1.2.1 Syllabus of new courses introduced

Course Title: **Product Realization**	Course Code: 16EMEP205
Total Contact Credits: **0-0-2**	Duration of SEE Credits: -
ISA Marks: 80	ESA Marks: 20

Week #	Particulars	Venue
Week 1 and Week 2	➢ Introduction to Prototyping - Specifications, Part Drawings, Assembly Drawings, PCB Layout, Wireframe , Pseudocode, BOM, Process Plan, Fabrication and Test Plan Validation ➢ IOT Workshop	Studio Engagement
Week 3	➢ Identifying sub-assemblies ➢ Procurement of logistics for proof of concept testing. ➢ Selection of materials for all the parts and joining techniques ➢ Selection of UI and Core Component of Android	Makers Space/
Week 4	➢ Process plan ➢ Identifying the proper machines, tools and operations required for prototyping. ➢ Selection of appropriate raw materials for prototyping. ➢ Demonstrate breadboard prototype of entire electronics in the system. (To have tested electronic circuit for PCB design) ➢ UI implementation using XML	
Week 5	➢ Fabricate the parts for sub assembly ➢ Initiate schematic entry in PCB design software, also refine and optimize thesize of the board. ➢ UI implementation and validation	
Week 6	➢ Fabricate the parts for sub assembly ➢ Generate gerber files for the optimal PCB design. ➢ Android core component implementation and Unit Testing	
Week 7	➢ Fabricate the parts for sub assembly ➢ Fabricate PCB using MITS machine, solder components and test the design. ➢ Android core component implementation and Unit Testing	
Week 8	➢ Assemble the sub assemblies and check for interference and functionality	

	➢ Revisit PCB testing for increasing reliability of the design. (test to avoid/eliminate lose connections, dry soldering, andbad electronic components) ➢ Android core components integration and testing	
Week 9	➢ Test the functional prototype using proper identified test methods. ➢ Demonstrate working of fully functional PCB. ➢ Configuration of IoT Server	
Week 10	➢ Integratesubsystems for prototype testing. ➢ Analyse the test results ➢ System modification ➢ System integration	
Week 11	➢ Final concluding review ➢ Product catalog ➢ System Tesing.	Studio/ Makers Space

**** Templates to be provided for week wise activities.***

References

1. Pahl, G., Beitz, W., Feldhusen, J. and Grote ; "Engineering Design-A Systematic Approach" by, K.-H- Springer; 3rd ed. 2007

Course Code: 18EMEE303	Course Title: Turbo Machines	
L-T-P-SS: 3-0-0-0	Credits: 3	Contact Hrs: 3
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 3		Exam Duration: 3 hrs

Content	Hrs
Unit - I	
Chapter No. 1:Principles of Turbo Machinery Definition of turbo machine, Comparison with positive displacement machine, Classification; Application of first and second law to turbo-machines, Efficiencies. Dimensionless parameters and their physical significance, Effect of Reynolds number, Specific speed, Illustrative examples on dimensional analysis and model studies.	5
Chapter No. 2: Energy Exchange In Turbo Machine Euler Turbine equation, Alternate form of Euler turbine equation-components of energy transfer, Degree of reaction, General Analysis of a turbo machine-effect of blade discharge angle on energy transfer and degree of reaction, General analysis of centrifugal pumps and compressors-effect of blade discharge angle on performance, Theoretical head-capacity relationship.	5
Chapter No. 3 : General Analysis of Turbo Machines Axial flow compressors and pumps-general expression for degree of reaction, velocity triangles for different values of degree of reaction, General analysis of axial and radial flow turbines-utilization factor and degree of reaction, Condition for maximum utilization factor-optimum blade speed ratio for different types of turbines.	6
Unit -II	
Chapter No. 4: Compressible Flow Fundamentals Energy and momentum equations for compressible fluid flows, various regions of flows, reference velocities, stagnation state, velocity of sound, critical states, Mach number, critical Mach number, types of waves, Mach cone, Mach angle, effect of Mach number on compressibility.	5
Chapter No. 5: Centrifugal Compressors Stage velocity triangles, slip factor, power input factor, Stage work, Pressure developed, stage efficiency and surging, stalling and prewhirl. Expression for pressure ratio developed in a	6

stage, work done factor, efficiencies, Problems.	
Chapter No. 6: Axial flow Compressors Axial Flow Compressors: Basic operations, elementary theory, factors affecting stage pressure ratio, Blockage in the compressor annulus, degree of reaction, three-dimensional flow, design process, blade design, calculation of stage performance, compressibility effects, off-design performance**.**	5
Unit -III	
Chapter No. 7: Flow through Variable Area Ducts Isentropic flow through variable area ducts, T-s and h-s diagrams for nozzle and diffuser flows, area ratio as a function of Mach number, mass flow rate through nozzles and diffusers, effect of friction in flow through nozzles.	4
Chapter No. 8:Steam Turbines Classification, impulse –reaction stages, condition for maximum blade efficiency, stage efficiency. Compounding-need for compounding, method of compounding, impulse staging-condition for maximum utilization factor for multi stage turbine with equiangular blades, effect of blade and nozzle losses, Reaction turbine, Parson's reaction turbine.	4

