KONGU ENGINEERING COLLEGE, PERUNDURAI - 638 060

MINUTES OF THE MEETING OF BOARD OF STUDIES IN AUTOMOBILE ENGINEERING

MEETING No. 23

DATE : 12-02-2022

TIME : 10.00 AM (Online/ Offline)

Google Meet Id: https://meet.google.com/mqv-jasn-bpz

The following members were present for the meeting:

1.	**Dr. C. Jegadheesan** Associate Professor and Head Department of Automobile Engineering Kongu Engineering College	Chairman
2.	**Dr. M. Bharathiraja** Associate Professor & Head Department of Automobile Engineering Bannari Amman Institute of Technology Sathyamangalam - 638401	University Nominee
3.	**Dr. M. Subramanian** Associate Professor Department of Automobile Engineering PSG College of Techonlogy Coimbatore - 641112	Academic Council Nominee
4.	**Dr. K. Prabu** Associate Professor Department of Automotive Engineering Vellore Institute of Technology Vellore - 632014	Academic Council Nominee
5.	**Mr. R.D. Yoganand** AGM – Product Development Ashok Leyland Limited Chennai – 600103	Industry Representative
6.	**Mr. J. Ajith** Engineer Brakes India Pvt Ltd, Padi, Chennai - 600050	Alumni Representative
7.	**Dr. P. Somasundaram** Professor Department of Automobile Engineering Kongu Engineering College	Internal Member
8.	**Dr. P. C. Murugan** Associate Professor Department of Automobile Engineering Kongu Engineering College	Internal Member
9.	**Mr. K.S. Karthi Vinith** Assistant Professor Department of Automobile Engineering Kongu Engineering College	Internal Member
10.	**Mr. S. Sathiskumar** Assistant Professor Department of Automobile Engineering Kongu Engineering College	Internal Member
11.	**Mr. P. Senthil Kumar** Assistant Professor Department of Automobile Engineering Kongu Engineering College	Internal Member

15/02/2022

12.	**Mr. N. Boopalan** Assistant Professor Department of Automobile Engineering Kongu Engineering College	Internal Member
13.	**Mr. S. Ranjithkumar** Assistant Professor Department of Automobile Engineering Kongu Engineering College	Internal Member
13.	**Mr. M. Boopathi** Assistant Professor Department of Automobile Engineering Kongu Engineering College	Internal Member

The following members were present as special invitees: Nil

The following members have requested for leave of absence: Nil

Meeting of the Automobile Engineering Board:

Chairman/BoS welcomed the members and briefed on curriculum, syllabi of courses to be added and syllabi of courses to be modified under Regulation 2020 for UG & PG Programmes.

The board discussed and approved the following points as per the agenda:

Item No. 23.1: Ratification of the following items under R2018 & R2020 as given in Annexure-I.

a. One / Two credit courses
b. Online courses
It is resolved to ratify the above items a and b as given in Annexure – I.

Item No. 23.2. Approval of the curriculum, syllabi of courses to be added newly and syllabi of courses to be modified from 2nd semester to 8th semester for BE Automobile Engineering under R2020 as given in Annexure-II.

The members discussed the curriculum, syllabi of courses to be added newly and syllabi of courses to be modified from 2nd semester to 8th semester for BE Automobile Engineering as given in Annexure-II and approved the same.

Item No. 23.3. Approval of the syllabi of courses to be studied for honours degree under R2020 as given in Annexure-III.

The members discussed the syllabi of the courses to be studied for honours degree under R2020 as given in Annexure – III and approved the same.

Item No. 23.4. Approval for Value Added Courses (one / two credit courses), on-line courses with syllabi to be offered from first semester onwards. Transfer of credits from UGC & AICTE approved institutions and Credit transfer from foreign universities under R2018 & R2020 as given in Annexure-IV.

The members discussed the value added courses (one/ two credit courses), on-line courses with syllabi to be offered from first semester onwards. Transfer of credits from UGC and AICTE approved institutions including NPTEL, SWAYAM, etc., and Credit transfer from foreign universities under R2018 & R2020 (from the year 2021-22 onwards) as given in Annexure – IV and approved the same.

15/02/2022

Item No. 23.5. Approval of Syllabus for PhD courses under R2020 as given in Annexure-V.

NA

Reporting Item No. 23.6. Proctored online/ conventional examination system being followed for the November / December 2021 end semester / trimester examinations as given in Annexure-VI.

The members appreciated the proctored online/ conventional examination system being followed for the November / December 2021 end semester / trimester examinations as given in Annexure-VI.

The meeting was concluded with a vote of thanks to the members.

Name & Signature (Dr. M. Bharathiraja)	Name & Signature (Dr. M. Subramanian)
Name & Signature (Dr. K. Prabu)	15/02/22 Name & Signature (Mr. J. Ajith)
Name & Signature (Mr. R.D. Yoganand)	15/2/22 Name & Signature (Dr. P. Somasundaram)
15/2/22 Name & Signature (Dr. P. C. Murugan)	15/2/22 Name & Signature (Mr. K.S. Karthi Vinith)
15/2/22 Name & Signature (Mr. S. Sathiskumar)	15/2/22 Name & Signature (Mr. P. Senthil Kumar)
15/2/22 Name & Signature (Mr. N. Boopalan)	15/2/2022 Name & Signature (Mr. S. Ranjithkumar)
15/2/22 Name & Signature (Mr. M. Boopathi)	15/2/2022 Name & Signature (Dr. C. Jegadheesan) Chairman/BoS

Dr. C.JEGADHEESAN
ASSOCIATE PROFESSOR & HEAD
DEPT. OF AUTOMOBILE ENGG.
KONGU ENGINEERING COLLEGE
THOPPUPALAYAM (Po)
PERUNDURAI, ERODE - 638 060

Annexure – I

Ratification items under R2018 & R2020 implemented during the academic year 2021-22 and previous years.

a. One / Two Credit courses

- 18VAC38 - Lean Manufacturing
- 18VAC35 - Automotive Component Modelling Using Autocad
- 18VAC34 - Fuel Cell Technology and Its Electrochemistry

b. Online courses

- Automation in Production Systems and Management
- Product Design and Development

