Ability / Skill Enhancement Courses				
Course Code	**Course title**	L	T/SDA	P
MMAU258A	**Automotive Heating, Ventilation and Air Conditioning**	1	0	0
MMAU258B	**Battery management system**	1	0	0
MMAU258C	**Autonomous Vehicles**	1	0	0
MMAU258D	**Drive cycles of Electric Vehicles**	1	0	0

Ability Enhancement Courses (AEC):.These courses are designed to help students enhance their skills in communication, language, and personality development. They also promote a deeper understanding of subjects like social sciences and ethics, culture and human behaviour, human rights, and the law. **Skill Enhancement Course (SEC):** Skill Enhancement Course means a course designed to provide value-based or skill-based knowledge and should contain both theory and lab/hands-on/training/fieldwork. The main purpose of these courses is to provide students with life skills in the hands-on mode to increase their employability.

If AEC/SEC courses are ONLINE (MOOCs) courses suggested by the concerned board of studies. These courses will be made available on **www. online.vtu.ac.in**, however online courses are not considered for vertical progression, but qualifying in online courses is mandatory for the award of the degree.

Core Courses

Specialization Course Code	Course Title
MMAU201	**Automotive Engine And Systems**
MMAU202	**Automotive Power trains**
MMAU203	**Manufacturing Techniques in Automotive Engineering**
MMAU214x	**Professional elective 3**
MMAU215x	**Professional elective 4**
MMAU206	**Automotive Body Engineering and safety**

Automotive Engine And Systems			
Course Code	MMAU201	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:2:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 10-12 Lab slots	Total Marks	100
Credits	04	Exam Hours	03

Course Learning objectives:

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

1. The course provides students with fundamental knowledge and principles in material
    a. Removal processes.
2. In this course, the students apply the fundamentals and principles of metal cutting to
    a. practical applications through multiple labs using lathes, milling machines, grinding
    b. machines, and drill presses, Computer Numerical Control etc.
3. To demonstrate the fundamentals of machining processes and machine tools.
4. To develop knowledge and importance of metal cutting parameters.
5. To develop fundamental knowledge on tool materials, cutting fluids and tool wear Mechanisms.
6. To apply knowledge of basic mathematics to calculate the machining parameters for different machining processes.

Module-1

Introduction:

Definition of a heat engine; external and internal combustion engine; basic engine components and nomenclature; the working principles of engines; classification of IC engines; application of IC engines.

Fuel Supply Systems:

SI Engine: Principle of elementary carburetor, Mixture requirements for steady state and transient operation, Gasoline Fuel Injection.

Engines: Fuel injection pump systems- Types, constructional features and operation, Factors influencing fuel spray atomization, penetration and dispersion of diesel,

Fuel Injection Pumps (inline, rotary), Filters, Governors – Types of Governors - fuel feed pumps and Types, injectors and nozzles – types, functions and necessities, injection lag, pressure waves in fuel lines

Teaching Learning Process

Teaching-Learning Process Process Teaching-Learning Process

Module-2

Module-2 Combustion in SI engines: Essential features of ignition timing and ignition voltage, MBT timing, knock detection and control strategies, thermodynamic analysis of SI engine combustion, analysis of cylinder pressure data. Combustion in CI engines: Essential features of injection timing and delay period, correlations for ignition delay in engines, effect of fuel properties, types of combustion chambers and merits of the different types, analysis of cylinder pressure data, fuel spray behavior.

Module-3

Module-3 Cooling and Lubrication System: Cooling System: Necessity, variation of gas temperature, Areas oh heat flow, heat transfer, piston and cylinder temperature,. Heat rejected to coolant, quantity of water required, cooling system, air cooling, water cooling, thermodynamics of forced circulation, thermostats, pressurized water cooling, regenerative cooling, comparison of air and water cooling, radiators types, cooling fan – power requirement, antifreeze solution. Lubrication System: Lubricants, lubricating systems, Lubrication of piston rings, bearings, oil consumption, Oil cooling. Heat transfer coefficients, liquid and air cooled engines, coolants, additives and lubricity improvers, oil filters, pumps, and crankcase ventilation – type

Module-4

Engine Management System: Combined ignition and fuel management systems. Digital control techniques. Complete vehicle control systems, Artificial intelligence and engine management, Exhaust emission control in SI and CI engines, Techniques Recent Developments in Automotive Engines: Supercharger, Working Principle, Effect of Super charging, Types and Methods of Super charging, Turbo Charger, Working Principle, Turbo lag, VVT, V-TEC i-VTEC and IDTEC. ATFT, CRDI system – working Principle, Advantages and Effect of CRDI on emission reductions, Hybrid vehicles and fuel cells

Module-5

Engine Performance Testing: Engine performance parameters; Methods of determination of BP, IP, FP, volumetric, thermal, mechanical, scavenging efficiencies, etc., types of dynamometers, Morse Test, Numerical Problems in Engine Testing , Engine Performance and heat balance sheet

PRACTICAL COMPONENT OF IPCC(May cover all / major modules)

Experiments 1 Assembling and Disassembling of Engine
2 Modeling of engine using appropriate material.
3 Study of lubrication systems in the proprotypes
4 Study on Fuel Supply Systems and modeling
5 Study on coolant
6 Study and performance of the engine and measuring the performance of engine

Assessment Details (both CIE and SEE) The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE.

A student shall be deemed to have satisfied the academic requirements and earned thecredits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together CIE for the theory component of IPCC

1. Two Tests each of 20 Marks
2. Two assignments each of 10 Marks/One Skill Development Activity of 20 marks
3. Total Marks of two tests and two assignments/one Skill Development Activity added will be CIE for 60 marks, marks scored will be proportionally scaled down to 30 marks.
4. CIE for the practical component of IPCC

- On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The15 marks are for conducting the experiment and preparation of the laboratory record, the other 05 marks shall be for the test conducted at the end of the semester.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to 15 marks.
- The laboratory test at the end /after completion of all the experiments shall be conducted for 50 marks and scaled down to 05 marks.
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the Laboratory component of IPCC for 20 marks. .

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03 hours)

1. The question paper will be set for 100 marks and marks scored will be scaled down proportionately to 50 marks.
2. The question paper will have ten questions. Each question is set for 20 marks.
3. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), should have a mix of topics under that module.
4. The students have to answer full questions, selecting one full question from each module.

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper shall include questions from the practical component).

- The minimum marks to be secured in CIE to appear for SEE shall be the 15 (50% of maximum marks-30) in the theory component and 10 (50% of maximum marks -20) in the practical component. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included. The maximum of 04/05 questions to be set from the practical component of IPCC, the total marks of all questions should not be more than the 20 marks.
- SEE will be conducted for 100 marks and students shall secure 40% of the maximum marks to qualify in the SEE. Marks secured will be scaled down to 50. (Student has to secure an aggregate of 50% of maximum marks

of the course(CIE+SEE)

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Two Unit Tests each of **25 Marks**
2. Two assignments each of **25 Marks** or **one Skill Development Activity of 50 marks** to attain the COs and POs

The sum of two tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Books

1. Metal Cutting Principles - M.C. Shaw - Oxford Publication – 1985.
2. Fundamentals of metal cutting & Machine Tools-by B.L.Juneja& G.S–Sekhar -Wiley Eastern

Web links and Video Lectures (e-Resources):

- .Web links and Video Lectures (e-Resources):
- VTU e-Shikshana Program
- VTU EDUSAT Program 20.06.2023 10.08.2023 10
- Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

Skill Development Activities Suggested

- Quizzes
- Assignments
- Seminars

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Understand all the concepts of Metal Cutting	5
CO2	Understand and analyse tool wear and Tool life	4
CO3	Each concept of Metal Cutting	5

Automotive Power Trains			
Course Code	MMAU202	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	25Hrs+10-12ActivitySessions	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:
To understand the basic concepts associated with the design and Functioning and applications of Robots To study about the drives and sensors used in Robots

Module-1

Over view of Vehicle Power trains System:
Outlines of Power Trains, Power train functions, Power train layout and components, Main and Auxiliary functions, Requirements profile, Interrelations: Direction of rotation, Transmission Ratio and Torque, Road Profiles, Load Profiles, Typical Vehicle uses and Driver types, Performance features of Vehicle Transmissions. Design trends in Transmission, Kinematical relations of power trains, Numerical problems.
Match in engine and transmission:
Roadloadsandaxleloads,Derivingconditiondiagram,Idealtransmissionandengine-transmissionsmatching, Total ratio and overall gear ratio- Selecting the largest power- train ratio, Selecting the smallest power-train ratio,Selectingtheintermediategears-sawtoothprofile,Geometricalgearsteps,Progressivegearsteps, Numericalproblems.05Hrs

Teaching-Learning Process	Chalk and talk method/ Power Point Presentation

Module-2

Start-up Devices:
One-wayclutch,Bandclutch,Multi-diskclutch,ClutchDesignandAnalysis,HydrodynamicClutchesandTorque Converters:Principles,CharacteristiccurvesofHydrodynamicClutches,ConstructionandoperationofTorque Converter, Input/output characteristics, Design Considerations, Trilok Converter, Torque Converter test diagram, Interaction of engine and Trilok Converter, Numerical problems.05 Hrs

Teaching-Learning Process	Chalk and talk method/Power Point Presentation

Module-3

Manual Transmissions:
ManualTransmissionLayoutsandComponents,Basicgearboxconstruction,gear-setswithfixedaxles, countershafttransmissionandepicyclicgears,schemesforreversegear.TransmissionPowerFlows, Numericalproblems. 05Hrs

Teaching-Learning Process	Chalk and talk method/Power Point Presentation

Module-4

Gear shifting mechanisms, Layout and design of Synchronizers:
Internal shifting mechanisms and External shifting mechanisms, Classification of shiftingelements,synchronizerfunctionalrequirements,synchronizingprocess,designofsynchronizers,alternativetransmissionsynchronizers.
05Hrs

Teaching-Learning Process	Chalk and talk method/Power Point Presentation

Module-5

AutomaticTransmissions:
Level of automation, Gear shift mode, stepped and Continuously Variable Transmissions, synchronizer gear boxes, epicycloidalgearboxes,CarCVT'S:VanDoorneContinuouslyVariableTransmission(CVT)andTorotrakContinuously Variable Transmission (CVT). Design and analysis of planetary gear trains, Gear ratios and clutch engagementschedule,Clutchtorquesinsteadystatecondition,Torqueanalysisinshiftingprocess,Numericalproblems.05Hrs

Teaching-Learning Process	Chalk and talk method/Power Point Presentation

AssessmentDetails(bothCIEandSEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE.A student shall be deemed to have satisfied the academic requirements and earned the creditsallotted toeachsubject/courseif the student securesnot lessthan 50%(50marksoutof 100)in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

ContinuousInternalEvaluation:

1. ThreeUnitTestseachof**20Marks**
2. Twoassignmentseachof**20Marks**or**oneSkillDevelopmentActivityof40marks** toattaintheCOsand POs

Thesumofthreetests,twoassignments/skillDevelopmentActivities,willbe**scaleddownto50marks**

CIEmethods/questionpaperisdesignedtoattainthedifferentlevelsofBloom'staxonomyasperthe outcomedefinedforthecourse.

