinvent Nature and Ourselves. Basic Books.
9. Standards for Plant Synthetic Biology -
<http://onlinelibrary.wiley.com/doi/10.1111/nph.13532/full>
10. Synthetic and Systems Biology for Microbial production of Commodity Chemicals –
11. <http://www.nature.com/articles/npjsba20169>.
12. Biotechnology and Synthetic Biology Approaches for Metabolic Engineering of Bioenergy Crops - <https://www.ncbi.nlm.nih.gov/pubmed/27030440>.
13. Microarray Data Analysis: Gene Expression Data Analysis. A Beginner's Guide by: Helen Causton (Imperial College), J Quackenbush and Alvis Brazma (The European Bioinformatics Institute).
14. A Practical Approach to Microarray Data Analysis (Hardcover) by Daniel P. Berrar (Editor), Werner Dubitzky (Editor), Martin Granzow (Editor).