Annexure - II

(i) Curriculum, syllabi of courses to be added newly and syllabi of courses to be modified from 2nd semester to final semester for BE Automobile Engineering R2020

(a) List of courses newly added:

S.No.	Course Code and Course Name	Semester	Regulation
1.	20AUL53 - Vehicle Dynamics Simulation Laboratory	V	R2020

(b) List of courses modified the syllabus content:

S.No.	Course Code & Course Name	Semester	Regulation
NA			

(c) List of courses removed:

S.No.	Course Code & Course Name	Semester	Regulation
1.	20AUL53 – Two and Three Wheeler Laboratory	V	R2020

(d) List of courses swapped:

S.No.	Course Code(s) & Course Name(s)	Existing Semester	Swapped Semester	Regulation
1.	20CSC31 - Programming in C (2021 - 2022)	III	II	R2020
2.	20CSC41 - Python Programming (2021 - 2022)	IV	III	R2020
3.	20AUT21 - Mechanics of Fluids and Hydraulic Machines (2020 - 2021)	II	IV	R2020

B.E. AUTOMOBILE ENGINEERING CURRICULUM – R2020

SEMESTER – I

Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
		L	T	P		CA	ESE	Total	
Theory/Theory with Practical									
20EGT11	English Language Skills	3	0	0	3	50	50	100	HS
20MAC11	Matrices and Differential Equations	3	1*	2*	4	50	50	100	BS
20PHT11	Applied Physics	3	0	0	3	50	50	100	BS
20CYT11	Applied Chemistry	3	0	0	3	50	50	100	BS
20MEC11	Engineering Drawing	2	0	2	3	50	50	100	ES
20AUT11	Statics and Dynamics	3	1	0	4	50	50	100	PC
Practical / Employability Enhancement									
20PHL11	Physical Sciences Laboratory I	0	0	2	1	50	50	100	BS
20MEL11	Engineering Practices Laboratory	0	0	2	1	50	50	100	ES
20VEC11	Yoga and Values for Holistic Development	1	0	1	1	100	0	100	HS
20MNT11	Induction Training Program	--	--	--	0	100	0	100	MC
Total Credits to be earned					23				

SEMESTER – II									
Course Code	Course Title	Hours / Week			Credit	Maximum Marks			
		L	T	P		CA	ESE	Total	
Theory/Theory with Practical									
20EGT21	Advanced Communication Skills	3	0	0	3	50	50	100	HS
20MAC21	Multivariable Calculus and Complex Analysis	3	1*	2*	4	50	50	100	BS
20PHT22	Materials Science and Metallurgy	3	0	0	3	50	50	100	BS
20CYT22	Chemistry for Mechanical Systems	3	0	0	3	50	50	100	BS
20AUT21 / 20CSC31	Mechanics of Fluids and Hydraulic Machines (2020 - 2021)	3	1	0	4	50	50	100	PC
	Programming in C (2021 - 2022)	3	0	2	4	50	50	100	ES
20AUT22	Manufacturing Technology	3	0	0	3	50	50	100	ES
Practical / Employability Enhancement									
20PHL23	Physical Sciences Laboratory II	0	0	2	1	50	50	100	BS
20AUL21	Manufacturing Technology Laboratory	0	0	2	1	50	50	100	ES
Total Credits to be earned					22				

SEMESTER – III									
Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
		L	T	P		CA	ESE	Total	
Theory/Theory with Practical									
20MAT31	Probability and Partial Differential Equations	3	1	0	4	50	50	100	BS
20CSC31 / 20CSC41	Programming in C (2020 - 2021) Python Programming (2021 - 2022)	3	0	2	4	50	50	100	ES
20AUT31	Mechanics of Deformable Bodies	3	0	0	3	50	50	100	PC
20AUT32	Automotive Powertrain	3	0	0	3	50	50	100	PC
20AUT33	Thermodynamics	3	1	0	4	50	50	100	PC
20AUT34	Automotive Electrical Systems & Drives	3	0	2	4	50	50	100	ES
Practical / Employability Enhancement									
20AUL31	Mechanics of Deformable Bodies Laboratory	0	0	2	1	50	50	100	PC
20AUL32	Automotive Power Train Laboratory	0	0	2	1	50	50	100	PC
20MNT31	Environmental Science	2	0	0	0	100	0	100	MC
Total Credits to be earned					24				

[redacted]

[redacted]	Course Title	Hours / Week			Credit	Maximum Marks			Category
		L	T	P		CA	ESE	Total	
[redacted] Theory with Practical									
[redacted] 20MAT41	Statistics and Numerical Methods	3	1	0	4	50	50	100	BS
20CSC41 / 20AUT21	Python Programming (2020 - 2021)	3	0	2	4	50	50	100	ES
	Mechanics of Fluids and Hydraulic Machines (2021 - 2022)	3	1	0	4	50	50	100	PC
20AUT41	Thermal Engineering and Heat Transfer	3	1	0	4	50	50	100	PC
20AUT42	Automotive Chassis	3	0	0	3	50	50	100	PC
	Open Elective - I	3	1/0	0/2	4	50	50	100	OE
Practical / Employability Enhancement									
20AUL41	Fuels and Lubricants Laboratory	0	0	2	1	50	50	100	PC
20AUL42	Automotive Chassis Components Laboratory	0	0	2	1	50	50	100	PC
20EGL31	English for Workplace Communication Laboratory	0	0	2	1	50	50	100	HS
20GET41	Universal Human Values	2	0	0	2	100	0	100	HS
Total Credits to be earned					24				

SEMESTER – V

Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
		L	T	P		CA	ESE	Total	
Theory/Theory with Practical									
20AUT51	Mechanics of Machines	3	0	0	3	50	50	100	PC
20AUT52	Automotive Sensors and Controllers	3	0	0	3	50	50	100	PC
20AUT53	Vehicle Dynamics	3	0	0	3	50	50	100	PC
	Open Elective - II	3	1/0	0/2	4	50	50	100	OE
	Professional Elective - I	3	0	0	3	50	50	100	PE
Practical / Employability Enhancement									
20AUL51	Computer Aided Design Laboratory	0	0	2	1	50	50	100	PC
20AUL52	Automotive Sensors and Controllers Laboratory	0	0	2	1	50	50	100	PC
20AUL53	Vehicle Dynamics Simulation Laboratory	0	0	2	1	50	50	100	PC
20GEI51	Professional Skills Training 1 / Industrial Training 1	--	--	--	2	100	0	100	EC
Total Credits to be earned					21				