SemesterEndExamination:

1. TheSEEquestionpaperwillbesetfor100marksandthemarksscoredwillbeproportionatelyreducedto 50.
2. Thequestionpaperwillhavetenfullquestionscarryingequalmarks.
3. Eachfullquestionisfor20marks.Therewillbetwofullquestions(withamaximumoffoursub-questions) from each module.
4. Eachfullquestionwillhaveasub-questioncoveringallthetopicsundera module.
5. Thestudentswillhavetoanswerfivefull questions,selectingonefullquestionfrom eachmodule

SuggestedLearningResources:

ReferenceBooks:

1. AutomotiveTransmissions:Fundamentals,Selection,DesignandApplication,GisbertLechner,Harald Naunheimer, Springer-Verlag BerlinHeidelberg, New York, ISBN 3-540-65903.
2. DesignPractices:PassengerCarAutomaticTransmissions,Manyauthors,ThirdEdition,AE-18,SAE,Warrendale, 1994.
3. HandbookofAutomotivePowertrainandChassisDesign-J.Fenton,ProfessionalEngineeringPublishing,London 1998.
4. GearsandTransmissions,Vol.4-J.G.Giles,AutomotiveTechnologyseries,Butterworth,London1969.

WeblinksandVideoLectures(e-Resources):

- .VTUe-ShikshanaProgram
- VTUEDUSATProgram

SkillDevelopmentActivitiesSuggested

- Quizzes
- Assignments
- Seminars
- IndustrialVisit

Courseoutcome(CourseSkillSet)

Attheendofthecoursethestudentwillbeableto:

Sl.No.	Description	BloomsLevel
CO1	Uponcompletionofthiscourse, thestudentscanableto applythebasicengineering.	5
CO2	Tolearnaboutknowledgeforthedesignof robotics.	5
CO3	Willunderstandrobotkinematicsandrobotprogramming.	4
CO4	WillunderstandapplicationofRobots.	5
CO5	Tolearnaboutforceandtorquesensing.	5

Manufacturing Techniques In Automotive Engineering			
Course Code	**MMAU203**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	25 Hrs+10-12 Activity Sessions	Total Marks	100
Credits	3	Exam Hours	3

Course Learning objectives:

- Understanding Metal forming
- Understanding Powder Metallurgy

Module-1

Sheet Metal Forming: Introduction, Forming methods, shearing and Blanking, Bending, stretch forming, Deep drawing, redrawing operations, Defects in formed products. High Energy Rate Forming: Explosive forming, Electro-hydraulic forming, Electro-magnetic forming, Super Plastic Forming – Process principles, Equipment, Process variables, Merits and Limitations 05 Hrs

Module-2

Forging: Classification, various stages during forging, Forging equipment, brief description, deformation in compression, forging defects. Residual stresses in forging. Special Casting processes: Gravity die-casting, Pressure die casting, Centrifugal casting, Squeeze Casting, Slush casting, Thixo-casting and Continuous Casting Processes. Different casting techniques for manufacturing of automotive components like cylinder block, piston, flywheel, bearing liners, etc. 05 Hrs

Module-3

Powder Metallurgy Processing: Process details and special characteristics of Powder Metallurgy process, Powder making methods, Characteristics of Powders, Process flow chart, Process steps and Process variables. Compaction techniques like CIP & HIP (Cold Iso-static and Hot Isostatic pressing), Product design considerations, Applications of Powder metallurgy 05 Hrs

Module-4

Joining methods- Fusion: MIG-CO2 welding, Flux Cored Arc Welding, Resistance Seam, Spot and Projection Welding-Process principles, Equipment, Process variables, Merits and Limitations. Solid State Welding: Friction Welding, Friction Stir Welding - Process principles, Equipment, 08 Hours Page 31 of 44 Process variables, Merits and Limitations. 05 Hrs

Module-5

Joining of Plastics: Heated tool welding or hot bar welding, Hot gas welding or pendulum welding, High frequency welding, Ultrasonic welding, Friction welding, Induction welding. 05 Hrs

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

3. Two Unit Tests each of **25 Marks**
4. Two assignments each of **25 Marks** or **one Skill Development Activity of 50 marks** to attain the COs and POs

The sum of two tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

6. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
7. The question paper will have ten full questions carrying equal marks.

8. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
9. Each full question will have a sub-question covering all the topics under a module.
10. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Text Books:

1. Fundamentals of Working of Metals- Sach G., Pergamon Press.
2. Engineering Materials & their applications, R. A. Flinn& P. K. Trojan, 4th edition, Jaico Publishing House.

Reference Books:

1. ASM Handbook on Powder Metallurgy, Volume 17, ASM publications
2. High speed combustion engines- P.M. Heldt, Oxford and IBH Publishing Co, New York, 1990.
3. AWS Hand Book on welding
4. Welding Technology- O.P. Khanna.
5. Welding for Engineers-Udin, funk &Wulf. 6. Welding and Welding Technology- R.L. Little.

Web links and Video Lectures (e-Resources):

- VTU e-Shikshana Program
- VTU EDUSAT Program

Skill Development Activities Suggested

- Quizzes
- Assignments
- Seminars

Automobile Body Engineering and Safety			
Course Code	**MMAU206**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	48 h	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- Understand the basics of metal forming.
- Recognize the importance of metal forging using different geometrical shapes and various defects.
- Understanding the concept of rolling ,types of rolling mills and processes and its defects
- To understand the concepts of extrusion and drawing and their applications.
- To understand the types of sheet metal forming processes and here

Module-1

Introduction: Types of car bodies, bus bodies and commercial vehicle bodies. Interior Ergonomics: Introduction, Seating dimensions, Interior ergonomics, ergonomics system design, seat comfort, requirements of drivers and passenger seats, suspension seats, split frame seating, back passion reducers, dash board instruments, electronic displays, commercial vehicle cabin ergonomics, mechanical package layout, goods vehicle layout. Visibility, regulations, drivers visibility, methods of improving visibility, Window winding and seat adjustment mechanisms. 08 Hrs

Module-2

Aerodynamics: Basics, Vehicle drag and types, Various types of forces and moments, effects of forces and moments, various body optimization techniques for minimum drag, Principle of wind tunnel technology, flow visualization techniques, tests with scale models, aerodynamic study for heavy vehicles. Body Materials, Trim, Mechanisms: Steel sheet, timber, plastic, GRP, properties of materials - Corrosion - Anticorrosion methods – Selection of paint and painting process - Body trim items - Body mechanisms 08 Hrs

Module-3

Noise and vibration: Noise characteristics, Sources of noise, sound measurement techniques: Sound level meter, time and frequency weighting, Sound spectra – Octave band analysis, Various types of acoustic testing chambers, Sound power measurement from Sound pressure: Free field method, Reverberant field method, SemiReverberant field method and Comparison method (using calibrated Sources) Two- microphone probe for measuring; Sound power measurement from Sound Intensity, Body structural vibrations, chassis bearing vibration, designing against fatigue, methods of noise suppression.08 Hrs

Module-4

Body Loads and Design of Vehicle Bodies: Idealized structure- structural surface, shear panel method, symmetric and asymmetrical vertical loads in car, longitudinal loads, different loading situations. Vehicle Layout design: preliminary design, Load distribution on vehicle structure, stress analysis of bus body structure under bendingand torsion, stress analysis in integral bus body, Design of chassis frame, Rules and regulations for body, Recent safety measures, Testing of body. 08 Hrs

Module-5

Vehicle safety: Active and passive safety, Restraint systems used in automobiles: safety belts, Head restraints, Air bags, Knee bolsters, Importance of Bumpers and their design, Types of safety glass and their requirements, Importance of Ergonomics in Automotive safety- Locations of controls. Vehicle structures for crash worthiness: Types of crash / roll over Tests, Regulatory requirements for crash testing, Instrumentation, high speed photography, Image Analysis. 08 Hrs

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

5. Two Unit Tests each of **25 Marks**
6. Two assignments each of **25 Marks** or **one Skill Development Activity of 50 marks** to attain the COs and POs

The sum of two tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

11. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
12. The question paper will have ten full questions carrying equal marks.
13. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
14. Each full question will have a sub-question covering all the topics under a module.
15. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Books

1.Vehicle Body Engineering-Pawloski J., Business Books Ltd.
2. The automotive chassis: Engineering principle - Reimpell J, 2nd Edition, 1983.
3. Low speed Automobile Accidents -Watts, A. J., et al Lawyers and Judges 1996
4. An Introduction to Modern Vehicle Design- JullianHappian-Smith SAE, 2002

Web links and Video Lectures (e-Resources):

- VTU e-Shikshana Program
- VTU EDUSAT Program

Skill Development Activities Suggested

- Quizzes
- Assignments
- Seminars

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Understand the basics of metal forming.	3
CO2	Recognize the importance of metal forging using different geometrical shapes and various defects.	4
CO3	Understanding the concept of rolling ,types of rolling mills and processes and its defects	5
CO4	To understand the concepts of extrusion and drawing and their applications.	5
CO5	To understand the types of sheet metal forming processes and here	5

Professional Elective-3

Automotive Embedded Systems

Course Code	**MMAU214A**	**CIE Marks**	**50**
Teaching Hours/Week	**(L:P:SDA) 2:0:2**	**SEE Marks**	**50**
Pedagogy	**25 Hrs+10-12**	**Sessions Total Marks**	**100**
Total Hours of Activity Credits	**03**	**Exam Hours**	**03**

