Government of Karnataka

DEPARTMENT OF COLLEGIATE AND TECHNICAL EDUCATION

Curriculum Structure
IV Semester Scheme of Studies- Diploma in Automobile Engineering

Sl. No.	Course Category / Teaching Department	Course Code	Course Name	Hours per week			Total contact hrs /week	Credits	CIE Marks		SEE Marks		Total Marks	Min Marks for Passing (including CIE	Assigned Grade	Grade Point	SGPA and CGPA
				L	T	P			Max	Min	Max	Min					
Integrated Courses																	**Both SGPA & CGPA**
1	P/AT	20AT41P	Advanced Automotive Systems	3	1	4	8	6	60	24	40	16	100	40			
2	P/AT	20AT42P	Design and Drafting	3	1	4	8	6	60	24	40	16	100	40			
3	P/AT	20AT43P	Vehicle Body Engineering and Dynamics	3	1	4	8	6	60	24	40	16	100	40			
4	P/AT	20AT44P	Fuels and Pollution Control	3	1	4	8	6	60	24	40	16	100	40			
Audit Course																	
5	AU/	20AT45T	Indian Constitution	2	0	0	2	2	50	20	-	-	50	20			
Total				**14**	**4**	**16**	**34**	**26**	**290**	**116**	**160**	**64**	**450**	**180**			

***PC: Programme Core:: AU-Audit Course:: L: Lecture:: T: Tutorial:: P: Practice**

Government of Karnataka
DEPARTMENT OF COLLEGIATE AND TECHNICAL EDUCATION

Programme	Automobile Engineering	**Semester**	IV
Course Code	20AT41P	**Type of Course**	Programme Core
Course Name	Advanced Automotive Systems	**Contact Hours**	8 hours/week 104 hours/semester
Teaching Scheme	L:T:P :: 3:1:4	**Credits**	6
CIE Marks	60	**SEE Marks**	40

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)**
			3 hours/week	1 hour/week	4 hours/week (2 hours/batch twice in a week)
1	2	2,3,4	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.
2	2	2,3,4	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 in vehicle. 2. Diagnose and troubleshoot TPS and crank position sensor with

					engine scanner (and multi-meter).
3	2	2,3,4	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 in vehicle. 2. Diagnose and troubleshoot piezoelectric knock sensor and temperature sensor with engine scanner (and multi-meter).
4	2	2,3,4	1. Mass air flow Sensor-types 2. construction and working of hot film and hot wire type sensors. 3. Potentiometer type -need-working. principle.	Refer Table 1	1. Diagnose and troubleshoot Potentiometer with engine scanner (and multi-meter). 2. Build circuit to demonstrate the testing and working of Potentiometer, LVDT type ride height sensors, rain sensor.
5	1,2	2,3,4	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.
6	1	2,3,4	1.**Power steering** - types, construction and working- HPS. 2. Construction & working -linkage power steering, Integral power steering. 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.
7	1	2,3,4	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.
8	1	2,3,4	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.

9	1	2,3,4	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.
10	1,2	2,3,4	1. Electronic stability control-working principle. 2. Hill assistance and traction control system – working principle. 3. Air bag system-need-types-layout of accelerometer-based air bag system.	Refer Table 1	1. Virtual Demonstration of Electronic stability control. 2. Virtual demonstration of air bag systems.
11	1,2	2,3,4,7	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.
12	1,2	2,3,4,7	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.
13	1	2,3,4,7	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			**39**	**13**	**52**

*** 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)**

Table 1: Suggestive Activities for Tutorials: (The List is only shared as an Example and not inclusive of all possible activities of the course. Student and Faculty are encouraged to choose activities that are relevant to the topic and on the availability of such resources at their institution)

Sl. No.	Week	Suggested Activity
1	1	Open an ECU from a vehicle and reconnect as per the pin configuration.
2	2	Study and give a Presentation on diagnosis of CAN.
3	3	Make a list of various sensors used in a vehicle with their position and submit it as an assignment.
4	4	Make a list of various actuators used in a vehicle with their positionand submit it as an assignment.
5	5	Study and present on the topic evolution of fuel injection and benefits of electronic fuel injection.
6	6	Check modern vehicles which comes with CRDI and Inline systems and present the comparison of their efficiency, speed and other performance of the vehicle.
7	7	Submit as an assignment with proper justificationon air bags for 2-wheeler vehicle system.
8	8	Study and Present on reverse parking collision-avoidance assist system.
9	9	Submit a report on various navigation systems used in India.
10	10	Make a group of 5 and visit nearest showroom discuss on the topic battery life, cost of replacement, recycling of batteries in EV and write a report on the observed data.
11	11	List and present the merits and demerits of modern vehicles using clutch-less manual transmission and automatic transmission.
12	12	Study and present on electronically controlled air springs.
13	13	Study and Present on construction and working of electrical power steering.