Text Book

1. ShepherdD.G., Principals of Turbo Machinery, Macmillan Publishers,1st Edn.1964
2. Yadav R., (2007) 'Steam & gas turbines and power plant engineering', *Central Publishing House Allahabad*, Vol. 1,
3. S. M. Yahya, Turbines, Compressors & Fans,Tata McGraw Hill Co. Ltd., 2nd edition, 2002.
4. E Rathakrishnan, Gas Dynamics, PHI- 2nd edition, 2009.

References

1.Kadambi V. Manohar Prasad,An Introduction to Energy Conversion, Vol-III Turbo Machinery, New Age International, 1st Edn, 2006.
2.Saravanamutto H.I.H, Rogers G.F.C., Cohen H, Gas Turbine Theory, 5th edn., Pearson Education, 2006.

Course Code: 15EMEE417	Course Title: **Modern Trends in Manufacturing**	
L-T-P-SS:**3-0-0-0**	Credits:**3**	Contact Hrs: **50**
CIE Marks: **50**	SEE Marks: **50**	Total Marks: **100**
Teaching Hrs: **50**		Exam Duration: **3 Hours**

No	Contents	Hrs
	Unit I	
1	**Chapter No. 1: Systematic Approach for Manufacturing Strategy** Seven Losses Regarding Productivity and Profitability, Feasibility Study of Productivity Improvement, Four Levels of Manufacturing Strategy.	4
2	**Chapter No. 2:Management and productivity in Engineering** Definition of Engineering, Management and Management Engineering, Industrial Engineering and Productivity, Necessity of Facts and Work Measurement Productivity, Purpose of Productivity Improvement, Engineering Approach for Productivity, Three Levels of Improvement, Points of Successful Productivity, Relationship of Methods, Performance, and Utilization to Standard Time.	8
3	**Chapter No. 3: Concurrent Engineering** Introduction, importance of CE , building blocks of CE, Important factors in concurrent engineering process , communication models, benefits and its tools.	3
	Unit II	
4	**Chapter No. 4: Continuous process improvement** Introduction, Japanese concept of continuous improvement (kaizen), innovation concept of improvement, need for continuous improvement, tools for continuous improvement, steps in implementing continuous improvement, three pillars of continuous improvement, standardization, quality circles, suggestion systems, kaizen and management, kaizen umbrella, TPM, Six sigma, FMEA and discussion of few case studies.	08
5	**Chapter No. 5: Pull production systems** introduction to TPS, KANBAN system, difference between pull and push system, other types of kanban, kanban rules, adapting to fluctuation in demand through kanban, a detailed kanban system example, supplier kanban and sequence schedule for kanban.	07

Unit – III		
6	**Chapter No. 6: Quality Management Systems** Need for ISO 9000 and Other Quality Systems, ISO 9000:2000 Quality System – Elements, Implementation of Quality System, Documentation, Quality Auditing, QS 9000, ISO 14000 –Concept, Requirements and Benefits.	**05**
7	**Chapter No. 6: Six sigma** Principles of Six sigma, project selection for six sigma, six sigma problem solving, design for six sigma, six sigma in service and small organization, six sigma and lean production, statistical thinking and application, statistical foundation, statistical methodology, design of experiments, analysis of variances.	**05**

Text Book:

1. Masaki Imai, 'KAIZEN', McGraw Hill International.
2. ShigeyasuSakamoto , "Beyond World-Class Productivity", Springer-Verlag London Limited 2010.
3. Dale H. Besterfield, "Total Quality Management", Pearson Education, Asia.

References:

1. Richard J. Schonberger, 'Japanese Manufacturing Techniques', The Free Press – Macmillan Publication.
2. James R. Evans and William M. Lindsay, 'The Management and Control of Quality'.

Course Code: **19EMEE302**	Course Title: **Advanced Statistics and Machine Learning**	
L-T-P : 0-0-3	Credits: 03	Contact Hrs: 06
ISA Marks: 80	ESA Marks: 20	Total Marks: 100
Teaching Hrs: 80		Exam Duration: 2 Hrs.