Course Learning objectives:

1. Identify and describe different types of material processing techniques for advanced materials 2. Ability to select suitable material for specific applications

Module-1

Electronics in Automotive: Introduction Body and convenience electronics: vehicle power supply controllers and lighting modules, door control modules, Safety electronics: active safety systems: ABS, ASR, ESP 05 Hrs

TeachingLearning Process:Chalk and talk method / PowerPoint Presentation

Module-2

passive safety systems: Restraint systems and their associated sensors in an automobile. Powertrain Electronics: Gasoline engine management, Infotainment electronics: Dashboard/instrument cluster, car audio, telematic systems, navigation systems, multimedia systems, cross application technologies. 42V vehicle power supply system.05 Hrs

TeachingLearning Process: Chalk and talk method / PowerPoint Presentation

Module-3

Drive by Wire: Challenges and opportunities of X-by-wire: system & design requirements steer-by-wire, brake-by-wire, suspension-by-wire, gas-by wire, power-by-wire, shift by-wire. Future of Automotive Electronics. 05 Hrs

TeachingLearning Process: Chalk and talk method / PowerPoint Presentation

Module-4

HARDWARE MODULES: MC9S12XD family features -Modes of operation-functional block diagram overview-programming model. Memory Map Overview Pulse Width Modulator (PWM) –On-chip ADC Serial Communication Protocol: SCI, SPI,IIC, CAN05 Hrs

TeachingLearning Process: Chalk and talk method / PowerPoint Presentation

Module-5

Software Development Tools: Introduction to HCS12XDT512 Student Learning Kit & PBMCU (Project Board) – Introduction to Code Warrior IDE-Editing-Debugging Simulating simple programs. Flashing code into HCS12XDT512 SLK board and testing 05 Hrs

TeachingLearning Process: Chalk and talk method / PowerPoint Presentation

Assessment Details (both CIE and SEE) The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together. **Continuous Internal Evaluation:**

1. Three Unit Tests each of 20 Marks
2. Two assignments each of 20 Marks or one Skill Development Activity of 40 marks to attain the COs and POs The sum of three tests, two assignments/skill Development Activities, will be scaled down to 50 marks CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. 2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources: Text books:

1. Semiconductors-Technical Information, Technologies and characteristic data, PublicisCorporatePublishing 2nd revised and considerably enlarged edition, 2004,
2. Freescale MC9S12XDP512 data sheet
3. Automotive Electronics Handbook- Ronald K Jurgen , McGraw Hill , 2000.

4. Semiconductors: Technical Information, Technologies and Characteristic Data- Werner Klingenstein& Team, Publicis Corporate Publishing, 2nd edition, 2004

5. Intelligent Vehicle Technologies: Theory and Applications- LjuboVlacic, Michel Parent & FurnioHarshima, , Butterworth-Heinemann publications, 2001.

Web links and Video Lectures (e-Resources):

- VTU e-Shikshana Program
- VTU EDUSAT Program

Skill Development Activities Suggested

- **Quizzes Assignments Seminars**

Course outcome (Course Skill Set) At the end of the course the student will be able to :		
Sl. No	**Description**	**Blooms Level**
CO1	Classify materials and physical characteristics.	5
CO2	Understand iron carbon equilibrium diagram, TTT diagram, heat treatment process of various steels.	5
CO3	Understand alloys of various nonferrous metals.	5
CO4	Understand polymers, ceramics and their mechanical – thermal properties	4
CO5	Identify the composites and their structure and Understand applications of ceramics	5

Professional Elective-3			
Vehicle Maintenance and Fleet Management			
Course Code	**MMAU214B**	**CIE Marks**	**50**
Teaching Hours/Week	**(L:P:SDA) 2:0:2**	**SEE Marks**	**50**
Pedagogy	**25 Hrs+10-12**	**Sessions Total Marks**	**100**
Total Hours of Activity Credits	**03**	**Exam Hours**	**03**

Course Learning objectives:

To provide the students with the necessary fundamentals for understanding the material properties given by the available heat treatment processes.

Module-1

Maintenance Tool, Shop, Schedule, Records: Standard tool set, torque wrenches, compression and vacuum gauges, engine analyzer and scanner, computerized wheel alignment and balancing, gauges for engine tune up and pollution measurement, spark plug cleaner, cylinder re boring machine, fuel injection calibration machine. 05 Hrs

TeachingLearning Process:Chalk and talk method / PowerPoint Presentation

Module-2

Importance of maintenance: Schedule and unscheduled maintenance. Scope of maintenance. Equipment downtime. Vehicle inspection. Reports. Log books. Trip sheet. Lay out and requirements of maintenance shop. 05 Hrs

TeachingLearning Process: Chalk and talk method / PowerPoint Presentation

Module-3

Power Plant Repair and Overhauling: Dismantling of power plant and its components. Cleaning methods. Inspection and checking. Repair and reconditioning methods for all engine components. Maintenance of ignition system, fuel injection system, cooling system,- lubrication system. Power plant trouble shooting chart.

5 Hrs

TeachingLearning Process: Chalk and talk method / PowerPoint Presentation

Module-4

The Concept of Transport: The means of transport, classifications, and road transport - advantages of road transport, advantages of motor transport, and motor transport in India - types of road and their features. Transit Operation: Route planning - route location, stop location, route schedules, vehicle and labor scheduling, traffic control - traffic signals, signal timing, freeway control systems. . 05 Hrs

TeachingLearning Process: Chalk and talk method / PowerPoint Presentation

Module-5

Legal Aspects: Motor vehicle act- registration, necessity of permits, insurance, test of competence to drive, mistake / offences for which a driver can be punished, adult workers - hours of work, running time, split duty, journey time, round journey time, layover, frequency. 05 Hrs

TeachingLearning Process: Chalk and talk method / PowerPoint Presentation

Assessment Details (both CIE and SEE): The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together. **Continuous Internal Evaluation:**

1 Three Unit Tests each of **20 Marks**

2 Two assignments each of **20 Marks** or one Skill Development Activity of **40 marks** to attain the COs and POs The sum of three tests, two assignments/skill Development Activities, will be scaled down to 50 marks CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. 2. The question paper will have ten full questions carrying equal marks.

3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources: Text books:

1. A.W.Judge, Motor Vehicle Servicing, 3rd Edition, Pitman Paperpack, London , 1969.
2. W.Crouse, Everyday Automobile repair, Intl.student edition, TMH, New Delhi, 1986.
3. John Dolu, Manage "Fleet management ", McGraw-Hill Co., 1984.
4. Government of India Publication, "The Motor vehicle Act ", 1989.
5. Kitchin L D, "Bus operation ", llliffe and Sons Ltd., London, III Edition, 1992.
6. Frazee, fledell, Spicer,-Automobile collision Work, American technical publications, Chicago, 1953. 7. A,W.Judge, Maintenance of high speed diesel engines, Chapman Hall Ltd., London, 1956.
7. 8. V.L.Maleev, Diesel Engine operation and maintenance, McGraw Hill Book CO., New york, 1995. 9. Vehicle servicing manuals.

Web links and Video Lectures (e-Resources):

- VTU e-Shikshana Program
- VTU EDUSAT Program

Skill Development Activities Suggested

- **Quizzes Assignments Seminars**

Course outcome (Course Skill Set) At the end of the course the student will be able to :

Sl. No	Description	Blooms Level
CO1	To understand the principles of operations, tests to evaluate mechanical and tribological properties.	5
CO2	To understand the principles of failure analysis and examination of failed components.	5
CO3	To understand the strain rate testing, test machine requirements and specimens measurements.	5
CO4	To understand and describe the different types of coating and working principles.	5
CO5	To learn and understand different heat treatment processes and their effect on finishing	5

Professional Elective-3			
INDUSTRIAL ROBOTICS AND EXPERT SYSTEMS			
Course Code	**MMAU214C**	**CIE Marks**	**50**
Teaching Hours/Week	**(L:P:SDA) 3:0:0**	**SEE Marks**	**50**
Pedagogy	**40 Hrs**	**Sessions Total Marks**	**100**
Total Hours of Activity Credits	**03**	**Exam Hours**	**03**

Course Learning objectives:

The goal of this course is for students to understand the methodologies and application of change management and relational 3D CAD product design within the confines of a Product Data Management (PDM) system in PLM environments.

Module-1

Introduction and Robot Kinematics Definition need and scope of Industrial robots – Robot anatomy – Work volume – Precision movement – End effectors – Sensors. Robot Kinematics – Direct and inverse kinematics – Robot trajectories – Control of robot manipulators – Robot dynamics – Methods for orientation and location of objects. 08Hrs

TeachingLearning Process:Chalk and talk method / PowerPoint Presentation

Module-2

Robot sensors Transducers and Sensors – Tactile sensor – Proximity and range sensors – Sensing joint forces – Robotic vision system – Image Representation - Image Grabbing –Image processing and analysis – Edge Enhancement – Contrast Stretching – Band Rationing - Image segmentation – Pattern recognition – Training of vision system. 08Hrs

TeachingLearning Process: Chalk and talk method / PowerPoint Presentation

Module-3

Robot drives and control Controlling the Robot motion – Position and velocity sensing devices – Design of drive systems – Hydraulic and Pneumatic drives – Linear and rotary actuators and control valves – Electro hydraulic servo valves, electric drives – Motors – Designing of end effectors – Vacuum, magnetic and air operated grippers. Robot Cell Design and Application Robot work cell design and control – Safety in Robotics. 08Hrs

TeachingLearning Process: Chalk and talk method / PowerPoint Presentation

Module-4

Methods of Robot Programming Robot Programming, Artificial Intelligence and Expert Systems - Characteristics of task level languages lead through programming methods – Motion interpolation.

