SAEA2603	AIRCRAFT DESIGN PROJECT LAB	L	T	P	Credits	Total Marks
		0	-	4	2	100

COURSE OBJECTIVES

- To classify the types of Aircrafts and its data collection.
- To estimate the weight of an Aircraft pertaining to preliminary hand calculations
- To select the appropriate airfoil, wing tail, control surface and power plant for the preliminary design Aircraft.
- To analyze the performance of the preliminary design Aircraft.
- To perform the structural analysis of the preliminary design Aircraft.
- To design the landing gear opted for the newly designed Aircraft.

SUGGESTED LIST OF EXPERIMENTS

1. Data collection.
2. Preliminary weight estimation.
3. Airfoil selection, Wing tail and control surfaces
4. Power plant selection
5. Balance diagram.
6. Drag estimation.
7. Rate of climb calculations at various altitudes, Turn performance
8. Range and Endurance, Takeoff and landing distance calculation
9. Stability calculations
10. V-n diagram
11. Wing and fuselage Design.
12. Shear force and bending moment diagrams of various aircraft structures.
13. Structural weight distribution.
14. Landing gear Design.
15. Detailed CAD drawings of wing, fuselage ,tail surfaces and control surfaces and their stress analysis using structural software
16. Detailed Design project report.

COURSE OUTCOMES

At the end of the course, student will be able to:

- CO1: Categorize the types of Aircraft and its specifications to perform the conceptual design of new Aircraft.
- CO2: Estimate the gross weight and payload weight of an Aircraft for the preliminary designed Aircraft.
- CO3: Deduct the appropriate selection of airfoil, wing-tail configuration for the preliminary Aircraft.
- CO4: Analyze the preliminary designed Aircraft's performance and its control.
- CO5: Evaluate the structural analysis of airframe parts of the preliminary designed Aircraft.
- CO6: Design the appropriate landing gear that suits the preliminary designed Aircraft.

SMEA4003	INDUSTRY 4.0 FOR DESIGN AND MANUFACTURING	L	T	P	Credits	Total Marks
		2	-	0	2	100

COURSE OBJECTIVES

➢ To enable students understand the fundamentals and the contributing technologies of Industry 4.0.
➢ To make the students evaluate the suitability of Industry 4.0 technologies for the design and manufacturing sectors.
➢ To help the students implement the Industry 4.0 technologies to diverse applications.

UNIT 1 CONTRIBUTING TECHNOLOGIES 8 hrs
Brief introduction to the industrial revolutions. Contributing technologies to Industry 4.0: Additive manufacturing, Digital twin, Internet of things, Smart sensors, AR and VR, Artificial intelligence, Cloud computing, Block chain, Big data and analytics. Challenges and opportunities.

UNIT 2 ADVANCED CAD TECHNOLOGIES 8 hrs
Introduction to CAD. Enabling technologies: Digital twin, AR/VR, AI. Cloud computing, Touch/Voice/Motion enabled CAD, Customized CAD, Cloud based CAD, Digital twin and live simulation.

UNIT 3 SMART MANUFACTURING SYSTEMS 8 hrs
Enabling technologies: AI, Cloud computing, Robotics, IoT. Digital manufacturing: CNC, Cloud based manufacturing, IoT based manufacturing, Advanced CNC programming. Additive manufacturing. Micro electro mechanical systems. Robotics: Robotic automation, Collaborative robots, Autonomous robots, Swarm robots, and Modular robots.

UNIT 4 SMART FACTORY ENABLERS 8 hrs
Enabling technologies. Smart energy: Improving energy efficiency with data, Smart grids. Clean energy. Smart logistics. Smart Inspection. Smart decision making.

UNIT 5 AUTOMOMOUS VEHICLES 8 hrs
Introduction: Traditional mobility versus autonomous driving, Levels of automation, and challenges. Enabling technologies. Self-propelled vehicles, Drones, Unmanned aerial vehicles, Space crafts

UNIT 6 CASE STUDIES 5 hrs
Case studies related to Industry 4.0 applications, such as, transportation, energy, infrastructure, manufacturing, and product design sectors.

Max. 45 Hrs.

COURSE OUTCOMES

At the end of the course, the students will be able to:
CO1: Justify how the digitalization technologies are advantageous to the design and manufacturing industries.
CO2: Use the advanced CAD technologies to create the CAD models.
CO3: Use the smart manufacturing technologies to produce the components and products.
CO4: Recommend the enabling technologies to make various factory operations smarter.
CO5: Choose the suitable sensors and technologies to the future autonomous vehicles, drones and space crafts.
CO6: Prepare a report with the challenges faced currently, the enabling technologies to become smarter, and the steps needed for the effective implementation for the given case study.