4. CIE and SEE Assessment Methodologies

Sl. No	Assessment	Test Week	Duration In minutes	Max marks	Conversion
1.	CIE-1 Written Test	5	80	30	Average of three tests 30
2.	CIE-2Written Test	9	80	30	
3	CIE-3Written Test	13	80	30	
4.	CIE-4 Skill Test-Practice	6	180	100	Average of two skill tests 20
5	CIE-5 Skill Test-Practice	12	180	100	
6	CIE-6 Portfolio continuous evaluation of Activity through Rubrics	1-13		10	10
				Total CIE Marks	60
	Semester End Examination (Practice)		180	100	40

Total Marks	**100**

5. a) Format for CIE written Test

Course Name	**Advanced Automotive Systems**	Test	I/II/III	Sem	III/IV
Course Code	**20AT41P**	Duration	80 Min	Marks	30

Note: Answer any one full question from each section. Each full question carries 10 marks.

Section	Assessment Questions	Cognitive Levels	Course Outcome	Marks
I	1			
	2			
II	3			
	4			
III	5			
	6			

Note for the Course coordinator: Each question may have one, two or three subdivisions. Optional questions in each section carry the same weightage of marks, Cognitive level and course outcomes.

5. b) CIE Skill Test-I Scheme of Evaluation

SL. No.	**CO**	**Particulars/Dimension**	**Marks**
1	1	One question on "Service and troubleshoot different power steering". a) Analysis of defects. –05 m b) Service/ Troubleshooting. –25 m	30
2	2	One question on "Sensors and sensor monitoring mechanisms aligned to automotive systems/different signal conditioning techniques/ interfacing techniques/ actuator mechanisms." **From week (1-3)** a) Identification or Circuit building - 10 m b) Dragonize or troubleshooting - 20m	30
3	2	One question on "Sensors and sensor monitoring mechanisms aligned to automotive systems/different signal conditioning techniques/ interfacing techniques/ actuator mechanisms." **From week (5&6)** a) Identification or Circuit building -10 m b) Dragonize or troubleshooting - 20m	30
4	1,2	Portfolio evaluation of practical sessions (1-6 week)	10
		Total Marks	**100**

5. c) CIE Skill Test-II Scheme of Evaluation

SL. No.	**CO**	**Particulars/Dimension**	**Marks**
1	1,2	One question on "Service and troubleshoot different advanced automotive components".	45

		a) Identification of defects –15 m b) Question on Troubleshooting. –30 m	
2	1,2	One question on "Service and troubleshoot advanced electronic systems" a) Identification of defects -10 m b) Question on Servicing/ Troubleshooting. –35m	45
3	1,2	Portfolio evaluation of practical sessions (7-12) week	10
		Total Marks	**100**

6. Rubrics for Assessment of Activity (Qualitative Assessment)

Sl. No.	Dimension	Beginner	Intermediate	Good	Advanced	Expert	Students Score
		2	4	6	8	10	
1		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	8
2		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	6
3		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	2
4		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	2
	Average Marks= (8+6+2+2)/4=4.5						**5**

Note: Dimension and Descriptor shall be defined by the respective course coordinator as per the activities

7. 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)

8. SEE Scheme of Evaluation

SL. No.	**CO**	**Particulars/Dimension**	**Marks**
1	1	One question on "Service and troubleshoot different advanced automotive components/ advanced electronic systems". a) Identification of defects. –20 m b) Servicing/Troubleshooting. –30 m	50

2	2	One question on "Sensors and sensor monitoring mechanisms aligned to automotive systems/different signal conditioning techniques/ interfacing techniques/ actuator mechanisms." c) Identification or Circuit building - 10 m d) Dragonize or troubleshooting - 10 m	20
3	1,2	Portfolio evaluation of practical sessions (1-13) week	10
4	1,2	Viva-voce	20
		Total Marks	**100**