08 Hrs

Teaching Learning Process: Chalk and talk method / PowerPoint Presentation

Module-5

Artificial intelligence Artificial intelligence – Basics – Goals of artificial intelligence – AI techniques – problem representation in AI – Problem reduction and solution techniques - Application of AI and KBES in Robots 08Hrs

Teaching Learning Process: Chalk and talk method / PowerPoint Presentation

Assessment Details (both CIE and SEE): The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together. **Continuous Internal Evaluation:**

1 Three Unit Tests each of **20 Marks**

2 Two assignments each of **20 Marks** or one Skill Development Activity of **40 marks** to attain the COs and POs The sum of three tests, two assignments/skill Development Activities, will be scaled down to 50 marks CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. 2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources: Text books:

(1) Computer Integrated Design and Manufacturing - David Bed worth. Mark Henderson &. Philips Wolfe - McGraw

Hill Inc

(2) Visual Modeling with Rational Rose and UML - Terry Quatrain - Addison Wesley

Reference Books : (1)Wind-chill - RS.O Reference manuals - 2000.

Web links and Video Lectures (e-Resources):

- VTU e-Shikshana Program
- VTU EDUSAT Program

Skill Development Activities Suggested

- **Quizzes Assignments Seminars**

Course outcome (Course Skill Set) At the end of the course the student will be able to :

Sl. No	Description	Blooms Level
CO1	Explain the concepts, tools and techniques for managing product data.	5
CO2	Analyze various processes in the product data management frameworks.	5
CO3	Evaluate risks in large and complex workflow management environments.	5
CO4	Develop product data management plans for various types of organizations.	5

Professional Elective-3			
Simulation I. C. Engine Processes			
Course Code	**MMAU214D**	**CIE Marks**	**50**
Teaching Hours/Week	**(L:P:SDA) 2:0:2**	**SEE Marks**	**50**
Pedagogy	**25 Hrs+10-12 Activity Sessions**	**Sessions Total Marks**	**100**
Total Hours of Activity Credits	**03**	**Exam Hours**	**03**

Course Learning objectives:

1. To develop an understanding of basic concepts and role of Logistics and supply chain management in business.
2. To understand how supply chain drivers play an important role in redefining value chain excellence of Firms.

Module-1

Principle Of Computer Modeling and Simulation: Monte Carlo simulation, Nature of computer modeling and simulation, advantages of simulation, limitations of simulation, and areas of application. System and Environment: Components of a system-iscrete and continuous systems. Models of a system-a variety of modeling approaches.05 Hrs

TeachingLearning Process:Chalk and talk method / PowerPoint Presentation

Module-2

Design and Evaluation of Simulation Experiments: Variance reduction techniques-antithetic variablesvariables verification and validation of simulation models. 05 Hrs

TeachingLearning Process: Chalk and talk method / PowerPoint Presentation

Module-3

S.I. Engine Simulation and Two Stroke Engine: Simulation of Otto cycle at full throttle, part throttle and supercharged conditions. Progressive combustion, Exhaust and intake process analysis. Two Stroke Engine Simulation-Engine and Porting Geometry, Gas Flow, Scavenging. 05 Hrs

TeachingLearning Process: Chalk and talk method / PowerPoint Presentation

Module-4

C.I. Engine Simulation: Simulation of ideal Diesel cycle and Diesel cycle at full throttle, part throttle and supercharged conditions. Zero dimensional combustion model, Progressive combustion, Exhaust and intake process analysis. 05 Hrs

TeachingLearning Process: Chalk and talk method / PowerPoint Presentation

Module-5

Simulation Exercises: Case studies of Simulation for 2 stoke and 4 stroke engine. Simulation exercises using computers – MATLAB/SimuLink, Pro-E / ICEM, CFD Analysis, FE Analysis procedures, Advantages of FEA, Simple Exercise using MSC Nastran. Multi-body Simulation Exercises: Simple Multi-body Suspension, Four Bar mechanisms, Handling Analysis of simple Bogie using MSC Adams.05 Hrs

TeachingLearning Process: Chalk and talk method / PowerPoint Presentation

Assessment Details (both CIE and SEE): The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together. **Continuous Internal Evaluation:**

1 Three Unit Tests each of **20 Marks**

2 Two assignments each of **20 Marks** or one Skill Development Activity of **40 marks** to attain the COs and POs The sum of three tests, two assignments/skill Development Activities, **will be scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. 2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

1. Combustion Modeling in Reciprocating Engines - J. N. Mattavi and C. A. Amann, Plenum Press, 1980.
2. The Thermodynamics and Gas Dynamics of Internal Combustion Engines, Vol. I & II - Horlock and Winterbone, Clarendon Press, 1986.

3. The Basic Design of two-stroke engines - Gordon P. Blair, SAE Publication, 1990.
4. Internal Combustion Engine Modeling - J. I. Ramos, Hemisphere Publishing Corporation, 1989
5. MSC Nastran / Adams User Manual
6. MATLAB User manual
7. System Simulation with digital Computer - NARSINGH DEO, prentice Hall Of India,1979

Web links and Video Lectures (e-Resources):

- VTU e-Shikshana Program
- VTU EDUSAT Program

Skill Development Activities Suggested

- **Quizzes Assignments Seminars**

Course outcome (Course Skill Set) At the end of the course the student will be able to :

Sl. No	Description	Blooms Level
CO1	To understand issues & challenges in implementing & developing lean manufacturing techniques from TPS & its contribution for improving organizational performance.	5
CO2	Apply lean techniques to bring competitive business culture for improving organization performance	5
CO3	Analyze how lean techniques can be applied to manufacturing & service industry	4
CO4	Developing lean management strategy for Supply chain management.	4

Professional Elective-4			
Vehicle Performence			
Course Code	**MMAU215A**	**CIE Marks**	**50**
Teaching Hours/Week	**(L:P:SDA) 2:0:2**	**SEE Marks**	**50**
Pedagogy	**25 Hrs+10-12 Activity Sessions**	**Sessions Total Marks**	**100**
Total Hours of Activity Credits	**03**	**Exam Hours**	**03**

Course Learning objectives:

1. To understand the concept of Quality
2. To understand the Implication of Quality on Business 3. To Implement Quality Implementation Programs

Module-1

Introduction to vehicle system: Morphology of vehicles, General layout of passenger cars and commercial vehicle, Type of power units, arrangement of power train, Vehicle controls 05 Hrs

TeachingLearning Process:Chalk and talk method / PowerPoint Presentation

Module-2

Friction and rolling resistance of pneumatic tyres: Aerodynamics forces and moments, Relationship between tractive effort and longitudinal slip of tyres, cornering properties of tyres, Equation of motion and maximum tractive effort. 05Hrs

TeachingLearning Process: Chalk and talk method / PowerPoint Presentation

Module-3

Vehicle performance estimation and prediction: Power plant characteristic and transmission related requirements, Vehicle acceleration, and max. Speed, Gradability Drive systems comparison. 05 Hrs

TeachingLearning Process: Chalk and talk method / PowerPoint Presentation

Module-4

Vehicle transmissions: Characteristics and features friction clutches, mechanical geared transmission lay shaft and epicyclic gearbox, Synchronizers, Fluid coupling and torque converters. Drive lines, two wheel drive, four wheel drive, braking arrangement, safety in braking, weight transfer steering, and cornering power of tyres.05 Hrs

TeachingLearning Process: Chalk and talk method / PowerPoint Presentation

Module-5

Handling characteristics of vehicles: Steering geometry, steady state handling characteristics, steady state response to steering input. Directional stability of vehicle. Effect of shock and vibration on human being, comfort criteria.05 Hrs

TeachingLearning Process: Chalk and talk method / PowerPoint Presentation

Assessment Details (both CIE and SEE): The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together. **Continuous Internal Evaluation:**

1 Three Unit Tests each of **20 Marks**

2 Two assignments each of **20 Marks** or one Skill Development Activity of **40 marks** to attain the COs and POs The sum of three tests, two assignments/skill Development Activities, **will be scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. 2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Textbooks:

1. Theory and Practice of Mechanical Vibrations- Rao J.S. and Gupta. K., Wiley Eastern Ltd., 2ndEdition,2002.
2. Theory of ground vehicle- J. Y. Wong, John Wiley and Sons Inc., New York,1stEdition, 1978.
3. Automobile Mechanics- Dr. N. K. Giri, Seventh reprint, Khanna Publishers, Delhi, 3rdEdition,2005 **Reference Books:**

1. Mechanics of road vehicle- W. Steeds, Illiffe Books Ltd, London3rdEdition, 1992.
2. Steering, Suspension tyres- J. G. Giles, Illife Books Lid London1st Edition, 1975.

3. Automotive chassis- P. M .Heldt, Chilton Co,New York, 1st Edition,1982.
4. Vehicle Dynamics- J. R. Ellis, Business Books, London, 2ndEdition,1969.

Web links and Video Lectures (e-Resources):

- VTU e-Shikshana Program
- VTU EDUSAT Program

Skill Development Activities Suggested

- **Quizzes Assignments Seminars**

Course outcome (Course Skill Set) At the end of the course the student will be able to :		
Sl. No	**Description**	**Blooms Level**
CO1	Understanding the system of vehicles	3
CO2	Understanding the tyre resistance and vehicle performence	3
CO3	Understanding the transmission system	4
CO4	Understanding the characterstics and stability of vehicles	4

Professional Elective-4			
AUTOMOTIVE ELECTRICAL AND ELECTRONIC SYSTEMS			
Course Code	**MMAU215B**	**CIE Marks**	**50**
Teaching Hours/Week	**(L:P:SDA) 2:0:2**	**SEE Marks**	**50**
Pedagogy	**25 Hrs+10-12 Activity Sessions**	**Sessions Total Marks**	**100**
Total Hours of Activity Credits	**03**	**Exam Hours**	**03**

Course Learning objectives:

This course aims to provide its trainees with the knowledge and the decision-making tools to face new challenges arising from current market demands, while remaining oriented towards a circular economy and keeping aware of environmental needs.