SEMESTER – VI									
Course Code	Course Title	Hours / Week			Credit	Maximum Marks			
		L	T	P		CA	ESE	Total	
Theory/Theory with Practical									
20AUT61	Machine Design	3	0	0	3	50	50	100	PC
20AUT62	Automotive Control System	3	0	0	3	50	50	100	PC
20AUT63	Automotive Embedded Systems	3	0	0	3	50	50	100	PC
	Open Elective - III	3	0	0	3	50	50	100	OE
Practical / Employability Enhancement									
20AUL61	Computer Aided Analysis Laboratory	0	0	2	1	50	50	100	PC
20AUL62	Vehicle Maintenance Laboratory	0	0	2	1	50	50	100	PC
20AUL63	Automotive Embedded Systems Laboratory	0	0	2	1	50	50	100	PC
20AUP61	Project Work 1	0	0	4	2	100	0	100	EC
20GEI61	Professional Skills Training 2 / Industrial Training 2	--	--	--	2	100	0	100	EC
20GEP61	Comprehensive Test and Viva	--	--	--	2	100	0	100	EC
Total Credits to be earned					21				

SEMESTER – VII									
Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
		L	T	P		CA	ESE	Total	
Theory/Theory with Practical									
20MBT71	Economics and Management for Engineers	3	0	0	3	50	50	100	HS
20AUT71	Hybrid and Electric Vehicles	3	0	0	3	50	50	100	PC
	Professional Elective – II	3	0	0	3	50	50	100	PE
	Professional Elective – III	3	0	0	3	50	50	100	PE
	Professional Elective – IV	3	0	0	3	50	50	100	PE
	Professional Elective - V	3	0	0	3	50	50	100	PE
Practical / Employability Enhancement									
20AUP71	Project Work 2 Phase I	0	0	6	3	50	50	100	EC
Total Credits to be earned					21				

SEMESTER – VIII									
Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
		L	T	P		CA	ESE	Total	
Theory/Theory with Practical									
	Open Elective - IV	3	0	0	3	50	50	100	OE
	Professional Elective -VI	3	0	0	3	50	50	100	PE
Practical / Employability Enhancement									
20AUP81	Project Work 2 Phase II	0	0	14	7	50	50	100	EC
Total Credits to be earned					13				

20AUL53 - VEHICLE DYNAMICS SIMULATION LABORATORY

Programme & Branch	**B.E. – Automobile Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
Prerequisites	**NIL**	**5**	**PC**	**0**	**0**	**2**	**1**
Preamble	This course provides hands on experience in modeling and simulating various automotive systems to evaluate various performance						

List of Exercises / Experiments:

1.	Introduction to Matlab and Simulink
2.	Introduction to SimScape and Vehicle Dynamics Blockset
3.	Calculate static and dynamic axle loads of a vehicle
4.	Evaluate tractive force and acceleration parameters of a car
5.	Estimate braking torque of disc and drum brakes
6.	Analyze braking performance of a car
7.	Compare stiffness of car tyre and truck tyre for different payload
8.	Compute tyre forces, offset and self-aligning torque
9.	Calculate cornering resistance of a four axled truck for various steering angles
10.	Evaluate steady state cornering characteristics of a vehicle
11.	Estimate ride comfort using quarter car model at constant velocity on a random road
12.	Analyze dynamics of a quarter car model with non-linear spring and sky hook damper crossing an obstacle

Total:30

REFERENCES/MANUAL/SOFTWARE:

1.	Laboratory Manual

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	Evaluate and analyze longitudinal dynamics of a vehicle	Applying (K3), Precision (S3)
CO2	Estimate handling and tyre characteristics of a vehicle	Applying (K3), Precision (S3)
CO3	Compute and analyze ride comfort characteristics of a vehicle	Applying (K3), Precision (S3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	1	3				1	1		2	3	
CO2	3	3	2	1	3				1	1		2	3	
CO3	3	3	2	1	3				1	1		2	3	

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

Annexure - III

Syllabi of the courses to be studied for BE Automobile Engineering with Honours in E - Mobility under R2020

DEPARTMENT OF AUTOMOBILE ENGINEERING

If a candidate earns 18 to 20 credits additionally in any particular specialization during the programme, such candidate can be awarded with Honours degree in that specialization as per the guidelines of AICTE upon getting the approval from Anna University, Chennai. A candidate shall have not less than 8.0 CGPA and no history of arrears to opt for the honours degree and has to maintain the same during the entire programme.

BE Degree in Automobile Engineering with Honours in E - Mobility

List of courses to be studied additionally for Honours degree

S.No.	Course Title	Hours / Week			Credit
		L	T	P	
1.	Advanced Energy Storage and Management	3	0	0	3
2.	Power Electronics and Drives	3	0	0	3
3.	Vehicle Networking and Communication	3	0	0	3
4.	Automotive IoT Technologies	3	0	0	3
5.	Modelling and Control of Electric Vehicles	2	0	2	3
6.	Connected and Autonomous Vehicles	3	0	0	3
Total Credits					**18**

20AUTXX – ADVANCED ENERGY STORAGE AND MANAGEMENT

Programme & Branch	B.E. – Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Nil			3	0	0	3

Preamble	This course provides knowledge on advanced energy storage and its management techniques used in electric vehicles.

Unit - I	**Energy Storage Devices**	9

Battery parameters - Overview of lithium-ion batteries and supercapacitors - Limits to potential future developments - Lead–acid batteries - Nickel–metal hydride and nickel–zinc batteries - Post-lithium-ion battery chemistries.

Unit - II	**Lithium-ion batteries**	9

Cell designs - Battery pack design - Environmental aspects - Safety requirements - Future developments in cell chemistries - Future developments in Li-ion battery packs - Market forces and future trends - High-performance electrode materials.

Unit - III	**Battery design and performance**	9

Design of high-voltage battery packs for electric vehicles - High-voltage battery management systems (BMS) - Requirements – Topology - Design - Cell balancing, battery state estimation, and safety aspects of battery management systems.