9. Equipment/software list with Specification for a batch of 20 students

Sl. No.	Particulars	Specification	Quantity
1	Multi-cylinder Engine with Electronic control unit and different engine sensors.		2 sets
2	ECU's of other vehicle systems (ABS, Transmission)		2 sets
3	Throttle position sensors / kit, crank shaft position sensor (Magnetic pickup coil type, Hall type)/kit, exhaust gas sensor/kit, mass flow sensor, LVDT height sensors, rain sensor, knock sensor and temperature sensor, Potentiometer.		4 each
4	Solenoid stepper motor demo kit.		5
5	Automatic hydraulic transmission with Torque converter.		2
6	Automated manual transmission.		2
7	Continuously variable transmission		2
8	Air spring suspension system demo model.		1
9	Hydro-elastic spring suspension system demo model.		1
10	Engine scanner		1
11	Hydraulic power steering trainer unit.		2
12	Electrical power steering trainer unit.		2
13	ABS trainer unit.		2
14	Air bag trainer unit.		2
15	Limited Slip differential		2

Government of Karnataka

DEPARTMENT OF COLLEGIATE AND TECHNICAL EDUCATION

Programme	Automobile Engineering	**Semester**	IV
Course Code	20AT42P	**Type of Course**	Programme Core
Course Name	Design and Drafting	**Contact Hours**	8 hours/week 104 hours/semester
Teaching Scheme	L: T:P: 3:1:4	**Credits**	6
CIE Marks	60	**SEE Marks**	40

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 will develop 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)**
			3 hours/week	1 hour/week	4 hours/week (2 hours/batch twice in a week)
1	1,3	1,2,3	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.

2	1,2	1,2,3	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.
3	2	1,2,3	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.
4	1,3	1,2,3,4	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.
5	3	1,2,3,4	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.
6	3	1,2,3,4	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 create a 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.
7	3	1,2,3	1. Coil spring-terms used in helical compression spring. Simple problems 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.
8	3	1,2,3,4	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.
9	3	1,2,3,4	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.
10	3	1,2,3,4	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 create a 2D drawing using any CAD software like-solid edge, UG-NX, etc..
11	3	1,2,3,4,7	1. Torque transmitted through single 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 create a 2D drawing using any CAD software like-solid edge, UG-NX, etc.
12	3	1,2,3,4,7	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 2D drawing using any CAD software like-solid edge/UG-NX. 2. Create an 3D-assembly model of a helical gear and then create a 2Ddrawing using any CAD software like-solid edge/UG-NX.
13	2,3	1,2,3,4,7	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 pinion and 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			**39**	**13**	**52**

*** 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)**

Table 1: Suggestive Activities for Tutorials: (The List is only shared as an Example and not inclusive of all possible activities of the course. Student and Faculty are encouraged to choose activities that are relevant to the topic and on the availability of such resources at their institution)

Sl. No.	Week	Suggested Activity
1	1	Study on "influence of center of gravity on vehicle performance." Present on the suitable location of CG.
2	2	Study and give a presentation of GD&T drawings & symbols. Read and document an industrial drawing using GD&T.
3	3	Study and present on classification of tolerance with examples.
4	4	Using part modelling work bench tools create a different type of helical spring (assume suitable dimensions)
5	5	Using part modelling work bench tools create a lock nut with split pin (assume suitable dimensions)
6	6	Study and present with suitable video/diagrams on different stresses in shafts and keys.
7	7	Study and document on failures of universal joint and its advancements to overcome the problem.
8	8	Discuss on different methods of designing of piston. Design a suitable piston to increase volumetric efficiency.
9	9	Study on analysis of forces on connecting rod and use simulation software to show forces acting on connecting rod.
10	10	Study dual mass flywheel. Refer a journal paper and present on the advantages of using dual mass flywheel.
11	11	Study and present on the topic "design consideration of heavy-duty clutches"
12	12	Study gear nomenclature and submit a report as an assignment.

4. CIE and SEE Assessment Methodologies

Sl. No	Assessment	Test Week	Duration In minutes	Max marks	Conversion
1.	CIE-1 Written Test	5	80	30	Average of three tests 30
2.	CIE-2Written Test	9	80	30	
3	CIE-3Written Test	13	80	30	
4.	CIE-4 Skill Test-Practice	6	180	100	Average of two skill tests 20
5	CIE-5 Skill Test-Practice	12	180	100	
6	CIE-6 Portfolio continuous evaluation of Activity through Rubrics	1-13		10	10
				Total CIE Marks	60
	Semester End Examination (Practice)		180	100	40
				Total Marks	**100**

5. Format for CIE written Test

Course Name	**Design and Drafting**	Test	I/II/III	Sem	III/IV
Course Code	**20AT42P**	Duration	80 Min	Marks	30
Note: Answer any one full question from each section. Each full question carries 10 marks.					

