Jharkhand University of Technology, Ranchi
Diploma -Automobile Engineering/Mechanical (Automobile) Engineering

III[rd] -Semester

S.No.	Course Code	Course Title	Hours per week				Cr	FM	Overall Pass Marks	Internal (CIE)	External (SEE)	Categorization
			L	T	P	J						
01	AUT301	Automobile Chassis and Transmission System	3	1	0		4	100	40	30	70	AUT
02	AUT302	Automotive Electrical System	3	1	0		4	100	40	30	70	AUT
03	AUT303	Thermal Engineering and Engine Testing	3	1	0		4	100	40	30	70	AUT
04	AUT304	Automotive Manufacturing Processes	3	1	0		4	100	40	30	70	AUT
Total			**12**	**4**	**0**		**16**	**400**	--	--	--	--
Practical			**L**	**T**	**P**		**Cr**	**FM**	**Overall Pass Marks**	**Internal**	**External**	**Categorization**
05	AUT301P	Automobile Chassis and Transmission System	0	0	4		2	50	25	30	20	AUT
06	AUT302P	Automotive Electrical System	0	0	4		2	50	25	30	20	AUT
07	AUT303P	Thermal Engineering and Engine Testing	0	0	4	6	2	50	25	30	20	AUT
08	AUT304P	Automotive Manufacturing Processes	0	0	4		2	50	25	30	20	AUT
Total			**0**	**0**	**16**		**8**	**200**	--	--	--	--
Audit Course			**L**	**T**	**P**		**Cr**	**FM**	**Overall Pass Marks**	**Internal**	**External**	**Categorization**
09	AUC301	Professional Skills	3	0	0		Passing in Audit Course shall be mandatory.					
10	AUC302P	Sports/NCC/NSS/YOGA/Painting/Music/ Classical Dance	6				Student shall participate actively in one of the activities and for Passing of the semester "Participation Certificate" in activity will be mandatory. Student participation shall be monitored and participation record shall be maintained at institute level.					
Total			**3**	**0**	**0**		--	--	--	--	--	--
Grand Total			**15**	**4**	**16**	**6**	**24**	**600**	--	--	--	--

***AUT- Automobile; AUC- Audit Course; L: Lecture, T: Tutorial, P: Practice.**

J- Self learning hours shall not be reflected in the Time table. Self-learning includes micro project/ assignment/ other activities as mentioned in earlier semester.

Jharkhand University of Technology, Ranchi
Diploma (Automobile Engineering/Mechanical Engineering Automobile)

IVth Semester

S.No.	Course Code	Course Title	Hours per week				Cr	FM	Overall Pass Marks	Internal (CIE)	External (SEE)	Categorization
			L	T	P	J						
01	AUT401	Advanced Automotive Systems	3	1	0		4	100	40	30	70	AUT
02	AUT402	Design and Drafting	3	1	0		4	100	40	30	70	AUT
03	AUT403	Vehicle Body Engineering and Dynamics	3	1	0		4	100	40	30	70	AUT
04	AUT404	Fuels and Pollution Control	3	1	0		4	100	40	30	70	AUT
Total			**12**	**4**	**0**		**16**	**400**	--	--	--	--
Practical			**L**	**T**	**P**		**Cr**	**FM**		**Internal**	**External**	**Categorization**
05	AUT401P	Advanced Automotive Systems	0	0	4		2	50	25	30	20	AUT
06	AUT402P	Design and Drafting	0	0	4		2	50	25	30	20	AUT
07	AUT403P	Vehicle Body Engineering and Dynamics	0	0	4	6	2	50	25	30	20	AUT
08	AUT404P	Fuels and Pollution Control	0	0	4		2	50	25	30	20	AUT
Total			**-**	**-**	**16**		**8**	**200**	--	--	--	--
Audit Course			**L**	**T**	**P**		**Cr**	**FM**		**Internal**	**External**	**Categorization**
09	AUC401	Mastering Personal Finance (Basic to Advance Strategies)	3	0	0		Passing in Audit Course shall be mandatory.					
10	AUC402P	Sports/NCC/NSS/YOGA/Painting/Music/ Classical Dance	6				Student shall participate actively in one of the activities and for Passing of the semester "Participation Certificate" in activity will be mandatory. Student participation shall be monitored and participation record shall be maintained at institute level.					
11	INT401P	Summer Internship	6-8 Weeks				2	--	--	1/0	--	INT
Total			**3**	**0**	**0**		**2**	--	--	--	--	--
Grand Total			**12**	**4**	**23**	**6**	**26**	**600**	--	--	--	--

Note-

1. **AUT- Automobile; AU- Audit Course; L: Lecture, T: Tutorial, P: Practice, CIE- Continuous Internal Evaluation, SEE- Semester End Evaluation.**
2. **INT- Internship (Completion of internship will be marked as-1; Non-completion of internship will be marked as-0 by the institution; The submitted write up & presentation record shall be kept safely by the institution).**
3. **J- Self learning hours shall not be reflected in the Time table. Self-learning includes Micro project/ assignment/ other activities as mentioned in earlier semester.**

Jharkhand University of Technology
Ranchi, 834010

SYLLABUS

For Diploma Program in

Automobile Engineering/Mechanical Engineering Automobile

(Effective from 2024-25)

DEPARTMENT OF AUTOMOBILE ENGINEERING

(3rd – SEMESTER)

Automobile Chassis and Transmission System

Subject Code -AUT301

1. Rationale:

Automobile chassis and transmission forms the core of Automobile Engineering. The course is designed to impart knowledge and skills regarding chassis and transmission that make a complete automobile. The major systems include clutch system, transmission system, drive system, steering mechanism, suspension system, braking system and wheels and tyres without which propulsion of vehicle is not possible.

2. Course Outcomes/Skill Sets: At the end of the course the student will be able to:

CO-01	Examine a given chassis frame, document all frame measurements, compare and align the frame to predefined standards.
CO-02	Repair and/or service a given transmission system, steering system, braking system, suspension system and braking system.
CO-03	Check wheel alignment for a given vehicle and perform the alignment to pre-defined standards.
CO-04	Design or identify alloy wheels after studying the chassis frame and demonstrate repair and replacement of tyres for a given vehicle.

3. Course Content

Week	CO	PO	Lecture (Knowledge Criteria)	Tutorial (Activity Criteria)	Practice (Performance Criteria)
			1. **Frames**- purpose- loads acting - types –construction-ladder type-x type-integral, sections used in frames- Channel-Box-Tubular. 2. Materials used for frames & sub frames-need. Checking the alignment of chassis frame. 3.**Clutch**-Requirements-Classifications. Principle of friction clutch, Clutch Lining materials.	Refer Table 1.	1.a) Instruction on Personal Protection Equipment, Workshop Safety, First Aid, Safety Charts of dos and Don'ts in work area. b) Identification of different sections of chassis frame. 2.a) Analyse different loads acting on the frame. b) Checking the alignment of chassis frame and align it to the predefined standards.
			1. Construction and working -single plate (Coil Spring type & Diaphragm type)	Refer Table 1.	1. Service & troubleshoot a single plate clutch (coil spring type) with faults,

			2.Construction and Working of Centrifugal clutch and Multiplate clutch. 3.Clutch adjustment, clutch troubles and their causes.		causes and remedies. 2. a) Service and troubleshoot a centrifugal clutch by removing it from the vehicle with faults, causes and remedies. b) Clutch adjustment - free play adjustment – adjustment of lever. Replacement of clutch cable.
			1.**Gearbox**-Necessity-classification. 2. Construction and working of synchromesh gear box. Comparison of synchromesh gear box with other type. 3.Synchroniser-need-construction and working.	0	1. Service & troubleshoot of a multiplate clutch by removing it from the vehicle with faults causes and remedies. 2. Overhauling of a 2-wheeler gearbox & calculation of gear ratio w.r.t number of teeth.
			1. Gear box troubles shooting and their causes. 2. Planetary gear train-construction and working. 3. Front Axle – Types – Construction – Materials - Live (drive shaft) - Dead axle (conventional), Stub axles - Types - construction.	Refer Table 1.	1. Overhauling of a synchromesh gearbox & calculation of gear ratio w.r.t number of teeth. Gearbox troubles shooting and their causes. 2. Demonstration of servicing of planetary gear train/video.
			1. **Steering system** -mechanisms-types –Ackerman mechanism, steering gear box-need-types. 2. Construction and working- Rack & Pinion 3. Construction and working of recirculating ball type steering gearbox.	Refer Table 1.	1. Overhauling of a front axle & hub greasing. 2. Overhauling of rack & pinion type of steering system.