Unit - IV	**Thermal management of batteries**	9

Motivation - Heat sources, sinks, and thermal balance - Design aspects - Exemplary design calculations - Technologies in comparison - Aging of lithium-ion batteries - Aging effects - Cell design and cell integrity - Aging of battery packs.

Unit - V	**Battery charging systems and Recycling**	9

Mobility behavior and charging - Classification of battery charging systems - Advantages and disadvantages - Standards for electric vehicle batteries - Testing procedures - Battery recycling - Recycling technologies - Recycling of lithium batteries.

Total:45

TEXT BOOK:

1.	Bruno Scrosati, Jürgen Garche, and Werner Tillmetz, "Advances in Battery Technologies for Electric Vehicles", 1st Edition, Woodhead Publishing, UK, 2015.	I,II,III,IV,V

REFERENCES:

1.	Advances in Battery Technologies for Electric Vehicles. Netherlands, Elsevier Science, 2015.
2.	Javani, Nader., Hamut, Halil S.., Dinçer, Ibrahim. Thermal Management of Electric Vehicle Battery Systems. United Kingdom: Wiley, 2017.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	explain the concept of energy storage devices used in automobile.	Understanding (K2)
CO2	illustrate the construction and working of Lithium-ion batteries.	Understanding (K2)
CO3	design and development of batteries for electric vehicle applications.	Applying (K3)
CO4	describe about the thermal management techniques for energy storage devices.	Understanding (K2)
CO5	explain the battery charging systems and recycling techniques.	Understanding (K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1				2					1	1	3
CO2	3	2	1				2					1	1	3
CO3	3	3	1			2	2					1	1	3
CO4	3	2	1				2					1	1	3
CO5	3	2	3			2	2					1	1	3

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	80					100
CAT2	20	60	20				100
CAT3	20	80					100
ESE	20	60	20				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

20AUTXX - POWER ELECTRONICS AND DRIVES

Programme & Branch	B.E. – Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Automotive Electrical Systems			3	0	0	3

Preamble	This course depicts the working principles of power electronic devices, converters, drives and their applications.	
Unit - I	**Drive Motor Characteristics:**	9
Mechanical characteristics – Speed – Torque characteristics of various loads and drive motors – Braking of electrical motors – DC Motors: Shunt, series and compound – Single phase and three phase induction motors.		
Unit - II	**AC-DC and DC-AC Converters :**	9
Principle of phase controlled converter with R and RL load - freewheeling Diode- single phase full wave converter – single phase semi converter – three phase semi converter – three phase fully controlled converter – Introduction to inverter –1ϕ and 3ϕ Voltage source inverters –PWM inverters.		
Unit - III	**DC - DC and AC - AC Converter:**	9
DC Chopper – Control strategies – Principle of operation – Step up and step down chopper – Single phase AC voltage controller – On - off control and phase control – Sequence control of AC voltage controller – 1ϕ Step up and step down cycle converters		
Unit - IV	**Electric DC Drives:**	9
DC Drives - Introduction to DC drives – Basic performance equations of DC motor – single phase DC drives – three phase DC drives – Chopper Drives – two quadrant chopper drive – four quadrant chopper drive.		
Unit - V	**AC Drives:**	9
Introduction – Induction motor drives – speed control of 3-phase induction motor – stator voltage control – stator frequency control – stator voltage and frequency control – stator current control – static rotor resistance control – slip power recovery control.		

Total: 45

TEXT BOOK:

1.	Bimbhra B.S., "Power Electronics", 5th Edition, Kanna Publishers, New Delhi, 2012.	I,II,III,IV,V

REFERENCES:

1.	Singh M.D. & Kanchandhani K.B., "Power Electronics", McGraw Hill, New Delhi, 2007.
2.	Gobal K. Dubey, "Fundamentals of Electrical Drives", 2nd Edition, Narosal Publishing House, New Delhi, 2001.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	explain the various drive characteristics of electrical motors	Understanding (K2)
CO2	describe the working principle of power inverters used in electric vehicles	Understanding (K2)
CO3	express the construction and working of choppers used in electric vehicles	Understanding (K2)
CO4	select a suitable power converter for a given DC drives	Applying (K3)
CO5	choose an appropriate power converter for a given AC drives	Applying (K3)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1									1		3
CO2	3	2	1									1		3
CO3	3	2	1									1		3
CO4	3	2	1									1		3
CO5	3	2	1									1		3

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	20	80					100
CAT2	20	80					100
CAT3	10	60	30				100
ESE	10	50	40				100

*** ±3% may be varied (CAT 1, 2, 3 – 50 marks & ESE – 100 marks)**

20AUTXX - VEHICLE NETWORKING AND COMMUNICATION

Programme & Branch	B.E. – Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Automotive Embedded Systems			3	0	0	3

Preamble	This course deals with networking and communication systems involved in a vehicle.	
Unit - I	**Introducing the Smart Vehicle:**	9
Intra-Vehicle Communications: Communications Protocols - Additional Intra-Vehicle Communication Functions - Systems and Sensors. Inter-Vehicle Communications: Cooperative Driving - Consumer Assistance - Smart Parking.		
Unit - II	**Communications Fundamentals:**	9
Fundamental Concepts: Powers of 10 – Frequency – Bandwidth - Power Measurements - Signal-to-Noise Ratio - Transmission Rate Constraints. Radio Frequency Spectrum Allocation: U.S. Spectrum Allocation - Band Nomenclature – Applications. Radar Operations: Police Radar - Types of Radar. IEEE Wireless LANs: IEEE Standards.		
Unit - III	**Controller Area Network:**	9
CAN Versions - Types of Controllers - Layered Architecture - CAN Bus. Message Frames: Data Frame - Remote Frame - Error Frame - Overload Frame. Error Handling: Communications Error Handling - Parity Checking - Block Checking - CAN Error Handling - Node Removal - Error Detection Methods - CAN Controller Operations.		
Unit - IV	**Intra-Vehicle Communications:**	9
Wired Communications: Network Comparison - Two-Tier Approach - LIN Applications - CAN Applications. Wireless Communications – Bluetooth: Operation - Spectrum Utilization – Modulation -Frequency Hopping -Logical Channels - Device Addressing - Operational Modes - Service Discovery Protocol - Vehicle Applications. Satellite Services: Satellite Radio - Vehicle Care - Traffic Status		
Unit - V	**Inter-Vehicle Communications:**	9
Ad Hoc Networking – Formation - Rationale for Use – Applications - Communications Technologies - Vehicle Frequency Utilization. The Intelligent Roadway - Roadway Design - Lane Direction - Road Junction - Traffic Light - Road Exit - Temporary Obstacles - Transmission Methods - Evolving Smart Vehicle.		

