Government of Karnataka
Department of Technical Education

Diploma in Automobile Engineering.

C-25 Scheme of Studies

(Effect from the AY 2025-26)

Government of Karnataka
DEPARTMENT OF TECHNICAL EDUCATION

Curriculum Structure

I Semester Scheme of Studies-Automobile Engineering

Sl. No.	Teaching Department	Course Code	Course Name	Hours per week			Total Contact Hours/week	Credits	CIE Marks		Theory SEE Marks		Practice SEE Marks		Total Marks
				L	T	P			Max	Min	Max	Min	Max	Min	
Integrated Courses															
1	SC	25SC11I	Engineering Mathematics-I	4	0	4	8	6	50	20	50	20	-	-	100
2	ENG	25EG01I	Essential English Communication	4	0	4	8	6	50	20	-	-	50	20	100
3	ME	25ME01I	Computer Aided Engineering. Drawing	3	0	4	7	5	50	20	-	-	50	20	100
4	AT	25AT11I	Elements of Automobile Engineering.	4	0	4	8	6	50	20	50	20	-	-	100
Audit Course															
5	AT	25AT12T	Environmental Sustainability	2	0	0	2	2	50	20	-	-	-	-	50
6	Personality Development		NCC/NSS/YOGA/SPORTS...	Students are expected to engage in any one of these activities from 1st semester to 6th semester(No Credits)											
			Total	**17**	**0**	**16**	**33**	**25**	**250**	**-**	**100**	**-**	**100**	**-**	**450**

Government of Karnataka

DEPARTMENT OFTECHNICAL EDUCATION

Curriculum Structure

II Semester Scheme of Studies- Automobile Engineering

Sl. No.	Teaching Department	Course Code	Course Name	Hours per week			Total Contact Hours/week	Credits	CIE Marks		Theory SEE Marks		Practice SEE Marks		Total Marks
				L	T	P			Max	Min	Max	Min	Max	Min	
Integrated Courses															
1	SC	25SC21I	Engineering Mathematics-II	4	0	4	8	6	50	20	50	20	-	-	100
2	CS	25CS01I	IT Skills	3	0	4	7	5	50	20	-	-	50	20	100
3	EE	25EE01I	Fundamentals of Electrical & Electronics Engineering.	3	0	4	7	5	50	20	-	-	50	20	100
4	AT	25AT21I	Vehicle Transmission and Stability	4	0	4	8	6	50	20	50	20	-	-	100
Audit Course															
5	AT	25AT22T	Indian Constitution	2	0	0	2	2	50	20	-	-	-	-	50
6	Personality Development		NCC/NSS/YOGA/SPORTS...	Students are expected to engage in any one of these activities from 1st semester to 6th semester (No Credits)											
			Total	**16**	**0**	**16**	**32**	**24**	**250**	**-**	**100**	**-**	**100**	**-**	**450**

Government of Karnataka
DEPARTMENT OF TECHNICAL EDUCATION

Program	**Automobile Engineering**	**Semester**	**I**
Course Name	Elements of Automobile Engineering	**Type of Course**	Integrated
Course Code	25AT11I	**Contact Hours**	8 hours/week (104 hours/semester)
Teaching Scheme	L: T:P- 4:0:4	**Credits**	6
CIE Marks	50	**SEE Marks**	50 (Theory)

1. Rationale: Make the students to appreciate the materials used in automobiles. Introduce the students to different fasteners and drives used in automobiles. Prepare the students to perform basic service and manufacturing activities.

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

CO-01	Make use of different measuring instruments following standard procedures.
CO-02	Identify the properties and applications of different materials used in automobiles.
C0-03	Illustrate the concept of different types of fasteners, bearings and drives in automobiles.
CO-04	Demonstrate the essential manufacturing process used in automobile industries.
CO-05	Illustrate the working of IC Engines and measure the different parameters of the vehicle and engine.

3. Course Content:

Week	**CO**	**PO**	**Theory (4 Hours per week)**	**Practice (4 Hours per week)**
1	1	1,4	Introduction to units of measurement system, system of units-CGS, FPS, MKS and SI system. Derived units-area, volume, and pressure, Conversion of units from one system to other system.	Practice on use of vernier caliper, outside micrometer, inside micrometer, telescopic gauge. Calculate the area and volume of regular geometrical objects using measuring instruments.
2	2	1,4,5,7	Classification of materials, ferrous materials-properties, types. Cast iron-properties, types, applications. Steel-properties, types, applications. Non-ferrous metals-properties, types. Copper-properties, applications.	Identify the different types of metals. Identify different Ferrous metals. Check and recognise the Physical properties of Ferrous metals.
3	2	1,4,5,7	Aluminum-properties, applications. Merits and Demerits	Identify different non-ferrous metals. Check and recognise the Physical

			of nonferrous materials. Steel Alloys-Concept, need, applications. Copper alloys-types, properties, applications. plastics-properties, types.	properties of nonferrous metals.
4	2	1,4,5,7	Thermoplastic-properties, applications. thermoset plastic-properties, applications. Environmental effects of plastics. Glass- properties, applications. Ceramics- properties, applications, Composite materials- types, applications, merits, and demerits.	Identification of different plastics, glasses, composites, and ceramics. Check and recognise the physical properties of different materials. Practice on riveting and de-riveting.
5	3	1,4	Fasteners –concept, types. Riveting- Introduction, types, but joint and lap joint, applications. Welding-concept, types, applications. soldering- concept, applications. brazing-concept, applications.	Identify different parts of rivet and types of riveting. Practice on riveting and de-riveting. Practice on soldering process.
6	3	1,4	Screw thread terminology, Types of screw fastenings, Types of locking methods. Forms of screw threads- British standard Whitworth (B.S.W.) thread, square thread, ACME thread	Identify and Practice on removal and refitting of bolts, screws, and studs. Practice tightening fasteners with specified torque using a torque wrench. Practice locking bolts and nuts using different locking methods. Identification of different types of thread and check the pitch using a pitch gauge.
7	3	1,4	Keys-concept, types. Construction of Tapered sunk key and woodruff Key. Splines-applications. Couplings-concept, types. Unprotected type flange coupling-working, applications.	Practice on identification and replacement of different types of keys. Practice on removal and refitting of machine parts from splines. Practice on removal and refitting of flange coupling.
8	3	1,4	Shaft-meaning, types, applications. Power transmission – introduction, types. Working of Belt drive - open and cross belt drives, working of chain drives, Working of gear drives – simple and compound. Gear trains. Comparison of belt drives, chain drives, gear drives and applications.	Identification of different types of belts, Practice on replacement of belts, and adjustment of belt tension. Practice on replacement and tension adjustment of Chain drives. Lubrication of chain drives. Calculation of speed ratio of belt, chain, and gear drive.
9	3	1,4	Bearings-need, types. Construction-shell bearing, ball bearing, roller bearing, thrust bearing, Applications.	Identify different parts of the bearing. Practice checking, removing, and refitting shell and ball bearings using appropriate tools.
10	4	1,4	Casting concept, types, applications. Pattern- concept,	Practice making moulds using moulding sand.

			types. forging-concept, types, applications. Extrusion-concept, types, applications.	Practice creating a pointed rod using the forging process.
11	5	1,4	Automobile – introduction, classification. Vehicle terminology – Wheelbase, wheel track, ground clearance, front and rear overhang, overall height, overall width, overall length, gross weight, Kerb weight. Chassis layout – 2-wheeler and 4-wheeler.	Measurement of wheelbase, wheel track, ground clearance, front and rear overhang, overall height, and overall width. Find the location of the chassis and engine number and get their impression (VIN).
12	5	1,4	Engine terminologies – bore, stroke, TDC, BDC, swept volume, clearance volume, total volume, and compression ratio. IC engines – introduction, classification.	Measurement of the bore, stroke length, swept volume, clearance volume, and total volume. Find the compression ratio.
13	5	1,4	Working of 4-stroke SI and CI engine, 2-stroke petrol engine, Comparison of 2 and 4 stroke engine, comparison of SI and CI engine.	Dismantling and assembly of single-cylinder petrol engine and identifying different components of the engine.

4. References:

1. Automobile Engineering vol-2, Kripal Singh Standard publications

2. Automobile Engineering, R B Gupta Satya Prakashan

3. Automotive Engines, S Srinivasan Tata McGraw-Hill

4. Automotive Technology, H M Sethi Tata McGraw-Hill

5.Automotive Mechanics Crouse and Anglin Tata McGraw-Hill

6. Automotive Engineering vol-2, Anil Chikara Satya Prakashan

7. The Automobile, Harbans Singh rayat S Chand

8. Automobile Engineering, Er.A.K. Babu, Er Ajit Pal Singh S Chand

9. Automobile Engineering, Er S.K. Gupta S. Chand

10. Automotive mechanics by W.H Crouse and Anglin

11. Automobile engineering by N.K Giri

12. Automobile engineering by Ramalingam K. K

Rubrics for Portfolio evaluation Level of Achievement						
Assessment Parameter		**Excellent (10)**	**Very Good (8)**	**Fair (6)**	**Poor (4)**	**Score**
AP1	**Organization of Report and Timely Submission**	Lab report is well organized as directed and submitted on time	Lab report is well organized but not submitted on time	Report contains few errors and not submitted on time them	Poor organization and late submission	
AP2	**Knowledge of Tools and Procedures**	Demonstrates deep knowledge of tools and procedures; answer the related questions with explanations and elaboration	Adequate knowledge of most tools and procedures; answer the related questions, but fails to elaborate	Superficial knowledge of tools and procedures; able to answer only some of the related basic questions	Lack of information about most of the tools and procedures; cannot even answer basic related questions	
AP3	**Team Working Skills**	Positive in interacting with all group members, encourages such interaction in others, and always sensitive to the abilities and feelings of others' contributions; Actively helps to identify group goals and works effectively to meet them in assigned roles	Interacts with all group members spontaneously and contributes in a way that is sensitive to the abilities and feelings of others; Demonstrates commitment to group goals and carries out assigned roles effectively	Interacts with other group members if prompted, but sometimes expresses opinions which are insensitive to the abilities and feelings of others; Demonstrates commitment to group goals, but has difficulty performing assigned roles	Rarely interacts within a group, even with prompting, and shows frequent lack of sensitivity to others' feelings and abilities in opinions expressed; Shows little commitment to group goals and fails to perform assigned roles	
AP4	**Result Analysis and Data Interpretation**	Excellent insight and well-focused results and discussion; Data completely and appropriately interpreted and no overinterpretation	Adequate insight but missed some important points in results and discussion; Interpreted most data correctly but some conclusions may be suspect or over-interpreted	Little insight and analysed only the most basic points; Interpreted some data correctly but significant errors, omissions still present.	No insight and entirely missed the point of the experiment; Little or no attempt to interpret data or overinterpreted data.	
AP5	**Task Management**	Very Effective in managing the assigned task and allow experimenter(s) to achieve all goals	Somewhat effective in managing the assigned tasks and allow experimenter(s) to achieve most goals.	Somewhat ineffective in managing the assigned task and allow experimenter(s) to achieve only few goals.	Very ineffective and would not allow experimenters to achieve any goals	

5. CIE and SEE Assessment Methodologies:

Sl. No	Assessment	Test Week	Duration (minutes)	Max marks	
1	CIE-1 Theory Test	4	90	50	**Average of all CIE=50 Marks**
2	CIE-2 Practice Test	7	180	50	
3	CIE-3 Theory Test	10	90	50	
4	CIE-4 Practice Test	13	180	50	
5	CIE-5 Portfolio evaluation of all the activities through Rubrics	1-13	-	50	
Total Continuous Internal Evaluation (CIE)					50 Marks
Semester End Examination (SEE) -Theory			90	50	50 marks
Total Marks					**100 Marks**
Note: *1) Minimum marks to pass in CIE & SEE is 40% individually* *2) Minimum number of activities is to be performed are Two.*					

5. SEE - Theory Assessment Methodologies

Sl. No	SEE – Theory Assessment	Duration (minutes)	Max marks	Min marks to pass
1.	Semester End Examination-Theory	90	50	20

6. CIE Theory Test model question paper:

Program	**Automobile Engineering**		**Semester I**	
Course Name	Elements of Automobile Engineering		**Test**	I
Course Code	25AT11I	**Duration:**90 min	**Marks**	50
Name of the Course Coordinator:				
Note: Answer any one full question from each section. Each full question carries 25 marks.				

Q. No	**Questions**	**Cognitive Level**	**CO**	**M**
	Section - 1			
1	a) Convert 100mm into meters. -5M b) Classify the engineering materials used in automobiles -10M c) Compare Ferrous and non-ferrous metals -10M	L2	1, 2	25
2	a) Convert 10 N/mm2 into kg/Cm2. -10M b) Compare thermosetting plastic and thermoplastic -5M c) Classify composites -10M	L2	1, 2	
	Section - 2			
3	a) Explain the screw thread terminology with a neat sketch -10M b) Explain double nut locking type method with sketch-10M c) Compare temporary and permanent fastenings -5M	L2, L3	3	25
4	a) Explain the open belt drive with a neat sketch – 10M b) Explain the compound gear drive with a neat sketch -10M c) Compare Belt drive and chain drive – 5M	L2, L3	3	

Note: *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.*

Course Coordinator **Programme Co-Ordinator.** **IQAC Chairman**

7. CIE-1 Practice Test model question paper:

Program	**Automobile Engineering**			**Semester**	I
CourseName	Elements of Automobile engineering			**Test**	II/IV
Course Code	25AT11I	**Duration**	180 min	**Marks**	50
Name of the Course Coordinator:					
Questions				**CO**	**Marks**
1. Find the volume of the cylindrical object using Vernier caliper. 2. Perform revitting and derivetting operation on the given job. OR 1. Measure the dimension of the given object using inside and outside micrometers. 2. Replace the given chain drive, adjust tension and lubricate the same.				1, 3 1, 3	50 50
Scheme of assessment: a) Procedure writing- 3+3=6 b) Conduction-10, troubleshoot-3/calculation-3, results-2, 10+3+2 (15 x 2 experiments = 30) c) Viva voce - 10 d) Portfolio evaluation of practical record – 4					
				Total Marks	**50**

Signature of the Course Coordinator **Signature of the HOD**

8. Suggestive Activities:

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 relevantto the topic and on the availability of such resources at their institution.

Sl. No.	**Suggestive Activities for Tutorials**
01	Collect information on different measuring instruments and prepare a report.
02	Collect different samples of materials and descriptions of each.
03	Collect different types of bearings, and compare and list their applications.
04	Collect the specifications of different vehicles
05	Collect different types of gear and list their application
06	Collect different components of the IC engine and list their features.

9. Rubrics for Assessment of Activity (Qualitative Assessment)

Sl. No.	Dimension	Beginner	Intermediate	Good	Advanced	Expert	Students Score
		2	4	6	8	10	
1	Collection of data/ Material	Limited information	Collects basic information	Collects more information	Collects developed information	Collects a great deal of information	8
2	Quality of data	Irrelevant	Less relevant	Needs improvement	Satisfactory	Very relevant	6
3	Quality of report	Not planned	Less organized	Moderately organized	Organized	As per the standards	4
4	Timely submission	Late submission	Submits after due date	Submits after reminders	Submit after a reminder	On time submission	2
5	Data references	No references.	Irrelevant references.	Given References not from authentic source.	Given references are from authenticated sources.	Enough authenticated references are given.	6
	Example: Total Marks=(8+6+4+2+6)=26						**26/50**

Note: *a) The respective course coordinator shall define dimension and Descriptor as per the activities*
b) Activities should be typed report.

10. SEE –Model Theory Question Paper-1

Program	Automobile Engineering	**Semester**	I
CourseName	Elements of Automobile engineering	**Marks**	50
Course Code	25AT11I	**Duration**	90Min

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

Q No	Questions	Cognitive Levels	Course Out comes	Marks
	Section -1			
1	a) Convert 10 kg/cm^2 into N/mm^2. b) Classify the engineering materials used in automobiles	L2	1, 2	4 6
2	a) Compare thermosetting plastic and thermoplastic. b) Convert 120N-m into Kg-m.	L2	1,2	6 4
	Section -2			
3	a) Explain split pin type locking method with a neat sketch. b) Explain the working of cross belt drive with a neat sketch	L3	3	4 6
4	a) Sketch the screw thread terminologies. b) Explain the working of compound gear drive with a neat sketch.	L3	3	4 6
	Section -3			

5	a) State the applications of forging. b) Draw the layout of four-wheeler chassis and label the parts.	L3	4, 5	5 5
6	a) The bore and stroke of engine are 110 mm and 120 mm. The clearance volume is assumed 10% of swept volume. Find the compression ratio. b) List the applications of casting.	L3	4, 5	6 4
Section -4				
7	Explain the working of 4 stroke CI engine with sketch.	L3	5	10
8	Explain the working of 2-stroke SI engine with sketch.	L3	5	10
Section -5				
9	Explain the following vehicle terminologies – Wheel base, wheel track, ground clearance, front and rear overhang.	L3	5	10
10	Explain the following engine terminologies – bore, stroke, TDC, BDC, swept volume, clearance volume, total volume, and compression ratio.	L3	5	10

Note: *While framing the SEE questions for question papers provide equal weightage to the content of each week*

SEE –Model Theory Question Paper-2

Program	Automobile Engineering	**Semester**	I
CourseName	Elements of Automobile engineering	**Marks**	50
Course Code	25AT11I	**Duration**	90 Min

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

Q No	Questions	Cognitive Levels	Course Out comes	Marks
Section -1				
1	a) Convert 15 m^3 into $mm^{3.}$ b) Classify the engineering materials used in automobiles	L2	1, 2	5 5
2	a) Write any 5 applications of glass. b) Convert 15 Kg-m to N-m.	L2	1, 2	5 5
Section -2				
3	a) Explain the working of cross belt drive with a neat sketch. b) Explain the following physical properties of metals. (i) Plasticity (ii) Resilience (iii) Yield strength	L3	2, 3	4 6
4	a) With a neat sketch explain the construction of roller bearing.	L3	2, 3	6 4

	b) List the properties of aluminum.			
Section -3				
5	a) Classify the automobiles in detail. b) List different types of welding with their applications.	L3	3, 5	4 6
6	a) List the advantages of disadvantages of composites. b) Explain bore, stroke, TDC, BDC and swept volume.	L3	3, 5	5 5
Section -4				
7	a) Explain the construction of 4-skroke CI engine with a neat sketch. b) Draw the sketch of unprotected Flange coupling and label the parts.	L3	3, 5	6 4
8	a) Sketch and label the woodruff key with their applications. b) Compare SI & CI engine.	L3	3, 5	5 5
Section -5				
9	a) List the types and applications of forging. b) Explain the working of 2-stroke petrol engine.	L3	4, 5	5 5
10	a) Write the types of casting with their applications. b) Represent wheel base, wheel track, ground clearance, overall length and overall height with the help of a sketch.	L3	4, 5	5 5

SEE –Model Theory Question Paper-3

Program	Automobile Engineering	**Semester**	I
CourseName	Elements of Automobile engineering	**Marks**	50
Course Code		**Duration**	3 Hrs.

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

Q No	Questions	Cognitive Levels	Course Out comes	Marks
Section -1				
1	a) Convert 20 cm^2 into $m^{2.}$ b) List the properties and applications of copper.	L2	1, 2	5 5
2	a) List the applications of ceramics. b) Convert 15 m2 into mm2.	L2	1,2	4 6
Section -2				
3	a) Explain the working of chain drive with a neat sketch. b) Classify IC engines in detail.	L3	3, 5	5 5

4	a) Draw the layout of the 4-wheeler chassis and explain function of each chassis component. b) State the need of bearing and list the types along with their applications.	L3	3, 5	4 6
Section -3				
5	a) Draw British Standard with worth (BSW) thread. b) Classify automobile in detail.	L3	3, 5	4 6
6	a) Write the applications of soldering and brazing. b) Represent wheel base, wheel track, ground clearance, overall height, overall length on a layout of a vehicle.	L3	3, 5	5 5
Section -4				
7	a) Explain with a sketch simple gear drive. b) Explain the working of SI engine with a sketch.	L3	3, 5	4 6
8	a) List the types of keys with their applications. b) Compare two stroke and four stroke engines.	L3	3, 5	4 6
Section -5				
9	a) List the types of shafts with their applications. b) Explain the working of 4-stroke CI engine with a sketch.	L3	3, 5	4 6
10	a) List the types of locking methods and explain any one method with a sketch. b) Represent bore, stroke, TDC, BDC and stroke length of an engine on a sketch.	L3	3, 5	6 4

11. Equipment/software list with Specification for a batch of 30 students

SN	Particulars	Specification	Quantity
1	Open end spanner set.	Drop forged (6 to 32mm) 12 pc	02
2	Ring spanner set.	Drop forged (6 to 32mm) 12 pc	02
3	Tubular spanner set.	Drop forged (6 to 32mm) 12 pc	02
4	Socket set.	Drop forged (6 to 32) 27 pc	02
5	Allen key set.	1.5 to 10mm (9 pc)	02
6	Pipe wrench.	10 inches	02
7	Adjustable screw wrench.	0 to 30mm 10 inch	01
8	Adjustable screw wrench	0 to 19mm 6 inch	01
9	Torque wrench.	20 to 100Nm	02
10	Water pump pliers.	250mm	02
11	Vice grip pliers.	250mm	02
12	Combination pliers.	200mm	02
13	Nose pliers.	165mm	02
14	Circlip pliers. (inside, outside, straight bent)	180mm	02 each
15	screw driver (star, flat).	8 pc	02 set
16	Hammers (ball peen, sledge).	500g, 5kg	02 each

17	Mallets.	Steel handle 500g	02
18	Wheel spanners.	18 mm	02
19	Tyre levers.	18 inches	02 each
20	Pneumatic wrench.	340 Nm	02
21	Electrical wrench.	188Nm	02
22	Spark plug spanner.	6-22 mm	02
23	Chisels.	12 to 38mm 5pc	02 each
24	Punches (hallow, solid)	7 pc	02 each
25	scrapers.	Triangular scrapers	02 each
26	Files.	Soft grip handle set of 9	02 each
27	Speed handle.	½ inch	02
28	Oil can.	½ pint capacity	02
29	Tyre pressure gauge.	12x5x2 cm	02
30	Compression gauge.	28x25x5 cm	02
31	Vacuum gauge.	38x89x67 mm	02
32	Feeler gauge.	20x20x5 cm	02
33	Bench vice.	6 inches jaw opening	02
34	Leg vice.		01
35	Arbor press.	1 ton capacity	01
36	Two-wheeler lifting platform.	Suitable up to 500Kg	01
37	Spark plug cleaning and testing machine.	Adjustable Spark Tester with Two Spark Plug Socket, 100 240v with Protective Cover Ignition Tester. Heat Resistance Spark Tester Automotive Tools for 10mm,14mm &16mm Spark Plug	01
38	Valve spring compressors.	C Type	02
39	Oil filter wrench.	Chain type & Belt type	01
40	Trays. (1X1mt).	1X1mt	08
41	Two stroke single cylinder petrol engine	50 to 150CC engine	02
43	Four stroke single cylinder petrol engine	150 CC air cooled engine	02
43	Four stroke Multi cylinder petrol engine	800 - 1500 CC water cooled engine	02
44	Four stroke single cylinder diesel engine	350-500CC water cooled engine	02
45	Four stroke Multi cylinder diesel engine	1.5 to 2L engine	02
46	Two-wheeler chassis	Motor cycle	01
47	Three-wheeler chassis	Auto rickshaw	01
48	Four-wheeler chassis	LMV	01
49	High pressure car washer.	Operating pressure -4 to-45bar, Motor rating – 2.5 to 4.5hp, Flow rate -015 to 15 LPM.	01
50	High pressure greasing bucket.	Bucket capacity – 40L, Grease transmission rate – 0.7to 0.85 LPM.	01
51	Air compressor.	Two stages, 3 Phase, tank capacity – 200 to 300L, Discharge pressure – 10 to 12 Bar.	01
52	Bearing Puller	3 Jaw	01
53	Two post lift.	Hydraulic type, Lifting capacity – 4 Tons, Min. lifting height – 100 to 115 mm, Maximum lifting height – 1700	01

		to 1800mm	
54	Hand greasing gun (lever type, push type).	Lever & Push type	02 each
55	Vulcanizing machine.	Operating voltage 230V	02
56	Steel props	Capacity 500 to 600 Kg.	08
57	Major Mechanic Tool kit	Full set	02
58	Automatic tyre changer	Air Requirement – 8 to 10bar, Internal Rim Clamping -12-to-23-inch, External Rim Clamping- 10-to-20-inch, Maximum Tire Diameter-40 to 41 inches.	01
59	Vernier Caliper	15 cm, LC- 0.02	01
60	Dial Vernier Caliper	15 cm, LC – 0.01	01
61	Screw gauge	0-50mm,	01
62	Inside micrometer	0-50mm	01
63	Telescopic gauge	10mm to 100mm wit accessories	1 set
64	Dial bore gauge	0-10mm	01
65	Combination set	-	01
65	Hydraulic jack	2 tones	02

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Government of Karnataka
DEPARTMENT OF TECHNICAL EDUCATION

Program	**Automobile Engineering**	**Semester**	**II**
Course Name	**Vehicle Transmission and Stability**	**Type of Course**	Integrated
Course Code	25AT21I	**Contact Hours**	104 Hrs/Sem 8 Hrs/week
Teaching Scheme	L: T:P 4:0:4	**Credits**	6
CIE Marks	**50**	**SEE Marks**	**50 (Theory)**

4. Rationale:

The power transmission from engine to wheel decides the vehicle's efficiency and handling. The student should appreciate the need for each component of power transmission system. The student should justify the constructional features of each component of transmission system. The student should be able to troubleshoot and service each transmission and control system component for the safe and efficient use of automobiles.