			1. Steering geometry-definition, define and explain-camber-caster-king pin inclination 2. Define and explain-combined angle toe in and toe out, correct steering angle, under steer and over steer 3. Define and explain-Wheel base, wheel track, Toe-in, Toe-out, over length, over all height, front over-hang, rear over-hang, ground clearance.	Refer Table 1.	1. Overhauling of a Worm &nut/ Recirculating steering system with different steering gear box with backlash, end-play Adjustment. 2.a) Practice on wheel balancing. b) Measurement of Wheel base, wheel track, Toe-in, Toe-out, overall length, over all height, front over-hang, rear over-hang, ground clearance.
			1. Define and explain-Cornering force, self-righting torque, steering linkages, special steering columns (tilt, length & collapsible). 2. Wheel alignment and wheel balancing-need- procedure. 3. **Propeller shaft** – function - construction, universal joints & slip joints.	Refer Table 1.	1. Practice on checking of wheel alignment and adjustment (computerized/mechanical)& prepare the detailed trouble shooting chart. 2. Servicing of a propeller shaft & universal joint.
			1. Function- types construction & working - cross or spider type - flexible ring type - Rzeppa joint - Tripod joint. 2. **Final drive**- Purpose- types. Differential- necessity- principle 3. Differential - construction & working. backlash, differential lock, inter-axle differential, transaxle types.	Refer Table 1.	1. Checking of constant velocity joint for wear & tear and replace it with new one. 2. Overhauling of differential with backlash adjustment & calculate the gear ratio.
			1. **Rear axle**- loads acting- types - construction and operation - hotch	Refer Table 1.	1. Servicing and troubleshooting of Rear axle of fully floating axle housing.

			kiss - torque tube drive, rear axle drive. 2. Construction of rear axle shaft supporting- fully floating and semi floating arrangements, axle housings, trouble shooting. 3. **Brakes** - Type. Internal expanding Drum Brake- Construction & Working. Disc Brake (Calliper types) – Construction & Working (slider calliper type). Parking Brake- Types-Operating Mechanism.		2. Servicing and troubleshooting of Rear axle of semi -floating axle housing.
			1. Hydraulic Brakes- principle. Master Cylinder- Working. 2. Tandem Master Cylinder- working. 3. wheel cylinder- Types- Working.	Refer Table 1.	1. Servicing & trouble shooting of a drum brake & Disc brake. 2. Servicing of a Tandem master cylinder.
			1. Bleeding of brakes– Brake lining materials- Brake adjustment. 2. **Suspension System** - Construction & Working of Leaf spring and Coil Spring Suspension system. 3. Working of - Hydraulic Suspension & Telescopic suspension.	Refer Table 1, Study the latest technological changes in this course in this course and present the impact of these changes on industry.	1. Bleeding of hydraulic brake system, free-play & brake shoe adjustments. 2. Overhauling leaf spring & re-cambering.
			1. Working of Independent Suspension- Front Wheel & rear Wheel.	Refer Table 1, Study the latest technological changes in	1. Overhauling of an independent suspension system. 2. a) Practice on using different jacks to remove

			2. **Wheels**- Types of wheels, construction, structure and function, wheel dimensions. 3. Constructional details-wire-disc. Alloy wheel- Construction, choosing right alloy wheel for the vehicle, changing of the steel wheel to alloy wheel.	this course in this course and present the impact of these changes on industry.	wheels from (different) vehicle(s).
			1.**Tyres**-Types- Construction (Tube& Tubeless). Cross ply tire construction, Radial ply tire construction. 2. Tyre thread pattern, Tyre selection. Tyre pressure and Wear, Tyre maintenance 3. Changing of the tyre, Precaution to be taken while removing tyre. Rotation of the tyre - Need-procedure.	Refer Table 1, Study the latest technological changes in this course in this course and present the impact of these changes on industry.	1.Practice on Changing the steel wheel to alloy wheel. 2. a) Practice on removal of tyre from disc and mending the punctured tubes using hot patch and cold patch. b) Repair of tubeless tyre.
Total in hours					

Note: At the end of each practical student has to prepare trouble shooting chart and prepare repair estimation.

5.Reference:

Sl. No.	Description
1	Automobile Engineering by R B Gupta (Satya Publication)
2	Automobile Engineering Vol I By Kirpal Singh (Standard publication).
3	The Automobile Engineering Vol-2 By K.M Guptha (Umesh publications)
4	Automobile Engineering by Er S K Gupta (S Chand)
5	Automotive Technology by Jack Erjavec (CENGAGE Learning)

Automotive Electrical System

Subject Code -AUT302

1. **Rationale:** The course aims to impart basic skills and understanding of automotive electrical systems, equipment and their working details. Automobile electrical system has gradually evolved over the years. The automobiles electrical system comprises of wiring technologies that are used for distributing power to other parts of a vehicle and various electrical components for production, storage and distribution of electrical power.

2. **Course Outcomes/Skill Sets:** At the end of the course the student will be able to*:*

CO-01	Test a battery, identify the problem, service and charge it using the right method suitable for that battery type.
CO-02	Test charging, cranking, ignition systems and dashboard instruments and service or troubleshoot it for any problems identified.
CO-03	Diagnose the electrical system, estimate the cost of repairing or replacement and make recommendation of either repair or replace based on cost benefit analysis.
CO-04	Study a given wiring diagram, list all the components, build the wiring circuits, test and repair to ensure the circuit provides the necessary output/result as required.

3. Course Content

Week	CO	PO	Lecture (Knowledge Criteria)	Tutorial (Activity Criteria)	Practice (Performance Criteria)
			1. **Earth Return System**: Introduction-Earth return and insulated systems, 6 volts and 12 volts system. 2. Fusing of circuits, low and high voltage automobile cables, cable specifications and sizes, Colour cables, Circuit tracing 3. Diagram of typical wiring system, Wiring Harness. Tracing fault in wiring, Fault location test. Symbols used in automobile electrical systems.	Refer Table 1	1. a) Demonstrate the wiring flow pattern in the Vehicle. b) Demonstrate the wiring color code used for different circuits. 2. a) Study a given wiring diagram and list all the components b) Practice on troubleshooting of wiring defects.

			1. **Battery** -purpose-types, construction and working-Lead acid. 2. Methods of charging the Battery and how to choose which type of Charging method. 3. Battery capacity-Battery efficiency, ratings.	Refer Table 1	1.a) Test the battery charge condition using hydrometer, Voltmeter, Test the battery condition using battery tester. b) Practice on preparation of electrolyte. 2. a) Charging of Lead acid battery by constant voltage method. b) Practice on Charging multiple batteries
			1. Battery maintenance and troubleshooting. 2.Construction and working of Lithium-ion battery. 3. Maintenance-free batteries.	Refer Table 1	1. a) Practice on Charging multiple batteries by trickle charging b) Practice on finding the defects and troubleshooting of batteries. 2. Practice on Servicing of lithium-ion battery.
			1.**Estimation & Costing**: Introduction, Procedure of Estimation. 2. Introduction to Costing, Elements of cost, Components of cost. 3. Procedure of Costing.	Refer Table 1	1. Estimate the cost of repairing or replacement the battery/Wiring system, make recommendation of either repair or replace based on cost benefit analysis. 2. Case study on estimation of servicing/repair of any one electrical component in vehicle.
			1. **Charging system**-purpose-circuit diagram. DC generator- principle, construction and working.	Refer Table 1	1. Practice on servicing of the Alternator. 2. Test the stator, rotor and rectifier for

			2. Alternator charging circuit with alternator principle, construction and working. 3. Regulator for A.C. Generators-Construction and working.		continuity, short and open circuit using Multifunction Tester/ Test lamp.
			1. Electronic voltage regulators-Construction and working. 2. Defects and troubleshooting Alternators. 3. **Starting system** -requirements-circuit diagram-working principle.	Refer Table 1	1. Practice on testing of voltage regulators. 2. Practice on finding the Defects and troubleshooting of alternators and estimate the same.
			1. Construction and working: series, shunt wound motor. 2. Construction and working of Bendix drive. 3. Construction and working of positive engaging drive with shift lever.	Refer Table 1	1. Practice on servicing of the starter motor. 2. Servicing of Bendix drive.
			1. Construction and working of overrunning clutch drive 2. Construction and Working of Axial Sliding armature drive. 3. Solenoid switch with two winding-construction and working.	Refer Table 1	1. Test field windings, brush holder's armature and solenoid switch for continuity, short and open circuit using growler/ Multifunction Tester. 2. Repair and Service Estimation of the stator motor.
			1. **Ignition System**: Fundamentals-Ignition timing (with respect to load& speed). Types of ignition systems, components. 2. Construction & Working of battery Ignition system. Construction & working of magneto ignition systems.	Refer Table 1	1. a) Diagnose Ignition problems and demonstrate the trouble shooting of the same b) Repair/Service estimation the same. 2. Checking and setting ignition timing and starting the engine.