Section	Assessment Questions	Cognitive Levels	Course Outcome	Marks
I	1			
	2			
II	3			
	4			
III	5			
	6			
Note for the Course coordinator: Each question may have one, two or three subdivisions. Optional questions in each section carry the same weightage of marks, Cognitive level and course outcomes.				

6. Rubrics for Assessment of Activity (Qualitative Assessment)

Sl. No.	Dimension	Beginner	Intermediate	Good	Advanced	Expert	Students Score
		2	4	6	8	10	
1		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	8
2		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	6
3		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	2
4		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	2
	Average Marks= (8+6+2+2)/4=4.5						**5**

Note: Dimension and Descriptor shall be defined by the respective course coordinator as per the activities

7. 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)

8. CIE Skill Test and SEE Scheme of Evaluation

SL. No.	CO	Particulars/Dimension	Marks
1	1,2	One question on simple load carrying members/The codes and standards used in design process. Practical question/Interpret the given chart - 20m	20
2	3	One question on "Use computer-based techniques in drafting of machine components used in automobile" a) 3D- drafting of all components - 30 m b) Assembly model -10 m c) Front view, side view, top view – 10 m	50

3	1,2,3	Portfolio evaluation of practical sessions (1-13 week)	10
4	1,2,3	Viva-voce	20
		Total Marks	**100**

NOTE: Use same format of evaluation for CIE skill test. Portfolio evaluation of practical session should be considered from "Week 1-6" for 1st CIE and "Week 7-12" for 2nd CIE each 10 marks.

9. Equipment/software list with Specification for a batch of 20 students

Sl. No.	Particulars	Specification	Quantity
1	Universal testing machine.	30 ton	1
2	Any Genuine CAD software or free and open-source CAD software (solid edge, solid works, AutoCAD etc.).		30
3	Any Genuine or free and opensource Simulation Software.		30
4	Computer with minimum 16inch color monitor, Intel/AMD latest generation i5 processor, 4 GB graphics card, 8 GB RAM, 512 GB SSD, 1 TB HDD, DVD read write drive.		30
5	UPS with 5 KW sine wave.		2
6	LED/LCD Projector with 500 lumens (20000 hrs)		4

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DEPARTMENT OF COLLEGIATE AND TECHNICAL EDUCATION

Programme	Automobile Engineering	**Semester**	IV
Course Code	20AT43P	**Type of Course**	Programme Core
Course Name	Vehicle Body Engineering and Dynamics	**Contact Hours**	8 hours/week 104 hours/semester
Teaching Scheme	L:T:P :: 3:1:4	**Credits**	6
CIE Marks	60	**SEE Marks**	40

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 with ergonomical 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)**
			3 hours/week	1 hour/week	4 hours/week (2 hours/batch twice in a week)
1	1,2	1,4	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.

2	1	1,4	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.
3	1		1. **Vehicle body repair -** Identification of location of parts and panels. Techniques/ procedure required to Repair of body panel, minor and major structural 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.
4	3	1,4	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.

5	3,5	1,4,7	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.
6	4	1,4	1. **HVAC system -** Functions**-** Working of vehicle air condition system and its layout 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 automatic AC refilling machine. 2.HVAC system troubleshooting.
7	5	1,4	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 surplus power of different wheel drive.

8	5	2,4	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 given vehicle by analytical method using its specification and compare it with actual parameters. 2. Using the simulation software examine the different performance parameters of a given vehicle.
9	5		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.
10	6	2,4	**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.
11	6	2,4,7	**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.
12	6	2,4,7	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.
13	5	2,4,7	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			**39**	**13**	**52**

*** 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)**

Table 1: Suggestive Activities for Tutorials: (The List is only shared as an Example and not inclusive of all possible activities of the course. Student and Faculty are encouraged to choose activities that are relevant to the topic and on the availability of such resources at their institution)

Sl. No.	Week	Suggested Activity
1	1	Study advantages of plastics and Aluminum over other body materials. List and present all the Aluminum body materials used in a given car.
2	2	Study and demonstrate various tools used in body repair.
3	3	Present on "Modern techniques of painting a car".
4	4	Visit a nearby car paint shop to witness corrosion coating and painting process and record the details and present it as an assignment.
5	5	Refer any one journal paper and present on corrosion prevention techniques on vehicle bodies.
6	6	Study and present on different types of air conditioner refrigerants and the effects on atmosphere.
7	7	Study car dashboard and car interior decoration, suggest innovative dashboard with neat sketch.
8	8	Study on weight distribution of a vehicle during braking and prepare a report on how the weight is transferred during braking.
9	9	"Does a car really need spoiler?" justify your answer. Install a spoiler to given car in a suitable place considering aerodynamics.