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

CO-01	Perform maintenance and troubleshooting activities of the transmission system and its components.
CO-02	Perform maintenance and troubleshooting activities for the steering system and its components.
CO-03	Perform maintenance and troubleshooting activities for the Braking system and its components.
CO-04	Perform maintenance and troubleshooting activities for the Suspension system, Wheels, and tyres.

6. Course Content

WEEK	**CO**	**PO**	**Theory**	**Practice**
1	1	1,2,4	**Clutch-** Introduction Purpose**,** Requirements, Principle, Classifications. Clutch Lining materials. Construction and working of single plate clutch - Coil Spring type & Diaphragm type.	Removal and refitting of clutch from vehicle. Servicing of Coil Spring type single plate clutch. Trouble shooting of single plate clutch.
2	1	1,2,4	Construction and Working of Centrifugal clutch and Multiplate clutch. Clutch operating mechanism, Clutch adjustment.	Servicing of centrifugal and multiplate clutch.
3	1	1,2,4	**Gearbox**-Necessity, classification. Construction and	Servicing of gear box and Find gear ratios.

			working of Constant mesh gear box and synchromesh gear box, Synchronizer-working, gear selector mechanism-types, working of floor mounted gear shift mechanism.	Trouble shooting of synchromesh gear box.
4	1	1,2,4	Propeller shaft-function, construction of propeller shaft, universal joints & slip joints-function, types. Construction & working of cross or spider type and flexible ring type. Constant velocity joints-need, types. working of Rzeppa joint and Tripod joint.	Servicing of a propeller shaft & universal joint. Check constant velocity joint for wear & tear.
5	1	1,2,4	**Final drive**- Purpose, types. **Differential**- necessity, principle. construction & working of differential.	Overhauling of differential. Practice on checking and adjustment of Backlash. Calculate the final drive gear ratio.
6	1	1,2,4	Construction and operation – hotch kiss and torque tube drive Rear axle-types of load acting, Types of rear axles. Construction of fully floating, semi-floating and ¾ floating.	Practice on Servicing of rear axle. Troubleshooting of fully floating axle housing. Servicing semi -floating axle housing.
7	2	1,2,4	**Front-Axle**-types, construction of live (drive shaft)-dead axle (conventional), stub axles-types **Steering-system**-purpose, requirements, mechanisms-types, Ackerman mechanism- layouts, steering gear box-need, types. construction and working of Rack & Pinion Steering gear box.	Overhauling of a front axle & hub greasing. Identification different parts of steering mechanism. Servicing of rack & pinion type of steering. Trouble shooting of rack and pinion steering gear mechanism.
8	2	1,2,4	Construction and working of worm and re-circulating ball nut type steering gear box, steering geometry-concept, concept and need of camber, caster, king pin inclination, combined angle, toe in and toe out.	Servicing of worm and recirculating ball nut type steering. Check and adjust the wheel alignment of vehicle.
9	3	1,2,4	**Braking system**-purpose, Requirements of automobile brakes - types of braking systems, Layout of hydraulic braking	Adjustments of mechanical brakes of two-wheeler.

			system, Construction and working of Tandem master cylinders.	Servicing of Tandem master cylinder.
10	3	1,2,4	Wheel cylinder –types, construction and working of double acting wheel cylinder, Constructional details of Internal expanding shoe brakes, concept of trailing and leading shoes, shoe materials, disc brakes - construction and working, Advantages and limitations of disc brakes.	Bleeding of hydraulic brake system, free-play & brake shoe adjustments. Servicing & trouble shooting of a drum brake & Disc brake.
11	4	1,2,4	**Suspension system**-functions, Requirements of a good suspension system, Construction and working of rigid axle suspension, construction and working of McPherson strut, double wishbone, trailing link and Semi-independent suspension systems.	Servicing of rigid axle and independent suspension system. Troubleshooting of suspension system.
12	4	1,2,4	Types of springs used in suspension system –construction of leaf spring, coil spring, and Torsion bar, working of Stabilizer bar, sprung and un sprung weight-concept. Need of shock absorber, Working of Telescopic shock absorber -	Servicing of leaf spring. Checking the stiffness of coil spring. Removing and refitting of telescopic shock absorber.
13	4	1,2,4	**Wheels**-requirements-types, Constructional details-wire-disc-alloy wheel. **Tires**-function-types-construction-tube-tubeless, radial type, treads pattern – need, aspect ratio and specifications.	Practice on removing and refitting of wheel from vehicle by using proper tools and identify tyre and disc specifications. Hot and cold tyre puncture practice. Check and repair of puncture in tube less tyre. Check and adjust wheel balancing.

4. References:

Sl., NO	Title of the book	Author	Publisher
1	Automotive Mechanics	W. H. Crouse & Anglin	Tata MC Graw-Hill
2	Automotive Technology	N.K. Giri	Khanna publications
3	The Automobile Engineering Vol-2	K.M Gupta	Umesh publications
4	Automotive Technology	Jack Erjavec	CENGAGE Learning
5	Automobile Engineering	K.M Gupta	Umesh publications
6	Automobile Engg Vol I	Kirpal Singh	Standard publication
7	Automobile Engineering	**Er S K Gupta**	S Chand
8	Automobile Engineering	Er A K Babu Er Ajit pal singh	S Chand
9	Automobile engineering	R B Gupta	Kanna Publications
10	Automotive engineering Vol-II Power Transmission.	Anil Chikara	Satya Prakashan.

6. Reference URLs:

- https://www.youtube.com/watch?v=pqF-aBtTBnY
- https://www.youtube.com/watch?v=TcYsV063lk8
- https://www.youtube.com/watch?v=6BaECAbapRg
- https://www.youtube.com/watch?v=zd69cDTZDco
- https://www.youtube.com/watch?v=kpVdQ8CIFsI
- https://www.youtube.com/watch?v=agLa0A8GAfc
- https://www.youtube.com/watch?v=QPaUJfA1KsY
- https://www.youtube.com/watch?v=vOo3TLgL0kM
- https://www.youtube.com/watch?v=IKywZ730JFs
- https://www.youtube.com/watch?v=gIGvhvOhLHU
- https://www.youtube.com/watch?v=pmWbei6beBg
- https://www.youtube.com/watch?v=R-hk9NvFang
- https://www.youtube.com/watch?v=SOgoejxzF8c
- https://www.youtube.com/watch?v=8qeaNQABPQk
- https://www.youtube.com/watch?v=bMg_j5_AGMg
- https://www.youtube.com/watch?v=bnc3VnQ8kUY
- https://www.youtube.com/watch?v=bBwQ-UiveTs
- https://www.youtube.com/watch?v=oUchfOF6EMs
- https://www.youtube.com/watch?v=uTqU35K_8AU

Rubrics for Portfolio evaluation Level of Achievement						
Assessment Parameter		**Excellent (10)**	**Very Good (8)**	**Fair (6)**	**Poor (4)**	**Score**
AP1	**Organization of Report and Timely Submission**	Lab report is well organized as directed and submitted on time	Lab report is well organized but not submitted on time	Report contains few errors and not submitted on time them	Poor organization and late submission	
AP2	**Knowledge of Tools and Procedures**	Demonstrates deep knowledge of tools and procedures; answer the related questions with explanations and elaboration	Adequate knowledge of most tools and procedures; answer the related questions, but fails to elaborate	Superficial knowledge of tools and procedures; able to answer only some of the related basic questions	Lack of information about most of the tools and procedures; cannot even answer basic related questions	
AP3	**Team Working Skills**	Positive in interacting with all group members, encourages such interaction in others, and always sensitive to the abilities and feelings of others' contributions; Actively helps to identify group goals and works effectively to meet them in assigned roles	Interacts with all group members spontaneously and contributes in a way that is sensitive to the abilities and feelings of others; Demonstrates commitment to group goals and carries out assigned roles effectively	Interacts with other group members if prompted, but sometimes expresses opinions which are insensitive to the abilities and feelings of others; Demonstrates commitment to group goals, but has difficulty performing assigned roles	Rarely interacts within a group, even with prompting, and shows frequent lack of sensitivity to others' feelings and abilities in opinions expressed; Shows little commitment to group goals and fails to perform assigned roles	
AP4	**Result Analysis and Data Interpretation**	Excellent insight and well-focused results and discussion; Data completely and appropriately interpreted and no overinterpretation	Adequate insight but missed some important points in results and discussion; Interpreted most data correctly but some conclusions may be suspect or over-interpreted	Little insight and analysed only the most basic points; Interpreted some data correctly but significant errors, omissions still present.	No insight and entirely missed the point of the experiment; Little or no attempt to interpret data or overinterpreted data.	
AP5	**Task Management**	Very Effective in managing the assigned task and allow experimenter(s) to achieve all goals	Somewhat effective in managing the assigned tasks and allow experimenter(s) to achieve most goals.	Somewhat ineffective in managing the assigned task and allow experimenter(s) to achieve only few goals.	Very ineffective and would not allow experimenters to achieve any goals	

7. CIE Assessment Methodologies

Sl. No	CIE Assessment	Test Week	Duration (minutes)	Max marks	
1.	CIE-1TheoryTest	4	90	50	Average of all CIE=50 Marks
2.	CIE-2Practice Test	7	180	50	
3	CIE-3TheoryTest	10	90	50	
4.	CIE-4Practice Test	13	180	50	
5	CIE-5 Portfolio evaluation of all the activities through Rubrics	1-13		50	
				Total	**50 Marks**

Sl. No	SEE – Theory Assessment	Duration (minutes)	Max marks	Min marks to pass
1.	Semester End Examination-Theory	90	50	20

8. CIE Theory Test model question paper

Program	**Automobile Engineering**			**Semester - II**	
Course Name	**Vehicle Transmission and Stability**			**Test**	**I/III**
Course Code	25AT21I	**Duration**	**90 min**	**Marks**	**50**
Name of the Course Coordinator:					
Note: Answer any one full question from each section. Each full question carries equal marks.					

Q.No	Questions	Cognitive Level	Course Outcome	Marks
	Section - 1			
1	a) Classify the types of clutches. 5M b) Explain the working of Centrifugal clutch. 10M c) Explain the construction of Diaphragm Spring clutch. 10M	L2	1	25
2	a) List requirements of a good clutch. 5M b) Explain working of Single plate clutch. 10M	L2	1	

	c) State the troubles, causes and remedies of single plate clutch.			
Section - 2				
3	a) State the necessity of gearbox. 5M b) Explain working of Synchromesh gearbox. 10M c) Explain the construction of propellor shaft. 10M	L3	1	25
4	a) State the functions of universal joint and slip joint. 5M b) Explain Construction of cross or spider universal joint. 10M c) Explain working of gear selector mechanism. 10M	L3	1	
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.				

Signature of the Course Coordinator **Signature of the HOD** **Signature of the IQAC**

9. CIE-1 Practice Test model question paper

Program	**Automobile Engineering**			**Semester**	**II**
Course Name	**Vehicle Transmission and Stability.**			**Test**	**II/IV**
Course Code	25AT21I	**Duration**	**180 min**	**Marks**	**50**
Name of the Course Coordinator:					
Questions				**CO**	**Marks**
1. Service and trouble shoot the given clutch. 2. Overhauling of differential with backlash adjustment & calculate the gear ratio. OR 3. Servicing of the given gearbox and finding the gear ratios io. 4. Servicing of Propeller shaft				**1**	**50**
Scheme of assessment: a) Procedure writing. 3+3=6 b) Conduction/ Trouble shoot/ Calculation and result=10+3+2=15(15x2 Exp=30) c) Viva -voce 10M d) Portfolio evaluation of practical record 4M					
				Total Marks	**50**

Note: CIE1 Experiment from 1 to 7 weeks

Signature of the Course Coordinator **Signature of the HOD**

10. Suggestive Activities for Tutorials:

The List is 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 **Two activities**, each for **50 marks** should be evaluated with proper rubrics.

Sl.No.	Suggestive Activities for Tutorials
01	Visit authorized service station for four-wheeler and prepare a service station layout
02	Collect different types of clutches and prepare a report.
03	Visit nearby garage and collect information on Different types of gear boxes and prepare a report.
04	Visit nearby garage and collect information on Different types of final drives (single reduction and double reduction) and prepare a report.
05	Visit nearby service station and collect information on Different types of steering gear boxes.
06	Visit tyre sale show room and prepare a detailed report containing information on tread pattern, radial, bias, aspect ratio etc.

11.Rubrics for Assessment of Activity (Qualitative Assessment)

Sl. No.	Dimension	Beginner	Intermediate	Good	Advanced	Expert	Students Score
		2	4	6	8	10	
1	Collection of data/ Material	Limited information	Collects basic information	Collects more information	Collects developed information	Collects a great deal of information	8
2	Quality of data	Irrelevant	Less relevant	Needs improvement	Satisfactory	Very relevant	6
3	Quality of report	Not planned	Less organized	Moderately organized	Organized	As per the standards	4
4	Timely submission	Late submission	Submits after due date	Submits after reminders	Submit after a reminder	On time submission	2
5	Data references	No references.	Irrelevant references.	Given References not from authentic source.	Given references are from authenticated sources.	Enough authenticated references are given.	6
	Example: Total Marks=(8+6+4+2+6)=26						**26/50**

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

12. SEE–Model Theory Question Paper-1

Program	**Automobile Engineering**	**Semester**	**II**
Course Name	**Vehicle Transmission and Stability**	**Marks**	**50**
Course Code	25AT21I	**Duration**	**90 Min**

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

Q No	Questions	Cognitive Levels	Course Outcomes	Marks
	Section -1			

1	a) Classify the types of clutches. b) Sketch and label the parts of diaphragm spring clutch.	L2 L3	1	4 6
2	a) Summarize the requirements of a good clutch. b) Sketch and label the parts of Multi plate clutch.	L2 L3	1	4 6
Section -2				
3	a) Explain the working of Synchromesh gearbox with neat sketch.	L3	1	10
4	a) Explain the working of gear selector mechanism with a neat sketch.	L3	1	10
Section -3				
5	a) Explain the necessity of differential. b) Sketch and label the parts of Hotch kiss drive.	L3	1	4 6
6	b) Explain the construction of differential with a neat sketch.	L3	1	10
Section -4				
7	a) Differentiate live and dead axle. b) Explain Caster and camber.	L2 L3	2	4 6
8	a) Discuss the purpose of steering system. b) Explain recirculating ball and nut type steering gearbox.	L2 L3	2	4 6
Section -5				
9	a) List requirements of automobile brakes. b) Explain Double wish bone suspension system	L2 L3	3 4	4 6
10	a). List the types of automobile brakes. b) Illustrate the tube less tyre construction.	L2 L3	3 4	4 6

13. SEE–Model Theory Question Paper-2

Program	**Automobile Engineering**	**Semester**	**II**
Course Name	**Vehicle Transmission and Stability**	**Marks**	**50**
Course Code	25AT21I	**Duration**	**90 Min**

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

Q No	Questions	Cognitive Levels	Course Outcomes	Marks
Section -1				
1	a) State the requirements of clutch. b) Explain the working of centrifugal clutch with a neat sketch.	L1 L2	1	10
2	a) Explain the working of Multi plate clutch. b) State the troubles, causes and remedies of clutch.	L2 L1	1	4 6

Section -2				
3	a) State the necessity of gearbox. b) Sketch and explain propellor shaft.	L1 L3	1	4 6
4	a) State the functions of universal joint and propellor shaft. b) Explain the Construction of cross or spider universal joint.	L1 L3	1	4 6
Section -3				
5	a) List the types of steering gear box. b) Explain King pin Inclination and combined angle.	L3 L3	2	4 6
6	a) Explain steering geometry. b) Explain toe-in and toe-out with sketch	L3 L3	2	4 6
Section -4				
7	a) State the Requirements of automobile brakes b) Explain the concept of trailing and leading shoes,	L2 L3	3	4 6
8	a) Differentiate primary and secondary brakes. b) Sketch and label the parts of fixed caliper disc brake.	L2 L3	3	4 6
Section -5				
9	a) Explain the tubeless tire. b) Sketch and label of telescopic shock absorber.	L3 L3	4	4 6
10	a) Explain the tubed tyre. b) Sketch and explain construction of leaf spring.	L3 L3	4	4 6

14. SEE–Model Theory Question Paper-3

Program	**Automobile Engineering**	**Semester**	**II**
Course Name	**Vehicle Transmission and Stability**	**Marks**	**50**
Course Code	25AT21I	**Duration**	**90 Min**

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

Q No	Questions	Cognitive Levels	Course Outcomes	Marks
Section -1				
1	a) State the necessity of gear box. b) Explain the Construction of single plate clutch with a sketch.	L1 L3	1	4 6

2	a) State different clutch lining material b) List causes and remedies for slipping clutch	L1 L3	1	4 6
Section -2				
3	a) State requirements of friction clutch b) Explain construction of constant mesh gear box with a neat sketch	L1 L3	1	4 6
4	a) State Necessities of synchronizer b) List the Causes and remedies for hard gear shifting.	L1 L3	1	4 6
Section -3				
5	a) List the Purpose of steering. b) Explain rack and pinion type of steering gear with sketch	L3 L3	2	4 6
6	a) Draw the layout of Steering system b) Explain Ackerman steering mechanism	L3 L3	2	4 6
Section -4				
7	a) Draw the Layout of hydraulic braking system b) Explain construction details of internal expanding brake shoe.	L3 L3	3	4 6
8	c) List the requirements of braking system. d) Explain the working of wheel cylinder.	L3 L3	3	4 6
Section -5				
9	a) List the types of springs used in suspension system. b) with neat sketch and label the parts of double acting shock absorber.	L3 L3	4	4 6
10	a) List requirement so good suspension system. b) Explain the construction of tubed tyre.	L3 L3	4	4 6

15.Equipment/software list with Specification for a batch of 30 students:

Sl.No.	Particulars	Specification	Quantity
01	Major mechanic tool kit		4
02	Bearing Puller	2leg,3leg pullers	2each
03	Nylon mallet	1.5 "	4
04	Ball peen hammer	2lb	4
05	Steel probs		6
06	Torque wrench (0-200 Nm)		1each
07	Arbor press	2 t0n capacity	1
8	Hydraulic press (20 Tons)		1
10	Hydraulic trolley jack	2 ton	1
11	Dial gauges with magnetic stand, feeler gauges,		1
12	Air compressor	Multi stage 200liters tank	1

13	Electronic Tyre inflators		1
14	Two post hoists	4 ton	1
15	Single plate clutches (Coil & Diaphragm Spring type)	4-wheeler	4
16	Multi plate clutch	2-wheeler	4
17	Gear boxes (constant & synchromesh mesh)	4-wheeler	4
18	Transfer case	4-wheeler	4
19	Propeller shaft assembly	4-wheeler	4
20	Rear axle assembly with wheels	4-wheeler	4
21	Front axle assembly with wheels	LCV	4
22	Steering gearbox assemblies (different types)	4-wheeler	1each
23	Chassis frame with Independent & leaf spring suspension system	4-wheeler	1
24	Mechanical brake assemblies	4-wheeler	1
25	Hydraulic brake system.	4-wheeler	1
26	Master Cylinder-Single piston and Tandem master cylinder.	4-wheeler	4
27	Wheel cylinders-single piston and double piston.	4-wheeler	4
28	Drum brake assemblies.	4-wheeler	4
29	Disc brake assemblies	4-wheeler	4
30	Trainer kits of transmission components.	4-wheeler	1 each
31	Hydraulic Brake trainer kits	4-wheeler	1

Government of Karnataka

DEPARTMENT OF TECHNICAL EDUCATION

Curriculum Structure

III Semester Scheme of Studies- Automobile Engineering

Sl. No.	Teaching Department	Course Code	Course Name	Hours per week			Total Contact Hours/week	Credits	CIE Marks		Theory SEE Marks		Practice SEE Marks		Total Marks
				L	T	P			Max	Min	Max	Min	Max	Min	
Integrated Courses															
1	AT	25AT31I	Automobile electrical system	4	0	4	8	6	50	20	50	20	-	-	100
2	AT	25AT32I	IC Engine and Engine Maintenance.	4	0	4	8	6	50	20	50	20	-	-	100
3	AT	25AT33I	Thermodynamics, combustion and engine testing.	3	0	4	7	5	50	20	-	-	50	20	100
4	AT	25AT34I	Automobile Fuels and Green Technologies	3	0	4	7	5	50	20	-	-	50	20	100
Audit Course															
5	KAN	25KA31T	Kannada –I Sahithya Sinchana-I/Balake Kannada-I	2	0	0	2	2	50	20	-	-	-	-	50
Total				**16**	**0**	**16**	**32**	**24**	**250**	**-**	**100**	**-**	**100**	**-**	**450**

Government of Karnataka

DEPARTMENT OF TECHNICAL EDUCATION

Curriculum Structure

IV Semester Scheme of Studies- Automobile Engineering

Sl. No.	Teaching Department	Course Code	Course Name	Hours per week			Total Contact Hours/week	Credits	CIE Marks		Theory SEE Marks		Practice SEE Marks		Total Marks
				L	T	P			Max	Min	Max	Min	Max	Min	
Integrated Courses															
1	AT	25AT41I	Hydraulics and Pneumatics	4	0	4	8	6	50	20	50	20	-	-	100
2	AT	25AT42I	Advanced Automotive Systems	4	0	4	8	6	50	20	50	20	-	-	100
3	AT	25AT43I	Vehicle body engineering and dynamics.	3	0	4	7	5	50	20	-	-	50	20	100
4	AT	25AT44I	Machine design and drafting	3	0	4	7	5	50	20	-	-	50	20	100
Audit Course															
5	KA	25KA41T	Kannada –II Sahithya Sinchana-II/Balake Kannada-II	2	0	0	2	2	50	20	-	-	-	-	50
Total				**16**	**0**	**16**	**32**	**24**	**250**	**-**	**100**	**-**	**100**	**-**	**450**

Government of Karnataka
DEPARTMENT OF TECHNICAL EDUCATION

Program	**Automobile Engineering**	**Semester**	**III**
Course Name	**Automobile electrical system**	**Type of Course**	Integrated
Course Code	**25AT31I**	**Contact Hours/Week**	08
Teaching Scheme	L: T:P. 4:0:4	**Credits**	06
CIE Marks	**50**	**SEE Marks**	**50 (Theory)**

7. Rationale: The automobile has various electrical systems for its efficient working. The student must justify the use of various electrical systems in automobiles. The student should also be able to perform trouble shooting and service activities of electrical components and systems.

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

CO-01	Perform the Service and troubleshooting activities of different Batteries of automobile.
CO-02	Perform the Service and troubleshooting activities of charging and Starting systems.
CO-03	Perform the Service and troubleshooting activities of ignition systems and their components.
CO-04	Perform the Service and troubleshooting activities of Lighting and accessories.

9. Course Content:

WEEK	CO	PO	Theory	Practice
1	**1**	**1,2,4**	**Battery** -Purpose, types, construction and working of Lead acid battery. Battery capacity- Concept, types, Concepts of Reserve capacity. Battery efficiency, Concept of Ampere hour rating, Cold rating, twenty-hour rating. Charging the Battery- Types, Illustrate the constant voltage and constant current methods of charging.	Conduct an experiment to check the battery charge condition using hydrometer, Voltmeter. Test the battery condition using a battery tester. Practice Preparation of electrolyte and charging of battery. Practice on finding the defects and troubleshooting of batteries.
2	**1**	**1,4,5**	Lithium-ion battery – Types, Construction and working of	Demonstrate the Circuit diagram for Earth return

			Lithium-ion battery. Comparison of Lead acid and lithium-ion batteries. Types of circuits-circuit diagrams of Earth return system, insulated wire return system-merits and demerits.	system (Positive and negative) and insulated wire return system. Practice safe disposal of batteries.
3	**2**	**1,2,4**	**Charging system** Illustrate the different Electrical symbols. Charging system-purpose-circuit diagram with DC generator, D C generator-principle, Alternator charging circuit, Alternator-working principle, construction and working. electronic voltage regulators-construction and working, comparison between generator and alternator.	Practice on Servicing of dc generator and testing. Practice on Servicing of alternator and testing. Troubleshooting of charging system.
4	**2**	**1,2,4**	**Staring system-** Requirements, circuit diagram, working principle, construction and working of series-shunt wound motor, Drive mechanism-need-types, construction, and working-Standard Bendix drive-positive engaging drive with shift lever and over running clutch drive.	Practice on Servicing of starter motor. Practice on Servicing of starter motor drives. Trouble shooting of starting system.
5	**3**	**1,2,4**	**Ignition system** Requirement types, battery coil ignition system-circuit diagram-function of each component, Ignition coil-function-construction and working.	Practice to build ignition circuit Practice on setting of ignition timing Trouble shooting of ignition system
6	**3**	**1,2,4**	Magneto ignition system-circuit diagram of High-tension rotating magnet type ignition system-function of each component, Working with the Electronic Ignition system, and Distributor less ignition system.	Practice on Servicing of magneto ignition system. Trouble shooting of magneto ignition system.
7	**3**	**1,4**	Spark plug-classification-construction-specification, spark plug gap, heat range and reach-types, Hot and cold plugs, definition, and importance Firing order-definition-need Repair cost estimation of ignition system.	Practice on servicing of spark plug and setting of gaps. Practice on testing spark plugs using spark plug testing machine. Practice identification of engine condition by observing the condition of spark plug terminals.