			3. Construction & Working of Electronic Ignition system. Distributer less ignition system (DIS).		
			1. **Spark plug**-classification 2. construction-Types-specification. 3. Spark plug gap, heat range and reach- definition and importance.	Refer Table 1	1. Servicing of the DIS and repair/Service estimation the same. 2. a) Servicing of the sparkplug cleaning, testing and adjusting gap. b) Service estimation of the same.
			1. Principle of automobile illumination. 2. Different bulbs used in automobile, fuses and relay. 3. Head lamp mounting and construction -Types.	Refer Table 1, Study the latest technological changes in this course in this course and present the impact of these changes on industry.	1. Practice on replacement of bulbs, fuses and relays and estimate the cost of replacement of the same. 2. Practice on aiming of head lights.
			1. Working and Construction of windscreen-wipers. Working of Horn. 2. Working of electrical fuel pump, fuel gauge. 3. Working of oil and temperature gauge.	Refer Table 1, Study the latest technological changes in this course in this course and present the impact of these changes on industry.	1. Practice on servicing of the Wiper and horn & service estimation of the same. 2. Practice on testing of fuel gauge, oil gauge & Temperature gauge.

			1. Speedometer, odometer, etc. (Dash board instruments). 2. Wiring diagram of 2-wheeler - Circuit & construction. 3. Wiring diagram of 4-wheeler- Circuit & construction.	Refer Table 1, Study the latest technological changes in this course in this course and present the impact of these changes on industry.	1. Practice on Circuit building of electrical Components, test andrepair to ensure the circuit provides the necessary output/result as required. 2. Practice on testing of dashboard instruments.

Note: At the end of each practical, student has to prepare trouble shooting chart and prepare repair estimation.

5. Reference:

Sl. No.	Description
1	Automobile Engineering Vol-2 by Kirpal Singh (Standard Publications).
2	Automobile Electrical Equipment by P.M. Kohli (Tata McGraw-Hill).
3	The Automobile Engineering by Harban Singh Reyath (S Chand & Co).
4	The Automobile Engineering Vol-2 by K.M Guptha (Umesh publications).
5	Automobile Electrical and Electronic systems by Tom Denton (SAE publication).
6	Vehicle Maintenance & Garage Practice by Jigar A. Doshi (PHI Learning, Delhi).
7	Mechanical Estimating and Costing by S.C. Sharma & T.R.Banga (KHANNA PUBLISHERS).

Thermal Engineering and Engine Testing

Subject Code -AUT303

1. **Rationale:** The course will enable the students to learn the principles, concepts and application of thermodynamic laws and an air standard cycle which is needed to look after an IC engine. The operating behavior of an IC engine on test bed is the common purpose to learn various parameters like fuel consumption, various powers and efficiency. This course enables us to run internal combustion engines under realistic conditions and examine new combustion processes under part and full load conditions and various rotation speeds.

2. **Course Outcomes/Skill Sets:** At the end of the course the student will be able to*:*

CO-01	Explain the concept of thermodynamics and demonstrate its application through simple experiments.
CO-02	Test lubrication and cooling systems and service or troubleshoot it for any problems identified.
CO-03	Draw, label and compare SI and CI engines in terms of their operations, efficiency, fuel, speed, pressure and knocking.
CO-04	Explain abnormal combustion process and demonstrate with experiments both how it occurs andits prevention for a given engine.
CO-05	Conduct an engine performance test, draw its performance characteristics and measure friction power, air / fuel ratio and efficiencies.

3. Course Content

Week	CO	PO	Lecture (Knowledge Criteria)	Tutorial (Activity Criteria)	Practice (Performance Criteria)
			1. **Fundamentals of thermodynamic** - System, surroundings, intensive and extensive property. 2. Laws of thermodynamics- Zeroth, First and Second law. 3. Gas Laws – Boyle's law - Charles's Law - Avogadro's law - Joule's law.	Refer Table 1	1.Illustration of systemand surrounding usingsimple experiments/Virtual simulations, Video demonstration & documentation. 2. Illustrate the principles of the laws of thermodynamics using simple experiments/ Virtual simulations, Video demonstration& documentation.

			1.Relationship between the two specific heats- characteristic gas constant R. Adiabatic index ϒ. 2. Definition of enthalpy and entropy. 3. **Introduction to thermodynamic processes** - PVT relations -work done, heat transfer, change in internal energy, change in enthalpy and entropy for constant volume and constant pressure process.	Problems on thermodynamic processes.	1. Case study on enthalpy and entropy. 2. Simple experiments on work and heat, Video demonstration &documentation.
			1. PVT relations -work done, heat transfer, change in internal energy, change in enthalpy and entropy for isothermal process. 2. PVT relations -work done, heat transfer, change in internal energy, change in enthalpy and entropy for isentropic process. 3. Air standard cycles. Types, assumptions made in air standard cycles. Note: No derivations are needed.	Refer Table 1	1.Virtual exposure on thermodynamic processes. **or** Drawing of PV diagrams of process and cycles using software and find various parameters. 2. Virtual exposure on thermodynamic processes/ Drawing of PV diagrams of process using software and find various parameters.
			1. Explanation of PV and T-S diagrams of Carnot cycle. 2. Explanation of PV and T-S diagrams of Otto cycle. 3. Explanation of PV and T-S diagrams of Diesel cycle. Note: No derivations are needed.	Problems on Air standard cycles.	**1.**Virtual exposure on the otto Cycle **or** Drawing of PV diagrams of cycles(otto) using any software and find various parameters. 2.Virtual exposure on the Diesel Cycle **or**

					Drawing of PV diagrams of cycles (Diesel) using any software and find various parameters.
			1.**Lubrication System**: Need-Types-Layout of pump feed system. 2. Oil Pump-Types- Gear pump-Rotor type- Vane type. 3. Oil filter- need- Types-Construction and working of cartridge type oil filter.	Refer Table 1	1. Find the Oil level and replace the engine oil and oil filter and Quality checking 2. Servicing of oil pumps and filters **Note:** Prepare the trouble shooting chart.
			1.**Cooling System**: Need- types-Comparison- Layout of pump circulation system. 2. Construction and working of Water pump- radiator 3. Thermostat - Need-Types-Construction & Working of Wax type	Refer Table 1	1. Servicing of cooling system. 2. Servicing of water pump and radiator. **Note:** Prepare the trouble shooting chart.
			1. **Combustion in engines** – Stages of combustion in SI engines and Diesel engines. 2. SI engine detonation & pre-ignition- process- effects 3. Controlling methods of SI engine detonation & pre-ignition.	Refer Table 1	1.Case study on detonation and preignition for SI engine and write a report on the study conducted. 2.Using engine scanner, identify the knocking in SI engine.
			1. CI engine detonation 2. Knocking- process- effects. 3. Controlling methods of CI engine detonation.	Refer Table 1	1.Case study on detonation and preignition for CI engine and write a report on the study conducted. 2.Using engine scanner, identify the knocking in CI engine.
			1.**Engine performance**-determination of IP- BP - MEP-	Refer Table 1	1. Determine the Compression pressure