10	10	Study air resistance & rolling resistance losses. Suggest and present remedies to prevent these losses.
11	11	Study and present importance of shape optimization in racing cars.
12	12	Visit a manufacturing industry and witness the working of a wind tunnel and present the report based on the study and submit as an assignment.

4. CIE and SEE Assessment Methodologies

Sl. No	Assessment	Test Week	Duration In minutes	Max marks	Conversion
1.	CIE-1 Written Test	5	80	30	Average of three tests 30
2.	CIE-2Written Test	9	80	30	
3	CIE-3Written Test	13	80	30	
4.	CIE-4 Skill Test-Practice	6	180	100	Average of two skill tests 20
5	CIE-5 Skill Test-Practice	12	180	100	
6	CIE-6 Portfolio continuous evaluation of Activity through Rubrics	1-13		10	10
Total CIE Marks					60
Semester End Examination (Practice)			180	100	40
Total Marks					**100**

5. a) Format for CIE written Test

Course Name	**Vehicle Body Engineering and Dynamics**	Test	I/II/III	Sem	III/IV
Course Code	**20AT42P**	Duration	80 Min	Marks	30

Note: Answer any one full question from each section. Each full question carries 10 marks.

Section	Assessment Questions	Cognitive Levels	Course Outcome	Marks
I	1			
	2			
II	3			
	4			
III	5			
	6			

Note for the Course coordinator: Each question may have one, two or three subdivisions. Optional questions in each section carry the same weightage of marks, Cognitive level and course outcomes.

5. b) CIE Skill Test-I Scheme of Evaluation

SL. No.	CO	Particulars/Dimension	Marks
1	1	One question on "Vehicle body materials & Vehicle body repair." a) Identification of the material type - 10 m b) Removing & Refitting/ repair -20 m	20
2	1,2	One question on "glass materials, refitting and adessives".	20

		a) Identification of the material type - 10 m b) Removing & Refitting/ repair -20 m	
3	3	One skill- oriented question on "metal corrosion and painting" a) Safety precautions followed - 5 b) Identification of problem -10 c) Servicing/ Coating/ Painting -10	25
4	4	One question on "air-conditioning cooling system". a) Identification of defects - b) Troubleshooting/ Servicing `	25
5	1,2,3,4	Portfolio evaluation of practical sessions (1-6 week)	10

5. c) CIE Skill Test-II Scheme of Evaluation

SL. No.	CO	Particulars/Dimension	Marks
1	5	Question on body dynamics a) Demonstration of the given case based on case study/Simulation technique - 15 m b) Identification of the key points - 05 m	20
2	5	One question on "aerodynamics and wind tunnel". c) Demonstration of the given case based on case study/Simulation technique - 15 m d) Identification of the key points - 05 m	20
3	6	One skill-oriented question on braking system/bus body/ steering system. a) Analyzing the problem - 10m b) Troubleshooting/ simulation technique - 30m	40
4	5,6	Viva-voce	10
5	5,6	Portfolio evaluation of practical sessions (7-12 week)	10
		Total Marks	**100**

6. Rubrics for Assessment of Activity (Qualitative Assessment)

Sl. No.	Dimension	Beginner	Intermediate	Good	Advanced	Expert	Students Score
		2	4	6	8	10	
1		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	8
2		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	6
3		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	2
4		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	2
						Average Marks= (8+6+2+2)/4=4.5	**5**

Note: Dimension and Descriptor shall be defined by the respective course coordinator as per the activities

7. 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

8. SEE Scheme of Evaluation

SL. No.	CO	Particulars/Dimension	Marks
1	1,6	One question on "Vehicle body materials& type and repair/glass materials and refitting." a) Identification of the material type - 10 m b) Removing & Refitting/ repair -20 m Or One skill-oriented question on braking system/bus body/ steering system. a) Analyzing the problem - 05m b) Troubleshooting/ simulation technique - 25m	30
2	2,3,4	One skill- oriented question on "adessive/metal corrosion / painting" a) Safety precautions followed - 5 b) Identification of problem -10 c) Servicing/ Coating/ Painting -25 Or One skill- oriented question on "air condition system" a) Safety precautions followed - 5 b) Identification of problem -10 c) Servicing - 25	40