Content	Hrs
Unit - 1	
1. Introduction to Machine Learning Introduction to Supervised, Unsupervised, and Reinforcement Learning; Statistics for ML; Exploratory Data Analysis; Use of Python and working with CSV/XLS files. Python hands on: Installation, Introduction to Python libraries (Pandas, Numpy, matplotlib and so forth)	25 Hrs
Unit - 2	
2. Applied Statistics Statistics for ML; Data Wrangling; Exploratory Data Analysis; Visualization; Use of Python and working with CSV/DB Hands on: Preprocessing techniques	15 Hrs
3. Machine Learning Methods Introduction to ML Life Cycle; Regression – Predictive Modeling; Regularization; Feature Selection; Metrics for Prediction; Visualization;	18 Hrs
Unit - 3	
4. ML – Classification Introduction to Classification; Logistic Regression; Random Forests; Metrics for Classification; Visualization; Use of Python and DB	22 Hrs

Text Books (List of books as mentioned in the approved syllabus)

1. Trevor Hastie, Robert Tibshirani, and Jerome Friedman, “The Elements of Statistical Learning: Data Mining, Inference, and Prediction”, Springer, 2017.
2. Roger D Peng, “R Programming for Data Science”, Learnpub, 2015.

References

1. Geetha James, Trevor Hastie, Daniela Whitten, Robert Tibshirani, “An Introduction to Statistical Learning with Applications in R”, Springer, 2017.
2. Andrew Ng, “Machine Learning Yearning”, https://www.mlyearning.org/.
3. Michael Nielsen, “Neural Networks and Deep Learning”, http://neuralnetworksanddeeplearning.com/.

Course Code: **19EMEE307**	Course Title: **Machine Learning Applications**	
L-T-P : 0-0-3	Credits: 03	Contact Hrs: 06
ISA Marks: 80	ESA Marks: 20	Total Marks: 100
Teaching Hrs: 80		Exam Duration: 2 Hrs.

Content	Hrs
Unit - 1	
1. Unsupervised Learning Refresher week, Introduction to Unsupervised Learning, Clustering Analysis: K-Means, K-Medoid, DBSCAN, Hierarchical Clustering.	18 Hrs
Unit - 2	
2. Introduction to Deep Learning Frame-Work Introduction to DL, Exploring the popular DL frameworks, Getting started with TensorFlow, Introduction to Keras, Setting up the environment.	15 Hrs
3. Introduction to Deep Neural Network (DNN) Introduction- What is Deep Learning, Why Deep Learning and Why now, Mathematical building blocks of NN, Examples on Regression, Classification.	21 Hrs
Unit - 3	
4. Deep Learning in practice Introduction to Convnets, Understanding Recurrent NN, Examples	12 Hrs

Text Books (List of books as mentioned in the approved syllabus)

1. Trevor Hastie, Robert Tibshirani, and Jerome Friedman, “The Elements of Statistical Learning: Data Mining, Inference, and Prediction”, Springer, 2017.
2. Deep Learning, Ian Goodfellow, Yoshua Bengio et.al

References

1. Andrew Ng, “Machine Learning Yearning”, https://www.mlyearning.org/.
2. Michael Nielsen, “Neural Networks and Deep Learning”, http://neuralnetworksanddeeplearning.com/.
3. Deep Learning with Python, Francois Chollet

Course Code: 19EMEE301	Course Title: Vehicle Structure and Design Optimization	
L-T-P: 3-0-0	Credits: 3	Contact Hrs: 3 hrs/week
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 80		Exam Duration: 3 hrs

PART A (Study of Vehicle Structure)		
Sl. No.	**Content**	**Teaching Hours**
1	Brief explanation of different types of Loads and its effect; Different types of stresses- Static and Thermal, Different types of beams, Struts and Columns, thick and thin cylinders;	02
2	Understanding vehicle structure based on application; (e.g: 3box, load body and chassis)	04
3	Choices for Preparation of Virtual Model (1D, 2D, 3D representation);	03
4	Importance of Joinery;	02
5	Common performance measures for vehicle structures; (Stiffness, Modal, Durability)	03
6	Understanding Data and Assumptions; (e.g. nominal and tolerance, etc.)	02
7	Baseline data; (Initial collection of data which serves as a basis for comparison with the subsequently acquired data.)	02
8	Quality control in virtual environment;	03
9	Example case of static stiffness of BIW, Chassis; (BIW (short for Body in White) is a stage in automotive design and manufacturing. BIW refers to the body shell design of an automotive product such as cars. It is just a sheet metal welded structure. BIW will not have doors, engines, chassis or any other moving parts.)	05
10	Understanding effect of thermal loads on structure;	02
11	Understanding how to compute life based on stress results;	02
	Total-Theory	**30**
Hands on Session		
01	Demonstrate importance of geometric parameters on performance	05