Module-1

Storage Battery: Principle of lead acid cells, plates and their characteristics containers and separators, electrolyte and their preparation, effect of temperature on electrolyte, its specific gravity, capacity and efficiency, methods of charging from D.C. mains, defects and remedies of batteries, care of idle and new batteries. Recycling Process - Recent development in batteries Charging : D.C. Generators and Alternators their Characteristics. Control cutout, Electrical, Electro-mechanical and electronic regulators. Regulations for charging (For Discussion only) 05 Hrs

TeachingLearning Process:Chalk and talk method / PowerPoint Presentation

Module-2

Lighting System: Wiring Requirements, Insulated and earth return system, details of head light and side light, LED lighting system, wiring colour code, Sealed beam head lamp construction, head light dazzling and preventive methods. Static and Dynamic Beaming of lights. 05 Hrs

TeachingLearning Process: Chalk and talk method / PowerPoint Presentation

Module-3

Starter Motor & Drives: Battery motor starting system, condition at starting, behavior of starter during starting, series motor and its characteristics, consideration affecting size of motor, types of drives,startingcircuit. 05 Hrs

TeachingLearning Process: Chalk and talk method / PowerPoint Presentation

Module-4

Ignition systems and Engine Management Systems: Ignition fundamentals, Types of solid state ignition systems, components, construction and operating parameters, high energy ignition distributors, Electronic spark timing, Ignition Advance, Types DIS, MBT and control. 05 Hrs

TeachingLearning Process: Chalk and talk method / PowerPoint Presentation

Module-5

Combined ignition and fuel management systems.: Exhaust emission control, Digital control techniques – Dwell angle calculation, Ignition timing calculation and Injection duration calculation. Complete vehicle control systems, Artificial intelligence and engine management 05 Hrs

TeachingLearning Process: Chalk and talk method / PowerPoint Presentation

Assessment Details (both CIE and SEE): The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together. **Continuous Internal Evaluation:**

1 Three Unit Tests each of **20 Marks**

2 Two assignments each of **20 Marks** or one Skill Development Activity of **40 marks** to attain the COs and POs The sum of three tests, two assignments/skill Development Activities, **will be scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. 2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Textbooks:

1. Modern Electrical Equipment of Automobiles - Judge A.W., Chapman and Hall, London ,1992
2. Understanding Automotive Electronics - William B. Ribbens, 5th edition- Butter worth Heinemann, 1998
3. Automobile Electrical Equipment - Young. A. P.,& Griffiths. L., English Language Book Society & New Press, 1990.

Reference Books:

1. Automotive Hand Book -Bosch, SAE, 8th Edn.
2. Storage Batteries - Vinal. G.W., John Wiley & Sons inc., New York, 1985.
3. Automobile Electrical Equipment – Crouse W. H., McGraw Hill Book Co Inc., New York, 1980.
4. Electrical Ignition Equipment – Spread bury F. G., Constable & Co Ltd., London, 1962.
5. Automotive Computers and Digital Instrumentation - Robert N Brady, Prentice Hall, Eagle Wood Cliffs, New Jersey, 1988

Web links and Video Lectures (e-Resources):

- VTU e-Shikshana Program
- VTU EDUSAT Program

Skill Development Activities Suggested

- **Quizzes Assignments Seminars**

Course outcome (Course Skill Set) At the end of the course the student will be able to :

Sl. No	Description	Blooms Level
CO1	Understandig the battery and storage system	3
CO2	Understanding th lighting system	3
CO3	Understanding the startermotor and drives	4
CO4	Understanding the ignition system	4

Professional Elective-4			
Industry 4.0			
Course Code	**MMAU215C**	**CIE Marks**	**50**
Teaching Hours/Week	**(L:P:SDA) 2:0:2**	**SEE Marks**	**50**
Pedagogy	**40Hrs**	**Sessions Total Marks**	**100**
Total Hours of Activity Credits	**03**	**Exam Hours**	**03**

Course Learning objectives:

1. Define the basics of simulation modeling and replicating the practical situations in organizations
2. Generate random numbers and random variates using different techniques.
3. Develop simulation model using heuristic methods.

Module-1

Introduction to Industry 4.0: Introduction, core idea of Industry 4.0,origin concept of industry 4.0,Industry 4.0 production system, current state of industry 4.0, Technologies, How is India preparing for Industry 4.0 08Hrs

TeachingLearning Process:Chalk and talk method / PowerPoint Presentation

Module-2

A Conceptual Framework for Industry 4.0: Introduction, Main Concepts and Components of Industry 4.0, State of Art, Supportive Technologies, Proposed Framework for Industry 4.0. 08Hrs

TeachingLearning Process: Chalk and talk method / PowerPoint Presentation

Module-3

Technology Roadmap for Industry 4.0 : Introduction, Proposed Framework for Technology Roadmap, Strategy Phase, Strategy Phase, New Product and Process Development Phase.

08Hrs

TeachingLearning Process: Chalk and talk method / PowerPoint Presentation

Module-4

Advances in Robotics in the Era of Industry 4.0: Introduction, Recent Technological Components of RobotsAdvanced Sensor Technologies, Internet of Robotic Things, Cloud Robotics, and Cognitive Architecture for CyberPhysical Robotics, Industrial Robotic Applications- Manufacturing, Maintenance and Assembly. 08Hrs

TeachingLearning Process: Chalk and talk method / PowerPoint Presentation

Module-5

Obstacles and Framework Conditions for Industry 4.0 : Lack of A Digital Strategy alongside Resource Scarcity, Lack of standards and poor data security, Financing conditions, availability of skilled workers, comprehensive broadband infra- structure, 08Hrs

TeachingLearning Process: Chalk and talk method / PowerPoint Presentation

Assessment Details (both CIE and SEE): The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together. **Continuous Internal Evaluation:**

1 Three Unit Tests each of **20 Marks**

2 Two assignments each of **20 Marks** or one Skill Development Activity of **40 marks** to attain the COs and POs The sum of three tests, two assignments/skill Development Activities, **will be scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. 2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Textbooks:

1. Alp Ustundag and Emre Cevikcan,"Industry 4.0: Managing the Digital Transformation" .

2. Bartodziej, Christoph Jan,"The Concept Industry 4.0" .

3. Klaus Schwab,"The Fourth Industrial Revolution" .

4. Christian Schröder ,"The Challenges of Industry 4.0 for Small and Medium-sized Enterprises" **.**

Web links and Video Lectures (e-Resources):

- VTU e-Shikshana Program
- VTU EDUSAT Program

Skill Development Activities Suggested

- **Quizzes Assignments Seminars**

Course outcome (Course Skill Set) At the end of the course the student will be able to :

Sl. No	Description	Blooms Level
CO1	Understandig the Industry 4.0 system	3
CO2	Understanding th frame workof Industry 4.0 system	3
CO3	Understanding the Advances in Industry 4.0	4
CO4	Understanding the obstacles in Industry 4.0	4

Professional Elective-4			
AUTOMOTIVE CHASSIS			
Course Code	**MMAU215D**	**CIE Marks**	**50**
Teaching Hours/Week	**(L:P:SDA) 2:0:2**	**SEE Marks**	**50**
Pedagogy	**25 Hrs+10-12 Activity Sessions**	**Sessions Total Marks**	**100**
Total Hours of Activity Credits	**03**	**Exam Hours**	**03**

Course Learning objectives:

Understand various smart material and its importance in engineering application.

To Know various processing techniques of smart materials.

Module-1

Overview of Vehicle chassis System: General construction of chassis, Types of chassis layouts with respect to location of Power plant and drive arrangements and their comparison. Stability of vehicle on slope, weight distribution, numerical on above topics. 05 Hrs

TeachingLearning Process:Chalk and talk method / PowerPoint Presentation

Module-2

Frames: Types of frames, loads acting of frame, cross sections and materials for frames, loading points, sub frames, calculation of cross section of frame members, Testing of frames. 05 Hrs

TeachingLearning Process: Chalk and talk method / PowerPoint Presentation

Module-3

Front axle and steering systems: Types of front axles and stub axles, Axle parts and materials, loads and stresses, center sections, section near steering head, spring pads, Front wheel geometry- Camber, Castor, toe –in, toe out, King Pin Inclination, under steer and over steer conditions, etc. Condition for correct steering, types of steering gears, power steering, Types of linkages, Ackermann and Davis steering mechanisms, Reversible and Irreversible steering. 05 Hrs

TeachingLearning Process: Chalk and talk method / PowerPoint Presentation

Module-4

Suspension system: Need, functions and requirements of suspension system, types of suspension system, Constructional details of leaf spring, helper springs, coil springs, torsion bar, rubber springs, plastic springs, 05 Hrs

TeachingLearning Process: Chalk and talk method / PowerPoint Presentation

Module-5

Air bellows or pneumatic suspension, hydraulic suspension, constructional details of telescopic shock absorbers, independent suspension, front wheel independent suspension, rear wheel independent suspension, types, stabilizer, trouble shooting, Numerical problems. 05 Hrs

TeachingLearning Process: Chalk and talk method / PowerPoint Presentation

Assessment Details (both CIE and SEE): The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together. **Continuous Internal Evaluation:**

1 Three Unit Tests each of **20 Marks**

2 Two assignments each of **20 Marks** or one Skill Development Activity of **40 marks** to attain the COs and POs The sum of three tests, two assignments/skill Development Activities, **will be scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. 2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Textbooks:

1. Automotive Chassis – P.M. Heldt, Chilton & Co.
2. Automotive Mechanics – N.K. Giri ,Khanna Publications, New Delhi,2004.

Reference Books

1. Automotive mechanics – Joseph I Heintner, Affiliate d East West Press, New Delhi/Madras,1967 2. Automobile Engineering Vol. I - Kirpal Singh, Standard publications, New Delhi
3. A Text Book of Automobile Engineering- Laxmi Publications Private Ltd, 2007.

Web links and Video Lectures (e-Resources):

- VTU e-Shikshana Program
- VTU EDUSAT Program

Skill Development Activities Suggested

- **Quizzes Assignments Seminars**

Course outcome (Course Skill Set) At the end of the course the student will be able to :

Sl. No	Description	Blooms Level
CO1	Understandig theVehicle chasis system	3
CO2	Understanding th frame works of vehicles	3
CO3	Understanding the Axle an d steering system	4
CO4	Understanding the Suspension system	4

AEC-1			
Automotive Heating, Ventilation and Air Conditioning			
Course Code	**MMAU258A**	**CIE Marks**	**50**
Teaching Hours/Week	**(L:P:SDA) 1:0:0**	**SEE Marks**	**50**
Pedagogy	**15Hrs**	**Sessions Total Marks**	**100**
Total Hours of Activity Credits	**01**	**Exam Hours**	**01**
Examination Type(SEE)	**MCQ**		

Course Learning objectives:

Course objectives:

- To understand the basics of automotive heating, ventilation and air conditioning
- To study the fundamentals of air-conditioning system used in vehicles
- To classify and choose the right refrigerant for the vehicle air conditioning
- To learn the basics of psychrometry
- To expose to the maintenance and service of air conditioning systems used in vehicles

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Arrange visits to nearby power plants, receiving station and substations to give brief information about the electrical power generation.
3. Show Video/animation films to explain functioning of various machines
4. Encourage collaborative (Group Learning) Learning in the class
5. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking
6. as the ability to evaluate, generalize, and analyze information rather than simply recall it.
7. Topics will be introduced in a multiple representation.
8. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
9. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
10. Individual teacher can device the innovative pedagogy to improve the teaching-learning.