8	**4**	**1,4**	**Lighting system** Circuit diagrams of head light-parking light, side indicator, brake light, reverse gear light, Head light-construction, bulbs Different types of bulbs-applications.	Practice on replacement of bulb assemblies and relays. Practice on aiming of head lights.
9	**4**	**1,2,4**	Construction and working of Halogen head light bulb, HID bulb, LED bulb, merits, and demerits. Fuses-need-types.	Practice on replacing bulbs and fuses with safe disposal. Practice on finding open and short circuits of lighting system.
10	**4**	**1,4**	**Accessories** Construction and working of windscreen wipers, Horn, Electrical fuel pump. Construction of electrically adjustable outside rear view mirrors.	Practice on servicing of wiper motor and linkages. Practice on replacing wiper blades. Practice on servicing and tuning of horn.
11	**4**	**1,2,4**	Construction and working of analog type electrical fuel gauge, oil and temperature gauge, Speedometer, odometer.	Service and trouble shoot the circuits of electrical fuel gauge, oil and temperature gauge, Speedometer, and odometer.
12	**4**	**1,4**	Switches – Types, construction and working of Pushbutton and Solenoid switch. Construction and working of Dim-Dipper switch.	Practice on replacement of switches Practice on fault finding in the lighting circuit.
13	**4**	**1,3,4**	Wiring harness-meaning, need. Different types of cable connectors, wire specifications, color code of wires used in automobile circuits. Draw the Combined wiring diagram of two-wheeler and four-wheeler.	Construct and demonstrate the two-wheeler and four-wheeler circuit diagrams.

10. References:

Sl., NO	Title of the book	Author	Publisher
1	Automobile Electrical Equipment	Kohli	Tata McGraw-Hill
2	Automobile Engineering Vol-2	Kirpal Singh	Standard Publications
3	The Automobile Engineering Vol-2	K.M Gupta	Umesh publications
4	Diesel Engineering Electricity & Electronics	Joseph Bell	Cengage
5	Principals of Electrical Engineering & Electronics	V. K Mehta & Rohit Mehta	S Chand & Co
6	A system approach to Automotive Technology	Jack Erjavec	Cengage
7	The Automobile Engineering	Harban Singh Reyath	S Chand & Co
8	The Automobile Engineering	Er S K Gupta	S Chand & Co
9	Automobile Electrical Equipment	W. H. Crouse	Tata McGraw-Hill

9. CIE Assessment Methodologies

Sl. No	CIE Assessment	Test Week (At the End Of)	Duration (minutes)	Max marks	
1.	CIE-1TheoryTest	4	90	50	Average of all CIE=50 Marks
2.	CIE-2Practice Test	7	180	50	
3	CIE-3TheoryTest	10	90	50	
4.	CIE-4Practice Test	13	180	50	
5	CIE-5 Portfolio evaluation of all the activities through Rubrics	1-13		50	
				Total	**50 Marks**

10. SEE - Theory Assessment Methodologies

Sl. No	SEE – Theory Assessment	Duration (minutes)	Max marks	Min marks to pass
1.	Semester End Examination-Theory	90	50	20

Rubrics for Portfolio evaluation Level of Achievement						
Assessment Parameter		**Excellent (10)**	**Very Good (8)**	**Fair (6)**	**Poor (4)**	**Score**
AP1	**Organization of Report and Timely Submission**	Lab report is well organized as directed and submitted on time	Lab report is well organized but not submitted on time	Report contains few errors and not submitted them	Poor organization and late submission	
AP2	**Knowledge of Tools and Procedures**	Demonstrates deep knowledge of tools and procedures; answer the related questions with explanations and elaboration	Adequate knowledge of most tools and procedures; answer the related questions, but fails to elaborate	Superficial knowledge of tools and procedures; able to answer only some of the related basic questions	Lack of information about most of the tools and procedures; cannot even answer basic related questions	
AP3	**Team Working Skills**	Positive in interacting with all group members, encourages such interaction in others, and always sensitive to the abilities and feelings of others' contributions; Actively helps to identify group goals and works effectively to meet them in assigned roles	Interacts with all group members spontaneously and contributes in a way that is sensitive to the abilities and feelings of others; Demonstrates commitment to group goals and carries out assigned roles effectively	Interacts with other group members if prompted, but sometimes expresses opinions which are insensitive to the abilities and feelings of others; Demonstrates commitment to group goals, but has difficulty performing assigned roles	Rarely interacts within a group, even with prompting, and shows frequent lack of sensitivity to others' feelings and abilities in opinions expressed; Shows little commitment to group goals and fails to perform assigned roles	
AP4	**Result Analysis and Data Interpretation**	Excellent insight and well-focused results and discussion; Data completely and appropriately interpreted and no overinterpretation	Adequate insight but missed some important points in results and discussion; Interpreted most data correctly but some conclusions may be suspect or over-interpreted	Little insight and analysed only the most basic points; Interpreted some data correctly but significant errors, omissions still present.	No insight and entirely missed the point of the experiment; Little or no attempt to interpret data or overinterpreted data.	
AP5	**Task Management**	Very Effective in managing the assigned task and allow experimenter(s) to achieve all goals	Somewhat effective in managing the assigned tasks and allow experimenter(s) to achieve most goals.	Somewhat ineffective in managing the assigned task and allow experimenter(s) to achieve only few goals.	Very ineffective and would not allow experimenters to achieve any goals	

11. CIE -1 Theory Test model question paper

Program	**Automobile Engineering**			**Semester - III**	
Course Name	**Automobile electrical system**			**Test**	**I/III**
Course Code	**25AT31I**	**Duration**	**90 min**	**Marks**	**50**
Name of the Course Coordinator:					
Note: Answer one full question from each section. Each full question carries equal marks.					

Q.No	**Questions**	**Cognitive Level**	**Course Outcome**	**Marks**
	Section - 1			
1	a) List the different types of batteries. 5m b) Explain the Construction and working of lithium-ion battery with a neat sketch. 10m c) Compare lead acid batteries with lithium-ion batteries. 10m	L1 L2 L3	1	25
2	a) State the advantages and disadvantages of an insulated earth return system. 5m b) Explain the working of lead acid battery with equation.10m c)List the causes and remedies for 1. Loss of electrolyte 2. short circuiting of lead acid battery.10m	L1 L2 L3	1	
	Section - 2			
3	a) State the requirements of Starting system 5m b) Explain the Construction of DC generator with a neat sketch 10m c)Explain working of electronic voltage regulator. 10m	L1 L2 L3	2	25
4	a) State the purpose of charging system. 5m b) Explain with sketch construction and working of Standard Bendix drive 10m c)Explain the construction and working of overrunning clutch 10m	L1 L2 L3	2	

7. CIE Practice Test model question paper:

Program	**Automobile Engineering**			**Semester**	**III**
Course Name	**Automobile electrical system**			**Test**	**II/IV**
Course Code	**25AT31I**	**Duration**	**180 min**	**Marks**	**50**
Name of the Course Coordinator:					

Questions	**CO**	**Marks**
1. Conduct an experiment to check the battery charge condition using hydrometer. **OR** 2. Test the battery condition using battery tester and identify the troubles and suggest suitable remedies. 1. Conduct the experiment to trouble shoot and service magneto ignition system. **OR** 2. Conduct the experiment to trouble shoot and service the battery ignition system.	**1** **3** **1** **3**	**50**
Scheme of assessment: a) Procedure writing. 3+3=6 b) Conduction/ Trouble shoot/ Calculation and result=10+3+2=15(15x2Exp=30) c) Viva -voce 10M d) Portfolio evaluation of practical record 4M		
	Total Marks	**50**

Signature of the Course Coordinator **HOD** **IQAC**

8. Suggestive Activities for Tutorials:

The List is an Example and not inclusive of all possible activities of the course. Students and Faculty are encouraged to choose activities that are relevant to the topic

Sl.No.	Suggestive Activities for Tutorials
01	Construct a circuit of chargers and prepare detailed report
02	Construct a earth return circuit and prepare a detailed report.
03	Prepare a trouble shooting chart for charging system
04	Prepare a trouble shooting chart for starting system
05	Construct a battery coil ignition circuit to prepare detailed report
06	Build completes a car wiring circuit and prepare detailed report

Note: two activities, each activity for 50 marks with proper rubrics.

9 Rubrics for Assessment of Activity (Qualitative Assessment)

Sl. No.	Dimension	Beginner	Intermediate	Good	Advanced	Expert	Students Score
		2	4	6	8	10	
1	Collection of data/ Material	Limited information	Collect basic information	Collect more information	Collects developed information	Collects a great deal of information	
2	Quality of data	Irrelevant	Less relevant	Needs improvement	Satisfactory	Very relevant	
3	Quality of report	Not planned	Less organized	Moderately organized	Organized	As per the standards	
4	Timely submission	Late submission	Submits after due date	Submits after reminders	Submit after a reminder	On time submission	
5	Data references	No references.	Irrelevant references.	References not from authentic source.	Given references are from authenticated sources.	Enough authenticated references are given.	
	Example: Average Marks= (8+6+4+2+6=26)						

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

10. SEE- Model Theory Question Paper-1

Program	**Automobile Engineering**	**Semester**	**III**
Course Name	**Automobile electrical system**	**Marks**	**50**
Course Code	**25AT31I**	**Duration**	**90 Min**

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

Q No	**Questions**	**Cognitive Levels**	**Course Outcomes**	**Marks**
	Section -1			
1	a) State the advantages and disadvantages of insulated earth return system. b) Compare lead acid batteries with lithium-ion battery.	L3 L3	1	4 6
2	Explain the construction and working of Lead acid battery.	L3	1	10
	Section -2			
3	a) Draw the layout of the Charging system circuit and label the part. b) Sketch and label the parts of D C generator.	L3 L3	2	4 6
4	a) State the requirement of starting system. b) Explain standard Bendix drive.	L3	2	4 6
	Section -3			
5	a) State the requirements of the ignition system. b) Explain the magneto ignition system.	L3	3	4 6
6	a) Estimate the cost of repair for overhauling magneto ignition system.	L3	3	10
	Section -4			
7	a) Draw a circuit diagram for side indicators. b) Sketch and label the parts of sealed beam head lamp.	L1 L3	4	4 6
8	a) State different types of bulbs. b) sketch and explain electric horn.	L1 L3	4	4 6
	Section -5			

9	a) With a circuit diagram explaining the working of fuel gauge. b) Explain with sketch working of solenoid switch.	L3 L3	4	4 6
10	a) Draw the combined wiring diagram of a car and label.	L3	4	10

Model Theory Question Paper-2

Program	**Automobile Engineering**	**Semester**	**III**
Course Name	**Automobile electrical system**	**Marks**	**50**
Course Code	**25AT31I**	**Duration**	**90 Min**

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

Q No	Questions	Cognitive Levels	Course Outcomes	Marks
	Section -1			
1	a) State different types of battery rating. b) Explain earth return system and insulated return system with example.	L1 L3	1	4 6
2	a) State the different types of battery. b) Sketch and label lithium-ion battery.	L1 L3	1	4 6
	Section -2			
3	a) List the different types of electrical symbols in automobiles. b) Sketch and explain the construction of alternator.	L1 L3	2	4 6
4	a) State the need of drive mechanism. b) Explain the working of the series shunt wound motor.	L1 L3	2	4 6
	Section -3			
5	Explain distributor less ignition system with a neat sketch.	L3	3	10
6	Explain battery coil ignition system with a neat sketch.	L3	3	10
	Section -4			
7	a) State the importance of firing order. b) Draw a circuit diagram for reverse gear light.	L1 L3	3,4	4 6
8	a) List the different types of bulbs. b) Explain hot and cold plug with relevant sketches.	L1 L3	3,4	4 6

Section -5				
9	a) Draw the circuit diagram of dim-dipper switch. b) Explain the construction of halogen head lamp.	L1 L3	4	4 6
10	a) Draw the circuit diagram of temperature gauge. b) Sketch and label the different types of cable connectors.	L1 L3	4	4 6

Model Theory Question Paper-3

Program	**Automobile Engineering**	**Semester**	**III**
Course Name	**Automobile electrical system**	**Marks**	**50**
Course Code	**25AT31I**	**Duration**	**90 Min**

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

Q No	Questions	Cognitive Levels	Course Outcomes	Marks
Section -1				
1	a) Explain positive earth return system. b) Explain the methods of charging battery.	L3	1	4 6
2	a) Compare battery capacity and battery efficiency. b) Explain working of lead acid battery.	L3	1	4 6
Section -2				
3	a) Explain the working principle of DC generator. b) With a circuit diagram explain working of electronic. voltage regulator of an alternator.	L3	2	4 6
4	Explain with a neat sketch positive engaging drive with shift lever and over running clutch drive.	L3	2	10
Section -3				
5	a) List the requirements of ignition system. b) Sketch and explain rotating armature type high tension magneto Ignition system.	L1 L3	3	4 6
6	a) State the meaning of firing order and its importance. b) Compare hot plug and cold plug.	L1 L3	3	4 6
Section -4				
7	a) Sketch and label HID bulb. b) Sketch and label the different types of fuses.	L3	4	4 6
8	a) Explain with a neat sketch winds screen wiper motor.	L3	4	10

Section -5				
9	a) Explain construction of pushbutton. b) Explain construction and working of two winding solenoid switches.	L3	4	4 6
10	Sketch and label the components of a combined two-wheeler wiring diagram.	L3	4	10

12. Equipment/software list with Specification for a batch of 30 students.

Sl.No.	Particulars	Quantity
1.	Electrician tool kit	2
2.	Arbor press	1
3.	Voltmeter, Ammeter, Multi meter, Tong tester, feeler gauges,	2 each
4.	Air compressor	1
6.	Three jaw bearing pullers	2
7.	Growler	2
8.	Multifunction tester	2
9.	Battery Charger	1
10.	Spark plug cleaning & testing machine	1
11.	Neon timing light	2
12.	Tacho-dwell tester	1
13.	Hydrometer	4
14.	Cell tester and Battery Tester.	4
15.	Test lamps	2
16.	Auto electrical test bench	1
17.	Automotive electrical system trainer kit.	02

Government of Karnataka
DEPARTMENT OF TECHNICAL EDUCATION

Program	**Automobile Engineering**	**Semester**	**III**
Course Name	**IC Engine and Engine Maintenance**	**Type of Course**	Integrated
Course Code	**25AT32I**	**Contact Hours**	104 Hrs/Sem 8 Hrs/week
Teaching Scheme	L: T:P, 4:0:4	**Credits**	06
CIE Marks	**50**	**SEE Marks**	**50(Theory)**

1. Rationale:

I.C. engines are still the primary power source of automobiles. The student needs to justify different constructional features of components of IC engines. The students also need to develop skills to maintain and service the IC engines to keep them working efficiently.

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

CO-01	Perform different servicing activities of IC engine components using proper tools with standard procedure.
CO-02	Perform different servicing and maintenance activities of engine fuel feed system and manifolds.
CO-03	Perform different servicing and maintenance activities of engine cooling system.
CO-04	Perform different servicing and maintenance activities of engine lubrication system

3. Course Content

WEEK	**CO**	**PO**	**Theory**	**Practice**
1	1	1,2,4,5	**Introduction to Engine component-** Cylinder head- Function, Types, Construction, Materials. Cylinder Head Gasket- Function, Types Crankcase- Function, Construction, Materials.	Disassemble, clean, and inspect cylinder heads. Practice of Decarbonising the Cylinder Head and list the importance. Check the Cylinder head twist and wrap. Practice the Surface grinding of cylinder head.
2	1	1,4,5	Cylinder block - Function, Types, Construction, Materials. Cylinder Liner- Function, Types, Construction. Causes and effects of uneven wear of cylinders.	Check the Taperness and ovality of cylinder bore using dial bore gauge. Practice on performing reboarding using proper tools and process.
3	1	1,4	Valves - Function, Types,	Disassemble, clean, and

			Construction, Materials. Sodium cooled Valves – Function, Construction. Valve Mechanism- Types, Construction and Working of Overhead valve and Overhead Cam Mechanism. Tappets- Function, Types.	inspect Valves and Springs. Practice on Reconditioning of Valve and Valve lapping. Practice on checking and adjusting the tappet clearance. Reassemble the valve into the head.
4	1	1,2,4	Piston- Requirements, Function, Types, Construction, Materials. Types of Piston head, Piston Clearence, Piston Expansion Control methods, Construction -T slot type. Bi-metal piston.	Perform the Ridge reaming process. Disassemble, clean, and inspect Piston. Practice on Checking the Ring groove for Wear and Cleaning the carbon from a ring groove using a ring groove cleaner.
5	1	1,2,4	Piston Ring – Function, Types, Construction, Material. Piston Ring Terminology. Piston Pin - Function, Construction, Material. Piston Pin retaining Method, Construction – Fully floating method	Disassemble, clean, and inspect Piston Rings and check the End gap. Disassemble, clean, and inspect Piston pin. Reassemble the piston ring and pin.
6	1	1,2,4	Connecting Rod- Function, Construction, Material. Crankshaft - Function, type, Construction, Material. Camshaft - Function, Construction, material.	Check and adjust the Alignment of Connecting rod. Disassemble, clean, and inspect Crankshaft, inspect for crack detection using magnetic crack detector.
7	1	1,4	Flywheel - Function, Construction, Material. Valve drive trains – timing Belt, gear, and chain Vibration damper- Need, Types, Construction of rubber crankshaft damper.	Disassemble, clean, and inspect Flywheel. Practice on flywheel facing. Practice to remove the timing belt and adjust the tension.
8	2	1,4	Fuel supply system in SI engine - Types, Layout, Working of Gravity feed system and Pump Feed system. Carburetor- Function, Types, Construction and working of Simple carburetor. Fuel Pump- Function, Types, Construction and working of	Servicing of two wheeler carburettor. Disassemble, clean, and inspect the fuel pump. Practice on Replacement of fuel filter.

			Mechanical pump.	
9	2	1,4	Fuel supply system in CI engine- Types, Layout of Conventional fuel feed system. Fuel injection Pump- Function, Types, Construction and working of Inline FIP.	Practice on FIP servicing. Conduct the FIP Calibration.
10	2	1,4	Governor - Function, Types, Construction and working of centrifugal governor. Fuel Injectors - Function, Types, Construction and working of multi hole type Fuel injector. Fuel filter - Function, Types, Construction and working of diesel fuel filter and Water separator.	Conduct the Fuel injector servicing and testing. Practice of replacing the Fuel filter.
11	2	1,4	Air filter - Function, Types, Construction. Intake Manifolds - Function, Types, Construction, Material. Exhaust manifold - Function, Types, Construction, Material. Mufflers - Function, Types, Construction of Baffle type muffler.	Practice of Cleaning air filter. Practice of Cleaning the exhaust manifold and intake manifold.
12	3	1,2,4	Cooling system –Function, Requirements, types. Construction and working of Water-cooling system and Air-cooling system. Comparison between Water cooling and Air-cooling system. Construction and working of Radiator, water pump and wax type thermostat valve. Coolant- types, requirements.	Perform the Servicing of the Radiator. Perform the Servicing of water pump. Practice the reverse flush of cooling system. Inspect and check for proper working of thermostat valve.
13	4	1,2,4,5	Lubrication system – Types, Function, Requirement. Construction and Working of Pump lubrication and Splash Lubrication. Lubricants- Types, SAE ratings of lubricants. Oil filter- Function, Types, Construction and working of Oil filters.	Practice on Checking and refilling of the engine oil. Practice on Replace the Oil filter. Perform the servicing of the Oil Pump. Practice on safe disposal of used oil and filters.

4. References:

SN	Title of the book	Authors Name	Publishers name
1	Automobile Engineering Vol-2	Kripal Singh	Standard Publications
2	Automobile Engineering	R B Gupta	Satya Prakashan
3	Automotive Engines	S Srinivasan	Tata McGraw-Hill
4	Automotive Technology	H M Sethi	Tata McGraw-Hill
5	IC engines	M L Mathur, R P Sharma	Dhanpath Rai Publications
6	Automotive Engineering Vol-2	Anil Chikara	Satya Prakashan
7	Basic Automobile Engineering	C P Nakra	Dhanpath Rai Publications
8	Automobile Technology	N K Giri	Khanna Publications
9	Automotive Mechanics	Crouse and Anglin	Tata McGraw-Hill
10	Automotive Engines (Diagnosis, Repair and rebuild)	Tim Gilles	Cengage Publications

Websites:

1. https://www.youtube.com/watch?v=9BYm0HnLGRU
2. https://www.youtube.com/watch?v=5W1ucQsksSA
3. https://www.youtube.com/watch?v=wyspAHrMbb8
4. https://www.youtube.com/watch?v=zUuVQfvWSnI
5. https://www.youtube.com/watch?v=V7inC4lOpGs
6. https://www.youtube.com/watch?v=f45kAmjAOYA
7. https://www.youtube.com/watch?v=_HclvBmwWgQ
8. https://www.youtube.com/watch?v=DG-STqFiCg0
9. https://www.youtube.com/watch?v=mmmcj53TNic
10. https://www.youtube.com/watch?v=eFe43SnBlMI
11. https://www.youtube.com/watch?v=qUzvNA2b4ms
12. https://www.youtube.com/watch?v=MOoQMT9EfnQ
13. https://www.youtube.com/watch?v=EbjDH7fr_J8
14. https://www.youtube.com/watch?v=9-GSNR7W73M
15. https://www.youtube.com/watch?v=F6wmSCgVWOM
16. www.youtube.com/watch?v=jHZ4giLdbtc
17. http://lh5.ggpht.com/_dSeRrhZ5pEA/TdrCh5n7X2I/AAAAAAAAAOM/cNk-nB96CVU/Howmechanicalpumpworks_thumb4.jpg?imgmax=800
18. https://www.youtube.com/watch?v=0ycvbFxB87s
19. https://www.youtube.com/watch?v=BaEHVpKc-1Q

Rubrics for Portfolio evaluation Level of Achievement						
Assessment Parameter		**Excellent (10)**	**Very Good (8)**	**Fair (6)**	**Poor (4)**	**Score**
AP1	**Organization of Report and Timely Submission**	Lab report is well organized as directed and submitted on tim	Lab report is well organized but not submitted on time	Report contains few errors and not submitted on time them	Poor organization and late submission	
AP2	**Knowledge of Tools and Procedures**	Demonstrates deep knowledge of tools and procedures; answer the related questions with explanations and elaboration	Adequate knowledge of most tools and procedures; answer the related questions, but fails to elaborate	Superficial knowledge of tools and procedures; able to answer only some of the related basic questions	Lack of information about most of the tools and procedures; cannot even answer basic related questions	
AP3	**Team Working Skills**	Positive in interacting with all group members, encourages such interaction in others, and always sensitive to the abilities and feelings of others' contributions; Actively helps to identify group goals and works effectively to meet them in assigned roles	Interacts with all group members spontaneously and contributes in a way that is sensitive to the abilities and feelings of others; Demonstrates commitment to group goals and carries out assigned roles effectively	Interacts with other group members if prompted, but sometimes expresses opinions which are insensitive to the abilities and feelings of others; Demonstrates commitment to group goals, but has difficulty performing assigned roles	Rarely interacts within a group, even with prompting, and shows frequent lack of sensitivity to others' feelings and abilities in opinions expressed; Shows little commitment to group goals and fails to perform assigned roles	
AP4	**Result Analysis and Data Interpretation**	Excellent insight and well-focused results and discussion; Data completely and appropriately interpreted and no overinterpretation	Adequate insight but missed some important points in results and discussion; Interpreted most data correctly but some conclusions may be suspect or over-interpreted	Little insight and analysed only the most basic points; Interpreted some data correctly but significant errors, omissions still present.	No insight and entirely missed the point of the experiment; Little or no attempt to interpret data or overinterpreted data.	

AP5	**Task Management**	Very Effective in managing the assigned task and allow experimenter(s) to achieve all goals	Somewhat effective in managing the assigned tasks and allow experimenter(s) to achieve most goals.	Somewhat ineffective in managing the assigned task and allow experimenter(s) to achieve only few goals.	Very ineffective and would not allow experimenters to achieve any goals	

5. CIE Assessment Methodologies

Sl. No	CIE Assessment	Test Week	Duration (minutes)	Max marks	
1.	CIE-1TheoryTest	4	90	50	Average of all CIE=50 Marks
2.	CIE-2Practice Test	7	180	50	
3	CIE-3TheoryTest	10	90	50	
4.	CIE-4Practice Test	13	180	50	
5	CIE-5 Portfolio evaluation of all the activities through Rubrics	1-13		50	
Total					**50 arks**

6. SEE - Theory Assessment Methodologies

Sl. No	SEE – Theory Assessment	Duration (minutes)	Max marks	Min marks to pass
1.	Semester End Examination-Theory	90	50	20

7. CIE -1Theory Test model question paper

Program	**Automobile Engineering**			**Semester -**	
Course Name	**IC Engine and Engine Maintenance**			**Test**	**I/III**
Course Code	**25AT32I**	**Duration**	**90 min**	**Marks**	**50**
Name of the Course Coordinator:					
Note: Answer any one full question from each section. Each full question carries equal marks.					