			IMEP-BMEP- Engine Torque - piston speed. 2.Friction power- types of measuring friction power. 3. A/F ratio- Requirement of A/F ratio for different operating conditions of engine.		and vacuum pressure of multi cylinder engine 2.To determine A/F Ratio on the four-stroke diesel engine.
			1. Volumetric efficiency. Methods for increasing volumetric efficiency. 2. Simple problems on IP, BP, IMEP, BEMP. 3. Simple problems on FP, A/F ratio and Volumetric efficiency.	Refer Table 1	1. To determine volumetric Efficiency on the four-stroke diesel engine. 2. To determine volumetric Efficiency on the four-stroke diesel engine.
			1. Determination of IP of a multicylinder engine using Morse test. 2. TFC-SFC- BSFC- ISFC-Importance. 3. Simple problems.	Study the latest technological changes in this course in this course and present the impact of these changes on industry.	1. Conduct the experiment to determine indicated power of multicylinder engine using Morse test. 2. Conduct the experiment to determine indicated power of multicylinder engine using Morse test.
			1. Efficiency-Mechanical efficiency -Thermal efficiency- indicated thermal efficiency- brake thermal efficiency. 2. Methods to improve thermal efficiency of engine. 3. Simple problems.	Study the latest technological changes in this course in this course and present the impact of these changes on industry.	1. Conduct experiment to determine the different efficiencies of two stroke SI engine at Constant load and constant speed condition 2. Conduct experiment to determine the different efficiencies of four stroke SI engine at Constant load and constant speed condition.
			1. Performance characteristics V/s Engine speed.	Study the latest technological changes in this	1. Conduct experiment to determine the

			2. SI engine-Heat balance sheet. Performance Curves. Study of engine behavior using performance curves. 3. CI engine-Heat balance sheet and performance curves. Study of engine behavior using performance curves.	course in this course and present the impact of these changes on industry.	performance of four stroke SI engine at constant load and constant speed condition. Compute heat balancesheet for SI engine 2. Conduct experiment to determine the performance of four stroke CI engine at constant load and constant speed condition. Compute heat balance sheet for CI engine.

*** PO= Program Outcome as listed and defined in year 1 curriculum and PO – CO mapping with strength (Low/Medium/High) has to be mapped by the course Co-Ordinator. (Above only suggestive).**

5. Reference:

Sl. No.	Description
1	Thermal Engineering by R.S. Khurmi (S Chand & Co)
2	I C Engines by Mathur &Sharma (Danapat Rai & sons)
3	Thermal Engineering by R K Hegde and Niranjan Murthy (Sapna Publications)
4	Internal Combustion Engines by N Ganeshan (Tata MCgraw-Hill)
5	Thermal Engineering by Kodanda Ramanna
6	Automobile Engineering by Kirpal Singh (Vol 1 and II)
7	Basic and Applied thermodynamics by P.K. Nag (Tata MCgraw-Hill)

Automotive Manufacturig Processes

Subject Code -AUT304

1.Rationale: Manufacturing process is a branch of professional engineering that shares many common concepts and ideas with other fields of engineering such as mechanical, chemical, electrical, and industrial engineering. The manufacturing or production engineer's primary focus is to turn raw material into an updated or new product in the most effective, efficient & economic way possible. The objective of the course is to develop skill in the most important manufacturing processes in to a context of a production environment.

2. Course Outcomes/Skill Sets: At the end of the course the student will be able to:

CO-01	Review a given drawing to identify the metal to be used, select the appropriate welding method and the right electrodes to be used.
CO-02	Build a sheet metal model using metal fabrication, brazing, lathe and drilling processes while adhering to all prescribed workshop safety protocols.
CO-03	Inspect the model to identify defects in welding processes using prescribed inspection procedureand also explain press work operation needed for any identified repair.
CO-04	Explain and implement the requirements of ISO standards 9000 series.

3. Course Content

Week	CO	PO	Lecture (Knowledge Criteria)	Tutorial (Activity Criteria)	Practice (Performance Criteria)
			1.Introduction to Welding Technologyin Automobile Industry 2. Classification of welding and types of Welding Processes. 3. **Arc Welding**: Principle of Arc Welding- Types and preparation of materials in welding – Consumable Electrode method & Non-Consumable Electrode method. Steps involved in Arc Welding	Refer Table 1	1. a) Show various safety sign charts and Safety tips to be followed in the machine shop. Note down the Safety tips in the record book. b) Identify and record different Welding Joints in the Vehicle. 2. a) Practice on Material preparation for welding. b) Review the given drawing, Demonstrate and practice on selection of electrodes and setting the current, Arc initiation.

			1. TIG Welding – Construction- Working Principle- Material preparation- Process & Application. 2. GTAW- Operation- Equipment & Materials- Joint Design- Application. 3. GMAW- Operation- Equipment & Materials- Joint Design- Application.	Refer Table 1	1. Practice on Simple job work on Lap joint using metallic arc welding, GTAW & GMAW and Video demonstration & documentation of the same. 2. Practice on Simple job work on butt joint using metallic arc welding, GTAW & GMAW and Video demonstration & documentation of the same. Note: Use Personal Protective equipment & follow the safety practices against fumes and welding gases (Record all the safety tips followed).
			1. **Resistance Welding**- Principle- Construction & Working. Types of Resistance Welding. 2. Working principle- Spot Welding, Butt Welding 3. Seam Welding- Working Principle.	Refer Table 1	1. a) Demonstrate the safety precautions to be Practiced during spot welding and identify the welding method used to join the component in the given drawing. b) Case Study/ Industrial visit to metro, Aircraft outer bodies, Rail coaches etc. on spot welding and write a report on the same. 2. a) Demonstrate the safety precautions to be

					Practiced during seam welding. b) Case study/ Industrial visit on Seam welding and write a report on the same.
			1. **Gas welding**- Working process of Gas Welding and Gas cutting. Types of Gas Welding & Types of flames in Gas welding- Application. 2. Welding Defects and remedies. 3. **NON-DESTRUCTIVE TESTS (NDT):** Define NDT, Classify NDT methods, Visual inspection and its remedy.	Refer Table 1	1.a) Practice on Simple job work on Lap joint using gas welding. b) Identify the method of welding used to join the components in the given drawing and note down the electrode/binding material used. 2. a) Practice on Gas cutting. b) Practice on Visual inspection of the cracks by Microscope. Note: Use Personal Protective equipment & follow the safety rules (Record all the safety tips followed).
			1. Liquid Penetrant Testing – Basic steps in LPT, types of LPT and its remedy. 2. **Brazing:** Introduction-Types, Joint design**,** Cleaning the joint 3. Selecting the flux**,** Selection of a Brazing process, Post cleaning and inspections. Difference between brazing and welding.	Refer Table 1	1. Practice on Visual Inspection of the cracks by LPT and Video demonstration & documentation of the same. 2. Practice on Brazing of different automobile components and Video demonstration & documentation of the same. Note: Follow the safety rules (Record all the safety tips followed).

			1. **Sheet Metal Technology**- Introduction, Fundamentals of sheet metal work, Different hand tools usedin automobile body shop. 2. Sheet Metal operations: - **Cutting operation**-producing blanks, cutting holes, progressive, miscellaneous operation. 3. **Forming operation**-bending, Embossing, flanging, hemming, seaming, curling, wiring.	Refer Table 1	1. Demonstrate and record different types of tools used in automobile body shop. 2. Practice on Preparation of number plate using Embossing and rivet operation in sheet metal operation. **Note:** Follow the safety rules (Record all the safety tips followed).
			1. Ribbing, staking, crimping, bulging, beading, enclosing, tube forming. 2. **Drawing operation**- cupping, box drawing, panel drawing, Shallow, deep panel drawing. 3. Introduction to Press working. Power press- Types- Working.	Refer Table 1	1. Demonstrate and prepare various sheet metals joint for any one application. 2. Practice on any one drawing operation in sheet metal for any oneapplication and Video demonstration & documentation of the same. **Note:** Follow the Sheet Metal fabrication safety tips.
			1. Operations performed on press. Work & tool holding devices. 2.**Casting:** Introduction to metal castings and moulding in foundry. 3. Use of patterns, pattern materials.	Refer Table 1	1. Demonstrate the press work operation using hydraulic press. 2. a) Demonstrate the Selection of right type of foundry tools andequipment. b) Practice on Sand mixing.
			1. Types of patterns-single, split, loose 2. Sweep pattern, skeleton pattern, Gated Patterns – allowances.	Refer Table 1	1. Practice on preparingthe Square Mould. 2. Practice on preparing the Hexagonal Mould.