	of structure	
02	Demonstrate importance of cross members on performance of structure	05
Total-Hands-on		**10**
TOTAL		**40**
PART B **(Design Optimization)**		
Sl. No.	**Content**	**Teaching Hours**
1	Optimization in the Design Process, Engineering Design Practice, Characteristics of Different Industries, CAE and the Design Cycle, The impact of optimization on CAE, What is an Optimum Design?, Optimization terminology in a nutshell, Finding an Optimum, Formulation of an Optimization problem;	02
2	What is optimization in the context of EV structure;	02
3	Different types of design optimization;	02
4	How to plan and approach giving design guidance;	02
5	What is concept level design guidance (generative designs);	03
6	How to handle design guidance at a detailed design stage;	03
7	Examples - design guidance for stiffness attribute;	04
8	Examples - design guidance for durability attribute;	04
9	What is MDO, its application; (Medium density overlay-MDO is produced with a high-quality thermosetting resin-impregnated fiber surface bonded to one or both sides under heat and pressure to create an exterior-grade plywood panel.)	02
10	Watch-outs during design guidance process;	02
11	Examples - design guidance for NV & crash attribute;	04
	Total-Theory	**30**
Hands on Session		
01	Optimize front control arm of a vehicle for all its performance criteria. FAW up by 10%	05
02	Optimize B-Pillar for roof crush if GVW goes up by 20% due to electrification, Effect of wheel base increase on chassis stiffness and how to bring it back, Section optimization using morphing.	05
Total-Hands-on		**10**
	TOTAL	**40**

PROJECTS:

Objective: To carry out Baseline Performance, Virtual Testing and Design Countermeasures	
Sl. No.	**Content**
01	Battery case for EV;
02	Motor compartment / Passenger compartment - improve performance;
Objective: To Provide design guidance	
Sl. No.	**Content**
01	Battery case for EV (Metal vs Composite);
02	Motor compartment / Passenger compartment - improve performance;

.

Text Books/Reference Books:

1. Dr. N.K. Giri, Automotive Mechanics, 8th Edition,2008, Khanna Publication, New Delhi.
2. Practical Aspects of Structural Optimization, Altair University, 3rd Edition.
3. Robin Hardy, Iqbal Husain, "Electric and Hybrid Vehicles". CRC Press, ISBN 0-8493-1466-6.
4. Ron Hodkinson and John Fenton, "Lightweight Electric/ Hybrid Vehicle Design". SAE International
5. John M. Miller, Propulsion Systems for Hybrid Vehicles" Institute of Electrical Engineers, London, ISBN0 863413366.
6. Automobile Electrical and Electronic systems, Tom Denton, Third Edition, 2004, SAE International, SAE ISBN 0 7680 147 2, Society of Automotive Engineers. Inc 400 common wealth Drive, Warrendale, PA 15096-0001 USA.

Course Code:19EMEE401	Course Title: Dynamics & Durability of Vehicles	
L-T-P: 3-0-0	Credits: 3	Contact Hrs: 3 hrs/week
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 80		Exam Duration: 3 hrs

PART A (Dynamics of Vehicles)		
Sl. No.	**Content**	**Teaching Hours**
1	Introduction - Kinematics & Compliance in vehicles;	02
2	Introduction to Roads and Loads;	02
3	Introduction to Durability in industry;	02
4	Data and Assumptions for multi-body systems - quality control;	02
5	Loads mapping for downstream use with examples;	03
6	Example applications using Multi-Body Dynamic Systems;	03
7	Introduction - Flex Body;	02
8	Durability example with and without Flex body;	02
9	Control systems in Multi-Body;	02
Total-Theory		**20**
Hands on Session		
01	Build a 2/3 wheeler suspension system to carry out K&C	05
02	Build a 3 wheeler suspension system to carry out loads extraction for durability	05
Total-Hands-on		**10**
TOTAL		**30**

PROJECTS:

Objective: To carry out Dynamic and Durability of different chassis	
Sl. No.	**Content**
01	Compare durability of conventional ICE chassis with Electric version