Module-1

Air conditioning fundamentals: Fundamentals of refrigeration, basics of vehicle air conditioning system, location of air conditioning component in a car schematic layout of a refrigeration system, component like compressor, condenser, fan blower, expansion device expansion valve calibration, evaporator pressure regulator, low- and high-pressure switch.

Module-2

Air conditioning heating system: Automotive heaters manually controlled air conditioner heater system automatically control air conditioner air conditioning protection with heater diagnosis chart.

Module-3

Refrigerants: Introduction, classification, properties, selection criteria, commonly used refrigerants, eco-friendly refrigerants, global warming and ozone forming potential of refrigerants, containers, handling of refrigerants.

Module-4

Psychrometry: Introduction, Psychometric properties, Inside and outside design conditions of air conditioning system. Air distribution: introduction, factors affecting design of air distribution system, types of air distribution system, air flow through the dashboard recalculating unit, duct system, ventilation, vacuum reserve.

Module-5

Air conditioning maintenance and service: Cause of air conditioner failure, trouble shooting of air conditioning system, servicing heater system, removing and replacing components, leak testing, compressor service, charging and discharging, performance testing

Course outcome (Course Skill Set)

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

1. Understand the basics of automotive heating, ventilation and air conditioning
2. Identify different components of heating, ventilation and air conditioning systems used in vehicles
3. Analyse the problems heating, ventilation and air conditioning systems used in vehicles and take up the basic service to rectify them

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous internal Examination (CIE)

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

per the outcome defined for the course.

Semester End Examinations (SEE)

SEE paper shall be set for 50 questions, each of the 01 marks. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is **01 hour.** The student has to secure a minimum of 35% of the maximum marks meant for SEE.

Suggested Learning Resources:

Books

1. Automotive air Conditioning William H. Crouse, Tata McGraw Hill publication.
2. Automotive air Conditioning, Mitchell information service, PHI.
3. Hucho. W.H. - - Butterworths Co.

Web links and Video Lectures (e-Resources):

https://www.youtube.com/watch?v=nHZEAe08sE8
https://www.youtube.com/watch?v=04MlTepEIz4
https://www.youtube.com/watch?v=ODYEyAl8ztE
https://www.youtube.com/watch?v=oAjGHaQ-tn0
https://www.youtube.com/watch?v=NSUeRlJ2P0g

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. Watch http://www.digimat.in/nptel/courses/video/112105128/L42.html
2. NPTEL course certification
3. **System Assembly and Disassembly:**

Activity: HVAC System Assembly/Disassembly

Objective: Learn how to assemble and disassemble an HVAC system

AEC-2			
Battery management system			
Course Code	**MMAU258B**	**CIE Marks**	**50**
Teaching Hours/Week	**(L:P:SDA) 1:0:0**	**SEE Marks**	**50**
Pedagogy	**15Hrs**	**Sessions Total Marks**	**100**
Total Hours of Activity Credits	**01**	**Exam Hours**	**01**
Examination Type(SEE)	**MCQ**		

Course objectives:

At the end of the course, students will be able to understand

- Basics and functionalities of battery management systems
- Battery Pack sensing factors
- Knowledge on Battery Protection and Interface with Energy estimation

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.
1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Arrange visits to nearby power plants, receiving station and substations to give brief information about the electrical power generation.
3. Show Video/animation films to explain functioning of various machines
4. Encourage collaborative (Group Learning) Learning in the class
5. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking
6.
as the ability to evaluate, generalize, and analyze information rather than simply recall it.
7. Topics will be introduced in a multiple representation.
8. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
9. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
10. Individual teacher can device the innovative pedagogy to improve the teaching-learning.

Module-1

Introduction to BMS and BMS functionality- discussion of BMS functionality with sub-divisions, Battery pack topology,

Module-2

Battery-pack sensing in terms Voltage, Temperature, Current. Hall effect sensors.

Module-3

High-voltage contactor control, Isolation sensing and thermal control, Protection and interface

Module-4

Charger control, Communication via CAN bus, Logbook function, Range estimation, State-of-charge estimation

Module-5

Energy and power estimation, Pack total energy and pack total power, Diagnostics

Course outcome (Course Skill Set)

At the end of the course the student will be able to:
1. Basics and functionalities of battery management systems
2. Battery Pack sensing factors
3. Knowledge on Battery Protection and Interface with Energy estimation

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The

student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous internal Examination (CIE)

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

per the outcome defined for the course.

Semester End Examinations (SEE)

SEE paper shall be set for 50 questions, each of the 01 marks. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is **01 hour.** The student has to secure a minimum of 35% of the maximum marks meant for SEE.

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Suggested Learning Resources:

Books

1. Advanced Battery Management Technologies for Electric Vehicles by Rui Xiong, Weixiang Shen, Wiley Publications
2. NBattery Management System for Future Electric Vehicles, by Dirk Söffker and BedatriMoulik, MDPI publishers

Web links and Video Lectures (e-Resources):

1. http://mocha-java.uccs.edu/ECE5720/ECE5720-Notes01.pdf
2. https://www.youtube.com/watch?v=cS5tkvbC4ts

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. Component Identification and Functionality

Activity: Hands-On Component Examination

Objective: Learn the functions of different components in a BMS.

Procedure: Provide students with various BMS components such as battery cells, sensors, control units, and communication modules. Allow them to examine these parts, discussing their features and roles in the system.

2. Battery Pack Assembly and Configuration

Activity: Assembling a Battery Pack

Objective: Learn how to assemble and configure a battery pack.

Procedure: Provide students with individual battery cells, interconnects, and a casing. Guide them through the process of assembling a battery pack, ensuring proper connections and configuration for optimal performance.

3. https://www.udemy.com/course/complete-battery-management-system-course-level-1/
4. https://training.ti.com/introduction-battery-manage

Autonomous Vehicles			
Course Code	**MMAU258C**	**CIE Marks**	**50**
Teaching Hours/Week	**(L:P:SDA) 1:0:0**	**SEE Marks**	**50**
Pedagogy	**15Hrs**	**Sessions Total Marks**	**100**
Total Hours of Activity Credits	**01**	**Exam Hours**	**01**
Examination Type(SEE)	**MCQ**		

Courseobjectives:

This course will introduce you to the terminology, vehicles. By the end of this course, student will be able to: - design considerations and safety assessment of self-driving

1. Understand commonly used hardware used for self-driving vehicles
2. Identify the main components of the self-driving sof control tware stack - Program vehicle modelling
3. Analyse the safety frameworks and current industry practices for vehicle development

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Arrange visits to nearby power plants, receiving station and substations to give brief information about the electrical power generation.
3. Show Video/animation films to explain functioning of various machines
4. Encourage collaborative (Group Learning) Learning in the class
5. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking
6. as the ability to evaluate, generalize, and analyze information rather than simply recall it.
7. Topics will be introduced in a multiple representation.
8. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
9. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
10. Individual teacher can device the innovative pedagogy to improve the teaching-learning.

Module-1

Introduction to autonomous driving: autonomous driving technologies overview, autonomous driving algorithms: Sensing, Perception, Object Recognition and Tracking: Autonomous driving client system: Robot Operating System, Hardware platform: Autonomous driving cloud platform: Simulation, HD Map Production, Deep learning Model Training

Module-2

matic and differential GPS, precise point positi maps Visual Odometry: Stereo Visual Odometry, Monocul oning, GNSS INS integration, Localization with LiDA nalysis, satellite-based augmentation systems, real t ar Visual Odometry, Visual Inertial Odometry, Dead R and HD ime Reckoning and Wheel Odometry; Sensor fusion

Module-3

Perceptions In Autonomous driving: Introduction, Dat flow; Deep learning in Autonomous Driving Perception segmentation, Stereo and optical flow asets, Detection, Segmentation, Sterio, Optical flow : Convolutional Neural Networks, Detection, Semanti and Scene

Module-4

Prediction and Routing: Planning and control overview, Traffic prediction: Behaviour prediction as classification, Vehicle trajectory generation, Lane level routing: Constructing a weighted directed graph for routing, typical routing algorithms, routing graph cost

Module-5

Decision planning and control: Behavioural decisions, Motion planning, Feedback control, Reinforcement Learning Based Planning and Control, Client systems for Autonomous Driving: Operating sy Cloud platform for Autonomous driving: Introduction stems and computing platform

Course outcome (Course Skill Set)

1. Understand the Autonomous systems and its requirement

2. Explain different aspects like algorithm, sensing, o and create simple algorithms bject recognition and tracking, plan and control mo nd techniques and shall be able to do lane level ro s uting tion

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous internal Examination (CIE)

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

per the outcome defined for the course.

Semester End Examinations (SEE)

SEE paper shall be set for 50 questions, each of the 01 marks. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is **01 hour.** The student has to secure a minimum of 35% of the maximum marks meant for SEE.