			3. Types of moulding sand and properties.		
			1. Concept of Cope, Drag. Concept of Runner, riser & core. 2. Permanent mould casting –Die casting, Slush Casting. 3. Centrifugal casting, investment casting. Brief explanation of defectsin castings.	Refer Table 1	1. Practice on preparing the pattern cavity and provide runner and riser. (To show the concept of cope and drag) 2. Melt Wax cast the same in the prepared pattern of the mould.
			1. **Forging**: Introduction - Types- Working Processes of different types. 2. Working of Open and Closed Die-Forging. Effects of forging on microstructure. 3. Forging defects and their effects. Steel Forging in Automobile Industries- Need.	Refer Table 1, Study the latest technological changes in this course in this course and present the impact of these changes on industry.	1. Melt the Aluminium/tin/ Cool drink Tin and cast the same in the prepared pattern of the mould using electric furnace. Note: Follow all the safety precautions. 2. Demonstration of tools and equipment used in Forging operation. List & note down their functions.
			1. **ISO 9000 series Quality management system**: History of International Organisation for standardization. ISO members. ISO standards and rules. 2. History of ISO 9001. BS 5750. QMprinciple. 3. The main requirements of ISO 9001.	Refer Table 1, Study the latest technological changes in this course in this course and present the impact of these changes on industry.	1. Practice on smith Forging of the given Material. 2. Case study on ISO standards related to automotive industry. Note: Follow the safety precautions in the forging lab.

			1. **Lathe:** Types-Construction & working of engine lathe- Turning, step turning, taper turning & knurling. 2. **Drilling**: Working principle of Conventional drilling operation and its parts. 3. Nomenclature of drill tool. Hole drilling operation- Reaming, Boring, Counter boring.	Refer Table 1, Study the latest technological changes in this course in this course and present the impact of these changes on industry.	1. Demonstrate different parts of lathe and practice turning, step turning, taper turning & knurling operations. 2. Practice on drilling and counter boring of the given Sample. Note: Follow the safety practices.

*** PO= Program Outcome as listed and defined in year 1 curriculum and PO – CO mapping with strength (Low/Medium/High) has to be mapped by the course Co-Ordinator. (Above only suggestive)**

5. Reference:

Sl. No.	Description
1	Manufacturing Technology-1By P.C Sharma of S. CHAND Publications.
2	Elements of Workshop Technology Vol-I Manufacturing Process edition-ByHajraChoudry
3	Elements of Workshop TechnologyVol-II Manufacturing Process edition-ByHajraChoudry
4	Work shop technology By R. S KHURMI &J. K GUPTA of S. CHAND&Co.Ltd
5	Welding processes and technology – O.P Khanna
6	Manufacturing Technology: Foundry Forming and Welding, P.N.Rao 2nd Edition TMH
7	Welding and Welding technology, Richard L little, Mc. Graw Hill Education

(4th – SEMESTER)

Advanced Automotive Systems

Subject code – AUT401

1. Rationale: The automotive industry has observed a drastic evolution since 2010 with many advancements in technology. The traditional 4-wheeled cars, which were earlier equipped with basic features have transformed into connected cars with advanced features such as cloud computing, big data, and the Internet of Things (IoT), among others. There is increasing number of electronic embedded systems in 2- wheelers as well as passenger and commercial vehicles such as Antilock Braking System (ABS), Electronic Control Units (ECUs) for engine management, park assist, Electronic Stability Programme (ESP), glow plug timers, Capacitive Discharge Ignition (CDI), etc., that are nowadays being installed not only in luxury cars but also in mid-segment cars by manufacturers. This course focusses on developing skill on these advanced automotive systems.

***2.* Course Outcomes/Skill Sets:** At the end of the course the student will be able to*:*

CO-01	Test, Service and troubleshoot advanced automotive and electronic components of the given vehicle.
CO-02	Select an appropriate sensor and/or actuator for a given automated application, demonstrate collection of measurement data and explain process variables using sensors and transducers.

3. Course Content

Week	CO	PO	Lecture (Knowledge Criteria)	Tutorial (Activity Criteria)	Practice (Performance Criteria)
			1. Computer operation (ECU) - Block diagram of computer (ECU) with its microprocessor-functions working principle. 2. Microprocessors-design-program-information storage-information retrieval. 3. Typical multipoint fuel injection system input/output pin configuration	Refer Table 1	1. Identification of pin configuration of ECU of different engines. 2. a) Identification of pin configuration of ECU of other systems of vehicle. b) Study different error codes of different makes of ECU.
			1. Open loop and closed loop control systems 2. Multiplexing-concept. Computer networking-concept need-Controlled Area Network (CAN)-concept-merits-types. 3. Sensors- Definition, construction and working- throttle position sensor-crankshaft position sensor-types-	Refer Table 1	1.Demonstration of computer area network and Identify TPS and crankshaft position sensor and their locations used invehicle. 2. Diagnose and troubleshoot TPS and crank position sensor with engine scanner (and multi-meter).

			1. Construction and working of magnetic pickup coil type, Hall effect. 2. Construction and working-Piezoelectric combustion, Knock sensor, temperature sensor. 3. Strain gauge type manifold absolute sensor-exhaust gas oxygen sensor.	Refer Table 1	1 Identify piezoelectric knock sensor and temperature sensor and their locations used invehicle. 2. Diagnose and troubleshoot piezoelectric knock sensor and temperature sensor with engine scanner (and multi-meter).
			1. Mass air flow Sensor-types 2. construction and working of hotfilm and hot wire type sensors. 3. Potentiometer type -need-working. principle.	Refer Table 1	1. Diagnose and troubleshoot Potentiometer with enginescanner (and multi-meter). 2. Build circuit to demonstrate the testing and working of Potentiometer, LVDT type ride height sensors, rain sensor.
			1. LVDT type ride height sensors, rain sensor-need-working. principle. 2.Actuator-Definition, pulse width modulation of input voltage-duty cycle-need. 3. On/off solenoid proportionate solenoid-stepper motor-servo motor-relays-construction and working - applications.	Refer Table 1	1. Diagnose and troubleshoot LVDT type ride height sensors, rain sensor with engine scanner (and multi-meter). 2. Build circuit of On/off and proportionate solenoid stepper motor.
			1.**Power steering** - types, construction and working- HPS. 2. Construction & working -linkage power steering, Integral powersteering. 3. electronic rack and pinion power steering-electronic power steering.	Refer Table 1	1.Servicing and troubleshooting of hydraulic power steering. 2. Service and troubleshoot electronic rack and pinion power steering.
			1. Continuously variable transmission-construction and working. 2. Hydraulic automatic transmission-gear shifting process. 3. Automated manual transmissions-modes-working principle.		1. Service and troubleshoot of CVT. 2. Service and troubleshoot of Hydraulic automatic transmission.
			1. Torque converter- construction and working, torque converter. 2.Limited slip differential-need-types. 3. Working principle of clutch type LSD.	Refer Table 1	1. Servicing of torque converter 2. Service and troubleshoot clutch type LSD.

			1. Anti-lock brakes-Need and types, construction and working. 2. Anti-lock brake modulator. 3. Servo brakes -types, vacuum servo brakes-layout- working,	Refer Table 1	1. Test and troubleshoot wheel speed sensor of anti-lock braking system. 2. Servicing of servo brakes.
			1. Electronic stability control-working principle. 2. Hill assistance and traction control system – working principle. 3. Air bag system-need-types-layoutof accelerometer-based air bag system.	Refer Table 1	1. Virtual Demonstration of Electronic stability control. 2. Virtual demonstrationof air bag systems.
			1. Collision avoidance warning system-tyre pressure warning system- need-working. 2. Computer based instrumentation-working principle. 3.Trip information computer working principle, working principle-vehicle speed measurement.	Refer Table 1, Study the latest technological changes in this course in this course and present the impact of these changes on industry.	1. Test and troubleshoot of tyre pressure warning system. 2. Demonstration of computer-based instrumentation.
			1. Navigation- types- GPS navigation system. 2. Four-wheel drive system & all-wheel drive -types. 3.construction and working of permanent 4-wheel drive with viscous coupling.	Refer Table 1, Study the latest technological changes in this course in this course and present the impact of these changes on industry.	1. Demonstration of GPS navigation system. 2. Service and troubleshoot 4-wheel drive system.
			1. Air spring-types. construction and working- Bellows' air spring, piston air spring. 2. Hydro-elastic spring construction and working.	Refer Table 1, Study the latest technological changes in	1. Servicing and troubleshooting of air springs 2. Servicing and troubleshooting of hydro-elastic spring.