TEXT / REFERENCE BOOKS

1. 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,pp. 251- 267, 2019.
2. Klaus Schwab, "Fourth Industrial Revolution", Random House USA Inc, New York, USA, 2017.
3. Oliver Grunow, "Smart Factory and Industry 4.0. The current state of Application Technologies", Studylab Publications, 2016
4. Alasdair Gilchrist, "Industry 4.0: Industrial Internet of Things", Apress, 2016
5. Sang C. Suh, U. John Tanik, John N Carbone, Abdullah Eroglu, "Applied Cyber-Physical Systems", Springer Publications, New York, 2013.

Elective SAEA3020	HEAT TRANSFER TECHNIQUES	L	T	P	Credits	Total Marks
		3	1	0	4	100

COURSE OBJECTIVES

- ➢ To learn the various modes of heat transfer and understand the basic concepts of mass transfer
- ➢ To understand the applications of various experimental heat transfer correlations in engineering applications.
- ➢ To discuss the thermal analysis and sizing of heat exchangers
- ➢ To understand the concepts of high speed flow heat transfer

UNIT 1 INTRODUCTION AND CONDUCTION HEAT TRANSFER 9 Hrs.

Basic modes of heat transfer – One dimensional steady state heat conduction – Cartesian, cylindrical and spherical coordinates – Composite medium – Critical thickness – Effect of variation of thermal conductivity – Extended surfaces. Conduction with heat generation. Unsteady state heat conduction – Heat transfer analysis of Lumped system, Semi infinite and infinite solids – Use of TransientTemperature charts - Applications of numerical techniques.

UNIT 2 CONVECTIVE HEAT TRANSFER 9 Hrs.

Introduction-Forced convection-Development of velocity and thermal boundary layer by a flow on a vertical flat plate – Laminar and turbulent convective heat transfer analysis in flows over a flat plate, circular pipe and spherical surface. Free convective heat transfer over vertical flat plate, cylinders and spheres – Empirical relations , applications of numerical techniques in problem solving.

UNIT 3 RADIATIVE HEAT TRANSFER 9 Hrs.

Introduction – Physical mechanism of radiation – Radiation properties – Characteristics of surfacesEmissivity – Radiation shaper factor – Heat exchange between non-black bodies – Radiation shields.

UNIT 4 HEAT EXCHANGERS 9 Hrs.

Classification of heat exchangers – Temperature distribution – Overall heat transfer coefficient – Heat exchange analysis – LMTD Method and E-NTU Method.

UNIT 5 HEAT TRANSFER IN HIGH SPEED FLOW 9 Hrs

High-Speed flow heat transfer - Heat transfer in gas turbine combustion chamber-ablative heat transfer-Aerodynamic heating – Rocket thrust chambers - Numerical treatment.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1: Compare the various modes of heat transfer and analyse the conduction heat transfer in various systems in both steady and unsteady state conditions

CO2: Distinguish natural and forced convection phenomena and measure the heat transfer coefficient in external and internal fluid flow problems.

CO3: Apply the laws of radiation, analyse the radiation exchange between surfaces and the effect of radiation shields

CO4: Distinguish the types of heat exchangers and design the heat exchanger with LMTD and NTU approach

CO5: Describe the principles of high speed flow heat transfer and analyse the heat transfer problems in gas turbine combustion chamber

CO6: Describe the application of high speed flow heat transfer in aerospace components and analyse the heat transfer by numerical methods.

TEXT / REFERENCE BOOKS

1. Incropera, F.P. and Dewitt, D.P., Fundamentals of Heat and Mass Transfer, 7th Edition, John Wiley, 2011.
2. Holman, J.P., Heat Transfer, 10th Edition, Tata McGraw-Hill, 2010.
3. Cengel, Y.A., Heat Transfer - A Practical Approach, 2nd Edition, McGraw-Hill, 2002.
4. Sachedva, R.C., Fundamentals of Heat and Mass Transfer, 4th Edition, New Age International, 2012
5. Desmond E. Winterbone and Ali Turan; Advanced Thermodynamics for Engineers, Elsevier Ltd, 2015
6. Bengt Sunden and Juan Fu., Heat Transfer in Aerospace Applications, Academic Press, 2016
7. Yang.Y, Habiballah.M, Popp.M, Hulka.J, Liquid Rocket Thrust Chambers (Progress in Astronautics and Aeronautics), American Institute of Aeronautics and Astronautics, 2004