Q.No	**Questions**	**Cognitive Level**	**Course Outcome**	**Marks**
	Section - 1			
1	a) State the functions of gaskets 5m b) Sketch and explain construction of crankcase 10m c) explain different types of Liners 10m	L1 L3 L3	1	25
2	a) State different types of valves 4m b) Explain the construction of poppet valve with a neat sketch 10m c) Explain overhead cam valve operating mechanism 10m	L1 L3 L3	1	
	Section - 2			
3	a) List the functions of cylinder block 4m b) List the causes for uneven wear of cylinder block 10m c)Sketch and explain the piston 10m	L2 L2 L3	1	25
4	a) List the requirements of piston b) Sketch and explain T slot type piston expansion control method 10m c)Explain construction of sodium cooled valve	L2 L2 L3	1	
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.				

Signature of the Course Coordinator **Signature of the HOD** **Signature of the IQAC Chairman**

8. CIE-1 Practice Test model question paper

Program	**Automobile Engineering**			**Semester**	
Course Name	**IC Engine and Engine Maintenance**			**Test**	**II/IV**
Course Code	**25AT32I**	**Duration**	**180 min**	**Marks**	**50**
Name of the Course Coordinator:					
Questions				**CO**	**Marks**
1) Decarbonise the Cylinder Head and check the cylinder head for any damages. 2) Remove the ridge by using ridge reamer and check the cylinder for any possible damage. **OR** 3)Dismantle the valve mechanism and check the valves and components for damages. 4) Decarbonise the piston and check the piston ring grooves and other damages				**1**	**50**
Scheme of assessment a) Procedure writing 3+3=6 b) Conduction / trouble shooting/ results=10+3+2=15x2=30 c) viva-voce =10 d) Portfolio valuation/record=4					
				Total Marks	**50**

Signature of the Course Coordinator **Signature of the HOD**

9. Suggestive Activities for Tutorials:

The List is 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

Sl.No.	Suggestive Activities for Tutorials
01	Visit nearby service stations/garages and make report of Engine components, materials and gaskets used along with photographs.
02	Visit nearby garage/service station and collect information on different types of valve mechanism and materials.
03	Collect different types of piston head, piston ring types and materials.
04	Visit nearby garage/service station and collect information on specification of components of different automobile fuel feed systems.
05	Visit nearby garage/service station and collect information on specification of components of different automobile cooling system systems
06	Visit nearby garage/service station and collect information on specification of components of different automobile lubrication systems

10. Rubrics for Assessment of Activity (Qualitative Assessment)

Sl. No.	Dimension	Beginner	Intermediate	Good	Advanced	Expert	Students Score
		2	4	6	8	10	
1	Collection of data/ Material	Limited information	Collects basic information	Collects more information	Collects developed information	Collects a great deal of information	8
2	Quality of data	Irrelevant	Less relevant	Needs improvement	Satisfactory	Very relevant	6
3	Quality of report	Not planned	Less organized	Moderately organized	Organized	As per the standards	4
4	Timely submission	Late submission	Submits after due date	Submits after reminders	Submit after a reminder	On time submission	2
5	Data references	No references.	Irrelevant references.	Given References not from authentic source.	Given references are from authenticated sources.	Enough authenticated references are given.	6
	Example: Average Marks=(8+6+4+2+6)=26						**26/50**

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

11. SEE– Model Theory Question Paper-1

Program	**Automobile Engineering**	**Semester**	
Course Name	**IC Engine and Engine Maintenance**	**Marks**	**50**
Course Code	**25AT32I**	**Duration**	**90 Min**

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

Q No	Questions	Cognitive Levels	Course Outcomes	Marks
	Section -1			
1	a) List the types of cylinder head 4m b) Compare dry and wet liners 6m	L2 L3	1	10
2	a) List the different types of valve operating mechanism 4m b) Explain with neat sketch overhead valve operating mechanism 6m	L2 L3	1	10
	Section -2			
3	a) List the requirement of good piston 4m b) Sketch and label the parts of sodium cooled valve 6m	L2 L3	1	10
4	a) List the different types of piston head 4m b) Explain Bimetal piston with a neat sketch	L3 L3	1	10
	Section -3			
5	a) List the types of fuel supply system in SI engine b) Sketch and explain the simple carburetor 6m	L2 L3	2	10
6	a) Draw the Layout of fuel supply system in CI engine. b) Explain construction of fuel injection pump 6m	L3 L3	2	10
	Section -4			
7	a) List the merits and demerits of water-cooling system 4m b) Sketch and explain pump circulation water cooling system 6m	L3 L3	3	10
8	a) Explain air cooling system 4m b) Explain with sketch radiator 6m	L3 L3	3	10
	Section -5			
9	a) Explain the Importance of oil filter 4m b) Explain with neat sketch working of splash type lubrication system 6m	L3 L3	4	10
10	a) List the requirement of lubrication system 4m b) Explain with neat sketch working of Oil filter 6m	L3 L3	4	10

12. SEE–Model Theory Question Paper-2

Program	**Automobile Engineering**	**Semester**	
Course Name	**IC Engine and Engine Maintenance**	**Marks**	**50**
Course Code	**25AT32I**	**Duration**	**90 Min**

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

Q No	Questions	Cognitive Levels	Course Outcomes	Marks
	Section -1			
1	a) Sketch and label overhead valve operating mechanism 4m b) Explain expansion control method of piston by providing T slot with a neat sketch 6m	L3	1	10
2	a) List the Piston expansion controlling methods b) Explain the construction of cylinder block with sketch 6m	L3	1	10
	Section -2			
3	a) Sketch and explain the construction of crank case 4m b) Explain wet type of liners with neat sketch 6m	L3	1	10
4	a) List the types of valve mechanism 4m b) Explain expansion control method of bimetal piston with a neat sketch 6m	L3	1	10
	Section -3			
5	a) State the functions of Air filter 4m b) Explain intake manifold 6m	L1 L3	2	10
6	a) Draw the layout of fuel feed system in CI engine 4m b) Explain the working of FIP 6m	L1 L3	2	10
	Section -4			
7	a) State the merits of air-cooling system 4m b) Explain with sketch wax type thermostat valve 6m	L1 L3	3	10
8	a) State cooling system functions. 4m b) with sketch explain the working of water pump 6m	L1 L3	3	10
	Section -5			
9	a) Explain SAE ratings of Lubrication oil.4m b) Explain construction and working of oil filter 6m	L3	4	10
10	a) List the types of oil filters 4m b) Explain with sketch Pump lubrication system 6m	L3	4	10

13. SEE– Model Theory Question Paper-3

Program	**Automobile Engineering**	**Semester**	
Course Name	**IC Engine and Engine Maintenance**	**Marks**	**50**
Course Code	**25AT32I**	**Duration**	**90 Min**

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

Q No	Questions	Cognitive Levels	Course Outcomes	Marks
	Section -1			
1	a) State the necessity of tappet clearance 4m b) Explain dry liner with neat sketch 6m	L1 L2	1	10
2	a) State the construction of crankcase 4m b) Illustrate the overhead cam Valve mechanism 6m	L1 L2	1	10
	Section -2			
3	a) List the types of piston head 4m b) Explain the importance of piston pin and piston ring 6m	L1 L3	1	10
4	a) List the importance of piston clearance 4m b) Sketch and explain the construction of crank shaft 6m	L1 L3	1	10
	Section -3			
5	State the functions of fuel injectors 4m b) Explain the working of gravity feed system with sketch 6m	L1 L2	2	10
6	a) State the purpose of governor 4m b) Explain the working of gravity feed system with 6m	L1 L2	2	10
	Section -4			
7	a) State the necessity of cooling system b) compare the Air cooling and water-cooling systems	L1 L3	3	10
8	a) State the importance of radiator 4m b) Sketch and explain the Working of Pump 6m	L1 L3	3	10
	Section -5			
9	a) State the functions of oil filter 4m b) Explain with neat sketch working of splash type lubrication system 6m	L1 L3	4	10
10	a) State the importance of SAE ratings of lubricants.4m b) Explain with neat sketch working of Oil filter 6m	L1 L3	4	10

14.Equipment/software list with Specification for a batch of 30 students

Sl.No.	Particulars	Quantity
1	Open end spanner set.	02
2	Ring spanner set.	02
3	Tubular spanner set.	02
4	Socket set.	02
5	Allen key set.	02
6	Pipe wrench.	02
7	Adjustable screw wrench.	02
8	Torque wrench.	02
9	Water pump pliers.	02
10	Vice grip pliers.	02
11	Combination pliers.	02
12	Nose pliers.	02
13	Circlip pliers.(inside, outside, straight bent)	02 each
14	screw driver (star, flat).	02 set
15	Hammers (ball peen, sledge).	02 each
16	Mallets.	02
17	Pneumatic wrench.	02
18	Electrical wrench.	02
19	Spark plug spanner.	02
20	Chisels.	02 each
21	Punches (hallow, solid)	02 each
22	scrapers.	02 each
23	Files.	02 each
24	Speed handle.	02
25	Oil can.	02
26	Feeler gauge.	02
27	Bench vice.	02
28	Leg vice.	01
29	Harbor press.	01
30	Two-wheeler lifting platform.	01
31	Spark plug cleaning and testing machine.	01
32	Valve spring compressors.	02
33	Oil filter wrench.	01
34	Trays. (1X1mt).	08
35	Two stroke single cylinder petrol engine	02
36	Four stroke single cylinder petrol engine	02

Government of Karnataka
DEPARTMENT OF TECHNICAL EDUCATION

Program	**Automobile Engineering**	**Semester**	**III**
Course Name	**Thermodynamics, combustion and engine testing.**	**Type of Course**	Integrated
Course Code	**25AT33I**	**Contact Hours**	91 hours/sem 7 Hrs/week
Teaching Scheme	L: T:P, 3:0:4	**Credits**	5
CIE Marks	**50**	**SEE Marks**	**50 (Practice)**

1. **Rationale:** The IC engines are still in active use around the world and many automotive companies are considering active developments of IC Engines. Hence it is important for the student to learn basics of thermodynamics, fuel combustion and engine testing process.

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

CO-01	Demonstrate the basic thermodynamic concepts and gas laws using experiments and simulations.
CO-02	Demonstrate the concepts of heat transfer, thermodynamic process and cycles using simple experiments or simulations.
CO-03	Illustrate the complete concepts of normal and abnormal combustion in IC Engines.
CO-04	Perform different performance tests of IC engines as per standard procedure.

3. Course Content

WEEK	**CO**	**PO**	**Theory**	**Practice**
1	**1**	**1,3,4**	Fundamentals of thermodynamics Definition- System, boundary and surrounding. Thermodynamic systems – closed, open and isolated systems with examples. Pure substance, Thermodynamic equilibrium.	Illustration of system and surrounding using simple experiments/ Virtual simulations. Illustration of Thermodynamic equilibrium using simple experiments/ Virtual simulations.
2	**1**	**1,3,4**	Thermodynamic state, Process, Cycle. Properties of system- Intensive and Extensive properties with examples. Definitions for properties like pressure (p), Volume (v), Temperature (T), Enthalpy (H), Internal energy (U) with the units. Specific heat at constant pressure (Cp), specific heat at constant volume (Cv) and their units.	Demonstrate the different properties of gas by simple experiments or virtual simulations.
3	**1**	**1,2,4**	Definitions for work, Standard atmospheric conditions-NTP-STP.	Demonstrate the Laws of thermodynamics using simple

			Laws of thermodynamics: Zeroth law, first law, second law- Clausius statement, Kelvin-Planck statement.	experiments or virtual simulations.
4	**1**	**1,2,4**	Definition of Perfect gas. Boyle's law, Charle's Law, Gay Loussac's law, Avogadro's law and Joule's law with expressions.	Demonstrate the Boyles law using an online simulation. Demonstrate the Charle's law using an online simulation. Demonstrate the Gay-Lussac law using an online simulation
5	**2**	**1,2,4**	Derive the Characteristic gas equation, universal gas equation, universal gas constant. Relationship between two specific heats, Characteristic gas constant. Heat Transfer- Definition, Modes of heat transfer with examples, Factors affecting heat transfer.	Demonstrate the modes of heat transfer using simple experiment or virtual lab/ Simulation. Demonstrate the factors affecting heat transfer using simple experiments or Simulations.
6	**2**	**1,2,4**	Thermodynamic Process- PVT relations -work done, heat transfer, change in internal energy, change in enthalpy and entropy for constant volume, Pressure, temperature, entropy. Simple problems.	Demonstrate the work done, change in entropy and enthalpy of a process using online simulations. Conduct the experiment to study the behaviour of different process using virtual lab.
7	**2**	**1,2,4**	Air standard Cycles- definitions and types, assumptions made in air standard cycles. Description - P.V. and T-S diagrams of Carnot cycle, Otto cycle, diesel cycle Air standard efficiency for Carnot Cycle.	Conduct the experiment to study the behaviour of Carnot Cycle using computer simulations. Conduct the experiment to study the behaviour of Otto Cycle using computer simulations.
8	**3**	**1,2**	Combustion in SI engine - Stages of combustion with pressure crank angle diagram, ignition lag-concept, variables affecting ignition lag, abnormal combustion-types-preignition-concept, effects, detonation- definition, process, effects, controlling methods.	Identify different design features of SI engine affecting delay period and knocking. Recreate the knocking in SI engine by changing engine parameters.
9	**3**	**1,4**	Combustion in CI engine: Stages of combustion with pressure crank angle diagram, ignition delay -variables affecting delay period, knocking- definition, process, effects, controlling method.	Practice to draw the Valve timing diagram for 4 stroke engines. Identify different design features of CI engine affecting delay period and knocking.
10	**4**	**1,4**	Engine Performance Dynamometer- Function, Types. Determination of IHP, BHP, FHP, mean effective pressure - IMEP, BMEP, Engine Torque, Mechanical Efficiency, Thermal Efficiency- Brake Thermal Efficiency.	Demonstrate the different types of dynamometers. Conduct the Performance test for 4 stroke Petrol engine
11	**4**	**1,4**	Volumetric Efficiency, Air Standard	Conduct the Performance test for

			Efficiency. Theoretical fuel consumption, Specific Fuel consumption- Brake specific fuel consumption, Indicated specific fuel consumption.	4 stroke Diesel engine.
12	**4**	**1,2,4**	Air fuel ratios. Simple problems on Performance of engine. Morse Test, Problems on Morse test	Conduct the Morse test on multi cylinder Petrol engine.
13	**4**	**1,2,4**	Heat balance sheet –concept- Need, Simple Problems.	Conduct the experiment to draw Heat balance sheet on engine.

4. References:

SL., NO	Title of the book	Author	Publisher
1	Thermal Engineering	R.S. Khurmi	S Chand & Co
2	Thermal Engineering	R K Hegde and Niranjan. Murthy	Sapna Publications
3	Basic and applied thermodynamics	P.K. Nag	Tata McGraw-Hill
4	I C Engines	Mathur &Sharma	Danapat Rai & sons
5	I C Engines	V. Ganeshan	Tata McGraw-Hill

5. Websites:

https://www.youtube.com/watch?v=9GMBpZZtjXM

https://www.youtube.com/watch?v=gg-dlrbXxzI

https://www.youtube.com/watch?v=Xto88gMmDzw

https://www.youtube.com/watch?v=0Oq7bCSDPxE

https://www.youtube.com/watch?v=pucd2b7jZJw

https://www.youtube.com/watch?v=K8RzTmeVWfM

https://www.youtube.com/watch?v=fyadfj7NQqI

https://www.youtube.com/watch?v=YNGtJo-VspE

https://www.youtube.com/watch?v=NG41IbDtd44

https://www.youtube.com/watch?v=HeofLEQ6wuA

https://www.youtube.com/watch?v=W94iksaQwUo

https://www.youtube.com/watch?v=ZWKRw0HmBLE

6. CIE Assessment Methodologies

Sl. No	CIE Assessment	Test Week	Duration (minutes)	Max marks	
1.	CIE-1TheoryTest	4	90	50	Average of all CIE=50 Marks
2.	CIE-2Practice Test	7	180	50	
3	CIE-3TheoryTest	10	90	50	
4.	CIE-4Practice Test	13	180	50	
5	CIE-5 Portfolio evaluation of all the activities through Rubrics	1-13		50	
				Total	**50 Marks**

7. SEE – Practice Assessment Methodologies:

Sl. No	SEE – Practice Assessment	Duration (minutes)	Max marks	Min marks to pass
1.	Semester End Examination-Practice	180	50	20

8. CIE Theory Test model question paper

Program	**Automobile Engineering**			**Semester - III**	
Course Name	**Thermodynamics, combustion and engine testing.**			**Test**	**I**
Course Code	**25AT33I**	**Duration**	**90 min**	**Marks**	**50**
Name of the Course Coordinator:					
Note: Answer any one full question from each section. Each full question carries equal marks.					

Q.No	**Questions**	**Cognitive Level**	**Course Outcome**	**Marks**
	Section - 1			
1	a) Explain system, boundary and surroundings. 5M b) Explain closed, open and isolated systems with examples.10M c) Explain pressure, volume, temperature, Enthalpy and internal energy with their units. 10M	L2	1	25
2	a) Explain Thermodynamic equilibrium. 5M b) Explain specific heat at constant pressure and constant volume with their units. 10M c) Explain intensive and extensive properties with examples.	L2	1	
	Section - 2			
3	a) Explain work, STP and NTP conditions. 5M b) Explain Boyle's law, Charles's law and Avogadro's law with their expressions. 10M c) Explain Zeroth law and First law of thermodynamics. 10M	L3	1	25
4	a) Explain perfect gas with examples. 5M b) Explain Kelvin plank statement and Clausius statement. 10M c) Explain Gay Loussac's law and Joule's law with expressions. 10M	L3	1	
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.				

Signature of the Course Coordinator **Signature of the HOD** **Signature of the IQAC Chairman**

9. CIE Practice Test model question paper

Program	**Automobile Engineering**			**Semester**	**III**
Course Name	**Thermodynamics, combustion and engine testing.**			**Test**	**II**
Course Code	**25AT33I**	**Duration**	**180 min**	**Marks**	**50**
Name of the Course Coordinator:					

Questions	**CO**	**Marks**
		50
1. Illustrate system and surrounding with simple experiment/virtual simulation.	1	
2. Demonstrate the modes of heat transfer using simple experiment/simulation.	2	
OR		
3. Conduct an experiment to study the behavior of isochoric and isobaric process using virtual lab.	2	
4. Demonstrate Boyle's law using simulation.	1	
Scheme of assessment		
a) Procedure writing- 3+3=6M		**6**
b) Conduction-10M, troubleshoot/calculation-3M and results-2M, ((10+3+2=15), 15 x 2 experiments = 30M)		**30**
c) Viva voce – 10M		**10**
d) Portfolio evaluation of practical record – 4M		**04**
Total Marks		**50**

Signature of the Course Coordinator **Signature of the HOD**

10. Suggestive Activities for Tutorials:

The List is 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

Sl., No	**Suggestive Activities for Tutorials**
01	Create a physical or simulation model to simulate laws of thermodynamics.
02	Create a report on applications of laws of thermodynamics in engineering.
03	Create a physical or simulation model to demonstrate the laws of thermodynamics.
04	Prepare a report on applications of gas laws in engineering
05	Create a simulation model to draw the different cycles.
06	Prepare a report on various properties of different fuels required for good combustion.
07	Prepare a report on different combustion chambers used in SI engines.
08	Prepare a report on different combustion chambers used in CI engines.
09	Prepare reports on different dynamometers.

11.Rubrics sheet for assessing student activities: (Qualitative assessment)

Sl. No.	Dimension	Beginner	Intermediate	Good	Advanced	Expert	Students Score
		2	4	6	8	10	
1	Collection of data/ Material	Limited information	Collects basic information	Collects more information	Collects developed information	Collects a great deal of information	8
2	Quality of data	Irrelevant	Less relevant	Needs improvement	Satisfactory	Very relevant	6
3	Quality of report	Not planned	Less organized	Moderately organized	Organized	As per the standards	4
4	Timely submission	Late submission	Submits after due date	Submits after reminders	Submit after a reminder	On time submission	2
5	Data references	No references.	Irrelevant references.	Given References not from authentic source.	Given references are from authenticated sources.	Enough authenticated references are given.	6
	Example: Total=(8+6+4+2+6=26)						**26/50**

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

12. **Rubrics for Portfolio evaluation** **Level of Achievement**						
Assessment Parameter		**Excellent (10)**	**Very Good (8)**	**Fair (6)**	**Poor (4)**	**Score**
AP1	**Organization of Report and Timely Submission**	Lab report is well organized as directed and submitted on time	Lab report is well organized but not submitted on time	Report contains few errors and not submitted on time them	Poor organization and late submission	
AP2	**Knowledge of Tools and Procedures**	Demonstrates deep knowledge of tools and procedures; answer the related questions with explanations and elaboration	Adequate knowledge of most tools and procedures; answer the related questions, but fails to elaborate	Superficial knowledge of tools and procedures; able to answer only some of the related basic questions	Lack of information about most of the tools and procedures; cannot even answer basic related questions	
AP3	**Team Working Skills**	Positive in interacting with all group members, encourages such interaction in others, and always sensitive to the abilities and feelings of others' contributions; Actively helps to identify group goals and works effectively to meet them in assigned roles	Interacts with all group members spontaneously and contributes in a way that is sensitive to the abilities and feelings of others; Demonstrates commitment to group goals and carries out assigned roles effectively	Interacts with other group members if prompted, but sometimes expresses opinions which are insensitive to the abilities and feelings of others; Demonstrates commitment to group goals, but has difficulty performing assigned roles	Rarely interacts within a group, even with prompting, and shows frequent lack of sensitivity to others' feelings and abilities in opinions expressed; Shows little commitment to group goals and fails to perform assigned roles	
AP4	**Result Analysis and Data Interpretation**	Excellent insight and well-focused results and discussion; Data completely and appropriately interpreted and no overinterpretation	Adequate insight but missed some important points in results and discussion; Interpreted most data correctly but some conclusions may be suspect or over-interpreted	Little insight and analysed only the most basic points; Interpreted some data correctly but significant errors, omissions still present.	No insight and entirely missed the point of the experiment; Little or no attempt to interpret data or overinterpreted data.	
AP5	**Task Management**	Very Effective in managing the assigned task and allow experimenter(s) to achieve all goals	Somewhat effective in managing the assigned tasks and allow experimenter(s) to achieve most goals.	Somewhat ineffective in managing the assigned task and allow experimenter(s) to achieve only few goals.	Very ineffective and would not allow experimenters to achieve any goals	

13. SEE Model Practice Question Paper.

Program	**Automobile Engineering**		**Semester**	**III**
Course Name	**Thermodynamics, combustion and engine testing.**	**Course Code: 25AT33I**	**Duration**	**180 min**
Questions			**CO**	**Marks**
1. Conduct the experiment to study the behaviour of Otto Cycle using computer simulations. 2. Conduct the Performance test for 4 stroke Diesel engine. OR 1. Conduct the experiments to find work done, change in internal energy and entropy change of isochoric process. 2. Conduct the Morse test on multi cylinder Petrol engine.			**2** **4** **2** **4**	**50**
Scheme of assessment: a) Procedure writing- 3+3=6 b) Conduction-10M, troubleshoot/calculation-03M and results-02M, 10+3+2=15M, (15 x 2 experiments = 30) c) Viva voce - 10 d) Portfolio evaluation of practical record – 4				**6** **30** **10** **04**
			Total Marks	**50**

1) Signature of the Examiner **2) Signature of the Examiner**

14. Equipment/software list with Specification for a batch of 30students

Sl., No.	Particulars	Specification	Quantity
01	Gas law demonstration setups	A steel container with adjustable length with electric heating, temperature and pressure gauges	01
02	Computers	24-inch color LED monitor, intel i5 or AMD latest gen processor, 8 GB ram, 512 GB Ram with internet connections	20
03	Heat transfer testing setup	Electric heating, variable length, thick ness and material setup with multiple stage temperature measurement	01
04	Single cylinder petrol engine performance test rig	100 to 150 cc 4 stroke petrol engine, air cooled, rope or electric dynamometer, fuel and air consumption setups, speed measurement set up, engine temperature and exhaust temperature set ups.	01
05	Multi cylinder petrol engine test rig	3 or 4 cylinder 800 to 1500CC petrol engine, electric or hydraulic dynamometer, fuel, air consumption, speed measurement, inlet water temperature, outlet water temperature setup, inlet air and exhaust gas temperature measurement set ups, morse test setups	01
06	Single cylinder diesel engine test rig	150 to 500 cc 4 stroke Diesel engine, water cooled, rope or electric dynamo meter, fuel, air consumption, speed measurement, inlet water temperature, outlet water temperature setup, inlet air and exhaust gas temperature measurement set ups.	01
07	Multi cylinder diesel engine test rig	3 or 4 cylinder 800 to 1500CC diesel engine, electric or hydraulic dynamometer, fuel, air consumption, speed measurement, inlet water temperature, outlet water temperature setup, inlet air and exhaust gas temperature measurement set ups.	01

Government of Karnataka
DEPARTMENT OF TECHNICAL EDUCATION

Program	**Automobile Engineering**	**Semester**	**III**
Course Name	Automobile Fuels and Green Technologies	**Type of Course**	Practical
Course Code	25AT34I	**Contact Hours**	91 hours/Sem 7 Hrs/week
Teaching Scheme	L: T:P- 3:0:4	**Credits**	5
CIE Marks	50	**SEE Marks**	50 (Practice)

1. **Rationale:** Automobile emissions are the major contributors to environmental pollution. Hence, the student should interpret the use of different emission-controlling techniques of conventional fuel IC Engines. The students should also assess various alternative fuels and other alternative power sources for automobiles.