			3.Working principle-electronically controlled shock absorber.	this course in this course and present the impact of these changes on industry.	
Total in hours					

*** PO= Program Outcome as listed and defined in year 1 curriculum and PO – CO mapping with strength (Low/Medium/High) has to be mapped by the course coordinator. (Above only suggestive)**

5. Reference:

Sl. No.	Description
1	Understanding Automotive electronics, William Ribben, Butterworth-Heinemann Publications.
2	Automotive Computer Controlled Systems (Diagnostic tools and techniques), Allan. W. M Bonnick, Butterworth-Heinemann Publications.
3	Automobile electrical and electronic systems, Tom Denton, Butterworth-Heinemann Publications.
4	Electronic Engine Controls, Steve. V. Hatch, Cengage Learning.
5	Truck engines Fuel & computerized management systems, Sean Bennett, Cengage Learning.
6	Automobile engineering Vol I by Anil Chikara (Satya Prakashan)
7	Advanced vehicle technology by Heinz Heisler (Butterworth-Heinemann)
8	A Systems Approach to Automotive technology by Jack Erjavec (Cengage Learning)
9	Mechatronics by Prof C R Venkataramana
10	Mechatronics by W Bolten (Longman Pearson publications)

Design and Drafting

Subject code – AUT402

1. Rationale: Machine design is the most important activity in the mechanical industries. Success or failure of any industry is product design. Designers are individuals who use their talents to solve user-product problems on an on-going basis. Since design is the first step toward manufacturing, it is important that potential designers have some experience in manufacturing and industrial engineering. Design drawing willdevelop in detail from block drawings and sketches to very detailed technical drawings describing every component in a way that will enable them to be constructed and operated. This course enables the students to design and draw simple machine components using 3D modelling software.

***2.* Course Outcomes/Skill Sets:** At the end of the course the student will be able to*:*

CO-01	Analysis the behaviour of simple load carrying members which are subjected to an axial and shear loading and record the resulting impact of both loads.
CO-02	List the standards and codes used in the design process.
CO-03	Design automobile components and draft machine components used in a given automobile by computer-based techniques.

3. Course Content

Week	CO	PO	Lecture (Knowledge Criteria)	Tutorial (Activity Criteria)	Practice (Performance Criteria)
			1. Introduction to design. Simple stress and strains – tensile compressive, shear and Hooke's law. Factor of safety. 2. Young's modulus, modulus or rigidity, bulk modulus. Centre of gravity & moment of Inertia – importance. 3. Moment of Inertia about C.G for L-section and Channel section.	Refer Table 1	1. Drawing stress-strain diagram using UTM machine and record the resulting impact of both loads. 2. Finding Centre of gravity and moment of inertia of different shapes using analytical method and software like AutoCAD/Solid edge etc.

			1. Moment of Inertia about C.G for I Section, tubular section. 2. Limits-Need for limit system. Fit-Types of Fit – Clearance fit, interference fit, transition fit and their designation. 3. Allowance, Tolerance – System of tolerance dimensions (system of writing tolerance). Unilateral system and bilateral system.	Refer Table 1	1. a) Represent and interpret tolerances given in drawings. b) List the standards and codes used in the design process. 2. Practice to insert different fit, tolerance, precision and limit symbols using any CAD software.
			1. Specifying tolerances in assembly. Geometrical tolerance, positional tolerance. 2. Terminologies used in limits and fits – shaft, hole, basic size, actual size, zero-line, upper deviation, lower deviation. 3. System of Fits - Hole Basis System-Shaft Basis system.	Refer Table 1	1. Practice to insert appropriate ISO system of Limits, Fits and tolerances. 2. Practice calculating limits for a given tolerance case.
			1. Fasteners-types-screw terminology-types of screw profiles. 2. Locking of bolts-need-types. 3. Stresses acting in a bolt. Stresses in screw fastening due to external loading- Tensile-compressive-combined tensile & shear stress. Simple problems	Find the max stress in the bolt using any CAD software.	1. Using part modelling work bench tools and assembly workbench tools create a square nut and bolt. 2. Using part modelling work bench tools and assembly workbench tools create a hexagonal nut and bolt using any CAD software like-solid edge, UG-NX etc.
			1. Types of shafts, shaft materials, standard sizes.	Refer Table 1	1. Create a model of shaft and key using any

			2. Design of Shafts subjected to twisting & bending moment (Hollow and Solid) using strength and rigidity criteria. Simple problems 3. Keys-need, types. Design of keys under different load conditions- shear and crush. Simple problems.		CAD software like-solid edge, UG-NX etc. 2. Create an 3D-assembly model of shaft and key then create a 2D drawing using any CAD software like-solid edge, UG-NX etc.
			1. Couplings-purpose-requirements-types- applications. 2. Design of Muff coupling. Simple problems. 3. Design of Flange coupling-Unprotected. Simple problems.	Refer Table 1	1. Create an 3D-assembly model of Muff coupling and then createa 2D drawing using any CAD software like-solid edge, UG-NX etc. 2. Create an 3D-assembly model of flange coupling and then create a 2D drawing using any CAD software like-solid edge, UG-NX, etc.
			1. Coil spring-terms used in helical compression spring. Simpleproblems 2. Stresses & deflection of helical spring. Simple problems 3. Leaf springs- Effective & ineffective length, camber, stresses& deflection of semi elliptic leaf. Simple problems.	Refer Table 1	1. Using part modelling work bench tools create a helical spring CAD software like-solid edge, UG-NX etc. 2. Using part modelling work bench tools and assembly workbench tools create a leaf spring assembly.
			1. Design concepts of piston. 2. Design of piston, piston pin & piston rings based on strength and heat transfer. 3. Simple problems.	Refer Table 1	1. Create an 3D-assembly model of piston, piston rings and piston pin and then create a 2D drawing using any CAD software

					like-solid edge, UG-NX,etc. 2 Create an assembly model of piston, piston rings and piston pin and then create a 2D drawing using any CAD software like-solid edge, UG-NX, etc.
			1. Forces acting on connecting rod. 2. Design parameters of connecting rod. 3. Design of connecting rod. Simple problems.	Refer Table 1	1. Create an 3D-assembly model of connecting rod and then create a 2D drawing using any CAD software like-solid edge, UG-NX, etc. 2. Create an assembly model of connecting rod and then create a 2D drawing using any CAD software like-solid edge, UG-NX, etc.
			1. Design of flywheel. Simple Problems. 2. Cam and followers-types, Cam profile-types. 3. Construct a cam profile using uniform velocity method. Simple Problems.	Refer Table 1	1. Create an assembly 3D-model of flywheel and ring gear and then create a 2D drawing using any CAD software like-solid edge, UG-NX, etc. 2. Create an 3D-assembly model of camshaft and then createa 2D drawing using any CAD software like-solid edge, UG-NX, etc..
			1. Torque transmitted throughsingle and multi-plate clutches.	Refer Table 1,	1. Create an 3D-assembly model of single plate-clutch assembly and then

			2. Uniform intensity of pressure-uniform rate of wear conditions. 3. Design of single plate clutch and multi-plate clutch. Simple problems.	Study the latest technological changes in this course in this course and present the impact of these changes on industry.	create a 2D drawing using any CAD software like-solid edge, UG-NX, etc. 2. Create an assembly 3D-assembly model of single plate clutch assembly and then createa 2D drawing using any CAD software like-solid edge, UG-NX, etc.
			1. Gear-terminology of gear-gear teeth profiles. 2. Design of spur gear. Simple problems. 3. Find gear ratio, number of teeth and distance between lay shaft and main shaft.	Refer Table 1, Study the latest technological changes in this course in this course and present the impact of these changes on industry.	1. Create an 3D- assembly model of spur gear and then create a 2Ddrawing using any CAD software like-solid edge/UG-NX. 2. Create an 3D- assembly model of a helical gear and then create a 2Ddrawing usingany CAD software like- solid edge/UG-NX.
			1. Find different vehicle speed at different engine speed and gear ratios. 2. Brakes: Stopping distance, braking efficiency, Braking torque. Leading and trailing shoe, 3. Equation for Braking Torque on Leading and Trailing Shoe. Simple Problems.	Study the latest technological changes in this course in this course and present the impact of these changes on industry.	1. Create an 3D- assembly model of pinionand gear and then create a 2D drawing using any CAD software like-solid edge/ UG-NX. 2. Create an 3D-assembly model of Leading and trailing shoe(drum brake) and then create all 2D views using any CAD software like-solid edge/UG-NX.
Total in hours					

4. Reference:

Sl. No.	Description
1	A Text book of Machine Design by R.S. Khurmi&J.K.Gupta (S. Chand publication).
2	Design Of Machine Elements Vol I, Vol II by J.B.K. Das, P.L. Srinivas Murthy (Sapna Publication).
3	Auto Design by R B Gupta (Satya Prakashan).
4	Automobile Engineering Drawing by R B Gupta (Satya Prakashan).
5	CADD software for Engineers and Designers by Prof. Sham Tickoo (Dream tech press).
6	Automotive Mechanics by Dr.N.K. Giri (Khanna Publishers))
7	Automobile design Problem by R.S. Agarwal
8	Machine Drawing by K R Gopalakrishna (Subhas Stores)

Vehicle Body Engineering and Dynamics

Subject code – AUT403

1. Rationale: In automobile, the body work is the main structure which protects the occupants and any other payload. Thus, the body engineering plays an important role in construction of body and providing comfort and safety to the passengers. The automobile when rolling on the road is subjected to various types of forces. The main goals are reducing drag and wind noise, minimizing noise emission, and preventing undesired lift forces and other causes of aerodynamic in stability at high speeds. The main goal of this course is to impart skill of vehicle body construction, repair and dynamics of the vehicle which also improves the performance of vehicle.