PART B (Durability of Vehicles)		
Sl. No.	**Content**	**Teaching Hours**
1	Conduction, Convection, Steady state, Transient flows, Turbulence	02

	and its significance	
2	Importance of BTMS, Current state of thermal management in EV	02
3	Types of battery packs for xEV	02
4	Heat load calculation for battery packs	02
5	How to approach design assessment of power pack for thermal management	02
6	Importance of data & assumptions (includes baselining)	02
7	Example case of using AcuSolve to assess a design	04
8	How to improve the thermal performance of a power pack design	02
9	Importance of Drag co-eff for vehicles moving at high speeds	02
10	Fast assessment of A-Surface design for drag using VWT	02
11	Introduction to thermal management in electronic circuits	04
Total-Theory		**26**
Hands on Session		
01	Assume 2 different designs and compare the thermal performance	05
02	Prepare 2 vehicle designs (external surface) and compute drag	05
Total-Hands-on		**10**
TOTAL		**36**

PROJECTS:

Objective: To carry out to analyze then e heat produced during EV operation and streamline external airflow		
Sl. No.	**Content**	
01	Compute Delta T for a chosen EV battery pack	
02	Improve drag performance of a chosen external vehicle element	

Text Books/Reference Books:

1. Dr. N.K. Giri, Automotive Mechanics, 8th Edition,2008, Khanna Publication, New Delhi.
2. Practical Aspects of Structural Optimization, Altair University, 3rd Edition.
3. Robin Hardy, Iqbal Husain, "Electric and Hybrid Vehicles". CRC Press, ISBN 0-8493-1466-6.
4. Ron Hodkinson and John Fenton, "Lightweight Electric/ Hybrid Vehicle Design". SAE International
5. John M. Miller, Propulsion Systems for Hybrid Vehicles" Institute of Electrical Engineers, London, ISBN0 863413366.
6. Automobile Electrical and Electronic systems, Tom Denton, Third Edition, 2004, SAE International, SAE ISBN 0 7680 147 2, Society of Automotive Engineers. Inc 400 common wealth Drive, Warrendale, PA 15096-0001 USA.

Course Code: **19EMEE308**	Course Title: **Applications of Vibrations and Acoustics**	
L-T-P:**3-0-0**	Credits:**03**	Contact Hrs: 0**3**
ISA Marks: **50**	ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **40**		Exam Duration: **03 Hours**

.

Content	Hrs
Unit 1	
1. Response of Mechanical Systems to Vibrations and Shocks Characteristics of vibration and shock, response of linear mechanical systems to vibrations, response properties of non-linear systems, response of mechanical systems to stationary random vibrations, shock response and shock spectra, vibrations in structures.	**05**
2. Vibration Measuring Instrumentation and Techniques Introduction, displacement, velocity and acceleration transducers, smart sensors and transducers, electronic data sheets, selection of accelerometer, calibration and system performance checks, practical considerations in mounting accelerometers, sensor design technique (FEA), sensor selection, mounting, cabling practices and signal conditioning, sensor and signal analysis.	**05**
3. Fundamentals of Signal Analysis Data acquisition and processing, signal operations, frequency domain analysis, sampling of continuous time signals, Fast Fourier transform, FFT analyser setup, leakage and windowing, averaging, real-time analysis of stationary and transient signals.	**05**
Unit 2	
4. Vibration Monitoring and Analysis Techniques Transducer considerations, vibration data collection errors, time domain analysis, statistical descriptors of vibration signals, Lissajous pattern, frequency domain analysis, quefrency domain analysis, demodulation technique, advanced fault diagnostic techniques.	**05**
5. Modal Analysis Experimental aspects of modal testing, FRF data of SDOF and MDOF systems, Classical, OMA, ODS, SRS & FE Correlation, vibration and shock testing, examples of vibration and acoustics – automotive, aerospace and defence, engineering and white goods, research.	**05**

6. Vibration Control Introduction; Vibration Nomo graph and vibration criteria; Reduction of vibration at the source, Control of vibration; Control of natural frequencies, Introduction of damping, Vibration isolation for different types of foundation, Shock isolation, Active vibration control, Vibration absorbers: Undamped and damped dynamic vibration absorber.	**05**
Unit 3	
7. Fundamentals of Sound Sensor selection, measurement techniques, applications-environmental, product noise: sound power and sound pressure, noise source identification: intensity and acoustic holography, building acoustics, sound quality.	**05**
8. Standards for Noise and Vibration Standards for sensors, frequency analysis, sound level meter, sound power measurement, sound intensity measurement, vibration measurement, measurement of damping.	**05**

Text Book

1. C. Sujatha, Vibration and Acoustics, Tata McGraw-Hill Education, 2010
2. Bruel and Kjaer, Mechanical Vibration and Shock Measurements, Larsen & son, 2nd Edition, 1984.
3. M. L. Munjal, Noise and Vibration Control, World Scientific Publishing Co, Pvt. Ltd., 2013