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

CO-01	Perform the tests to find different properties of conventional and alternate fuels, and appreciate their importance.
CO-02	Perform service activities and troubleshooting of components of advanced fuel feed system
CO-03	Perform service activities and troubleshooting of components of emission control systems
CO-04	Validate the use of alternate power sources and pollution norms.

3. Course Content:

Week	**CO**	**PO**	**Theory** **(4 Hours per week)**	**Practice** **(4 Hours per week)**
1	1	1,4,5	Fuels – Introduction, types. Petroleum fuels – Concept, Types, Refining process. Properties of liquid and gaseous fuels. Merits and demerits of liquid and gaseous fuels. Octane and Cetane rating of fuels.	Determination of flash point and fire point of different liquid fuels. Determination of viscosity of petrol and Diesel fuel using a viscometer.
2	1	1,4,5,7	Alternative fuels – Introduction, types. Methanol – Properties, merits, demerits, storage, emissions. Ethanol – Properties, merits, demerits, storage, emissions. Engine modifications required for alternative fuel.	Determination of the Calorific value of methanol and ethanol using the bomb's calorimeter. Conduct the performance test using blends of ethanol and petrol.
3	1	1,4,5	Biodiesel – Introduction, properties, merits, demerits, storage, emissions. Biodiesel production processes.	Determination of flash point, and fire point of biodiesel. Conducting performance test using blends of biodiesel and diesel.

4	1	1,4,5	Hydrogen – Introduction, production process -types - production using electrolysis of water, properties, merits, demerits, storage, emissions. Engine modifications to use hydrogen. Fuel cells- introduction, types - Construction and working of PEM type.	Conduct an experiment to produce hydrogen using the electrolysis process.
5	2	1,4,5	CNG – Introduction, properties, merits, demerits, storage, emissions. Layout and working of CNG fuel feed system	Practice the installation of CNG kit to the car, setting. Practice on maintenance CNG kit.
6	2	1,4	Multipoint fuel injection system- layout, working, merits, classification. Gasoline direct injection system- Working, merits. construction and working of electronic petrol injector	Identification of different components of multipoint fuel injection and gasoline direct injection system. Practice removing and refitting different components of the fuel injection system. Practice on Petrol injector cleaning and testing.
7	2	1,4	Electronic Common rail diesel injection system- layout, working. Electronic Unit injection system- layout, working. Construction and working of electronic common rail diesel injector and Unit injector.	Identification of different components of electronic common rail diesel injection system and electronic unit injection system. Practice on servicing of CRDI and UI injectors.
8	2	1,2,4,5	Stratified engine -Need, types. Supercharging- Need, types. Turbocharging- Need, types. Construction and working of turbocharger. Boost control-need, types. working of waste gate method and Variable geometry method.	Practice the Servicing of a supercharger. Practice the Servicing of a turbocharger. Practice the Troubleshooting of turbochargers.
9	3	1,4,5	Pollutants from an automobile, Sources of pollutants in SI engine & CI engine. Mechanism of formation of nitrogen oxide, particulate, carbon monoxide and unburnt hydrocarbon in SI and CI engine.	Practice the measurement of HC, CO, CO2, and O2 using an exhaust gas analyzer. Practice the measurement of diesel engine emissions using the smoke meter.
10	3	1,2,4,5	Crankcase ventilation system- need, layout and working. Exhaust gas recirculation- need, layout and working. Catalytic converters -need, types. Construction and working of 3-	Practice on Servicing of PCV and EGR system. Practice removing and refitting the catalytic converter.

			way catalytic converter and exhaust manifold reactor. SCR and particulate filters of CI engines – Need, construction and working. Combustion chamber modifications to SI and CI Engines to control emissions.	Practice the troubleshooting of particulate emission control system of diesel engines. Practice the troubleshooting of PCV and EGR systems.
11	4	1,4,5	Emission norms- need, different emission standards for different engines in India. Driving cycles- types. Bharath stage emission standards and norms. Comparison of Bharath stage with European standards.	Prepare a report on the case study of implementing BS VI norms. Conduct the test for Emission and fuel consumption under different driving cycles.
12	4	1,5	Pollution- Types - air pollution, water pollution, Noise pollution, soil pollution. Effects of pollution on living things and environment. Reasons and effects of Acid rain and global warming.	Prepare a report on Case studies to control pollution, Soil quality, water, and air quality measurement.
13	4	1,4	Hybrid vehicle-Need, types. Layout & working of Series hybrid and parallel hybrid. Comparison of series to parallel hybrid. ARAI- Formation, functions. Formulation of standards. Central Motor vehicle rules.	Identify the different components of a hybrid vehicle. Demonstration of series and parallel hybrid vehicle working using demo models/test rigs. Prepare a report on the case study of ARAI comprehensive certification and homologation services.

4. References:

SN	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, Dhanpath 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.

Rubrics for Portfolio evaluation **Level of Achievement**						
Assessment Parameter		**Excellent (10)**	**Very Good (8)**	**Fair (6)**	**Poor (4)**	**Score**
AP1	**Organization of Report and Timely Submission**	Lab report is well organized as directed and submitted on time.	Lab report is well organized but not submitted on time	Report contains few errors and not submitted on time them	Poor organization and late submission	
AP2	**Knowledge of Tools and Procedures**	Demonstrates deep knowledge of tools and procedures; answer the related questions with explanations and elaboration	Adequate knowledge of most tools and procedures; answer the related questions, but fails to elaborate	Superficial knowledge of tools and procedures; able to answer only some of the related basic questions	Lack of information about most of the tools and procedures; cannot even answer basic related questions	
AP3	**Team Working Skills**	Positive in interacting with all group members, encourages such interaction in others, and always sensitive to the abilities and feelings of others' contributions; Actively helps to identify group goals and works effectively to meet them in assigned roles	Interacts with all group members spontaneously and contributes in a way that is sensitive to the abilities and feelings of others; Demonstrates commitment to group goals and carries out assigned roles effectively	Interacts with other group members if prompted, but sometimes expresses opinions which are insensitive to the abilities and feelings of others; Demonstrates commitment to group goals, but has difficulty performing assigned roles	Rarely interacts within a group, even with prompting, and shows frequent lack of sensitivity to others' feelings and abilities in opinions expressed; Shows little commitment to group goals and fails to perform assigned roles	
AP4	**Result Analysis and Data Interpretation**	Excellent insight and well-focused results and discussion; Data completely and appropriately interpreted and no overinterpretation	Adequate insight but missed some important points in results and discussion; Interpreted most data correctly but some conclusions may be suspect or over-interpreted	Little insight and analysed only the most basic points; Interpreted some data correctly but significant errors, omissions still present.	No insight and entirely missed the point of the experiment; Little or no attempt to interpret data or overinterpreted data.	
AP5	**Task Management**	Very Effective in managing the assigned task and allow experimenter(s) to achieve all goals	Somewhat effective in managing the assigned tasks and allow experimenter(s) to achieve most goals.	Somewhat ineffective in managing the assigned task and allow experimenter(s) to achieve only few goals.	Very ineffective and would not allow experimenters to achieve any goals	

5. CIE Assessment Methodologies:

Sl. No	Assessment	Test Week	Duration (minutes)	Max marks	
1	CIE-1 Theory Test	4	90	50	**Average of all CIE=50 Marks**
2	CIE-2 Practice Test	7	180	50	
3	CIE-3 Theory Test	10	90	50	
4	CIE-4 Practice Test	13	180	50	
5	CIE-5 Portfolio evaluation of all the activities through Rubrics	1-13	-	50	
Total Continuous Internal Evaluation (CIE)					50 Marks

6. SEE - Practice Assessment Methodologies

Sl. No	SEE – Practice Assessment	Duration (minutes)	Max marks	Min marks to pass
1.	Semester End Examination-Practical	180	50	20

7. CIE Theory Test:

Program	**Automobile Engineering**			**Semester IV**	
Course Name	Automobile Fuels and Green Technologies			**Test**	I
Course Code	25AT34I	**Duration**	90 min	**Marks**	50
Name of the Course Coordinator:					
Note: Answer any one full question from each section. Each full question carries 25 marks.					

Q. No	**Questions**	**Cognitive Level**	**Course Outcome**	**Marks**
	Section - 1			
1	a) List the properties of Liquid and gaseous fuels. -5M b) Explain the engine modifications required for alternative fuel. -10M c) List the properties of Methanol -5M d) Explain the Octane and Cetane rating of fuels. -5M	L2	C1	25
2	a) List the merits and demerits of Liquid and gaseous fuels. -10M b) Explain the refining process of petroleum products -10M c) List properties of Hydrogen -5M	L2	C1	
	Section - 2			
3	a) Explain the method of production of Hydrogen using electrolysis of water. - 10M b) List the merits and demerits of Methanol -5M c) Explain the Biodiesel production processes. -10 M	L3	C1	25
4	a) Explain the Construction and working of PEM type fuel cell– 10M b) List the merits and demerits of Biodiesel-10M c) List the different types of fuel cells – 5M	L3	C1	
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.				

Course Coordinator **HOD** **IQAC Chairman**

8. CIE Practice Test

Program	**Automobile Engineering**			**Semester**	IV
CourseName	Automobile Fuels and Green Technologies			**Test**	II
Course Code	25AT34I	**Duration**	180 min	**Marks**	50
Name of the Course Coordinator:					

Questions	**CO**	**Marks**
1. Experiment to calculate the Calorific value of methanol using the bomb's calorimeter. 2. With the standard procedure Practice the servicing of CRDI and UI injectors. **OR** 3. Experiment to calculate the flash point, and fire point of biodiesel. 4. With the standard procedure Practice the Petrol injector cleaning and testing.	1,2 1,2	**50**
Scheme of assessment: a) Procedure writing. 3+3=6 b) Conduction – 10M, Troubleshoot/ Calculation – 3M and result -2M =10+3+2=15(15x2=30M) c) Viva -voce- 10M d) Portfolio evaluation of practical record- 4M		
	Total Marks	**50**

Course Coordinator **HOD**

9. Suggestive Activities:

The List is an Example and not inclusive of all possible activities of the course. Students and Faculty are encouraged to choose activities that are relevant to the topic. Two activities, each for 50 marks should be evaluated with proper rubrics.

SN	Suggested Activity
1	Study the benefits of different alternative fuels and submit the report on the best alternative fuel for transit buses with proper justification.
2	List the properties of hydrogen and prepare a presentation on hydrogen fuel cell vehicles.
3	Take a survey on the effects of vehicular pollution on human health and present the effects of pollution on human health.
4	Refer to any one journal paper and present the mechanism of pollutant formation in an IC engine.
5	Prepare a report on hydrogen internal combustion engines.
6	Study and document the effect of the Diesel particulate trap on the efficiency of the engine and submit it as an assignment.
7	Document the impact of BS VI (Phase-2) norms on vehicle pollution as an assignment.

8	Collect information on different CNG vehicle in India and prepare a report.
9	Prepare a report Comparing Electric Vehicles, Hybrid Vehicles and Conventional IC engine Vehicles.
10	Collect the emissions data of different vehicle under different conditions and prepare a report.

10. Rubrics for Assessment of Activity (Qualitative Assessment)

Sl. No.	Dimension	Beginner	Intermediate	Good	Advanced	Expert	Students Score
		2	4	6	8	10	
1	Collection of data/ Material	Limited information	Collects basic information	Collects more information	Collects developed information	Collects a great deal of information	8
2	Quality of data	Irrelevant	Less relevant	Needs improvement	Satisfactory	Very relevant	6
3	Quality of report	Not planned	Less organized	Moderately organized	Organized	As per the standards	4
4	Timely submission	Late submission	Submits after due date	Submits after reminders	Submit after a reminder	On time submission	2
5	Data references	No references.	Irrelevant references.	Given References not from authentic source.	Given references are from authenticated sources.	Enough authenticated references are given.	6
	Total Marks= (8+6+4+2+6=26)						**26/50**

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

11. SEE- Model Practice Question Paper

Program	**Automobile Engineering**		**Semester**	IV
CourseName	Automobile Fuels and Green Technologies	**Course Code:** 25AT34I	**Duration**	3 Hrs.
Questions			**CO**	**Marks**
1) Conduct an experiment to calculate the Flash and fire point of Diesel			1	**50**
2) Conduct an experiment to Measure the HC, CO, CO2, and O2 using an exhaust gas analyzer.			3	
OR				
1) Conduct an experiment to calculate the calorific value of Diesel fuel using Bomb Calorimeter.			1	
2) Conduct the experiment to service the EGR valve and prepare a trouble shooting chart.			3	
Scheme of assessment: a) Procedure writing. 3+3=6 b) Conduction – 10M, Troubleshoot/ Calculation – 3M and result -2M =10+3+2=15(15x2 Exp=30M) c) Viva -voce- 10M d) Portfolio evaluation of practical record- 4M				
			Total Marks	**50**

1) Signature of the Examiner

2) Signature of the Examiner

12. Equipment/software list with Specification for a batch of 30 students

SN	Particulars	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 Cylinder FIP	2
10	Multi-hole diesel injector	6
11	MPFI petrol engine with all accessories (PCV, EGR, Catalytic converter)	2
12	CRDI diesel engine with all accessories (PCV, EGR, Catalytic convertor, SCR/Particulate filter)	2
13	Turbochargers and Superchargers	2 each
14	MPFI engine injector tester	1
15	Diesel engine injector tester	2
16	FIP Calibrating machine	1
17	Four gas BS-VI Compatible exhaust gas analyser	2
18	BS-VI Compatible Smoke meter	2
19	Catalytic Converter	2
20	Vehicle with micro-hybrid system	1
21	Vehicle full hybrid system.	1

Government of Karnataka
DEPARTMENT OF TECHNICAL EDUCATION

Program	**Automobile Engineering**	**Semester**	**IV**
Course Name	**Hydraulics and pneumatics**	**Type of Course**	Integrated
Course Code	25AT41I	**Contact Hours**	104 Hrs/sem 8 Hrs/week
Teaching Scheme	L: T:P 4:0:4	**Credits**	6
CIE Marks	**50**	**SEE Marks**	**50 (Theory)**

1. **Rationale:** Many hydraulic and pneumatic systems are used in the control mechanisms of automobiles and machines. Hence it is important to know the concepts of various Hydraulic and Pneumatic systems to troubleshoot the existing systems and to design the new control systems.

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

CO-01	Identify the applications of hydraulic and Pneumatic control systems in automobiles.
CO-02	Perform the various testing and maintenance activities of Hydraulic systems.
CO-03	Recreate the hydraulic and Pneumatic circuits used in Automobiles.
CO-04	Perform the various testing and maintenance activities of Pneumatic systems

3. Course Content:

WEEK	CO	PO	Theory	Practice
1	1	**1,4**	Fluid power engineering – Concept, importance – application, fluid – definition, properties, Bernoulli's equation- Principle. Pascal's law with illustrations, Power transmission methods, fluid system-types, block diagrams of hydraulics & pneumatic systems.	Identification of different components of hydraulic and pneumatic circuits. Demonstration of Bernoulli's Principle. Demonstration of Pascal's law.
2	**1**	**1,2,3,5**	Valves – functions, types, hydraulic spool valves-types, Pressure control valve, pressure relief valve, counter balance valve, pressure reducing valve, direction control valves – 2/2, 3/2, 4/2, 5/2, 5/3	Identification of features of pressure relief valve and Direction control valves. Servicing of different types of valves as per standard procedure.

				Practice the Safe disposal of used components and materials.
3	**1**	**1,4**	Methods of actuation of valves- Types, flow control valve- Types, Working of Needle valve, Ball valve and butterfly valve. Working of non-return/check valves and pilot operated sequence valve.	Demonstration of different actuation methods of valves using demo kits/simulations. Demonstration of functions of non-return valve, flow control valve using demo kits/simulations.
4	**2**	**1,2,3,4**	Actuators- functions, types, cylinder type-ram type and piston type- single acting cylinder, double acting actuator. Rotary actuators – gear, vane, piston type.	Design relevant circuit to demonstrate working of single acting and double acting actuator. Trouble shooting of single acting and double acting actuators.
5	**2**	**1,2,4**	Pumps- necessity, classification, construction and working of – external gear, lobe, vane pumps, piston- radial pumps.	Servicing and testing of gear, lobe, and vane pump.
6	**3**	**1,3,4**	Hydraulic circuits, hydraulic symbols, ports – markings and positions. Design of Hydraulic circuits: meter in circuits, meter out circuits, bleed off circuits, accumulator circuits.	Design the different types of hydraulic circuits using demo kits/ Simulations
7	**3**	**1,2,3,4**	Regenerative circuits, Pressure reducing circuits. Hydraulic circuits of systems used in automobiles- Hydraulic brake, Power steering.	Identify the faults for a given hydraulic system, analyze the causes and carry out the preventive measures. Create hydraulic brake circuit and power steering using relevant hydraulic symbols.
8	**4**	**1,2,4**	**Pneumatics:** Definition, importance, areas of application, properties of air, humidity. Air compressor- necessity, types, Working of reciprocating, diaphragm and vane compressor. Requirements of multistage compressor.	Service and test the different types of air compressor.
9	**4**	**1**	**Reservoirs:** Functions, air filter- screen type, bowl type. Pressure regulators- diaphragm type, lubricator, FRL unit.	Servicing of different types of air filter. Maintenance of FRL unit.
10	**4**	**1,2,4**	**Pneumatic actuators:** Necessity, Types. Air suspension- layout and working,	Service and testing of different pneumatic actuators. Servicing of different

			Merits & Demerits. Working of Piston type and bellow type air Springs,	components of air suspension. Troubleshooting of air suspension system.
11	**3**	**1,3**	Pneumatic symbols, basic pneumatic circuit- control of double acting cylinder using 4/2 DCV- pilot controlled double acting cylinder 4/2 DCV.	Create pneumatic circuits of control of single acting and double acting cylinder using relevant symbols.
12	**4**	**1,2**	Speed control circuit for double acting cylinder, semi-automatic material handling circuit, time delay circuit, pneumatic tool circuit. Air brake system- layout and working. Working of Air brake valve & brake chamber. Fail safe brake-Need, Layout, Working.	Identification of different components of air brake system. Servicing of brake valve and brake chamber. Trouble shooting of air brake system.
13	**3**	**1,2,3,5**	Maintenance of pneumatic systems- Purpose, common faults, preventive measures, and maintenance schedule. Combination circuits: **A**dvantages, Layout & Working of Hydro-pneumatic suspension, Merits & Demerits. Hydro elastic spring- Working. Air over hydraulic brakes- working.	Identify the faults of pneumatic system, analyze the causes and remedies. Create hydro pneumatic suspension circuit and air over hydraulic brake circuit. Appreciate the Safe disposal of used components and materials.

4. References:

Sl. no	Title of book	Author	Publisher
1	Hydraulic and Pneumatic Controls	K.Shanmuga.Sundaram	S.Chand & Co
2	Pneumatic Systems	S.R.Majumdar	Tata McGrawhill
3	Pneumatic Controls	Joji P	Wiley India Pvt Ltd
4	Fluid Power with Applications	Anthony Esposito	Pearson india
5	Hydraulics & Pneumatics	Andrew Parr	Jaico publishing house
6	Fluid Power Transmission & Control	A Alavudeen Khalid Hussain Syed N Shanmugum	Charotor Publisher Anand-388001

5. Web links:

Pascal's Law Demo
https://www.youtube.com/watch?v=VxLTDtaRCZk
Basic Hydraulic System
https://www.youtube.com/watch?v=KgphO-u7MlQ
Valves
https://www.youtube.com/watch?v=3RAxRed7QuE
Spool Valve
https://www.youtube.com/watch?v=dnVjKV74sAQ
Hydraulic Lifters
https://www.youtube.com/watch?v=lorANZ1Tptw
4/2 Directional Control Valves
https://www.youtube.com/watch?v=XOYqnLWCYEc
Pressure Regulating Valve
https://www.youtube.com/watch?v=sFAYW_D3G_g
Pilot Operated Pressure Relief Valve
https://www.youtube.com/watch?v=q5NV2gBsryk
Pressure Relief Valve Working
https://www.youtube.com/watch?v=DAqnpaHf2Qs
Pressure Reducing Valve
https://www.youtube.com/watch?v=YgnwuTJB-wc&list=PL9DA65D90A4561300
Mechanical Control Valve
https://www.youtube.com/watch?v=HJRE5EfTPcU
Non Return/Check Valve

https://www.youtube.com/watch?v=C-8FKgxSg68
https://www.youtube.com/watch?v=StHAmZpDHi0
https://www.youtube.com/watch?v=XAItnsUcES0&list=PLDaXKeQT8i0ojLE8MMzWQXp1HfeJMqc1
Pumps
https://www.youtube.com/watch?v=KM3ivQL6W6w
https://www.youtube.com/watch?v=bdib6XwxNuc
Gear Pump
https://www.youtube.com/watch?v=c6gwU7IHtlo
Vane Pump
https://www.youtube.com/watch?v=BnvzPoNSXCg
Lobe Pump
https://www.youtube.com/watch?v=vE7y0ElIrgk
Actuators
https://www.youtube.com/watch?v=cScz67tWqCY
Radial Piston Pump
https://www.youtube.com/watch?v=a58zzqfF5N0
Air Compressors
https://www.youtube.com/watch?v=Ue7BkzBARXw
FRL Unit
https://www.youtube.com/watch?v=zPT0YDERfy4

6. CIE Assessment Methodologies:

Sl. No	CIE Assessment	Test Week (end of)	Duration (minutes)	Max marks	
1.	CIE-1TheoryTest	4	90	50	Average of all CIE=50 Marks
2.	CIE-2Practice Test	7	180	50	
3	CIE-3TheoryTest	10	90	50	
4.	CIE-4Practice Test	13	180	50	
5	CIE-5 Portfolio evaluation of all the activities through Rubrics	1-13		50	
				Total	**50 Marks**

7. SEE - Theory Assessment Methodologies

Sl. No	SEE – Theory Assessment	Duration (minutes)	Max marks	Min marks to pass
1.	Semester End Examination-Theory	90	50	20

Rubrics for Portfolio evaluation **Level of Achievement**						
Assessment Parameter		**Excellent (10)**	**Very Good (8)**	**Fair (6)**	**Poor (4)**	**Score**
AP1	**Organization of Report and Timely Submission**	Lab report is well organized as directed and submitted on time	Lab report is well organized but not submitted on time	Report contains few errors and not submitted on time them	Poor organization and late submission	
AP2	**Knowledge of Tools and Procedures**	Demonstrates deep knowledge of tools and procedures; answer the related questions with explanations and elaboration	Adequate knowledge of most tools and procedures; answer the related questions, but fails to elaborate	Superficial knowledge of tools and procedures; able to answer only some of the related basic questions	Lack of information about most of the tools and procedures; cannot even answer basic related questions	
AP3	**Team Working Skills**	Positive in interacting with all group members, encourages such interaction in others, and always sensitive to the abilities and feelings of others' contributions; Actively helps to identify group goals and works effectively to meet them in assigned roles	Interacts with all group members spontaneously and contributes in a way that is sensitive to the abilities and feelings of others; Demonstrates commitment to group goals and carries out assigned roles effectively	Interacts with other group members if prompted, but sometimes expresses opinions which are insensitive to the abilities and feelings of others; Demonstrates commitment to group goals, but has difficulty performing assigned roles	Rarely interacts within a group, even with prompting, and shows frequent lack of sensitivity to others' feelings and abilities in opinions expressed; Shows little commitment to group goals and fails to perform assigned roles	
AP4	**Result Analysis and Data Interpretation**	Excellent insight and well-focused results and discussion; Data completely and appropriately interpreted and no overinterpretation	Adequate insight but missed some important points in results and discussion; Interpreted most data correctly but some conclusions may be suspect or over-interpreted	Little insight and analysed only the most basic points; Interpreted some data correctly but significant errors, omissions still present.	No insight and entirely missed the point of the experiment; Little or no attempt to interpret data or overinterpreted data.	
AP5	**Task Management**	Very Effective in managing the assigned task and allow experimenter(s) to achieve all goals	Somewhat effective in managing the assigned tasks and allow experimenter(s) to achieve most goals.	Somewhat ineffective in managing the assigned task and allow experimenter(s) to achieve only few goals.	Very ineffective and would not allow experimenters to achieve any goals	

8. CIE Theory Test model question paper

Program	**Automobile Engineering**			**Semester - III**	
Course Name	**Hydraulics and Pneumatics**			**Test**	**I/III**
Course Code	**25AT41I**	**Duration**	**90 min**	**Marks**	**50**
Name of the Course Coordinator:					
Note: Answer any one full question from each section. Each full question carries equal marks.					