***2.* Course Outcomes/Skill Sets:** At the end of the course the student will be able to*:*

CO-01	Identify the body and glass material for a given vehicle type and demonstrate replacement of windshield and vehicle body repair while complying with all necessary safety protocols.
CO-02	Select accessories for a given vehicle and list the right adhesives used to affix them.
CO-03	Check for metal corrosion on structural panel for a given vehicle, prepare corrosion spots and perform spray painting process.
CO-04	Test and troubleshoot or service the air conditioning system of a given vehicle.
CO-05	Design an aerodynamic vehicle body ensuring appropriate load distribution along withergonomical interiors.
CO-06	Design the steering system, braking system and bus body ensuring appropriate design parameters.

3. Course Content

Week	CO	PO	Lecture (Knowledge Criteria)	Tutorial (Activity Criteria)	Practice (Performance Criteria)
			1. Vehicle body -Need- body styles- Materials**.** 2. Composite materials- Advantage - types- Application. GRP, FRP, carbon reinforced plastics, insulating materials- need-types- properties. 3. **Automotive Adhesives & Sealant**- Need-Types, Structural adhesive. Application of Adhesive in Automobile	Refer Table 1	1.Identify and compare different materials in a vehicle body. 2. Practice on using of different adhesives and sealant in vehicle body. **Note:** Use Personal Protective gears & follow the safety rules.

			1.**Automotive Glass** – types- toughned glass, laminated glass, Bullet resistance glass. Difference between Toughened glass, sheet glass & Laminated glass. 2. Defrosting of windshield glass. Window winding mechanisms-types-mechanical & electrical. 3. Automatic window regulating mechanism and center locking Mechanism	Refer Table 1	1. Identify the glass material for a given vehicle. Practice on removing and refitting wind shield glasses. 2. Servicing of window regulating mechanisms. **Note:** Use Personal Protective gear & follow the safety rules.
			1. **Vehicle body repair -** Identificationof location of parts and panels. Techniques/ procedure required to Repair of body panel, minor and majorstructural damage. 2. Damages on chassis and body-diamond type, banana damage, twist damage, mash damage, dents and scratches, weld burrs. 3.Body & chassis alignment- Reasons & effects.	Refer Table 1	1. a) Remove and refit body panels, doors,floors and fenders. b) Demonstrate different processes for removing dents. 2.Checking and correcting the body and chassis alignment **Note:** Use Personal Protective gears &follow the safety rules.
			1. **Body painting-** objectives – Paint types. Elements of paint-pigment-resins- solvents. 2. Paint drying process-Types-drying principle of each type. 3. Composition & functions- primer paint- putty paint.	Refer Table 1	1. Practice on removing paint from the damaged area, practice on mixing and applying body filler. 2. Practice on applying primer, practice on feather edge sanding and masking. **Note:** Use Personal Protective gears &follow the safety rules.

			1. Spray painting - Types, air spray painting-procedure. 2. **Corrosion:** Causes and effects of corrosion on automobile bodies. Methods of corrosion protection. 3. **Interior aesthetics**: -Introduction, Seat ergonomics, seat belt -need-types. seat adjustment mechanisms.	Refer Table 1	1. Practice on cutting, scuffing, rubbing and polishing in painting. 2. Demonstrate and practice on anti - corrosion and rust prevention procedure on vehicle body. **Note:** Use Personal Protective gears &follow the safety rules.
			1. **HVAC system -** Functions- Working of vehicle air condition system and itslayout 2. Construction and working of expansion valve and Accumulator/ drier. 3. Working of heating and ventilation system in automobile.	Refer Table 1	1. Air conditioner maintenance and service using automaticAC refilling machine. 2.HVAC system troubleshooting.
			1.**Body Dynamics**: Different types of engines and drive location with their merits and demerits. 2. Different resistance to body motion. Wind resistance, rolling resistance and gradient resistance. 3. Power required for propulsion. Traction and tractive effort. Surplus power, acceleration, gradability, draw bar pull, Equivalent weight.	Refer Table 1	1. Case study on load distribution of a vehicle under different conditions (on level road and while ascending the hill). **or** Using the simulation software examine on load distribution of a vehicle under different conditions 2. Case study on resistance to vehicle motion and surpluspower of different wheel drive.

			1.Maximum acceleration, max tractive effort, reactions for front wheel, 4 wheel and rear wheel drive. 2.Simple Problems. 3. Simple Problems.	Refer Table 1	1.Find different performance parameters of a givenvehicle by analyticalmethod using its specification and compare it with actual parameters. 2. Using the simulation software examine the different performance parameters of a given vehicle.
			1. **Vehicle Aerodynamics:** Objectives, aerodynamic forces and moments. 2. Various body optimization techniques for minimum drag. 3. Various body design features to improve safety. Sources of noise and vibration- various noise and vibration reduction techniques.	Refer Table 1	1.Case Study on determining different type of flow on vehicle body and effects of aerodynamic forces and moments on vehicle body. Or Observe the aerodynamic drag forces using simulation software /set up. 2. Practice on Sources of body noises testing and methods of elimination. Water leakage test.
			Braking System: 1.Different forces acting on the vehicle moving on a level road and gradient - when-front wheel brakes applied, 2. Different forces acting on the vehicle moving on a level and gradient- when rear wheel brakes applied and all wheel brakes applied.	Refer Table 1	1.Case study on load distribution of a vehicle under different conditions while braking. Or Using the simulation software examine load distribution of a vehicle

			3. Weight transferred during braking, stopping distance, stopping time and efficiency of brakes.		under different conditions while braking. 2. Case study on weight transfer, stopping distance and time improvement under various conditions. Or Using the simulation software examine the weight transfer, stopping distance and time improvement under various conditions.
			Steering System: 1.True steering, over steering, under steering, minimum turning circle radius of vehicle. 2. Collapsible steering column- types, - Construction and working. 3. tilt-telescopic steering columns-construction and working.	Refer Table 1, Study the latest technological changes in this course in this course and present the impact of these changes on industry.	1.Finding minimum turning radius-analytical/ practical method. 2.Demonstration of different types of collapsible steering. Or Using the simulation software analyse the working of collapsible steering column.
			1. **Bus Body Details**: Types, Bus Body Lay Out: Floor height, engine location, entrance and exit location. 2. seating dimensions, Dimensions of driver's seat in relation to controls,driver's cabin design.	Refer Table 1 Study the latest technological changes in this course	1.Practice on checking of frame alignment and its correction. 2. Practice on Bus body dent removal and painting.