Total:45

TEXT BOOK:

1.	Held, Gilbert, "Inter- and Intra-Vehicle Communications", Auerbach Publications; 1st edition,2007.	I, II, III, IV, V

REFERENCES:

1.	Dr. Fei Hu , "Vehicle-to-Vehicle and Vehicle-to-Infrastructure Communications" CRC Press; 1st edition, 2020.
2.	Christoph Sommer, Falko Dressler, "Vehicular Networking", Cambridge University Press; 1st edition, 2015.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	explain the basic concepts of vehicle network and communications systems.	Understanding (K2)
CO2	describe the fundamentals and standards of communication systems.	Understanding (K2)
CO3	illustrate the controller area network and its operations.	Understanding (K2)
CO4	explain the intra- vehicle communication systems and its applications.	Understanding (K2)
CO5	describe the Inter vehicle networking and communication technologies.	Understanding (K2)

Mapping of COs with POs and PSOs														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1			1						1		3
CO2	3	1	1			1						1		3
CO3	3	1	1			1						1		3
CO4	3	1	1			1	1					1		3
CO5	3	1	1			1	1					1		3

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	25	75					100
CAT2	25	75					100
CAT3	30	70					100
ESE	30	70					100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

20AUTXX - AUTOMOTIVE IoT TECHNOLOGIES

Programme & Branch	B.E. – Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Automotive Sensors and Controllers			3	0	0	3

Preamble	This course provides knowledge on basic networking, IoT Technologies and its application in automotive industry.

Unit - I	**INTRODUCTION**	9

Basics of Networking – Network types, Layered Network Models, Addressing, TCP/IP Transport layer. Basics of Network Security – Security, Network Confidentiality, Message Integrity and Authenticity, Key Management, Internet Security, Firewall. Predecessors of IoT – Wireless Sensor Networks, Machine to Machine Communications, Cyber Physical Systems

Unit - II	**INTERNET OF THINGS**	9

Emergence of IoT - IoT Sensing and Actuation –IoT Processing Topologies and Types

Unit - III	**IoT TECHNOLOGIES**	9

IoT Connectivity Technologies - Cloud Computing - Fog Computing and Its Applications

Unit - IV	**HARDWARE INTEGRATION**	9

Beginning IoT Hardware Projects – Arduino Boards, Arduino Sketch, Raspberry Pi Boards; IoT Analytics – Machine Learning, Advantages of ML, Challenges in ML, Types of ML, Selected Algorithms in ML, Performance Metrics for Evaluating ML Algorithms.

Unit - V	**AUTOMOTIVE APPLICATIONS**	9

Biometric Car Door Opening System – Accident Monitoring System – Engine Oil and Coolant Level Monitoring System – Fleet and Driver Management System – Smart Road Communication System for Mobile Vehicles – Talking Road Turn at Pin Turn in Hilly Areas – Real Time Car Telematics Tracking System

Total:45

TEXT BOOK:

1.	Sudip Misra, Anandarup Mukherjee and Arjit Roy, "Introduction to IoT, 1st Edition, 2021, Cambridge University Press, United Kingdom	I,II,III,IV
2.	Rajesh Singh, Anta Gehlot, Raghuveer Chimata, Bhupendra Singh and P.S.Ranjit, "Internet of Things in Automotive Industry and Road Safety : Electronic Circuits, Program Coding and Cloud Servers" 1st Edition, River Publishers, Denmark	V

REFERENCES:

1.	Pethuru Raj and Anupama C.Raman, " The Internet of Things : Enabling Technologies, Platforms and use Cases", 1st Edition, 2017, CRC Press, London.
2.	Simone Cirani, Gianluigi Ferrari, Marco Picone, Luca Veltri, " Internet of Things : Architectures, Protocols and Standards", 1st Edition, 2019, John Wiley & Sons Ltd, Chennai

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	explain networking types and its security features.	Understanding (K2)
CO2	illustrate the various sensing, actuation and processing topologies of IoT.	Understanding (K2)
CO3	Compare the different IoT technologies for automotive applications.	Understanding (K2)
CO4	Describe about the integration of hardware with sensors .	Understanding (K2)
CO5	explain the various automotive applications using IoT	Understanding (K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1					2	1				1	1	3
CO2	3	1					2	1				1	1	3
CO3	3	1					2	1				1	1	3
CO4	3	1		2			2	1				1	1	3
CO5	3	1		2			2	1				1	1	3

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	80					100
CAT2	20	80					100
CAT3	20	80					100
ESE	20	80					100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

20AUTXX – CONNECTED AND AUTONOMOUS VEHICLES

Programme & Branch	B.E. – Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Nil			3	0	0	3

Preamble	This course provides a concept of artificial intelligence, as well as various associated techniques in the field of autonomous and connected vehicles in relation to ADAS systems.

Unit - I	**Artificial Intelligence for Vehicles:**	9

Introduction of AI - Methods of AI – Modern AI Challenges – Intelligent Vehicle – Explainable Artificial Intelligence (EAI) – Hybrid AI system – Advanced Driver Assistance Systems (ADAS) – Autonomous Vehicle – Construction of Intelligent Vehicle Building Blocks.

Unit - II	**Vision Sensors Algorithms:**	9

Vision sensors – Conventional Cameras – Emerging Sensors – Vision Algorithms – Type of Information – Estimation of Ego-movement and Localization – Detection of the navigable space – Detection of 3D plans and Obstacles - Visual Odometry

Unit - III	**Automated Driving Trajectory Planning:**	9

Definition – Trajectory Planning Characteristics – Prediction of Ghost Objects and Vehicles – Evaluation – Results on Real Vehicles and Simulators – Multi-objective Trajectory Planning – Linear Scalarization- Non-linear Scalarization – Ideal Methods – High Level Information - Multi Agent Planning for a Fleet of Vehicles.