Suggested Learning Resources:

Books

1. Creating Autonomous Vehicle Systems .Shaoshan Liu, Liyun Li, Jie Tang, Shuang Wu, Jean-Luc Gaudiot Morgan& Claypool Publishers, 1st Edition, 2018
2. Autonomous Vehicles for Safer Driving, Ronald K. Jurgen, SAE International Edition, 2013

Web links and Video Lectures (e-Resources):

1. https://analyticsindiamag.com/free-online-resources-get-started-autonomous-cars/.
2. https://innovationatwork.ieee.org/autonomous-vehicles-resources/
3. https://www.wired.com/story/guide-self-driving-cars/
4. https://www.nvidia.com/en-us/self-driving-cars/
5. https://www.youtube.com/watch?v=wAaSJUAKPuY

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. Explore related videos on the subject like https://www.youtube.com/watch?v=twMHsKYtHKA
2. Build simple VOICE CONTROLLED systems
3. Discuss the levels of autonomy, as defined by SAE

AEC-4			
Drive Cyclesof Electric Vehicles			
Course Code	**MMAU258D**	**CIE Marks**	**50**
Teaching Hours/Week	**(L:P:SDA) 1:0:0**	**SEE Marks**	**50**
Pedagogy	**15Hrs**	**Sessions Total Marks**	**100**
Total Hours of Activity	**01**	**Exam Hours**	**01**

Credits			
Examination Type(SEE)	**MCQ**		

Course objectives:

1. Learn and compute the drive train requirements and vehicle performance parameters.
2. Basics of vehicle dynamics and power and torque calculations
3. Concept of drive cycles and application of the same with reference to Indian Standard (IDC)

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Arrange visits to nearby power plants, receiving station and substations to give brief information about the electrical power generation.
3. Show Video/animation films to explain functioning of various machines
4. Encourage collaborative (Group Learning) Learning in the class
5. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking
6. as the ability to evaluate, generalize, and analyze information rather than simply recall it.
7. Topics will be introduced in a multiple representation.
8. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
9. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve thestudents' understanding.
10. Individual teacher can device the innovative pedagogy to improve the teaching-learning.

Module-1

Drive-train for a petrol vehicle, Petrol Vehicles to Electric Vehicles, Electric drive train, Engine, Motor & Controller: Force and Torque, Vehicle Speed and Power, Vehicle Performance parameters, Infrastructure Required for Vehicles to run, EV Charging Stations, Vehicle Control Unit (or MCU), Battery Power and Range Required, Battery Energy (Capacity),Battery Power

Module-2

Vehicle Dynamics, tractive force, Aerodynamic Drag, Rolling Resistance, Uphill Resistance, Acceleration, Forces acting on a vehicle in motion, Aerodynamic drag, Rolling Resistance and uphill Resistance, Typical values of Rolling Resistance, Gradient resistance,

Module-3

Power required to climb, Power and Torque to accelerate, Power required for acceleration (pick-up), Average Power required for acceleration, Power for pick-up acceleration alone

Module-4

Concept of a Drive-cycle-Drive Cycle, Definition of a Drive-cycle, Standard Drive Cycle, 2-wheeler / Auto India Drive Cycle (IDC), Compute Distance and Energy for the full drive-cycle, Low-end 2-wheeler,Spread-sheet for a typical 2- wheeler,Consider Regeneration Efficiency R = 0.5

Module-5

Drive Cycles and Energy used per km, E-auto, e-rickshaw and Compact Sedan, Electric Auto-E-auto: velocity, distance and acceleration, Energy per km of e-auto with R = 0.5,e-rickshaw: IDC-Energy Efficiency of e-rickshaw (R=50%),4- Wheelers: Modified Indian Drive Cycle (MIDC), Electric compact-Sedan-Compact Sedan Energy Efficiency, Low-end Electric Trucks-Delivery Truck Specs, Trucks: Modified Indian Drive Cycle (MIDC),Traction Energy used for a drive-cycle

ourse outcome (Course Skill Set)

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

1. Compute the drive train requirements and vehicle performance parameters.
2. Analyse the design parameters of vehicle dynamics and apply the same to arrive at power and torque requirement of different segments of EVs.
3. Understand and apply the concept of drive cycles and create Indian Drive Cycles for different segments of Electric Vehicle IDC)

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous internal Examination (CIE)

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

per the outcome defined for the course.

Semester End Examinations (SEE)

SEE paper shall be set for 50 questions, each of the 01 marks. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is **01 hour.** The student has to secure a minimum of 35% of the maximum marks meant for SEE.

Suggested Learning Resources:

Books

1. . Modern Electric, Hybrid Electric, and Fuel Cell Vehicles, Mehrdad Ehsani, Yimin Gao, Stefano Longo and Kambiz Ebrahimi, CRC Press, 2018, II Edition.

2. Electric Powertrain- Energy Systems, Power Electronics and Drives for Hybrid, Electric and Fuel Cell Vehicles John G. Hayes ,University College Cork, Ireland ,G. Abas Goodarzi, US Hybrid, California, USA, © 2018 John Wiley & Sons Ltd

Web links and Video Lectures (e-Resources):

1. IEEE Electrification Magazine: HTTPs://ieeexplore.ieee.org/document/8546812
2. Blog “understanding the EV Elephant”: HTTP://electric electric-vehicles vehicles-in -india.blogspot.com/
3. WRI-CBEEV Report: 'A Guidance Document on Accelerating Electric Mobility in India'
4. NITI Aayog Report: Zero Emission Vehicle (ZEV): Towards a policy Framework
5. NPTEL Video Course: NOC: Electric Vehicles and Renewable Energy

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. Construction of IDC and MIDC **for a typical 2-wheeler** in a **Spread-sheet**
2. Construction of IDC and MIDC **for a typical 4-wheeler** in a **Spread-sheet**
3. Construction of IDC and MIDC **for a typical mini -truck** in a **Spread-sheet**

AUTOMOTIVE ENGINEERING LAB –I			
Course Code	**MMAUL207**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	1:2:0	SEE Marks	50
Total Hours of Pedagogy	15 Hrs +10-12 Lab sessions	Total Marks	100
Credits	02	Exam Hours	3

Course objectives:
The course should enable the students to understand practical orientation of manufacturing processes.

01	Linear Static (Stress) Analysis of Automotive Engine Components such as Connecting Rod, Piston, Cylinder wall, Crank Shaft using FEA software Such as MSC Patran / MSC Nastran and etc
02	Modal Analysis of Automotive Engine Components using FEA software
03	Dynamics Analysis of Automotive Engine Components using FEA Software
04	Heat Transfer Analysis of Automotive Engine Components using FEA Software
05	Random Vibration analysis
06	Testing of Single Cylinder, Twin Cylinder and multi cylinder SI / CI engines for performance, Calculate BP, Thermal, volumetric efficiencies, and BSFC with emission testing
07	Conduct Morse test for finding FP, IP, Indicated thermal efficiency and Mechanical efficiency and tuning the engine parameters
08	Performance test on computerized IC engine test rig using conventional fuels and Alternate Fuels
09	Study and tuning of CRDI engine
10	Performance test on Variable Compression Ratio Engine

Course outcomes (Course Skill Set):
The course should enable the students to understand practical orientation of manufacturing processes.

Assessment Details (both CIE and SEE)
The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 40%of maximum marks in the semester-end examination(SEE). In total of CIE and SEE student has to secure 50% maximum marks of the course.

Continuous Internal Evaluation (CIE):
CIE marks for the practical course is **50 Marks**.
The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled downed to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8th week of the semester and the second test shall be conducted after the 14th week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The average of 02 tests is scaled down to 20 marks (40% of the maximum marks).
- The Sum of scaled-down marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.

Semester End Evaluation (SEE):
- SEE marks for the practical course is 50 Marks. SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University.
- All laboratory experiments are to be included for practical examination. (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. OR based on the course requirement evaluation rubrics shall be decided jointly by examiners.
- Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.
- General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks.
- SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)
- Change of experiment is allowed only once and 10% Marks allotted to the procedure part to be made zero.
- The duration of SEE is 03 hours

Suggested Learning Resources:
REFRENCE BOOKS
1. Metal Cutting Principles - M.C. Shaw - Oxford Publication – 1985.
2. Fundamentals of metal cutting & Machine Tools - by B.L.Juneja & G.S – Sekhar - Wiley Eastern.
3. Metal Cutting - V.C.Venkatesh & S.Chandrasekhanan - Pantice Hall – 1991.
4. Metal Cutting - Dr. B.J.Ranganath -Vikas Publications

PCC/PCCL/IPCC/PEC/MDC/PCC(PB): These are the courses which will suit the individual specializations

For the students who are willing to take up a two-semester duration Industry/Research Internship Leading to Project work /start-up

IIISEMESTER (A) Automobile Engineering

Sl. No	Course	Course Code	Course Title	Teaching Hours /Week			Examination				Credits
				Theory	Practical/ Mini–Project/ Internship	Tutorial/ Skill Development Activities	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	P	SDA					
1	PEC/MDC	Mxxx301/401	(Online Courses) 12 weeks duration							100	3
2		Mxxx302/402	(Online Courses)12 weeks duration							100	3
		Mxxx303/403	(Online Courses)12 weeks duration							100	3
3	INT	**MINT304**	Research Internship /Industry-Internship leading to project work/ Startup	Two-semester duration, SEE in the IV semester which leads to project work /start-up			03	100	---	100	3
TOTAL										**400**	**12**

IV SEMESTER (A)

Sl. No	Course	Course Code	Course Title	Teaching Hours /Week		Examination				Credits
				Theory	Practical/Field work	Duration in hours	CIE Marks	SEE Marks Viva voce	Total Marks	
				L	P					
1	INT	MINT401	Research Internship / Industry Internship Leading to Project Work/Start-up	Two Semester Duration		03	100	100	200	12
2	PROJ	MPROJ402	Project			03	100	100	200	16
TOTAL						**06**	**200**	**200**	**400**	**28**

INT: Industry/ Research Internship leading to the project work /startup**PROJ**: Project work outcome of Internship

(Project Phase-II is Viva voce SEE)

Taking up a two-semester Industry/Research Internship that leads to project work or a start-up can be a highly rewarding experience for students. It allows them to apply theoretical knowledge in practical settings, gain valuable industry or research experience, and potentially develop innovative solutions or business ideas. Here are some key steps and considerations for students pursuing such an internship:

Industry Internship: The main objective of the industry internship is to ensure that the intern is exposed to a real-world environment and gain practical experience. Often, it may be a practical exposure to the theory that has been learned during the academic period. The industry internship helps students understand of analytical concepts and tools, hone their skills in real-life situations, and build confidence in applying the skills learned.

Research Internship: A research internship is an opportunity for students or early career professionals to gain hands-on experience in conducting research under the guidance of a mentor or within a research team. These internships can take place in academic institutions, research organizations, government agencies, or private companies

Research /Industry Internship: In the third-semester Students have to be in touch with a guide/mentor/coordinator and regularly submit the report referred to the progress internship. Based on the progress report the Guide/Mentor/coordinator has to enter the CIE marks at the end of the 3rd semester. At the beginning of the 4th semester, students have to define the project topic out of the learning due to the Internship, upon completion of the project work he/she has to attend the SEE at the parent Institute.