			3. Constructional details: Frame construction, Double skin construction- Types of metal section used- Regulations- Conventional and Integral type construction.	in this course and present the impact of these changes on industry.	**Note:** Use Personal Protective gears & follow the safety rules.
			1. **Wind tunnels for automotive aerodynamics**: Introduction – Principles of wind tunnel technology. 2. Flow visualization techniques. Testing with wind tunnel balance (scale models). 3. Road Testing -Need-Equipment used in road testing. Crash test- need- types- Equipment needed- government regulation- rating.	Study the latest technological changes in this course in this course and present the impact of these changes on industry.	1. Case study on Analysis of flow visual technique. Case study on wind tunnel technology. Or Using the simulation software analyse the flow visual technique. 2. Case study to improve safety rating of a given vehicle.
Total in hours					

*** PO= Program Outcome as listed and defined in year 1 curriculum and PO – CO mapping with strength (Low/Medium/High) has to be mapped by the course coordinator. (Above only suggestive)**

5. Reference:

Sl. No.	Description
1	Vehicle body engineering by Giles J Pawlowsky (Business books limited)
2	Vehicle body layout and analysis by John Fenton (Mechanical Engg.Publication ltd, London.)
3	Aerodynamics of Road Vehicles by W.H. (Butter worth's 1987)
4	Automobile Engineering (Paint Technology) Vol V by Anil Chhikara, Satya Prakashana New Delhi
5	Automotive Engineering (Heating & Air conditioning) class room manual, Mark Schnubel, Cengage Learning
6	A. Pope - "Wind Tunnel Testing" - John Wiley & Sons - 2nd Edition, New York - 1974.
7	Vehicle maintenance and Garage practice by jigar A. Doshi, Dhruv U. Panchal, Jayesh P. Maniar.
8	Siemens NX 2019 for Designers, 12 Edition by Prof. Sham Tickoo, Purdue University Northwest, USA. (Tickoo-CADCIM Series)
9	Beginning MATLAB and Simulink: From Novice to Professional by Sulaymon Eshkabilov.
10	MATLAB and SIMULINK for Engineers by Agam Kumar Tyagi
11	Siemens NX 2021 for Designers, 14th Edition by Prof. Sham Tickoo, Purdue University Northwest

Fuels and Pollution Control

Subject code – AUT404

1.Rationale: Automobiles burn different kinds of fuels to generate mechanical power. Fuel burning also generates exhaust emissions, which pollutes the atmosphere. Increase in number of automobiles has resulted in atmospheric pollution beyond permissible limits in cities. Thus, automobile emissions have become a social concern and engineers are supposed to reduce it. Emission standards are therefore set in every country to control this problem. These standards specify maximum amount of pollutants that can be released into the environment by different types of vehicles. The students should therefore have knowledge about the pollutants produced by automobiles and ways to reduce the pollution by the use of the various emission control devices maintain level of pollutants in emissions of various kinds of automobiles.

2. Course Outcomes/Skill Sets: At the end of the course the student will be able to:

CO-01	Differentiate between petroleum and alternative fuels and analyse emission performance of an engine using alternative fuels.
CO-02	Test and troubleshoot or service a fuel feed system, supercharger, turbocharger and Micro-Hybrid Vehicle.
CO-03	Explain the formation of pollutants, its measurement techniques and list the appropriate methods to be used to control pollutions from vehicles.
CO-04	List emission standards & the regulations applicable to vehicles manufactured in India and carry out emission tests to record emission levels as per each standard.

3. Course Content

Week	CO	PO	Lecture (Knowledge Criteria)	Tutorial (Activity Criteria)	Practice (Performance Criteria)
			1. Petroleum fuels. Refining process. 2. Properties of liquid and gaseous fuels. Types – merits – demerits. 3. Alternative fuels –Methanol – properties merits- demerits -storage emissions.	Refer Table 1	1. Determination of flash point, fire point and viscosity of petrol fuel. 2. Determination of flash point, fire point and viscosity of Diesel fuel.
			1. Ethanol – properties merits-demerits -storage emissions. 2. Biodiesel - properties merits-demerits -storage emissions-Biodiesel production processes.	Refer Table 1	1. Determination of Calorific value of methanol and Ethanol using Bomb's calorimeter.

			3.Hydrogen - properties merits-demerits -storage emissions. CNG - properties merits- demerits -storage emissions- CNG fuel feed system layout.		2.a) Installation CNG kitto the car, setting and maintenance. b) Determination of Calorific value of CNG using Junker's calorimeter.
			1.Fuel feed system in SI engine-Requirements-types- Layout - Working of 2-wheeler carburetor. 2.Fuel feed system in CI engine-requirements-types- Layout- Inline and distributor system. 3. Governor- need- types- working of mechanical governor. single cylinder fuel injector pump. Multi hole fuel injector.	Refer Table 1	1.Servicing of 2-wheeler fuel feed system. 2.a) Servicing of typical CI engine fuel feed system. b) Trouble shooting offuel feed systems
			1. Stratified engine -Need- types. 2. Supercharging- need. Supercharger-types. 3.Turbocharging- need– types construction– working of turbocharger.	Refer Table 1	1. Servicing of super charger. 2. Servicing of a turbocharger.
			1. **Pollutants from an automobile** – Sources of pollutants in SI engine & Diesel engine 2. Formation of Particulate emission in Diesel engine. 3. Mechanism of nitrogen oxide, carbon monoxide and unburnt hydro carbon in SI engine.	Refer Table 1	1. Measurement of HC, CO, CO2, O2 using exhaustgas analyzer. 2. Measurement of smoke of Diesel engine using Smoke meter.
			1. **Methods of controlling pollution:** Crankcase ventilation system- need- layout. Exhaust gas recirculation-need- layout.	Refer Table 1	1. Servicing of PCV and EGR system 2. Servicing of catalytic converter.

			2. Catalytic converters -need-types - construction and working of 3-way catalytic converter. 3. SCR and Particulate filters to control particulate emission of diesel engine.		
			1. Electronic fuel injection-Advantage. Construction andworking - single point-multipoint fuel injectors. Variable valve timing- need-types. 2. Multipoint direct injection system-operating modes of direct injection. construction and working-petrol injectors. Variable length intake system-need. 3. CI Engine Electronic Fuel injection-types-construction and working-Electronic Diesel Control.	Refer Table 1	1. Service and troubleshoot single point injection system. 2. Service and troubleshoot multipoint injection systems.
			1. In line- Distributor pumps, construction and working. 2. Unit Injector-Common rail injection System 3. Electrohydraulic injector of CRDI system.	Refer Table 1	1. Servicing, calibrating and troubleshooting of Inline fuel pump system. 2. Servicing and troubleshooting of CRDI system.
			1. Battery operated vehicle-working principle -regenerative braking-working principle. 2. Fuel cells-types- construction and working of polymer electrolyte membrane type. 3. Hybrid vehicles-types- layouts of series and parallel.	Refer Table 1	1.Servicing and maintenance of battery-operated two-wheeler. 2. Servicing and maintenance of micro hybrid vehicles

			1. **Emission norms**-need- different emission standards for different engines in India. Driving cycles-need-types. 2. Bharath stage emission standards and norms. 3. Comparison of Bharath stage with European standards.	Refer Table 1	1. Case study on implantation of BS VI norms. 2. Test fuel consumption of a vehicle under different driving cycles.
			1. ARAI- Formation- functions. 2. Formulation of standards. Central Motor vehicle rules. Automotive pollution – air pollution & human health 3. Exhaust manifold- function, Exhaust manifold components, Muffler, Electronic muffler, Exhaust manifold reactor.	Refer Table 1, Study the latest technological changes in this course in this course and present the impact of these changes on industry.	1. Case study on standardization/ Formulation/ Certification. 2. Case study on effects of exhaust gas and advancement in exhaust manifold to control exhaust emission level.
			1. Performance of SI engine using different blends of ethanol- modifications to engine and fuel feed system. 2. Performance of SI engine using different blends of methanol. modifications to engine and fuel feed system. 3. Comparison of above emissions (1 & 2).	Refer Table 1, Study the latest technological changes in this course in this course and present the impact of these changes on industry.	1. Measure ethanol & methanol emission on a SI engine. 2.Conduct an experiment to measure various performance parameters of a SI engine using ethanol blend.
			1. Performance of Diesel engine using CNG- Modifications to engine and fuel feed system. 2. Performance of Diesel engine using biofuel- Modifications to engine and fuel feed system. 3. Comparison of above emissions (1 & 2).	Refer Table 1, Study the latest technological changes in this course in this course and present the impact of these	1. Measure CNG emission on CI engine. 2. Conduct an experiment to measure various performance parameters of a CI engine using biofuel blend.

				changes on industry.	
Total in hours					

*** PO= Program Outcome as listed and defined in year 1 curriculum and PO – CO mapping with strength (Low/Medium/High) has to be mapped by the course coordinator. (Above only suggestive)**

5. Reference:

Sl. No.	Description
1	Alternative fuels, Thipse, Jaico publications.
2	Alternative Fuels & the Environment, Frances S. Sterrett, Hardback Publications.
3	Alternative fuels, V.Ganeshan, McGraw Hill Education (India) Private Limited, New Delhi
4	Internal combustion Engine, M.L. Mathur and R.P. Sharma, Dhanpat Rai Publications.
5	SAE Transactions, "Vehicle Emission", 3 volumes, 1982
6	Automobiles and Pollution SAE Transaction, 1995.
7	Engine Emissions: pollution Formation and advances in control technology by B.P. Pundir.