Q.No	**Questions**	**Cognitive Level**	**Course Outcome**	**Marks**
	Section - 1			
1	a) List the types of valves and state the functions. 5M b) Illustrate Pascal's law with an example. 10M c) Explain with a neat sketch pressure control valve.10	L2	1	25
2	a) State the applications of Fluid power engineering.5M b) Draw the block diagrams of Hydraulics and Pneumatics. 10M c) Explain with a neat sketch counter balance valve. 10	L2	1	
	Section – 2			
3	a) List the classification of pumps. 5M b) Explain with a neat sketch vane type of actuator.10M c) Explain with a neat sketch external gear pump.10M	L3	2	25
4	a) List the functions of Actuators. 5M b) Explain with a neat sketch rotary type of actuator.10M c) Explain with a neat sketch a radial piston pump.	L3	2	
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.				

Signature of the Course Coordinator **HOD** **IQAC**

9. CIE Practice Test model question paper

Program	**Automobile Engineering**			**Semester**	
Course Name	**Hydraulics and Pneumatics**			**Test**	**II/IV**
Course Code	**25AT41I**	**Duration**	**180 min**	**Marks**	**50**
Name of the Course Coordinator:					

Questions	**CO**	**Marks**
1. Demonstrate Pascal's law 2. Design relevant circuit to demonstrate the working of single acting actuator. OR 3. Demonstrate actuation methods of different valves using demo kits. 4. Design relevant circuit to demonstrate working of double acting actuator.	**1** **2** **1** **2**	**50**
Scheme of assessment a) Procedure writing- 3+3=6 b) Conduction/troubleshoot/calculation and results- 10+3+2 (15 x 2 experiments = 30) c) Viva voce - 10 d) Portfolio evaluation of practical record – 4		
	Total Marks	**50**

Signature of the Course Coordinator **HOD** **IQAC**

10. Suggestive Activities for Tutorials:

The List is 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

Sl.No.	**Suggestive Activities for Tutorials**
01	Draw hydraulic circuits used in Automobile's, construction vehicles and garage equipment/machines.
02	Draw pneumatic circuits used in Automobile's, construction vehicles and garage equipment/machines.
03	Create different hydraulic circuits used in construction and agricultural vehicles.
04	Prepare a report on different hydraulic circuits used in hydraulic excavator.
05	Prepare a report on hydraulic drive motor control used in road roller.
06	Create different pneumatic circuits used in automobile.

11. Rubrics for Assessment of Activity (Qualitative Assessment)

Sl. No.	Dimension	Beginner	Intermediate	Good	Advanced	Expert	Students Score
		2	4	6	8	10	
1	Collection of data/ Material	Limited information	Collect basic information	Collect more information	Collects developed information	Collects a great deal of information	8
2	Quality of data	Irrelevant	Less relevant	Needs improvement	Satisfactory	Very relevant	6
3	Quality of report	Not planned	Less organized	Moderately organized	Organized	As per the standards	4
4	Timely submission	Late submission	Submits after due date	Submits after reminders	Submit after a reminder	On time submission	2
5	Data references	No references.	Irrelevant references.	References not from authentic source.	Given references are from authenticated sources.	Enough authenticated references are given.	6
	Example: Average Marks= (8+6+4+2+6=26)						

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

12. SEE–Model Theory Question Paper-1

Program	**Automobile Engineering**	**Semester**	**III**
Course Name	**Hydraulics and Pneumatics**	**Marks**	**50**
Course Code	**20AT41I**	**Duration**	**90 Min**

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

Q No	Questions	Cognitive Levels	Course Outcomes	Marks
	Section -1			
1	a) State Pascal's law with an example. b) Explain with a neat sketch 4/2 DCV.	L2	1	4 6
2	a) Sketch butterfly type flow control valve. b) Explain with a neat sketch Pilot operated sequence valve.	L2	1	4 6
	Section -2			
3	a) State the classification of pump. b) Sketch and label external gear pump.	L2	2	4 6
4	a) List the functions of actuators. b) Explain piston type of actuator with a neat sketch.	L2	2	4 6
	Section -3			

5	a) List the different types of hydraulic symbols. b) Design pressure reducing circuit.	L3	3	4 6
6	a) Design meter-out circuit. b) Sketch and label the parts of a hydraulic power steering.	L3	3	4 6
Section -4				
7	a) List the properties of air. b) Explain the working of diaphragm type of compressor.	L3	4	4 6
8	a) List the merits and demerits of air suspension system. b) Explain bellow type of air spring with a neat sketch.	L3	4	4 6
Section -5				
9	a) State the merits and demerits of hydro pneumatic suspension. b) Explain semiautomatic material handling circuit.	L3	3,4	4 6
10	a) Sketch layout of air-brake system. b) Sketch basic pneumatic circuit.	L3	3,4	4 6

13. SEE–Model Theory Question Paper-2

Program	**Automobile Engineering**	**Semester**	**III**
Course Name	**Hydraulics and Pneumatics**	**Marks**	**50**
Course Code	**25AT41I**	**Duration**	**90 Min**

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

Q No	Questions	Cognitive Levels	Course Outcomes	Marks
Section -1				
1	a) State the functions of valves. b) Sketch the block diagrams of hydraulic and pneumatic systems.	L2	1	4 6
2	a) List the basic components of a pneumatic circuit b) Explain the working of non-return valve.	L2	1	4 6
Section -2				
3	a) State the necessity of pumps. b) Explain Vane type of actuator with a neat sketch.	L2	2	4 6
4	a) List the types of actuators. b) Sketch lobe type gear pump.	L2	2	4 6
Section -3				
5	a) Design a pressure reducing circuit. b) Explain hydraulic brake with a neat sketch.	L3	3	4 6
6	a) Design a meter-in circuit. b) Design a bleed off circuit.	L3	3	4 6
Section -4				

7	a) Explain fail safe brake. b) Explain control of double acting cylinder using 4/2 DCV valve.	L3	3,4	4 6
8	a) Design time delay circuit. b) Explain the working of hydro-elastic spring.	L3	3,4	4 6
	Section -5			
9	a) State the areas of application of pneumatics. b) Sketch and label FRL unit.	L3	4	4 6
10	a) List the requirements of multi-stage compressor. b) Explain the working of piston type of air spring with a neat sketch.	L3	4	4 6

14. SEE–Model Theory Question Paper -3

Program	**Automobile Engineering**	**Semester**	**III**
Course Name	**Hydraulics and Pneumatics**	**Marks**	**50**
Course Code	**25AT41I**	**Duration**	**90 Min**

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

Q No	**Questions**	**Cognitive Levels**	**Course Outcomes**	**Marks**
	Section -1			
1	a) State the applications of fluid power engineering. b) Explain with a neat sketch 3/2 DCV.	L2	1	4 6
2	a) Sketch pressure relief valve. b) Explain ball type flow control valve.	L2	1	4 6
	Section -2			
3	a) State the necessity of pneumatic actuator. b) Explain double acting cylinder.	L2	2	4 6
4	a) Sketch radial pump. b) Explain with a neat sketch vane type of gear pump.	L2	2	4 6
	Section -3			
5	a) List the pneumatic symbols. b) Design accumulator circuit.	L3	3	4 6
6	a) Design meter out circuit. b) Design a regenerative circuit.	L3	3	4 6
	Section -4			
7	a) State the necessity of air compressor. b) Sketch double acting cylinder of 4/2 DCV.	L3	3,4	4 6

8	a) List the functions of a reservoir. b) State the advantages and disadvantages of hydro-pneumatic suspension.	L3	3,4	4 6
Section -5				
9	a) Sketch the layout of air suspension system. b) Design the layout of time-delay circuit.	L3	4	4 6
10	a) Sketch a lubricator. b) Sketch speed control circuit for a double acting cylinder.	L3	4	4 6

8. Equipment/software list with Specification for a batch of 30 students.

Sl. No.	Particulars	Specification	Quantity
1	Hydraulic trainer Kit	Trainer Kit	2
2	Hydraulic Power steering trainer kit	Trainer Kit	2
3	Hydraulic brake trainer kit		2
4	Hydraulic Gear Pump, G-rotor Pump, Lobe pump, Vane pump		2 each
5	Hydraulic Actuators	Single acting and Double acting	2 Each
5	Flow control valves	Ball valve, Gate type.	2 each
6	Pressure relief valve	Spring loaded type	2
7	Direction control valve	2/2,3/2,4/3/4/3	2 each
8	Pneumatic trainer kit		2
9	Air compressor	Double stage (200 Litr)	1
10	Air compressor	Reciprocating type, Diaphragm type	2 each
11	Pneumatic Rams	Single cylinder & double cylinder	2 each
12	Pneumatic Direction control Valves	2/2,3/2,4/3/4/3	2 each
13	Pneumatic pressure relief valves	Spring loaded type	2 each
14	Air suspension trainer kit		2
15	Air Brake trainer kit		2
16	Air Brake chambers	Single Chamber, Double Chamber & Tripple chamber type	2 each
17	Air brake valve		2
18	Air over hydraulic brake trainer kit		2
19	Simulation software's	Free and open source	1 each

Government of Karnataka
DEPARTMENT OF TECHNICAL EDUCATION

Program	**Automobile Engineering**	**Semester**	**IV**
Course Name	Advanced Automotive Systems	**Type of Course**	Theory
Course Code	25AT42I	**Contact Hours**	8 hours/week (104 hours/semester)
Teaching Scheme	L: T:P- 4:0:4	**Credits**	6
CIE Marks	50	**SEE Marks**	50 (Theory)

1. Rationale:

The modern automobile systems are controlled by various sensor and actuators. Hence the students should be able to justify the use of different sensors and actuators adopted in advanced electrical and mechanical systems used in automobile. The students should perform service activities related to sensors and actuators used in advanced electrical and mechanical systems of automobile.

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

CO-01	Perform the testing and troubleshooting of different sensors and actuators.
CO-02	Perform the troubleshooting activities of the advanced transmission and steering system.
CO-03	Perform the troubleshooting activities of advanced safety and stability systems.
CO-04	Perform the troubleshooting activities of battery vehicle and their components.

3. Course Content:

Week	**CO**	**PO**	**Theory (4 Hours per week)**	**Practice (4 Hours per week)**
1	1	1,2,4	Sensors-meaning-types. Actuators-meaning-types, electronic control systems-need-merits and demerits-types. – comparison. Microcontroller /ECM-need-layout of typical ECM-functions of each component of ECM. Working of ECM. Networking-concept, Multiplexing-concept, CAN-concept.	Identification of location of different ECMs used in automobile. Practice on safely removal and reconnection of different connections to ECM. Identification of different components and pin configurations of typical automobile ECM. Identify ECM related problems, reasons and suggest remedies.
2	1	1,2,4	TDC/RPM sensors-function-types-construction and working of Hall-effect and electromagnetic type types- circuit diagrams showing connection of theses sensors to ECM.	Identification of TDC/RPM and temperature sensor location. Practice on removal and refitting of TDC/RPM sensor and temperature sensor. Practice on testing of TDC/RPM sensor

			Temperature sensor-functions - construction and working- circuit diagram showing connection of this sensor to ECM.	and temperature sensor. Identify TDC/RPM sensor and temperature sensor related problems, reasons and suggest remedies.
3	1	1,2,4	Manifold pressure sensor-need-types-construction and working of MAP and MAF sensor-circuit diagrams showing connection of theses sensors to ECM. Knock sensor-need-construction and working-circuit diagram showing the connection to ECM.	Identification of location of MAP, MAF and knock sensor. Practice on removal and refitting of MAP, MAF and knock sensor. Practice on testing of these sensor. Identify MAP/MAF sensor and Knock sensor related problems, reasons and suggest remedies.
4	1	1,2,4	Throttle position sensor-functions-construction working-circuit diagram showing the connection to ECM. Exhaust gas oxygen sensor-functions-construction and working-circuit diagram showing connection to ECM.	Identification of location of TPS, and EGO sensor. Practice on removal and refitting of TPS and EGO sensor. Practice on testing of these sensor. Identify TPS sensor and EGO sensor related problems, reasons and suggest remedies.
5	1	1,2,4	Ride height sensor-potentiometer type and LVDT type-functions-construction and working-circuit diagram showing connection of these sensor to ECM. Rain sensor-function-types-construction and working of infrared type rain sensor.	Identification of location of ride height, and rain sensor. Practice on removal and refitting of ride height and rain sensor. Practice on testing of these sensor. Identify ride height sensor and rain sensor related problems, reasons and suggest remedies.
6	1	1,2,4	Impact sensor-functions-types-construction and working of magnetic bias and rolamite sensor. On/off solenoid-functions-construction and working on/off solenoid. Relay-functions-construction and working of relay.	Identification of location of impact sensor. Practice on removal and refitting of impact sensor. Practice on testing of impact sensor. Identify ride impact sensor related problems, reasons and suggest remedies. Practice on servicing of solenoid and relay.
7	1	1,4	Pulse width modulation-concept-need-Duty cycle-concept-construction and working of proportional solenoid. Stepper motor-construction and working-applications. Servomotor-construction and working.	Identify the location of proportional solenoid. Practice on controlling a motor/brightness of bulb using pulse width modulation. Practice on servicing and testing proportional solenoid. Practice on servicing and testing of stepper and servo motors.

8	2	1,2,4	Automated manual transmission-layout-working-merits. Continuously variable transmission-construction and working-merits and demerits. Torque converter-working-merits-demerits, Torque converter lock up-types-construction and working of centrifugal and double clutch type.	Removal and refitting of components of continuously variable transmission. Removal and refitting of automated manual transmission components. Trouble shooting of Continuously variable and automated manual transmission.
9	2	1,2,4	Hydraulic automatic transmission-working. dual clutch transmission-working. Viscous coupling-working limited slip differential-need-types-working of clutch type limited slip differential.	Removing and refitting different components of hydraulic automatic transmission. Removal and refitting of different components of limited slip differential. Trouble shooting of hydraulic automatic transmission.
10	2	1,2,4	Four-wheel drive system-concept-merits-demerits-types-layout of part-time four-wheel drive system and four-wheel drive system using viscous coupling. Electric power steering-types-construction and working of column mounted type electric power steering.	Identification of parts of four drive wheel system. Practice on servicing of transfer gear box. Practice on servicing of electric power steering. Trouble shooting of electric power steering.
11	3	1,2,4	Antilock brake system-need-layout-hydraulic modulator-construction working. Air bag system-need-layout-working. Collison avoidance system-need-layout-working.	Identification of antilock brake system components. Servicing of different components of antilock brake system. Identification of different components of air bag system. Trouble shooting of antilock brake system.
12	3	1,4	Computerised instrumentation system-layout-merits. electronic stability control system-need-layout. Traction control system-need-layout. Autonomous vehicle/driver less vehicle-concept-layout-merits-demerits.	Removal and refitting of components of instrumentation system. Identification of components of electronic stability, traction control system and autonomous vehicle.
13	4	1,2,4	Electric vehicle-layout-working, merits-demerits, battery management system, battery pack construction, brushless DC motor working, AC synchronous motor working-speed control. Regenerative braking-layout-working using both BLDC and AC synchronous motors-merits and demerits.	Identification of different components of battery vehicles. Safe removal of components of battery vehicle and refitting. Servicing of BLDC and A.C synchronous motors. Demonstration of electric vehicle using demo model/ test rigs. Trouble shooting of electric vehicle.

4. References:

1. Understanding Automotive electronics, William Ribbon, Butterworth-Heinemann Publications
2. Automotive Computer Controlled Systems (Diagnostic tools and techniques),
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. Modern Electric, Hybrid Electric and Fuel Cell Vehicles by Mehrdad Ehsani, Yimin Gao and Ali Emadi, CRC Press.
7. Electric Motors and Drives BY AUSTIN HUGHES and BILL DRURY
8. Electric and Hybrid Vehicles by Tom Denton, Routledge, 2016.

Rubrics for Portfolio evaluation Level of Achievement						
Assessment Parameter		**Excellent (10)**	**Very Good (8)**	**Fair (6)**	**Poor (4)**	**Score**
AP1	**Organization of Report and Timely Submission**	Lab report is well organized as directed and submitted on time	Lab report is well organized but not submitted on time	Report contains few errors and not submitted on time them	Poor organization and late submission	
AP2	**Knowledge of Tools and Procedures**	Demonstrates deep knowledge of tools and procedures; answer the related questions with explanations and elaboration	Adequate knowledge of most tools and procedures; answer the related questions, but fails to elaborate	Superficial knowledge of tools and procedures; able to answer only some of the related basic questions	Lack of information about most of the tools and procedures; cannot even answer basic related questions	
AP3	**Team Working Skills**	Positive in interacting with all group members, encourages such interaction in others, and always sensitive to the abilities and feelings of others' contributions; Actively helps to identify group goals and works effectively to meet them in assigned roles	Interacts with all group members spontaneously and contributes in a way that is sensitive to the abilities and feelings of others; Demonstrates commitment to group goals and carries out assigned roles effectively	Interacts with other group members if prompted, but sometimes expresses opinions which are insensitive to the abilities and feelings of others; Demonstrates commitment to group goals, but has difficulty performing assigned roles	Rarely interacts within a group, even with prompting, and shows frequent lack of sensitivity to others' feelings and abilities in opinions expressed; Shows little commitment to group goals and fails to perform assigned roles	
AP4	**Result Analysis and Data Interpretation**	Excellent insight and well-focused results and discussion; Data completely and appropriately interpreted and no overinterpretation	Adequate insight but missed some important points in results and discussion; Interpreted most data correctly but some conclusions may be suspect or over-interpreted	Little insight and analysed only the most basic points; Interpreted some data correctly but significant errors, omissions still present.	No insight and entirely missed the point of the experiment; Little or no attempt to interpret data or overinterpreted data.	
AP5	**Task Management**	Very Effective in managing the assigned task and allow experimenter(s) to achieve all goals	Somewhat effective in managing the assigned tasks and allow experimenter(s) to achieve most goals.	Somewhat ineffective in managing the assigned task and allow experimenter(s) to achieve only few goals.	Very ineffective and would not allow experimenters to achieve any goals	

5. CIE and SEE Assessment Methodologies:

Sl. No	CIE Assessment	Test Week	Duration (minutes)	Max marks	
1.	CIE-1TheoryTest	4	90	50	Average of all CIE=50 Marks
2.	CIE-2Practice Test	7	180	50	
3	CIE-3TheoryTest	10	90	50	
4.	CIE-4Practice Test	13	180	50	
5	CIE-5 Portfolio evaluation of all the activities through Rubrics	1-13		50	
				Total	**50 arks**

6. SEE - Theory Assessment Methodologies

Sl. No	SEE – Theory Assessment	Duration (minutes)	Max marks	Min marks to pass
1.	Semester End Examination-Theory	90	50	20

7. CIE Theory Test model question paper:

Program	**Automobile Engineering**			**Semester IV**	
Course Name	**Advanced Automotive Systems**			**Test**	I
Course Code	25AT42I	**Duration**	90 min	**Marks**	50
Name of the Course Coordinator:					
Note: Answer any one full question from each section. Each full question carries 25 marks.					

Q. No	**Questions**	**Cognitive Level**	**Course Outcome**	**Marks**
	Section - 1			
1	a) List the merits and demerits of electronic control systems.5M b) Explain with a neat sketch working of temperature sensor. 10 c) Draw the layout of microcontroller and label the parts. 10M	L2	1	25
2	a) Explain the concept of multiplexing. 5M b) Explain with a circuit diagram working of Hall effect sensor.10M c) Explain with a circuit diagram working of Electromagnetic type RPM sensor. 10M	L2	1	
	Section - 2			
3	a) With a block diagram, show how different sensors are connected to the ECM. 5M b) Explain with a circuit diagram working of manifold pressure sensor. 10M c) Explain with a circuit diagram working of throttle position sensor. 10M	L3	1	25
4	a) State the functions of exhaust gas oxygen sensor. 5M b) Explain with a circuit diagram working of MAF sensor. 10M c) Sketch the circuit diagram of Knock sensor with its working.10M	L3	1	

Note: *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.*

Signature of the Course Coordinator **Signature of the HOD** **Signature of the IQAC**

8. CIE Practice Test

Program	Automobile Engineering			Semester	IV
CourseName	Advanced Automotive Systems			Test	II
Course Code	25AT42I	Duration	180 min	Marks	50

Name of the Course Coordinator:

Questions	CL	CO	Marks
9. Identify the locations of various ECMs used in automobiles.	L1	1	50
10. Remove MAF sensor, test and refit the same.	L3		
OR		1	50
11. Identify the location of rain sensor, remove, test and refit the same.	L1		
12. Remove EGO sensor, test and refit the same.	L3		
Scheme of assessment a) Procedure writing- 3+3=6 b) Conduction-10M/troubleshoot or calculation-03M/results-02M, (15 x 2 experiments = 30) c) Viva voce - 10 d) Portfolio evaluation of practical record – 4			
		Total Marks	**50**

Signature of the Course Coordinator **Signature of the HOD**

9. Suggestive Activities:

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 relevantto the topic and on the availability of such resources at their institution. **Two activities**, each for **50 marks** should be evaluated with proper rubrics.

Sl. No.	Suggestive Activities for Tutorials
01	Open an ECU from a vehicle and reconnect as per the pin configuration.
02	Study and give a presentation on CAN.
03	Make a list of various sensors used in a vehicle with their position and submit it as an assignment.
04	Make a list of various actuators used in a vehicle with their position and submit it as an assignment.
05	Study and present on parking assist system.
06	Visit nearby workshop and know the working of AMT.
07	Study and present on construction and working of electrical power steering.
08	Prepare a report on working of different types of ABS system.
09	Prepare a presentation on working principle and actuation of air bags.

10	Prepare a simple working model of regenerative braking showing the working principle it.
11	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.
12	Visit an electric vehicle service station and identify the location of various 2-wheeler and 4-wheeler electric components.
13	Dismantle DC and BLDC motors, know the physical differences and working principle and prepare a report on it.

10. Rubrics for Assessment of Activity (Qualitative Assessment)

Sl. No.	Dimension	Beginner	Intermediate	Good	Advanced	Expert	Students Score
		2	4	6	8	10	
1	Collection of data/ Material	Limited information	Collects basic information	Collects more information	Collects developed information	Collects a great deal of information	8
2	Quality of data	Irrelevant	Less relevant	Needs improvement	Satisfactory	Very relevant	6
3	Quality of report	Not planned	Less organized	Moderately organized	Organized	As per the standards	4
4	Timely submission	Late submission	Submits after due date	Submits after reminders	Submit after a reminder	On time submission	2
5	Data references	No references.	Irrelevant references.	Given References not from authentic source.	Given references are from authenticated sources.	Enough authenticated references are given.	6
	Example: Average Marks=(8+6+4+2+6)=26						**26/50**

Note: *a) Dimension and Descriptor shall be defined by the respective course coordinator as per the activities*
b) Activities should be typed report.

11. SEE –Model Theory Question Paper-1

Program	**Automobile Engineering**	**Semester**	**IV**
CourseName	**Advanced Automotive System**	**Marks**	**50**
Course Code	25AT42I	**Duration**	**90min**

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

Q No	Questions	Cognitive Levels	Course Out comes	Marks
	Section -1			
1	a) Compare sensors and actuators. b) Explain ECM with a block diagram.	L2	CO-1	4 6
2	a) With a block diagram, show how different sensors are connected to the ECM. b) Explain with a circuit diagram working of temperature sensor.	L2	CO-1	4 6
	Section -2			
3	a) Sketch the circuit diagram of combustion knock sensor. b) Explain with a circuit diagram working of infrared type of rain sensor.	L3	CO-1	4 6
4	a) List the functions of Impact sensor. b) Explain with a circuit diagram working of magnetic bias sensor.	L3	CO-1	4 6
	Section -3			
5	a) List the applications of stepper motor. b) Draw the layout of automated manual transmission.	L3	CO-1, 2	4 6
6	a) Explain on/off solenoid with a sketch. b) Draw the layout of 4-wheel drive system.	L3	CO-1, 2	4 6
	Section -4			
7	a) List the merits of computerized instrumentation system. b) Draw the layout of traction control system.	L3	CO-3	4 6
8	a) Explain the working of dual clutch transmission system with a diagram b) Draw the layout of traction control system.	L3	CO-3	6 4
	Section -5			
9	With a block diagram explain regenerative braking.	L3	CO-4	10
10	Explain the Woking of BLDC motor with a sketch.	L3	CO-4	10

Note: *While framing the SEE questions for question papers provide equal weightage to the content of each week*

12. SEE –Model Theory Question Paper-2

Program	Automobile Engineering	**Semester**	IV
CourseName	Advanced Automotive System	**Marks**	50
Course Code	25AT42I	**Duration**	90Min.