3	1,2,3,4,5,6	Viva-voce	20
5	1,2,3,4,5,6	Portfolio evaluation of practical sessions (1-13 week)	10
		Total Marks	**100**

9. Equipment/software list with Specification for a batch of 20 students

Sl. No.	**Particulars**	**Specification**	**Quantity**
1	Four-wheeler with all body fittings and accessories.		1
2	Mini-Bus with all body fittings and accessories.		1
3	Body repair Equipment.		2
4	Body repair tool kit		2
5	Arc welding transformer up to 300 Amps with attachments and welding shields.		1
6	Gas welding machine with attachments and oxygen and acetylene cylinders.		1
7	Single action sander		1
8	Dual action sander		1
9	Dent repair kit		1
10	Magnetic Dent puller kit		1
11	Aluminum suction cup		1
12	Glue tab dent pullers		1
13	Polishing and buffing machine		1
14	Fully Automatic car AC servicing equipment		1
15	Paint booth		1
16	Spray painting equipment.		2
17	Vehicle AC demo kit.		2
18	Simulation software (Siemen's NX), any simulation software		10

Government of Karnataka

DEPARTMENT OF COLLEGIATE AND TECHNICAL EDUCATION

Programme	Automobile Engineering	**Semester**	IV
Course Code	20AT44P	**Type of Course**	Programme Core
Course Name	Fuels and Pollution Control	**Contact Hours**	8 hours/week 104 hours/semester
Teaching Scheme	L:T:P :: 3:1:4	**Credits**	6
CIE Marks	60	**SEE Marks**	40

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)**
			3 hours/week	1 hour/week	4 hours/week (2 hours/batch twice in a week)
1	1	5	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.
2	1	5	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 kit to the car, setting and maintenance. b) Determination of Calorific value of CNG using Junker's calorimeter.
3	2	1,5	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 of fuel feed systems
4	2	1,5	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.
5	3	4,5	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 exhaust gas analyzer. 2. Measurement of smoke of Diesel engine using Smoke meter.
6	3	5	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.		
7	3	4,5	1. Electronic fuel injection-Advantage. Construction and working -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.
8	3	4,5	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.
9	3	4,5	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

10	4	5	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.
11	4	4,5,7	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.
12	4	4,5,7	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.
13	4	4,5,7	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			**39**	**13**	**52**

*** 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)**

Table 1: Suggestive Activities for Tutorials: (The List is only shared as an Example and not inclusive of all possible activities of the course. Student and Faculty are encouraged to choose activities that are relevant to the topic and on the availability of such resources at their institution)

Sl. No.	Week	Suggested Activity
1	1	Study the benefits of different alternative fuels and submit the report on the best alternative fuel for transit buses with proper justification.
2	2	Study the characteristics of alcohol fuels and justify why methanol is used as a racing fuel and submit a report as an assignment.
3	3	List the properties of hydrogen and prepare a presentation on hydrogen fuel cell vehicles.
4	4	Discuss and present why a turbocharger/supercharger is an essential requirement for an aircraft engine.
5	5	Take a survey on the effects of vehicular pollution on human health and present the effects of pollution on human health.
6	6	Refer any one journal paper and present on mechanism of pollutant formation in an IC engine.
7	7	Study and present on motor cycle crankcase ventilation.
8	8	Study and present on passive SCR.
9	9	Study and document the effect of Diesel particulate trap on efficiency of the engine and submit as an assignment.
10	10	Document the impact of BS VI norms on vehicle pollution as an assignment.
11	11	Study and present the central motor vehicle rules 1989 and its amendment.
12	12	Make a group of students, ask them to collect the information on methanol and ethanol blends. Run the engine with any one blend measure the emission.
13	13	Refer any one journal on future of CNG in India and present the collected information.

4. CIE and SEE Assessment Methodologies

Sl. No	Assessment	Test Week	Duration In minutes	Max marks	Conversion
1.	CIE-1 Written Test	5	80	30	Average of three tests 30
2.	CIE-2Written Test	9	80	30	
3	CIE-3Written Test	13	80	30	
4.	CIE-4 Skill Test-Practice	6	180	100	Average of two skill tests 20
5	CIE-5 Skill Test-Practice	12	180	100	
6	CIE-6 Portfolio continuous evaluation of Activity through Rubrics	1-13		10	10
				Total CIE Marks	60
			Semester End Examination (Practice)	180 / 100	40
				Total Marks	**100**

5. a) Format for CIE written Test

Course Name	**Fuels and Pollution Control**	Test	I/II/III	Sem	III/IV
Course Code	**20AT44P**	Duration	80 Min	Marks	30

Note: Answer any one full question from each section. Each full question carries 10 marks.