Unit - IV	**ADAS for Automated and Connected Vehicle:**	9

Goal of ADAS - Generic Dynamic and Distributed Architecture – Environment and Climatic Conditions – Modelling of Perception Sensors – Connectivity Communication– Graphic Resources – Communication and Overall Risk – Automated Parking Maneuver – Co-pilot and Automated Driving – Eco-mobility and Eco-responsible Driving Profile – Case Studies.

Unit - V	**Cooperative Intelligent Transport Systems:**	9

Standards for Intelligent Transport Systems (ITS) – Architecture – Features of ITS Station Architecture – Deployment of Cooperative ITS services – Integration of Pedestrain Orientation of ADAS – Autonomous Vehicle – Legal Issues – Framework – Notion of Driver and Custodian – Liability Regime – Self-driving Vehicle Insurance – A Moroccan Case Study.

TEXT BOOK: Total:45

1. Abdelaziz Bensrhair and Thierry Bapin, "From AI to Autonomous and Connected Vehicles", Advanced Driver-Assistance Systems (ADAS), Volume 2, ISTE Ltd and John Wiley & Sons, Inc, UK and USA, 2021. I,II,III,IV,V

REFERENCES:

1. Hussein T. Mouftah, Melike Erol-Kantarci, and Sameh Sorour, "Connected and Autonomous Vehicles in Smart Cities", Ist Edition, CRC Press, Taylor & Francis Group, Finland, 2020.
2. Shaoshan Liu, Liyun Li, Jie Tang, Shuang Wu, and Jean-Luc Gaudiot, "Creating Autonomous Vehicle Systems" Second Edition, Morgan & Claypool, USA, 2020.

COURSE OUTCOMES: On completion of the course, the students will be able to	BT Mapped (Highest Level)
CO1 discuss the basic concepts and constructions of artificial intelligence in vehicles.	Understanding (K2)
CO2 describe the importance of sensors and visions algorithms for detection of objects.	Understanding (K2)
CO3 illustrate the various methods and characteristics of trajectory planning.	Understanding (K2)
CO4 explain the testing and evaluation of ADAS in connected vehicles.	Understanding (K2)
CO5 describe the standardized technologies enabling the exchange of data between vehicles	Understanding (K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	2		2	2					1	2	3
CO2	3	2	1	2		2	2					1	2	3
CO3	3	2	1	2		2	2					1	2	3
CO4	3	2	1	2		2	2					1	2	3
CO5	3	2	1	2		2	2					1	2	3

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	80					100
CAT2	20	80					100
CAT3	20	80					100
ESE	20	80					100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

Annexure – IV

Syllabi of One / Two credit courses

18VAC38 - LEAN MANUFACTURING

Programme & Branch	B.E. – Automobile Engineering	L	T	P	Credit
Prerequisites	Nil	2	0	0	2

Preamble	This course provide a knowledge on basic lean practice and the advanced lean concepts followed in the reputed organization.	
Unit - I	**LEAN BASICS:**	15
Lean basics 1 – Overview and scope – objectives – A brief history of lean – the lean enterprises – waste estimation – value streaming mapping – 5S and visual management. Lean Basics 2 – overview and scope – objectives – the lean enterprises - Heijunka – guide to level load – takt time production – single piece flow – standard work – tools of 3P – pull production – Kanban system.		
Unit - II	**ADVANCED LEAN CONCEPTS:**	15
Introduction to lean advance – standard work – cell design – pull production system – work load leveling – golf scoring – 7 ways – lean maturity tracker – strategy development – implementing PDCA and A3 – Case study.		

Total:30

REFERENCES:

1. James P. Womack, Daniel T. Jones, Lean Thinking, Free press business, Simon & Schuster, 2nd Edition, New York, 2003.
2. Maharjan S, Implementing the 5S methodology for the graphic communications management at University of Wisconsin-Stout), American Psychological Association, 6th edition, Menomonie, WI, 2011
3. Takashi Osada, The 5s's: Five Keys To A Total Quality Environment, Asian Productivity Organization, 2nd edition, Tokyo 1991.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	Discuss the fundamentals behind the 5S techniques.	Understanding(K2)
CO2	Explain the 5S standard and techniques.	Understanding(K2)
CO3	Illustrate the step by step to use 5S to organize a workplace.	Understanding(K2)
CO4	Understand the scope and breadth of 7 ways in industrial practice.	Understanding(K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	1								1		3
CO2	3	3	2	1								1		3
CO3	3	3	2	1								1		3
CO4	3	3	2	1								1		3

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	46	54					100
CAT2	45	55					100

18VAC34 – FUEL CELL TECHNOLOGY AND ITS ELECTROCHEMISTRY

Programme & Branch	B.E. – Automobile Engineering	L	T	P	Credit
Prerequisites	Nil	2	0	0	2

Preamble	This course addresses the various futuristic developments on alternate power source for the sustainable environment.	
Unit - I	**FUEL CELL TECHNOLOGY**	**10**
Introduction - Energy - Fuel Cell: A Green and Clean Energy Technology - History of Fuel Cell- Importance of Fuel Cell Over Battery - Types of Fuel Cells and Its Working- Power Range of Fuel Cells - Performance Evaluation of Fuel Cell - Merits and Demerits of Fuel Cells.		
Unit - II	**FUEL CELL PERFORMANCE**	**10**
Performance Characteristics and Test Setup- Current/Voltage, Voltage Efficiency and Power Density, Cell Design and Construction of Single Cell - Fabrication of Electrodes: Catalyst Ink Preparation - Coating Technique - Membrane Treatment - MEA Fabrication, Fuel Cell Stacks, Bi-Polar Plate, Humidifiers and Cooling Plates.		
Unit- III	**ELECTROCHEMISTRY OF FUEL CELL**	**10**
Materials and Methodology - Catalyst Preparation Techniques- Physicochemical Characterization: X-Ray Diffraction - Transmission Electron Microscope - Scanning Electron Microscopy - Electrochemical Set-Up and Characterization: Cyclic Voltammetry - Chronoamperometry - TAFEL Polarization.		