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

Q No	Questions	Cognitive Levels	Course Out comes	Marks
	Section -1			
1	a) Write a short note on CAN. b) Draw the layout of micro-controller and label the parts.	L2	CO-1	4 6
2	a) Sketch the circuit diagram of MAP sensor. b) Explain with a circuit diagram working of temperature sensor.	L2	CO-1	4 6
	Section -2			
3	a) Sketch the circuit diagram of EGO sensor. b) Explain with a circuit diagram working of LVDT sensor.	L3	CO-1	4 6
4	a) List the functions of ON/OFF solenoid. b) Explain the working of stepper motor.	L3	CO-1	4 6
	Section -3			
5	a) List the need and functions of antilock braking system. b) List the merits and demerits of torque converter. .	L3	CO-2, 3	4 6
6	a) Sketch and label the parts of ABS modulator. b) Explain the working of continuously variable transmission.	L3	CO-2, 3	4 6
	Section -4			
7	a) Draw the layout of ABS. b) Draw the layout of electric vehicle.	L3	CO-3, 4	4 6
8	a) List the need of electronic stability control system. b) Draw the layout of driverless vehicle.	L3	CO-3, 4	4 6
	Section -5			
9	Explain the working of AC synchronous motor with a neat sketch.	L3	CO-4	10
10	Explain the functions of battery management system.	L3	CO-4	10

13. SEE –Model Theory Question Paper-3

Program	**Automobile Engineering**	**Semester**	**IV**
CourseName	**Advanced Automotive System**	**Marks**	**50**
Course Code	25AT42I	**Duration**	**90Min**

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

Q No	Questions	Cognitive Levels	Course Out comes	Marks
	Section -1			
1	a) State the merits and demerits of electronic control systems. b) Explain the concept of multiplexing with a block diagram.	L2	CO-1	4 6
2	a) Sketch the circuit diagram of MAF sensor. b) Explain with a circuit diagram working of Electromagnetic type RPM sensor.	L2	CO-1	4 6
	Section -2			
3	a) Sketch the circuit diagram of throttle position sensor. b) Explain with a circuit diagram working of ride height sensor.	L3	CO-1	4 6
4	a) List the functions of Relay. b) Explain the construction and working of proportional solenoid with a sketch.	L3	CO-1	4 6
	Section -3			
5	a) List the merits and demerits of continuously variable transmission. b) Explain the working of centrifugal type lock up clutch.	L3	CO-2	4 6
6	a) Draw the layout of collision avoidance system. b) Explain the working of air bag system with a layout.	L3	CO-3	4 6
	Section -4			
7	a) List the advantages of BLDC motor. b) Draw the layout of computerized instrumentation system.	L3	CO-3, 4	4 6
8	a) List the merits of driverless vehicle. b) Explain the working of BLDC motor with a sketch.	L3	CO-3, 4	4 6
	Section -5			
9	Explain the construction of battery pack with a block diagram.	L3	CO-4	10
10	Explain the working AC synchronous motor with a neat sketch.	L3	CO-4	10

14. Equipment/software list with Specification for a batch of 30 students

SN	Particulars	Specification	Quantity
1	Multi-cylinder Engine with Electronic control unit and different engine sensors.	Multi-cylinder Engine with Electronic control unit and different engine sensors.	01
2	ECUs of other vehicle systems (ABS, Transmission)	ECUs of other vehicle systems (ABS, Transmission)	01
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.	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.	02
4	Solenoid stepper motor demo kit.	Solenoid stepper motor demo kit.	01
5	Automatic hydraulic transmission with Torque converter.	Automatic hydraulic transmission with Torque converter.	01
6	Automated manual transmission.	Automated manual transmission.	01
7	Continuously variable transmission	Continuously variable transmission	02
8	Electrical power steering trainer unit.	Electrical power steering trainer unit.	01
9	ABS trainer unit.	ABS trainer unit.	01
10	Air bag trainer unit.	Air bag trainer unit.	01
11	Limited Slip differential	Limited Slip differential	01
12	Electric Vehicle	2-wheeler. Motor Power 1200 – 1800 W Motor Type – BLDC Drive Type - Hub Motor Battery Type - Li-ion Battery Capacity 72 V/26 Ah	01
13	Electric Vehicle	4-wheeler. Engine Type – 3 Phase Induction Motor Max Power – 25.5 bhp @3750 rpm Max Torque – 53 Nm@ 0-3500 rpm	01
14	Hybrid Electric Vehicle – 4-wheeler.		01
15	Battery testing kit.	Voltage 6 V to 60 V	01
16	Lithium-Ion Battery Charger.	Input Voltage: 180-250 V AC Output Voltage: DC 54.6V Application: Suitable for 48V E-Bike Batteries Output Current: 3-4 A	01
17	Brushless DC Motor	Brushless DC Motor	01
18	Electric Vehicle Control Unit.	Electric Vehicle Control Unit.	01

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Government of Karnataka

DEPARTMENT OF TECHNICAL EDUCATION

Program	**Automobile Engineering**	**Semester**	**IV**
Course Name	**Vehicle body engineering and dynamics.**	**Type of Course**	Integrated
Course Code	25AT43I	**Contact Hours**	91hrs/sem 7 hrs/week
Teaching Scheme	L: T:P 3:0:4	**Credits**	5
CIE Marks	**50**	**SEE Marks**	**50 (Practice)**

1. **Rationale:** The safety, ergonomics and efficiency of the vehicle are important parameters in design of vehicle body. Hence the student should be able to appreciate concepts of safety, ergonomics and efficiency of car body. The student should perform various repair activities on vehicle body.

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

CO-01	Perform repair activities on vehicle body and paint with appropriate equipment and procedure.
CO-02	Perform service activities of vehicle safety and comfort systems,
CO-03	Calculate amount of power required for propulsion and vehicle performance parameters under different operating conditions of vehicle.
CO-04	Calculate different vehicle braking performance parameters under different operating conditions.

3. **Course Content**

WEEK	**CO**	**PO**	**Theory**	**Practice**
1	**1**	**1,4**	Car body-functions, requirements, classification based on body style, classification based on engine and drive wheel position-layout of each type-merits and demerits of each type.	Identification of different types of body style. Identification of different chassis components. Identification of different components of car body parts.
2	**1**	**1,4**	Parts of body-construction of each part-functions of each part. -materials used. Visibility-	Removing and refitting of front and rear bumper, front and rear bonnet, front left and right wings.

			concept-methods to improve visibility. Sources of noise and vibrations-methods to reduce noise and vibrations.	
3	**1**	**1,4**	Car body construction-types-process of unitary body construction. Welding-types, arc welding-types-components of arc welding-arc welding process. Gas welding-components of gas welding process-gas welding process-types of flame and their applications.	Practice on creating but, lap and T-joints using arc welding process. Practice on creating a tray and a funnel using sheet metal and join edges using gas welding process. Practice on producing three types of flames.
4	**1**	**1,4,5**	Car painting-objectives-elements of paint-functions of each element of paint, painting methods-types-air spray painting, air less spray painting, electrostatic painting.	Practice on removing of dent from panels. Practice on preparing body panels for painting. Practice on painting the body panels using any method of painting.
5	**2**	**1,4,5**	Passenger Safety-passive and active safety systems-crumple jones-passenger cage-impact energy flow, seat belt-types-working of three-point seat belt, collapsible steering-types-construction-telescopic and mesh type, pedestrian safety-methods to improve pedestrian safety.	Identification of passive safety systems of car. Removing and refitting of seat belts. Remove and refit steering columns from vehicle.
6	**2**	**1,4**	Ergonomics -concept-methods to improve ergonomics, Types of seats, Bucket seat construction and position adjustments, steering column tilt and reach adjustment mechanism, Doors-types-door glass operating mechanism-types-manual.	Remove and refit seats from the vehicle. All door removal and refitting. Servicing of manual door glass operating mechanism.
7	**2**	**1,4**	Electrical front door glass operating mechanism, central locking mechanism, remote control-concept-layout. Wind shield glass-need-types-construction of laminated glass, defrosting-concept-working.	Servicing of electrical door glass operating mechanism. Servicing of central locking system. Replacement of wind shield glass.

8	**2**	**1,4,5**	Car air conditioning-need-layout-working. Crash testing-need-types-procedure to conduct crash testing as per Bharat NCAP. Meaning of ratings as per the NCAP.	Trouble shooting of A.C system. Removing and refilling of refrigerant.
9	**3**	**1,2,3**	Aerodynamic forces acting on car body, methods to reduce car aerodynamic drag. Different resistances to car motion. Air resistance-rolling resistance, gradient resistance, power required for propulsion.	Find air resistance, rolling resistance, gradient resistance and power required for propulsion for different vehicle speed, road surface, and gradients. (Solve simple problems)
10	**3**	**1,2,3**	Relation between engine speed and vehicle speed, traction, tractive effort, maximum acceleration, gradability, and draw bar pull, equivalent weight, weight distribution for car on slope.	Find vehicle speed, tractive effort, acceleration, gradability, and draw bar pull under different engine speed gear ratios and vehicle weight. (Solve simple problems)
11	**3**	**1,2,3**	Maximum acceleration, tractive effort and road reactions under different drive conditions.	Calculation of maximum acceleration, tractive effort and road reactions under different drive conditions, different road and vehicle dimensions. (solve simple problems)
12	**4**	**1,2,3,4**	Breaking efficiency, stopping distance, Theory of internal shoe brakes, mean lining pressure and heat generation, Trailing and leading shoes-concept-applications	Calculation of braking torque, mean lining pressure and heat generation under different brake drum dimensions, braking force, material and type of shoe. (solve simple problems) Practice on finding braking distance and braking efficiency on different conditions of road and vehicle.
13	**4**	**1,2,3**	Road reactions and deceleration of vehicle on moving on slope with only front brakes applied, rear brakes applied and all brakes applied.	Find road reactions and deceleration of vehicle under different road conditions and with different dimensions of vehicle. (solve simple problems)

4. References:

Sl.No.	Title of Books	Author	Publication
1.	Automotive Engineering (Heating & Air conditioning) class room manual	Mark Schnabel Cengage Learning	Cengage Learning.

2.	Automobile Engineering vol VI (Air Conditioning System)	Anil Chikara	Cengage Satya Prakashan New Delhi
3	Automobile Engineering	Ramalingam K. K	
4	Automobile Engineering vol IV	Anil Chikara	Satya Prakashan New Delhi
4.	Vehicle Body Repair by James Duffy	J.M. Duffy	Cengage Learning
5	Automobile Engineering (Paint Technology) vol V	Anil Chikara	Satya Prakashan New Delhi
6	Vehicle Body Engineering	Pawlowski. J.,	
7	Body construction and design	Giles. J.C	
8	Vehicle Body layout and analysis	John Fenton	Mechanical Engineering Publication Ltd., London, 1982
9	Vehicle Body building and drawing	Braithwaite J. B	Heinemann Educational Books Ltd., London
10	Automotive Mechanics	Grouse W and Anglin D	Tata McGraw Hill Publication 10th edition, 2004

15. **Rubrics for Portfolio evaluation** **Level of Achievement**						
Assessment Parameter		**Excellent (10)**	**Very Good (8)**	**Fair (6)**	**Poor (4)**	**Score**
AP1	**Organization of Report and Timely Submission**	Lab report is well organized as directed and submitted on time	Lab report is well organized but not submitted on time	Report contains few errors and not submitted on time them	Poor organization and late submission	
AP2	**Knowledge of Tools and Procedures**	Demonstrates deep knowledge of tools and procedures; answer the related questions with explanations and elaboration	Adequate knowledge of most tools and procedures; answer the related questions, but fails to elaborate	Superficial knowledge of tools and procedures; able to answer only some of the related basic questions	Lack of information about most of the tools and procedures; cannot even answer basic related questions	
AP3	**Team Working Skills**	Positive in interacting with all group members, encourages such interaction in others, and always sensitive to the abilities and feelings of others' contributions; Actively helps to identify group goals and works effectively to meet them in assigned roles	Interacts with all group members spontaneously and contributes in a way that is sensitive to the abilities and feelings of others; Demonstrates commitment to group goals and carries out assigned roles effectively	Interacts with other group members if prompted, but sometimes expresses opinions which are insensitive to the abilities and feelings of others; Demonstrates commitment to group goals, but has difficulty performing assigned roles	Rarely interacts within a group, even with prompting, and shows frequent lack of sensitivity to others' feelings and abilities in opinions expressed; Shows little commitment to group goals and fails to perform assigned roles	
AP4	**Result Analysis and Data Interpretation**	Excellent insight and well-focused results and discussion; Data completely and appropriately interpreted and no overinterpretation	Adequate insight but missed some important points in results and discussion; Interpreted most data correctly but some conclusions may be suspect or over-interpreted	Little insight and analysed only the most basic points; Interpreted some data correctly but significant errors, omissions still present.	No insight and entirely missed the point of the experiment; Little or no attempt to interpret data or overinterpreted data.	
AP5	**Task Management**	Very Effective in managing the assigned task and allow experimenter(s) to achieve all goals	Somewhat effective in managing the assigned tasks and allow experimenter(s) to achieve most goals.	Somewhat ineffective in managing the assigned task and allow experimenter(s) to achieve only few goals.	Very ineffective and would not allow experimenters to achieve any goals	

5. CIE Assessment Methodologies

Sl. No	CIE Assessment	Test Week	Duration (minutes)	Max marks	
1.	CIE-1TheoryTest	4	90	50	Average of all CIE=50 Marks
2.	CIE-2Practice Test	7	180	50	
3	CIE-3TheoryTest	10	90	50	
4.	CIE-4Practice Test	13	180	50	
5	CIE-5 Portfolio evaluation of all the activities through Rubrics	1-13		50	
Total					**50 arks**

6. SEE – Practice Assessment Methodologies

Sl. No	SEE – Practice Assessment	Duration (minutes)	Max marks	Min marks to pass
1.	Semester End Examination-Practice	180	50	20

7. CIE Theory Test model question paper

Program	Automobile Engineering			Semester -IV	
Course Name	Vehicle body engineering and dynamics.			Test	I
Course Code	25AT43I	Duration	90 min	Marks	50
Name of the Course Coordinator:					
Note: Answer any one full question from each section. Each full question carries equal marks.					

Q. No	Questions	Cognitive Level	Course Outcome	Marks
	Section - 1			
1	a) Write the classification of car bodies. 10M b) List the methods to improve visibility. 05M c) Illustrate the arc welding process. 10M	L2 L2 L2	1	25
2	a) List the requirements of car body. 05M b) Explain the front engine and front wheel drive system 10M c) Illustrate gas welding process. 10M	L2 L2 L2	1	
	Section - 2			
3	a) List the functions of car paint. 05M b) Explain the process of air spray painting. 10M c) Explain the different parts of car body with a sketch. 10M	L3	1	25
4	a) List sources of noise and vibration from vehicle. 05M b) Explain the functions of each component of paint. 10M c) Explain the process electrostatic car painting. 10M	L3	1	

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.

Signature of the Course Coordinator **HOD** **IQAC Chairman**

8. CIE Practice Test model question paper

Program	**Automobile Engineering**			**Semester**	**IV**
Course Name	**Vehicle body engineering and dynamics.**			**Test**	**II/IV**
Course Code	25AT43I	**Duration**	**180 min**	**Marks**	**50**
Name of the Course Coordinator:					

Questions	**CO**	**Marks**
a. Remove and refit the front bumper of a given car using proper tools and procedure. b. Service the central locking system of the given car. OR c. Paint the given body part of the car using air painting process with proper procedure. d. Service the electrical door operating mechanism of the given car.	**1** **2** **1** **2**	**50**
Scheme of assessment a) Procedure writing- 3+3=6M b) Conduction-10M, troubleshoot/calculation-3M and results-2M, ((10+3+2=15), 15 x 2 experiments = 30M) c) Viva voce – 10M d) Portfolio evaluation of practical record – 4M		**6** **30** **10** **04**
	Total Marks	**50**

Signature of the Course Coordinator **Signature of the HOD**

9. Suggestive Activities for Tutorials:

The List is an Example and not inclusive of all possible activities of the course. Students and Faculty are encouraged to choose activities that are relevant to the topic. Two activities, each for 50 marks should be evaluated with proper rubrics.

Sl.No.	**Suggestive Activities for Tutorials**
01	Collect information on different vehicle bodies with photographs and specifications.
02	Collect information on different advanced paints and painting process.
03	Collect information on different tools and equipment used in body repair shops.
04	Collect information on different paint components used in car body painting shops.
05	Collect information on different advanced body repair process
06	Collect information on different advanced metal joining process.
07	Collect information on advance safety and comfort systems of vehicle.

10. Rubrics for Assessment of Activity (Qualitative Assessment)

Sl. No.	Dimension	Beginner	Intermediate	Good	Advanced	Expert	Students Score
		2	4	6	8	10	
1	Collection of data/ Material	Limited information	Collects basic information	Collects more information	Collects developed information	Collects a great deal of information	8
2	Quality of data	Irrelevant	Less relevant	Needs improvement	Satisfactory	Very relevant	6
3	Quality of report	Not planned	Less organized	Moderately organized	Organized	As per the standards	4
4	Timely submission	Late submission	Submits after due date	Submits after reminders	Submit after a reminder	On time submission	2
5	Data references	No references.	Irrelevant references.	Given References not from authentic source.	Given references are from authenticated sources.	Enough authenticated references are given.	6
	Example: Total= (8+6+4+2+6=26)						**26/50**

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

11. **SEE- Model Practice Question Paper**

Program	**Automobile Engineering**		**Semester**	**IV**
Course Name	**Vehicle body engineering and dynamics.**	**Course Code:** 25AT43I	**Duration**	**180 min**
Questions			**CO**	**Marks**
1. Paint the given car body part with specified painting method fallowing proper procedure. **2.** Find road reactions and acceleration of vehicle under given road conditions and with given dimensions of vehicle. **OR** 1. Remove the front left apron from the car, remove dents and refit to the car using proper tools. **2.** Find air resistance, rolling resistance, gradient resistance and power required for propulsion for given vehicle speed and other specified vehicle parameters.			**1** **3** **1** **3**	**50**
Scheme of assessment for practical questions. a) Procedure writing- 3 b) Conduction-10M, troubleshoot/calculation-3M and results-2M, Total= (3+10+3+2=18) **Scheme of assessment for problem questions.** Given data-03M, Formulae-03M, Calculation-10M, Results-02M, Total= ((3+10+3+2=18) e) Viva voce – 10M f) Portfolio evaluation of practical record – 4M				**3** **15** **18** **10** **04**
Total Marks				**50**

Signature of the Examiner **Signature of the Examiner**

12.Equipment/software list with Specification for a batch of 30 students

Sl.No.	Particulars	Specification	Quantity
01	Major mechanic tool kit		2
02	Two post vehicle lift	Electrically operated suitable to lift up to 5-ton vehicle.	1
03	Tripod stands	Carry capacity 1 ton	8
04	Body repair tools kit	Panel Beaters / Hammers, Shrinking Hammers, Body Hammers (soft-faced, flat, or round head, Slide Hammer, Dolly Blocks (Suitable for all type of dent removals)	2 set
	Manual Dent Pullers		2
	Pneumatic Dent Pullers		2
05	An unserviceable car with all body parts.	A typical mid-size car	2
06	Angle Grinders		2
07	Die Grinders		
08	Electrical body polishing tools.	Electrical Sanding and buffing tools	1 set
09	A paint booth	Controlled environmental booth with Heating, drying, cleaning controls suitable for a mid-size sedan.	1
10	Air compressor	Double stage, electrically operated, mounted on air tank, tank capacity-200liters	1
11	Paint spray gun	Half liter's capacity, spray angle and pressure adjustments.	2
12	Car AC servicing equipment	Leakage test, refrigerant removal and refilling	1

Government of Karnataka
DEPARTMENT OF TECHNICAL EDUCATION

Program	**Automobile Engineering**	**Semester**	**IV**
Course Name	**Machine design and drafting**	**Type of Course**	Integrated
Course Code	**25AT44I**	**Contact Hours**	91Hrs/sem 7Hrs/week
Teaching Scheme	L: T:P, 3:0:4	**Credits**	5
CIE Marks	**50**	**SEE Marks**	**50 (Practice)**

1. **Rationale:** Machine design, parametric modelling, geometric tolerance and dimensioning are important part of modern designing process. The student should learn the concepts of machine design and gain skills in parametric modelling.

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

CO-01	Perform experiments and calculations to find different material and shape related parameters required to design machine elements.
CO-02	Apply appropriate geometric tolerance and dimensioning symbols to machine drawings using free and open-source software.
CO-03	Design and create solid part models and assemblies of different machine elements using standard procedures.
CO-04	Design and create solid part models and assemblies of different Automotive Engine components using standard procedures.

3. Course Content

WEEK	**CO**	**PO**	**Theory**	**Practice**
1	**1**		Machine design-introduction, types, process. Force, Torque, couple, loads-types. Simple stress and strains – Tensile stress and compressive stress. Hooke's law, Young's modulus. Shear stress and strain, Shear modulus or modulus of rigidity. Stress-strain diagram. Working stress, Factor of safety-definition, purpose.	Conduct the tensile test on mild steel using UTM and plot the stress-strain diagram. Conduct the Compression test on Cast iron using UTM and plot the stress-strain diagram.
2	**1**		Linear and Lateral Strain, Poisson's Ratio. Volumetric strain, Bulk modulus. Resilience. Centre of gravity & moment of Inertia –	Practice to find the Centre of gravity and moment of inertia of L section, I Section and Box section using analytical method and free

			concept, Importance.	and open-source software/simulation.
3	**2**		Limits-Need for limit system. Fit-Types of Fit – Clearance fit, interference fit, transition fit and their designation. Allowance, Tolerance – System of Tolerance-shaft based and hole-based dimensions (system of writing tolerance). Unilateral system and bilateral system.	Practice to insert different fit, tolerance, precision, and limit symbols using free and open-source software. Identify the different types of fit and tolerances in automobile components drawings.
4	**3**		Fasteners-types, applications. Initial stresses in screw fastenings, Stresses induced in a bolt subjected to external load, simple problems.	Create the part models of square nut and bolt, Assemble using free and open-source software. Create the part models of hexagonal nut and bolt, Assemble using free and open-source software.
5	**1**		Shafts- Types, Materials, standard sizes of transmission shaft, applications. Stresses in Shafts, Design of Shafts subjected to twisting and bending only. Simple problems.	Identify different types of shafts used in Automobile vehicles and list the materials. Conduct the torsion test on mild steel using torsion testing machine or virtual lab.
6	**3**		Keys- need, types. Design of sunk key-forces acting on sunk key, strength of sunk key. Simple problems.	Identify the different types of keys and key ways used in industry. Create the part model of different types of keys using free and open-source software.
7	**3**		Couplings-Purpose, requirements-Types, Applications. Design of unprotected-flange coupling. Simple problems.	Create the part models of Muff coupling and assemble using free and open-source software. Create the part models of Unprotected type Flange coupling and assemble using free and open-source software.
8	**3**		Springs – Types, Materials. Helical spring- Applications, End connections for compression helical springs, Terms used in helical compression spring. Stresses in helical compression springs, Deflection of helical compression spring. Leaf springs- Applications, Length of leaf spring leaves. Standard Sizes of Automobile Suspension Springs.	using free and open-source software. Modelling work bench tools create a helical spring. using free and open-source software. part modelling work bench tools create a Leaf Spring. Simple problems on Helical springs.
9	**3**		Gear-Classification, terminology of gear. Law of gearing (Lewis Equation) Gear train, gear ratio, module of gear tooth, Centre distance between mani shaft and layshaft,	Create an 3D model of spur gear using any free hand software. Create an 3D model of a helical gear using any using free and open-source software. Simple problems.
10	**4**		Design consideration for a piston, Design of piston, piston pin & piston rings based on strength and heat	Create the part models of Piston, Piston Pin, Piston rings and assemble using free and open-

			transfer.	source software. Simple problems on design of piston.
11	**4**		Connecting rod- Forces acting on connecting rod, Design concept of connecting rod.	Create the part models of connecting rod and assemble Simple problems on Connecting rod.
12	**3**		Cam and followers-types, Cam profile-types. Construct a cam profile using uniform velocity method and simple hormonic motion.	Create a 3D-part model of camshaft using free and open-source software. Simple Problems.
13	**3**		Design of clutch- Torque Transmitted through Single and Multi plates Clutches considering uniform wear condition.	Create a 3D-assembly model of single plate clutch assembly using any using free and open-source software. Simple problems.