Section	Assessment Questions	Cognitive Levels	Course Outcome	Marks
I	1			
	2			
II	3			
	4			
III	5			
	6			

Note for the Course coordinator: Each question may have one, two or three subdivisions. Optional questions in each section carry the same weightage of marks, Cognitive level and course outcomes.

5. b) CIE Skill Test-I Scheme of Evaluation

SL. No.	CO	Particulars/Dimension	Marks
1	1	One Question on "fuels". a) Determining the fire point/flash point/ calorific value/ Servicing -15m b) Calculation -10m	25
2	2	One skill- oriented question on fuel feed system/supercharger/ turbocharger /stratified engine. a) Identification of the problem - 5m b) Servicing -20m	25
3	3	One question on measurement of the pollutants from automobile a) Measurements - 15 m b) Tabulation - 05 m	20
4	3	One question on "pollution control". a) Servicing -20m	20
5	1,2,3	Portfolio evaluation of practical sessions (1-6 week)	10
		Total Marks	**100**

5. c) CIE Skill Test-II Scheme of Evaluation

SL. No.	CO	Particulars/Dimension	Marks
1	3	One question on "methods of Pollution control" a) Servicing - 25 m	25
2	4	One question on "Emission standards" based on given case (case study). a) Identification of the key facts in the case - 05m b) Identification of the key issues - 05m	25

		c) Evaluate and recommend the course of action -15m	
3	4	One question on "performance of engine". a) Finding the performance parameter/fuel consumption - 25 m b) Tabulation -05 m	30
4	3,4	Portfolio evaluation of practical sessions (7-12 week)	10
5	3,4	Viva-voce	10
		Total Marks	**100**

6. Rubrics for Assessment of Activity (Qualitative Assessment)

Sl. No.	Dimension	Beginner	Intermediate	Good	Advanced	Expert	Students Score
		2	4	6	8	10	
1		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	8
2		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	6
3		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	2
4		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	2
						Average Marks= (8+6+2+2)/4=4.5	**5**

Note: Dimension and Descriptor shall be defined by the respective course coordinator as per the activities

7. 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.

8. SEE Scheme of Evaluation

SL. No.	CO	Particulars/Dimension	Marks
1	1,2	One Question on "fuels". a) Tabular column -5 m b) Determining the fire point/flash point/ calorific value/ Servicing -15m c) Calculation - 10 m Or One skill- oriented question on fuel feed system/supercharger/ turbocharger /stratified engine. a) Identification of problem - 05m b) Measurements - 25 m c) Accuracy -05 m	35

2	3,4	One question on "pollutants and control method" a) Identification of problem - 10 m b) Servicing- 25m Or One question on "Emission standards and testing procedures". a) Finding the performance parameter/fuel consumption - 25 m b) Tabulation –10m	35
4	1,2,3,4	Viva-voce	20
5	1,2,3,4	Portfolio evaluation of practical sessions (1-13 week)	10
		Total Marks	**100**

NOTE: Use same format of evaluation for CIE skill test. Portfolio evaluation of practical session should be considered from "Week 1-6" for 1st CIE and "Week 7-12" for 2nd CIE each 10 marks.

9. Equipment/software list with Specification for a batch of 20 students

Sl. No.	Particulars	Specification	Quantity
1	Pensky Martin Flash and Fire point Equipment		2
2	Redwood and Saybolt Viscometer		1
3	Bomb Calorimeter		1
4	Junker's gas Calorimeter		1
5	CNG kit		1
6	2-wheeler fuel feed system		4
7	Diesel engine with all accessories.		2
8	Single cylinder FIP		4
9	Multi hole diesel injector		6
10	MPFI petrol engine with all accessories (PCV, EGR, Catalytic convertor)		2
11	CRDI diesel engine with all accessories (PCV, EGR, Catalytic convertor, SCR/Particulate filter)		2
12	Turbochargers and Superchargers		2 each
13	MPFI engine injector tester		1
14	Diesel engine injector tester		2

15	FIP Calibrating machine		1
16	Four gas latest make exhaust gas analyser		2
17	Smoke meter		2
18	Catalytic Converter		2
19	Battery operated 2-wheeler		1
20	Vehicle with micro hybrid system		1