Internship Leading to Start-up: An internship that leads to a startup is an exciting pathway, blending real-world experience with entrepreneurial ambition. Here's a comprehensive guide to transitioning an internship experience into launching your startup: 1) Maximize your internship experience, 2) Identifying Viable Business Ideas, 3) Research and Validation 4) Building a Business Plan 5) Networking and Mentorship 6) Securing Funding 7) Establishing Startup 8) Launching and Marketing. By following these steps, you can effectively transition from an internship to launching a successful startup. This journey requires dedication, resilience, and a willingness to learn and adapt.

Mxxx301/401 to 303/403:MOOC courses of 12 weeks duration are the courses suggested by the Board of Studies of the University and will be displayed on www.online.vtu.ac.in. The online courses selected should not be the same as those studied in the first and second semesters of the program. The student will not be eligible to get their degree if they unintentionally select online courses that match previously finished courses. These courses are not considered for the vertical progression; however, qualifying for these courses and earning the credits is a must for the award of the degree. It is permitted to complete these online MOOC courses either in 3rd semester or in 4th semester.

For the students who are willing to take an Industry Internship for one-semester duration and independent project work next semester

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI
Scheme of Teaching and Examinations – 2024

M.Tech., in Mechanical Engineering(Specialization in Automobile Engineering)

Choice Based Credit System (CBCS) and Outcome Based Education (OBE)

IIISEMESTER (B)

Sl. No	Course	Course Code	Course Title	Teaching Hours /Week			Examination				Credits
				Theory	Practical/ Mini–Project/ Internship	Tutorial/ Skill Development Activities	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	P	SDA					
1	MDC/PEC	Mxxx301/401	(Online Course) (12 weeks courses)							100	3
		Mxxx302/402	(Online Course) (12 weeks courses)							100	3
2		Mxxx303/403	(Online Courses) (12-week course)							100	3
3	INT	24INT33	Industry Internship	One semester Duration			03	100	100	200	11
TOTAL				**06**	**00**	**00**				**500**	**20**

SEMESTER (B)

Sl. No	Course	Course Code	Course Title	Teaching Hours /Week		Examination				Credits
				Theory	Practical/ Field work	Duration in hours	CIE Marks	SEE Marks Viva voce	Total Marks	
				L	P					
1	Project	MPROJ41	Project work	--	08	03	100	100	200	20
				04	**08**	**03**	**100**	**100**	**200**	**20**

Industry Internship: The main objective of the industry internship is to ensure that the intern is exposed to a real-world environment and gains practical experience. Often, it may be a practical exposure to the theory that has been learned during the academic period. The industry internship helps students understand of analytical concepts and tools, hone their skills in real-life situations, and build confidence in applying the skills learned. The students who take up a one-semester Internship in the Industry have to appear SEE at the institute at the end of the semester as per the examination calendar. **Project Work:** Students in consultation with the guide shall carry out literature survey/ visit industries to finalize the topic of the Project. Subsequently, the students shall collect the material required for the selected project, prepare a synopsis, and narrate the methodology to carry out the project work. Each student, under the guidance of a Faculty, is required to

- Present the seminar on the selected project orally and/or through Power Point slides.
- Answer the queries and be involved in debate/discussion.
- Submit two copies of the typed report with a list of references.
- The participants shall take part in discussions to foster a friendly and stimulating environment in which the students are motivated to reach high standards and become self-confident

CIE marks for the project report (20 marks), seminar (20 marks) and question and answer (10 marks) shall be awarded (based on the quality of report and presentation skill, participation in the question and answer session by the student) by the committee constituted for the purpose by the Principal. The committee shall consist of internal guide and a faculty from the department with the senior most acting as the Chairperson.

Semester End Examination SEE marks for the project report (30 marks), seminar (10 marks) and question and answer session (10 marks) shall be awarded (based on the quality of the report and presentation skill, participation in the question and answer session) by the examiners appointed by the University.

Mxxx301/401 to 303/403:MOOC courses of 12 weeks duration are the courses suggested by the Board of Studies of the University and will be displayed on www.online.vtu.ac.in. The online courses selected should not be the same as those studied in the first and second semesters of the program. The student will not be eligible to get their degree if they unintentionally select online courses that match previously finished courses. These courses are not considered for the vertical progression; however, qualifying for these courses and earning the credits is a must for the award of the degree. It is permitted to complete these online MOOC courses either in 3rd semester or in 4th semester.

For the students who are willing to take a research-leading paper publication in Q1/Q2/Q3 Journals and to a PhD Registration												
IIISEMESTER (C)												
Sl. No	**Course**	**Course Code**	**Course Title**	**Teaching Hours /Week**			**Examination**				**Credits**
				Theory	**Practical/ Mini–Project/ Internship**	**Tutorial/ Skill Development Activities**	**Duration in hours**	**CIE Marks**	**SEE Marks**	**Total Marks**	
				L	P	SDA					
1	PCC/IPCC/ MDC/PEC	Mxxx301/401	(Online Course) (12 weeks courses)							100	3
		Mxxx302/402	(Online Course) (12 weeks courses)							100	3
2		Mxxx303/403	(Online Courses) (12-week course)							100	3
		Mxxx304/404	(Online Courses) (12-week course)							100	3
3	PROJ	MPROJ305	Project Phase-I	One semester Duration			03	100	---	100	6
TOTAL				**06**	**00**	**00**	**09**			**500**	**18**

IV SEMESTER (C)										
Sl. No	**Course**	**Course Code**	**Course Title**	**Teaching Hours /Week**		**Examination**				**Credits**
				Theory	**Practical/ Field work**	**Duration in hours**	**CIE Marks**	**SEE Marks Viva voce**	**Total Marks**	
				L	P					
1	Project	MPROJ41	Project work	--	08	03	100	100	200	22
				04	**08**	**03**	**100**	**100**	**200**	**22**

The research section of the university has to announce the number of seats for M.Tech. students who are seeking PhD (research study) admission through a project leading to the publication of the paper in Q1/Q2/Q3 journals. Only full-time research work will be permitted in the university department or approved research centers of the affiliated colleges of the university (guidelines need to be set up). Based on seat availability, the students are permitted to register for project work leading to the publication of papers in Q1/Q2/Q3 journals and admission to research (PhD) in their 3rd semester of the M.Tech., program

Project Phase-1 Project Phase-I, typically the initial phase in any project, is crucial as it lays the foundation for the entire project. This phase involves defining the project's scope, objectives, and initial planning. Here's a structured approach to effectively carry out Project Phase-I:

- **Project Charter:** Outlines the project's purpose, objectives, and stakeholders.
- **Scope Statement:** Defines the project boundaries and deliverables.
- **Requirements Document:** Captures all project requirements.
- **Project Plan:** Details the approach, timeline, and resource allocation.
- **Risk Management Plan:** Identifies and plans for potential risks.
- **Feasibility Study Report:** Assesses technical, economic, and operational feasibility.

Students in consultation with the guide shall carry out literature survey/visit industries to finalize the topic of the Project. Subsequently, the students shall collectthematerialrequiredfortheselectedproject,preparea synopsis,andnarratethemethodologyto carryoutthe projectwork.Eachstudent, under theguidanceofa faculty,is required to

- Presentttheseminarontheselected projectorallyand/orthroughpowerpointslides.
- Answerthe queries and be involved in debate/discussion.
- Submittwocopies ofthetypedreport withalist ofreferences.
- Theparticipantsshalltakepartindiscussionstofostera friendlyandstimulatingenvironmentinwhichthestudentsaremotivatedtoreachhighstandardsand becomeself-confident.

ContinuousInternalEvaluation(100 Marks).

CIE marks for the project report (60 marks), seminar (20 marks) and question and answer(20marks)shallbeawarded(basedonthequalityofreportandpresentationskill,participationinthequestionandanswersessionb ythestudent)bythecommitteeconstitutedforthepurposebythePrincipal.Thecommitteeshallconsistofan internalguide and afacultyfromthedepartment with theseniormost actingastheChairperson.

ProjectWorkPhase-II: Eachstudentshallbe involvedincarryingouttheprojectwork jointlyinconstantconsultationwithinternalguideandexternalguideandpreparetheprojectreport as perthe norms of the university to avoidplagiarism. Phase II of a project typically involves the detailed execution of the planned activities, continuous monitoring and control of the project's progress, and making necessary adjustments to ensure the project stays on track. Keep detailed records of all project activities, decisions, and changes.Ensure all project documentation is organized and accessible. Conduct a final project review to evaluate overall performance, achievements, and lessons learned. Document best practices and areas for improvement for future projects.

Paper Publication Process: Publishing a research paper based on your project in a Q1/Q2/Q3 journal involves several key steps, from writing the manuscript to navigating the peer review process. Here's a comprehensive guide:

Writing the Manuscript: Choose a clear and concise title that accurately reflects the content. Write an abstract summarizing the research question, methods, results, and conclusions.

Literature Review: Review relevant existing research to establish the foundation of your study.Identify gaps that your research aims to fill.

Methodology: Describe the research design, methods, and procedures in detail.Include information on data collection, analysis, and any tools or software used.

Results: Present the findings of your research clearly and logically.Use tables, figures, and charts to illustrate key results.

Discussion: Interpret the results and explain their implications.Compare your findings with existing research and discuss any discrepancies or new insights.

Conclusion: Summarize the main findings and their significance.Suggest potential future research directions.

References: Cite all sources used in your research following the journal's citation style.

Journal Selection: Choose a journal that aligns with the scope and focus of your research.Consider the journal's impact factor (Q1, Q2, Q3) and audience.

Review Journal Guidelines: Carefully read the journal's submission guidelines and ensure your manuscript

adheres to them.

Prepare Your Manuscript: Format your manuscript according to the journal's guidelines.Include all required sections and supplementary materials.

Cover Letter: Write a cover letter to the journal editor highlighting the significance of your research and why it fits the journal.

Submit the Manuscript: Use the journal's online submission system to submit your manuscript.Ensure all required information and documents are included.

Semester End Examination SEE marks for the project report (60 marks), seminar (20marks) and question and answer session (20 marks) shall be awarded (based on the qualityofreportandpresentationskill,participationinthequestionandanswersession)bythe examiners appointedbythe University.