Total:30

TEXT BOOK:

1.	Frano Babir. "PEM Fuel Cells: Theory and Practice". Elsevier Academic Press., USA, 2005.	I, II, III

REFERENCES:

2.	Mehrdad Ehsani, Yimin Gao, Sebastien E. Gay and Ali Emadi. "Modem Electric, Hybrid Electric and Fuel cell Vehicles". Fundamental, Theory and Design"., CRS Press, USA, 2004.
3.	Hutchings G, Polshettiwar, V and Asefa T. "Nanocatalysis Synthesis and Applications". Hoboken, NJ, John Wiley & Sons, Inc., USA, 2013.
4.	Thring R. H. "Fuel cells for Automotive Applications". Professional Engineering Publishing., UK, 2004

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	understand the basic concepts of fuel cells and its importance for clean sustainability	Understanding (K2)
CO2	recognize the performance, operational issues and challenges of different fuel cells	Understanding (K2)
CO3	outline the identify the suitable energy materials and its applications	Understanding (K2)
CO4	review an energy based systems from materials research to product development	Understanding (K2)

Mapping of COs with POs and PSOs														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	1	1	2	2					1		3
CO2	3	3	2	1	1	2	2					1		3
CO3	3	3	2	1	1	2	2					1		3
CO4	3	3	2	1	1	2	2					1		3
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	46	54					100
CAT2	45	55					100

18VAC35 - AUTOMOTIVE COMPONENT MODELLING USING AUTOCAD

Programme & Branch	B.E. – Automobile Engineering	L	T	P	Credit
Prerequisites	Basic computer operations	0	0	2	1
Preamble	This course provides knowledge on 2D modelling of automotive components by understanding 2D orthographic and isometric drawings using Auto CAD				

List of Exercises / Experiments:

1.	Basic commands: Point, Line, Circle, Arc, Polyline, Polygon, Rectangle
2.	Donut, Spline, Hatch, Fill, Object Snap, Grid Space, Layers, Move, Copy, Offset, Trim, Extend, Mirror, Array
3.	Stretch, Fillet, Explode, Scale, Line Weight, Text, Mtext, and Leader.
4.	Other Commands: Viewing, Geometry, Precision, Layers, Properties, Modifying, Blocks
5.	Layouts, Notes and Labels, Dimensions, Printing, Exporting, Shortcuts.
6.	Conversion of orthographic into isometric projection, Conversion of isometric into orthographic projection,
7.	2D Modelling of automotive components: Engine Crank, Cylinder, Piston,
8.	2D Modelling of automotive components: Gear, Connecting Rod
9.	2D Modelling of automotive components: Clutch Plate.
10.	2D Modelling of automotive components: Leaf Spring.
11.	2D Modelling of automotive components: Steering Knuckle, Tie Rod.
12.	2D Modelling of automotive components: Propeller Shaft
13.	2D Modelling of automotive components: Coil Spring
14.	2D Modelling of automotive components: Fly Wheel,
15.	2D Modelling of automotive components: Brake Pads, Chassis

Total: 30

REFERENCES:

1. Learn about AutoCAD – An Introduction to AutoCAD Beginners, Autodesk User Manual.
2. George Omura, Brian C. Benton, Mastering AutoCAD 2019 and AutoCAD LT 2019, Wiley - 2018
3. Bill Fane, AutoCAD For Dummies, Wiley - 2016

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	Read and understand various AutoCAD drawings meant for automobile components	Applying (K3)
CO2	Convert orthographic projection into isometric projection and vice versa.	Applying (K3)
CO3	Identify the mistakes or overlaps in the orthographic drawing	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1		2						2				1
CO2	2			2										1
CO3	2	1		2										1

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - PRACTICAL

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
Assessment – MCQ (50 Marks)	20	30	50				100
Practical Examination (50 Marks)	-	-	100				100

20XXX_____ MODELLING DRIVELINE SYSTEMS WITH MATLAB SIMSCAPE

Programme & Branch	B.E. – Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	NIL		VAC	2	0	2	3

Preamble	This course provides knowledge on modelling of automotive driveline systems using MATLAB Simscape	
Unit - I	**Simscape Fundamentals :**	5
Introduction to Simscape and the Physical Network Approach - Working with Simscape Components - Connecting Physical Domains -Combining Simscape Models and Simulink Models - Creating Custom Components with the Simscape Language		
Unit - II	**Driveline Modelling:**	5
Basic Motion, Torque, and Force Modelling - Driveline Actuation - Gear Coupling Control Using Clutches - Transmissions with Gear Ratios and Clutch Schedules - Drivetrain Disturbances - Frictional and Thermal Losses - Automatic Transmission with a Dual Clutch		
Unit - III	**Driveline Simulation:**	5
Driveline Simulation Performance - Driveline Degrees of Freedom - Driveline States & Effect of Clutches - Troubleshoot Clutch and Transmission Errors - Resolve Partitioning Solver Simulation Issues for Simscape Driveline Models		

List of Exercises / Experiments:

1.	Create a compound pulley model using simscape
2.	Create a power window mechanism consists of a cable drum and four pulleys all connected by a cable
3.	Model and simulate a simple automotive clutch
4.	Model and simulate clutches for accelerating and braking
5.	Model and simulate a hydraulically actuated clutch
6.	Model and simulate a simple two speed transmission
7.	Model and simulate a five speed manual transmission.
8.	Model and simulate a vehicle with a series hybrid transmission.
9.	Model and simulate a vehicle with a parallel hybrid transmission.
10.	Model and simulate a vehicle with a power-split hybrid transmission.