Government of Karnataka
Department of Collegiate and Technical Education

Programme	Audit Course	**Semester**	IV
Course Code	20AT45T	**Type of Course**	Audit
Course Name	**Indian Constitution**	**Contact Hours**	2 hours/week 26 hours/semester
Teaching Scheme	L:T:P :: 2:0:0	**Credits**	2
CIE Marks	50	**SEE Marks**	Nil

1. Course Outcomes: At the end of the Course, the student will be able to:

CO-01	**CO1**	Understand Preamble, salient features and importance of Indian Constitution.
CO-02	**CO2**	Understand Fundamental rights, duties and Directive principles of state policy.
CO-03	**CO3**	Understand Parliamentary system of governance, Structure, Functions, Power of Central, state governments (Legislative, Executive) and Judiciary.
CO-04	**CO4**	Understand Panchayat Raj Institutions and Local self-governments, UPSC, KPSC, NHRC, Status of women, RTE etc.

2. Course Content

Week	CO	Detailed Course Content	Contact Hours
1	1	Introduction to constitution of India-Formation and Composition of the Constituent Assembly-Salient features of the Constitution-Preamble to the Indian Constitution	2
2	1,2	Fundamental Rights- Definition, The right to equality, The right to freedom, The right against exploitation, The right to freedom of religion.	2
3	1,2	Cultural and educational rights and The right to constitutional remedies. Fundamental Duties, Directive principles of state policy.	2
4	1,3	Parliamentary system of governance- Structure of Parliament- Lok Sabha and Rajya Sabha. Functions of parliament- Legislative, Executive, Financial Function Powers of Lok Sabha and Rajya Sabha.	2
5	1,3	Procedure followed in parliament in making law, Annual financial statement (Budget) – procedure in parliament with respect to estimates, Appropriation bill, Supplementary, additional grants, Vote on account, votes on credit and exception grant, special provisions, rules of procedure.	2
6	1,3	Structure of union executive, Power and position of President. Vice President, Prime minister and council of ministers.	2
7	1,3	Structure of the judiciary: Jurisdiction and functions of Supreme Court, high court, and subordinate courts.	2
8	1,3	Federalism in the Indian constitution- Division of Powers: Union list, State list and concurrent list. Structure of state legislation, Legislative assembly and Legislative council.	2
9	1,3	Functions of state legislature, Structure of state executive-Powers and positions of Governor, Speaker, Deputy Speaker, Chief Minister and council of minister.	2

10	4	Local self-government- meaning-Three tier system, Village Panchayat-Taluk panchayat Zilla panchayat, Local bodies-Municipalities and Corporations, Bruhath Mahanagara Palike, Functions of Election commission, UPSC, KPSC.	2
11	4	Amendment of the constitution, Human Rights-Definition-constitutional provisions-right to life and liberty-Human Rights of Women-Discrimination against women steps that are to be taken to eliminate discrimination against women in Education, employment, health care, Economic and social life,	2
12	4	Status of Women in India - Women in rural areas, Constitutional Safeguards - Dowry Prohibition act 1961- Domestic violence act 2005- Sexual harassment at work place bill 2006. Human Rights of Children- Who is a child- list the Rights of the Child- Right to education, Protection of Children from Sexual Offences Act (POCSO)-2012-	2
13	1,4	National Human Rights Commission Constitution- Powers and function of the Commission-Employee rights- Provisions made, Contractual-Non contractual employee rights-Whistle blowing-definition-Aspects-Intellectual Property Rights (IPR)–Meaning-Need for protection- Briefly description of concept of patents, Copy right, Trademark	2
Total in Hours			**26 Hrs**

REFERENCES

1. Introduction to the Constitution of India- Dr. Durga Das Basu
2. Empowerment of rural women in India-Hemalatha H.M and Rameshwari Varma, Hema Prakashana.

4. CIE and SEE Assessment Methodologies

Sl. No	**Assessment**	**Test Week**	**Duration** In minutes	**Max marks**	**Conversion**
1.	CIE-1 Written Test	5	80	30	Average of three tests 30
2.	CIE-2 Written Test	9	80	30	
3	CIE-3 Written Test	13	80	30	
4.	CIE-4 MCQ	6	60	20	Average of two CIE = 20
5	CIE-5 Open Book Test	12	60	20	
Total CIE Marks					50
Semester End Examination (Practice)			-	-	-
Total Marks					**50**