Total: 45

REFERENCES:

1	https://in.mathworks.com/
2	Wei Liu., "Introduction to Hybrid Vehicle System Modelling and Control", Wiley India Pvt Ltd, New Delhi, 2015.
3	Harold Klee and Randal Allen., "Simulation of Dynamic Systems with MATLAB and Simulink" 3rd edition, CRC Press
4	Taylor & Francis Group, 2018

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	Select, organize and analyse various data using MATLAB	Applying (K3), Precision (S3)
CO2	Create and modelling of discrete and continuous systems	Applying (K3), Precision (S3)
CO3	Execute algorithms and develop libraries in MATLAB	Applying (K3), Precision (S3)
CO4	Model, simulate and analyse various data using MATLAB-SIMULINK	Applying (K3), Precision (S3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3				2	1	1	1	2	1
CO2	3	3	3	3	3				2	1	1	1	2	1
CO3	3	3	3	3	3				2	1	1	1	2	1
CO4	3	3	3	3	3				2	1	1	1	2	1

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
Assessment - I			50	50			100
Assessment - II			50	50			100

*** ± 3 % may be varied (CAT 1, 2, 3 – 50 marks & ESE – 100 marks)**

20XXX_____ MATLAB-SIMULINK FOR AUTOMOTIVE SYSTEM DESIGN

Programme & Branch	B.E. – Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	NIL		VAC	2	0	2	3

Preamble	This course provides knowledge on design of automotive systems using MATLAB-Simulink	
Unit - I	**MATLAB Fundamentals for Automotive Applications:**	5
MATLAB User Interface - Variables and commands - Analysis and visualization with vectors and matrices - Data selection, organization and analysing - Increasing automation with programming constructs and functions		
Unit - II	**Simulink Modelling of Automotive Systems:**	5
Introduction to Simulink - Creating and Simulating a Model – Modelling of Programming Constructs – Modelling of Discrete Systems – Modelling of Continuous Systems		
Unit - III	**Simulink Solver and Algorithms:**	5
Solver Selection - Developing Model Hierarchy - Modelling Conditionally Executed Algorithms - Combining Models into Diagrams - Creating and Managing Libraries		

List of Exercises / Experiments:

1.	Perform mathematical and statistical calculations with vectors and matrices as mathematical objects
2.	Extract, analyse and organise subsets of data to satisfy the given criteria.
3.	Perform typical data analysis tasks in MATLAB, including importing data from files, pre-processing data, fitting a model to data and creating a customized visualization of the model.
4.	Create flexible code that can interact with the user, make decisions, and adapt to different situations.
5.	Create a simple Simulink model, simulate it, and analyse the results.
6.	Model and simulate basic programming constructs in Simulink.
7.	Model and simulate discrete / continuous systems in Simulink.
8.	Select a solver that is appropriate for a given Simulink model.
9.	Create subsystems and execute based on a control signal input.
10.	Manage libraries to create and distribute custom blocks.

Total: 45

REFERENCES:

1	https://in.mathworks.com/
2	Shuvra Das., "Modelling for Hybrid and Electric Vehicles Using Simscape", Morgan & Claypool publishers, 2021.
3	Wei Liu., "Introduction to Hybrid Vehicle System Modelling and Control", Wiley India Pvt Ltd, New Delhi, 2015.
4	Holly Moore., "MATLAB for Engineers" 5th edition, Pearson Education Limited, 2019.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	Create and simulate compound models using Simscape.	Applying (K3), Precision (S3)
CO2	Model various manual and automatic driveline components used in vehicles.	Applying (K3), Precision (S3)
CO3	Simulate and resolve the issues in Simscape Driveline Models	Applying (K3), Precision (S3)
CO4	Model and simulate different types of vehicle transmission systems	Applying (K3), Precision (S3)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	3	3				2	1	1	1	2	1
CO2	3	3	3	3	3				2	1	1	1	2	1
CO3	3	3	3	3	3				2	1	1	1	2	1
CO4	3	3	3	3	3				2	1	1	1	2	1

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
Assessment - I			50	50			100
Assessment - II			50	50			100

*** ± 3 % may be varied (CAT 1, 2, 3 – 50 marks & ESE – 100 marks)**

Syllabi of Online courses

noc21-mg92 - Automation in Production Systems and Management

Course Layout

Week 1	:	Introduction to Manufacturing and Production Systems
Week 2	:	Automation in Manufacturing and Production Systems
Week 3	:	Product Development Process and Automation
Week 4	:	Fundamentals of NC Technology: Part-I
Week 5	:	Fundamentals of NC Technology: Part-II
Week 6	:	Flexible and Programmable Automation
Week 7	:	Cellular Manufacturing Systems
Week 8	:	Flexible Manufacturing Systems: Part-I
Week 9	:	Flexible Manufacturing Systems: Part-II
Week 10	:	Fundamentals of Robotic Systems
Week 11	:	Automated CAPP (Part-I)
Week 12	:	Automated CAPP (Part-II)

Books and references

1. Groover, M P, Automation, Production Systems, and Computer Integrated Manufacturing, Third Edition, Pearson Prentice Hall, Upper Saddle River
2. Groover, M P and Zimmers, E W Jr, CAD/CAM: Computer-aided Design and Manufacturing, Prentice-Hall of India Private Ltd.

noc21-de14 - Innovation by Design

Course Layout

Week 1:

- Module 1 – Introduction,
- Module 2 - First C: The Cause

Week 2:

- Module 3 - Second C: The Context,
- Module 4 - Third C: The Comprehension

Week 3:

- Module 5 - Fourth C: The Check,
- Module 6 - Fifth C: The Conception

Week 4:

- Module 7 - Sixth C: The Crafting,
- Module 8 - Seventh C: The Connection

Books and references

References

1. Chakku 7C's Link
2. Collaborative Model For Innovation Link
3. Pitfalls in the Innovation process Link
4. Innovation By Design – Collaboration is the key to cross the Pitsfalls in the Innovation Process Link

Annexure – V

NA

Annexure-VI

REPORTING ITEM

Online/ conventional method of examination system being followed for the November / December 2021 (both regular and arrear exams) End Semester / Trimester Examinations to be held in February 2022.

a) As per the directions issued by Anna University and guidelines issued by Higher Education Department, Government of Tamilnadu, BE / BTech, BSc and MSc (Integrated) End Semester Examinations will be conducted through online mode, with students taking up the examinations from their places of stay. Examinations will be proctored by using appropriate software and also be monitored by faculty invigilators.

b) MBA, MCA, ME / MTech and PhD coursework End Semester / Trimester Examinations will be conducted through conventional method (paper and pen) in campus.

c) The above examination procedure shall also be followed for the maximum period exhausted students