4. References:

Sl. No	**Title of Books**	**Author**	**Publications**
1	A Text book of Machine Design	R.S. Khurmi & J.K. Gupta	S. Chand publication
2	Machine design	S G Kulkarni	McGraw Hill Education
3	Introduction to Machine design	V B Bhandari	McGraw Hill Education
4	Automotive Mechanics	Dr N K Giri	Khanna Publishers
5	Design Of Machine Elements Vol I, Vol II	J.B.K. Das, P.L. Srinivas Murthy	Sapna Publication
6	Auto Design	R B Gupta	Satya Prakashan
7	Design Data Hand Book for Mechanical Engineers	K Mahadevan & K Balveer Reddy	CBS publications

5. LIST SOFTWARES/WEBSITES

1. http://nptel.ac.in/courses/Webcoursecontents/IIT%20Kharagpur/Machine%20design1/left_home.html
2 http://nptel.ac.in/courses/Webcoursecontents/IIT%20Kharagpur/Machine%20design1/left_mod4.html
3. http://nptel.ac.in/courses/Webcoursecontents/IIT%20Kharagpur/Machine%20design1/left_mod7.html.
4. http://nptel.ac.in/courses/Webcourse- contents/IIT%20Kharagpur/Machine%20design1/left_mod4.html
5. http://nptel.ac.in/courses/Webcoursecontents/IIT%20Kharagpur/Machine%20design1/left_mod5.html
6. http://nptel.ac.in/courses/Webcoursecontents/IIT%20Kharagpur/Machine%20design1/left_mod8.html

16. **Rubrics for Portfolio evaluation** **Level of Achievement**						
Assessment Parameter		**Excellent (10)**	**Very Good (8)**	**Fair (6)**	**Poor (4)**	**Score**
AP1	**Organization of Report and Timely Submission**	Lab report is well organized as directed and submitted on time	Lab report is well organized but not submitted on time	Report contains few errors and not submitted on time them	Poor organization and late submission	
AP2	**Knowledge of Tools and Procedures**	Demonstrates deep knowledge of tools and procedures; answer the related questions with explanations and elaboration	Adequate knowledge of most tools and procedures; answer the related questions, but fails to elaborate	Superficial knowledge of tools and procedures; able to answer only some of the related basic questions	Lack of information about most of the tools and procedures; cannot even answer basic related questions	
AP3	**Team Working Skills**	Positive in interacting with all group members, encourages such interaction in others, and always sensitive to the abilities and feelings of others' contributions; Actively helps to identify group goals and works effectively to meet them in assigned roles	Interacts with all group members spontaneously and contributes in a way that is sensitive to the abilities and feelings of others; Demonstrates commitment to group goals and carries out assigned roles effectively	Interacts with other group members if prompted, but sometimes expresses opinions which are insensitive to the abilities and feelings of others; Demonstrates commitment to group goals, but has difficulty performing assigned roles	Rarely interacts within a group, even with prompting, and shows frequent lack of sensitivity to others' feelings and abilities in opinions expressed; Shows little commitment to group goals and fails to perform assigned roles	
AP4	**Result Analysis and Data Interpretation**	Excellent insight and well-focused results and discussion; Data completely and appropriately interpreted and no overinterpretation	Adequate insight but missed some important points in results and discussion; Interpreted most data correctly but some conclusions may be suspect or over-interpreted	Little insight and analysed only the most basic points; Interpreted some data correctly but significant errors, omissions still present.	No insight and entirely missed the point of the experiment; Little or no attempt to interpret data or overinterpreted data.	
AP5	**Task Management**	Very Effective in managing the assigned task and allow experimenter(s) to achieve all goals	Somewhat effective in managing the assigned tasks and allow experimenter(s) to achieve most goals.	Somewhat ineffective in managing the assigned task and allow experimenter(s) to achieve only few goals.	Very ineffective and would not allow experimenters to achieve any goals	

6. CIE Assessment Methodologies

Sl. No	CIE Assessment	Test Week	Duration (minutes)	Max marks	
1.	CIE-1TheoryTest	4	90	50	Average of all CIE=50 Marks
2.	CIE-2Practice Test	7	180	50	
3	CIE-3TheoryTest	10	90	50	
4.	CIE-4Practice Test	13	180	50	
5	CIE-5 Portfolio evaluation of all the activities through Rubrics	1-13		50	
				Total	**50 arks**

7. SEE – Practice Assessment Methodologies

Sl. No	SEE – Practice Assessment	Duration (minutes)	Max marks	Min marks to pass
1.	Semester End Examination-Practice	180	50	20

8. CIE Theory Test model question paper

Program	**Automobile engineering**			**Semester -IV**	
Course Name	**Machine design and drafting**			**Test**	**I/III**
Course Code	**25AT44I**	**Duration**	**90 min**	**Marks**	**50**
Name of the Course Coordinator:					
Note: Answer any one full question from each section. Each full question carries equal marks.					

Q. No	**Questions**	**Cognitive Level**	**Course Outcome**	**Marks**
	Section - 1			
1	a) Illustrate the stress-strain diagram for ductile materials. 10M b) Explain the terms shear modulus and bulk modulus. 05M c) Illustrate the terms clearance fit, interference fit and transition fit. 10	L2 L2 L2	1 1 2	25
2	a) Explain the terms linear strain, lateral strain, poisons ratio and volumetric strain. 10M b) Illustrate the terms shaft based and hole-based tolerance10M c) Explain the terms center of gravity and moment of inertia 05M	L2 L2 L2	1 2 1	
	Section - 2			
3	a) Find the center of gravity of given shape. 10M b) An engine cylinder is 300 mm in diameter and the steam pressure is 0.7 N/mm2. If the cylinder head is held by 12 studs, find the size. Assume safe tensile stress as 28 MPa. 10M c) Explain the fasteners along with their applications. 05	L3 L3 L2	1 3 3	25
4	a) Find the area moment of inertia of given shape. 10M b) An eye bolt is to be used for lifting a load of 60 kN. Find the nominal diameter of the bolt, if the tensile stress is not to exceed 100 MPa. Assume coarse threads. 10M c) List different types of fasteners. 05M	L3 L3 L2	1 3 3	
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.				

Signature of the Course Coordinator **Signature of the HOD** **Signature of the IQAC Chairman**

9. CIE Practice Test model question paper

Program	**Automobile engineering**			**Semester**	
Course Name	**Machine design and drafting**			**Test**	**II/IV**
Course Code	**25AT44I**	**Duration**	**180 min**	**Marks**	**50**
Name of the Course Coordinator:					

Questions	**CO**	**Marks**
1) Conduct the experiment to draw the tensile stress-strain diagram for given ductile material. 2) Design a muff coupling under given load and material conditions and create the assembly model using any parametric modelling software. OR 3) Conduct the experiment to draw the stress-strain diagram of the ductile material under compression. **4)** Design the unprotected flange coupling under given load and material conditions and create the assembly model using any parametric modelling software.	**1** **3** **1** **3**	**50**
Scheme of assessment for 1 and 3 experiments: Procedure-03M, conduction-10M, tabular column and results-05M, total 3+10+5=18M		**18**
Scheme of assessment for 2 and 4 experiments: Given data-2, Formulae-3, Clculation-5, part model-5, Assembly model-3, Total=18M		**18**
Common parameters: Viva-10M Portfolio evaluation-04M		**10** **04**
	Total Marks	**50**

Signature of the Course Coordinator **Signature of the HOD**

10. **Suggestive Activities for Tutorials**:

The List is an Example and not inclusive of all possible activities of the course. Students and Faculty are encouraged to choose activities that are relevant to the topic. Two activities, each for 50 marks should be evaluated with proper rubrics.

Sl.No.	**Suggestive Activities for Tutorials**
01	Collect stress-strain diagrams of different engineering materials, compare and prepare a report.
02	Collect various properties of different materials, compare and prepare a report.
03	Find the center of gravity and moment of inertia of different sections manually and using software.
04	Collect different types of fasteners, measure the dimensions and create solid models using parametric software.
05	Collect information on different types of solid modeling software and crate comparative analysis report.
06	Collect any one type of coupling, automotive component measures its dimension and create a solid model using any one of parametric software.

11.Rubrics for Assessment of Activity (Qualitative Assessment)

Sl. No.	Dimension	Beginner	Intermediate	Good	Advanced	Expert	Student sScore
		2	4	6	8	10	
1	Collection of data/ Material	Limited information	Collects basic information	Collects more information	Collects developed information	Collects a great deal of information	8
2	Quality of data	Irrelevant	Less relevant	Needs improvement	Satisfactor y	Very relevant	6
3	Quality of report	Not planned	Less organized	Moderately organized	Organized	As per the standards	4
4	Timely submission	Late submission	Submits after due date	Submits after reminders	Submit after a reminder	On time submission	2
5	Data references	No references.	Irrelevant references.	Given References not from authentic source.	Given references are from authenticat ed sources.	Enough authenticat ed references are given.	6
	Example: Total= (8+6+4+2+6=26)						**26/50**

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

12. **SEE- Model Practice Question Paper**

Program	**Machine design and drafting**		**Semester**	
Course Name	**25AT44I**	**Course Code**	**Duration**	**180 min**
Questions			**CO**	**Marks**
1. Conduct the experiment to draw the tensile stress-strain diagram for given ductile material. 2. Design a Piston, piston pin, piston rings under given working condition and material and create an assembly model of piston, piston pin and rings using any one of the parametric modeling software. OR 1. Conduct the experiment to draw the stress-strain diagram of the ductile material under compression. **2.** Design the connecting rod upper half and lower half under given load and material conditions and create the assembly model using any parametric modelling software.			**1** **4**	**50**
Scheme of assessment for 1 and 3 experiments: Procedure-03M, conduction-10M, tabular column and results-05M, total 3+10+5=18M **Scheme of assessment for 2 and 4 experiments:** Given data-2, Formulae-3, Clculation-5, part model-5, Assembly model-3, Total=18M **Common parameters:** Viva-10M Portfolio evaluation-04M				**18** **18** **10** **04**
			Total Marks	**50**

2) Signature of the Examiner **2) Signature of the Examiner**

13. Equipment/softwarelistwithSpecificationforabatchof30students

Sl.No.	**Particulars**	**Specification**	**Quantity**
01	Desktop Computer.	Latest generation intel i5 or AMD equivalent desktop with 16 GB ram, 512 GB SSD, 24-inch LED Display, with Nvidia or AMD Graphics card with Microsoft 11 OS. And Office 2024	10
02	Parametric Model Software	Solid works by Dassault systems	10 copies
02	Universal testing Machine	40 Ton Capacity with Standard Accessories	1
03	UPS	5KVA Sine wave UPS	1

V & VI SEMESTER

Government of Karnataka

DEPARTMENT OFTECHNICAL EDUCATION

Curriculum Structure

V Semester Scheme of Studies- Automobile Engineering

Sl. No.	Teaching Department	Course Code	Course Name	Hours per week			Total Contact Hours/week	Credits	CIE Marks		Theory SEE Marks		Practice SEE Marks		Total Marks
				L	T	P			Max	Min	Max	Min	Max	Min	
Integrated Courses															
1	AT	SP-1	Specialization Pathway-I	4	0	4	8	6	50	20	50	20	-	-	100
2	AT	SP-2	Specialization Pathway-II	3	0	4	7	5	50	20	-	-	50	20	100
3	AT	SP-3	Specialization Pathway-III	3	0	4	7	5	50	20	-	-	50	20	100
4	AT	25AT54I	Project Management and Entrepreneurship	4	0	4	8	6	50	20	50	20	-	-	100
Total				**14**	**0**	**16**	**30**	**22**	**200**		**100**	**-**	**100**	**-**	**400**

SP	Course code	Course Name	SP	Course code	Course Name	SP	Course code	Course Name
SP-1	25AT51IA	Agricultural power equipment	**SP-2**	25AT52IA	Manufacturing Technology	**SP-3**	25AT53IA	Python for Automobile engineers.
	25AT51IB	Alternative Energy Technology		25AT52IB	Construction equipment and special vehicles		25AT53IB	Industrial Automation
	25AT51IC	Vehicle Management and Estimation		25AT52IC	Electric and Hybrid Vehicles		25AT53IC	Industrial Internet of Things (IIoT)
	25AT54I	Project Management and Entrepreneurship						

Government of Karnataka

DEPARTMENT OF TECHNICAL EDUCATION

Curriculum Structure

VI Semester Scheme of Studies- Automobile Engineering

Sl. No.	Department	Course Code	Course Name	Hours per week	No of Weeks	Credits	CIE Marks		Practice SEE Marks		Total Marks
							Max	Min	Max	Min	
1	AT	25AT61I	Internship/Capstone Project	40	13	13	50	20	50	20	100
Total				**40**	**13**	**13**	**50**	**20**	**50**	**20**	**100**

Government of Karnataka
DEPARTMENT OF TECHNICAL EDUCATION

Program	**Automobile Engineering**	**Semester**	**V**
Course Name	**Agricultural power equipment**	**Type of Course**	Integrated
Course Code	**25AT51IA**	**Contact Hours/Week**	08
Teaching Scheme	L: T:P. 4:0:4	**Credits**	06
CIE Marks	**50**	**SEE Marks**	**50 (Theory)**

9. **Rationale:** Studying farm tractors and equipment as a subject is based on the significant role that machinery plays in modern agriculture. Understanding this subject equips students, technicians, engineers, and farmers with the knowledge required to optimize farm operations, improve productivity, and contribute to the advancement of agricultural practices.

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

CO-01	Classify farm machinery based on their application
CO-02	Perform the servicing of the tractor and its components.
CO-03	Properly use and service agriculture equipment.
CO-04	Adopt methods to conserve the soil as well as effective utilization of agriculture implements.

11. Course Content:

WEEK	**CO**	**PO**	**Theory**	**Practice**
1	**1**	**1,6,7**	Farm Mechanization: Introduction, Objectives of farm mechanization, Scope of farm mechanization, Benefits of farm mechanization. Tractors manufacturers of India with their models and plant locations.	Prepare a report on merits and demerits of farm mechanization by conducting a field visit.
2	**1**	**1,6,7**	Classification of tractors based on their applications. Classification of Farm equipment based on their application. Farm equipment manufacturers in India with their machinery and plant locations.	Visit a tractor showroom and prepare a report on activities performed. Visit a farm equipment show room and prepare a report. Identification of different tractors and

				their parts.
3	**2**	**1,2,4**	Tractors gear box-types-construction and working of synchromesh gear box. Types of final drives-single, double reduction and planetary gears. Power take off shaft-need-types-construction and working of each type.	Servicing of tractor gear box, troubleshooting chart. Servicing of tractor final drive and PTO drive.
4	**2**	**1,2,4**	Steering in tractors- Introduction - construction and working, types- Power steering, Articulated Steering, Differential steering. Hydraulic system in tractors-draft and depth control mechanism.	Identification of parts of hydraulic draft and depth control system and servicing. Servicing of hydraulic power steering.
5	**2**	**1,2,4**	Brakes-types-split pedal braking. Track width adjustment-need-types Ballasting of tyres-need-types Methods of crop production, Classification of farm machines.	Servicing of braking system and Practice on changing front and rear track width adjustment. Visit nearest farm and identify method of crop production used and farm machinery used.
6	**2**	**1,2,4**	Tractor tyres and cage wheels-Specification of tyre, Cage Wheel-Necessity, Construction, application. Ballasting of tyre- Need, Method, application, and Advantages.	Practice the process of ballasting of tyre. Practice the process of tyre replacement and cage wheel.
7	**3**	**1,4**	Tillage-need-types-construction and working of Mould board plough, disc plough. Harrow plough-types-Single acting –double acting –offset harrow plough, cultivator, rotary plough**.**	Identification of tillage equipment, Practice the process of attachment of implement to the tractor with necessary adjustments.
8	**3**	**1,4**	Importance of Fertilizer application, Fertilizer drill machine, fertilizer spreader, methods of fertilizer application. Broadcasting, placement, foliar, fertigation, aerial application Pesticide sprayer- Sprayer nozzle, Pumps for spraying Sprayers-need-types-construction and working of boom sprayer.	Identification of parts of sprayers. Practice on use of different types of agricultural sprayers.
9	**3**	**1,4**	Harvesting-meaning-Functions of harvesting combine. Essential parts of harvesting combine. Functions of Power threshers, types of power threshers, construction and working of thresher, construction and working of reel, cutter bar.	Practice harvesting process using harvesting combine machine. Practice the process of using thresher**.**
10	**3**	**1,4**	Uses of drones in agriculture-	Practice on operation of drone.

			Field Monitoring and Crop Surveillance, Irrigation Management, Planting and Seeding, Pest and Disease Detection, Crop Spraying and Fertilization, Soil Health and Quality Assessment, Livestock Monitoring. Safety precautions to be followed and equipment to be used while spraying pesticides.	Practice on Crop Spraying and Fertilization by using drone.
11	**4**	**1,5**	Soil erosion - causes, types- water erosion - a) sheet erosion b) rill erosion c) Gully erosion, wind erosion and Human Induced Erosion (Accelerated Erosion), agents of soil erosion. Erosion control measures - contour cropping, strip cropping, mulching, terraces, bunds**.** Landslides-factors causing it, landslips, Measures for control.	Practice different control methods of soil erosion-contour ploughing, mulching, terracing, bunds, strips.
12	**4**	**1,6**	Field capacities & economics: Terms related to Field performance of Machines- Theoretical Field Capacity, Theoretical Time per hectare and acres, Effective Field Capacity, Effective Operating Time, Field Efficiency, Performance Efficiency.	Simple problems. Visit the nearest farm and measure the field performance of machines and compare.
13	**4**	**1,6**	Economics of machinery usage: 1.Fixed cost, variable cost. Depreciation – types-Straight line Method to calculate depreciation. 2. Operating cost, Estimation of cost of operation	Simple problems.

12. References:

Sl., NO	Title of the book	Author
1	Farm Mechanization for Production	Dhirendra Khare, S.B. Nahatkar, A.K. Shrivastava, A.K. Jha
2	Introductory Farm Machinery and Equipments Engineering	Amaresh Sarkar
3	Agronomy of Field Crops	SR Reddy Craig C and Kristine M Moncada Sheaffer
4	Introduction To Agronomy Food, Crops, And Environment	Craig C and Kristine M Moncada Sheaffer
5	Fluid power Engineering	RK Hegde & Niranjan Murthy
6	Farm machines and Equipment	C.P. Nakra
7	Farm Tractor Maintenance	S C Jain
8	Farm Tractors	Olyslager Organization
9	Tractors and Agricultural Machinery	Srinivasan, VV Narayanan, Sanjeev kumar singh, Geetha Lakshmi
10	Agricultural Drones Krishna K. R.	Krishna K. R

13. CIE Assessment Methodologies

Sl. No	CIE Assessment	Test Week (At the End Of)	Duration (minutes)	Max marks	
1.	CIE-1TheoryTest	4	90	50	Average of all CIE=50 Marks
2.	CIE-2Practice Test	7	180	50	
3	CIE-3TheoryTest	10	90	50	
4.	CIE-4Practice Test	13	180	50	
5	CIE-5 Portfolio evaluation of all the activities through Rubrics	1-13		50	
				Total	**50 Marks**

14. SEE - Theory Assessment Methodologies

Sl. No	SEE – Theory Assessment	Duration (minutes)	Max marks	Min marks to pass
1.	Semester End Examination-Theory	90	50	20

Rubrics for Portfolio evaluation Level of Achievement						
Assessment Parameter		**Excellent (10)**	**Very Good (8)**	**Fair (6)**	**Poor (4)**	**Score**
AP1	**Organization of Report and Timely Submission**	Lab report is well organized as directed and submitted on time	Lab report is well organized but not submitted on time	Report contains few errors and not submitted them	Poor organization and late submission	
AP2	**Knowledge of Tools and Procedures**	Demonstrates deep knowledge of tools and procedures; answer the related questions with explanations and elaboration	Adequate knowledge of most tools and procedures; answer the related questions, but fails to elaborate	Superficial knowledge of tools and procedures; able to answer only some of the related basic questions	Lack of information about most of the tools and procedures; cannot even answer basic related questions	
AP3	**Team Working Skills**	Positive in interacting with all group members, encourages such interaction in others, and always sensitive to the abilities and feelings of others' contributions; Actively helps to identify group goals and works effectively to meet them in assigned roles	Interacts with all group members spontaneously and contributes in a way that is sensitive to the abilities and feelings of others; Demonstrates commitment to group goals and carries out assigned roles effectively	Interacts with other group members if prompted, but sometimes expresses opinions which are insensitive to the abilities and feelings of others; Demonstrates commitment to group goals, but has difficulty performing assigned roles	Rarely interacts within a group, even with prompting, and shows frequent lack of sensitivity to others' feelings and abilities in opinions expressed; Shows little commitment to group goals and fails to perform assigned roles	
AP4	**Result Analysis and Data Interpretation**	Excellent insight and well-focused results and discussion; Data completely and appropriately interpreted and no overinterpretation	Adequate insight but missed some important points in results and discussion; Interpreted most data correctly but some conclusions may be suspect or over-interpreted	Little insight and analysed only the most basic points; Interpreted some data correctly but significant errors, omissions still present.	No insight and entirely missed the point of the experiment; Little or no attempt to interpret data or overinterpreted data.	
AP5	**Task Management**	Very Effective in managing the assigned task and allow experimenter(s) to achieve all goals	Somewhat effective in managing the assigned tasks and allow experimenter(s) to achieve most goals.	Somewhat ineffective in managing the assigned task and allow experimenter(s) to achieve only few goals.	Very ineffective and would not allow experimenters to achieve any goals	

15. CIE -1 Theory Test model question paper

Program	**Automobile Engineering**			**Semester - V**	
Course Name	**Agricultural power equipment**			**Test**	**I/III**
Course Code	**25AT**	**Duration**	**90 min**	**Marks**	**50**
Name of the Course Coordinator:					
Note: Answer one full question from each section. Each full question carries equal marks.					

Q.No	**Questions**	**Cognitive Level**	**Course Outcome**	**Marks**
	Section - 1			
1	a) List the tractor manufactures in India with locations. 5m b) List the advantages and disadvantages of farm mechanization. 10m c) List and explain the farm equipment. 10m	L1 L2 L3	1	25
2	a) List the objectives of farm mechanization. 5m b) Classify and explain the tractors based on their application. 10m c) Draw a tractor and label the parts. 10m	L1 L2 L3	1	
	Section - 2			
3	a) State the purpose of differential steering. b) Explain the construction and working of synchromesh gearbox with a neat sketch. 10m c) Explain the construction and working of power steering with sketch. 10m	L1 L2 L3	2	25
4	a) State the importance of final drive. b) Explain any one type of PTO Drive with neat sketch.10m c) Explain the working of hydraulic draft control mechanism. 10m	L1 L2 L3	2	

7. CIE Practice Test model question paper:

Program	**Automobile Engineering**			**Semester**	**V**
Course Name	**Agricultural power equipment**			**Test**	**II/IV**
Course Code	**25AT51IA**	**Duration**	**180 min**	**Marks**	**50**
Name of the Course Coordinator:					
Questions				**CO**	**Marks**
1. Servicing of tractor final drive and PTO drive. OR 2. Service the given tractor gearbox and identify the faults and give the remedies. 3. Servicing of braking system and Practice on changing front and rear track width adjustment. OR 4. Service the given hydraulic power steering.					**50**
Scheme of assessment: a) Procedure writing. 3+3=6 b) Conduction/ Trouble shoot/ Calculation and result=10+3+2=15(15x2Exp=30) c) Viva -voce 10M d) Portfolio evaluation of practical record 4M					
				Total Marks	**50**

Signature of the Course Coordinator **HOD** **IQAC**

8. Suggestive Activities for Tutorials:

The List is an Example and not inclusive of all possible activities of the course. Students and Faculty are encouraged to choose activities that are relevant to the topic

Sl.No.	**Suggestive Activities for Tutorials**
01	Prepare report or charts on locally available tractors, different systems observed on different tractors, different attachments used on tractor.
02	Visit any nearby tractor showroom and prepare a report on specification of different tractors.
03	Visit a farmland and compare the operation of tillage by comparing rotavator and cultivator.
04	Prepare a report to improve the efficiency of different Threshers.
05	Collect and prepare a report on different types of fertilizer nozzels and applications of fertilizer methods.
06	Suggest the effective use of drones in the agricultural fields.

Note: two activities, each activity for 50 marks with proper rubrics.

9 Rubrics for Assessment of Activity (Qualitative Assessment)

Sl. No.	Dimension	Beginner	Intermediate	Good	Advanced	Expert	Students Score
		2	4	6	8	10	
1	Collection of data/ Material	Limited information	Collect basic information	Collect more information	Collects developed information	Collects a great deal of information	8
2	Quality of data	Irrelevant	Less relevant	Needs improvement	Satisfactory	Very relevant	6
3	Quality of report	Not planned	Less organized	Moderately organized	Organized	As per the standards	4
4	Timely submission	Late submission	Submits after due date	Submits after reminders	Submit after a reminder	On time submission	2
5	Data references	No references.	Irrelevant references.	References not from authentic source.	Given references are from authenticated sources.	Enough authenticated references are given.	6
	Example: Average Marks= (8+6+4+2+6=26)						**26/50**

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

10. SEE- Model Theory Question Paper-1

Program	Automobile Engineering	Semester	V
Course Name	Agricultural power equipment	Marks	50
Course Code	**25AT51IA**	Duration	90 Min

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

Q No	Questions	Cognitive Levels	Course Outcomes	Marks
Section -1				
1	State the objectives of farm mechanization. List the farm equipment manufacturers in India with the location.	L2 L3	1,2	4 6
2	State the purpose of PTO shaft. List the types of tractors based on their application.	L2 L3	1,2	4 6
Section -2				
3	State the purpose of tractor gearbox. Discuss the importance of single reduction final drive.	L2	2	4 6
4	Explain with a neat sketch depth control hydraulic system in tractors.	L2	2	10
Section -3				
5	List the methods of crop production. Discuss the purpose of track width adjustment in tractor.	L3 L2	2	4 6
6	Explain the need and applications of ballasting of tyres.	L3	2	10
Section -4				
7	State the purpose of tillage. Explain the functions of harvesting combine.	L2 L3	3	4 6
8	Explain the methods of fertilizer applications.	L3	3	10
Section -5				
9	State effective field capacity and field efficiency. Compare fixed cost and variable cost.	L2 L3	4	5 5
10	Explain the uses of drones in agriculture. Explain the types of soil erosion.	L3	4	5 5

11. Model Theory Question Paper-2

Program	**Automobile Engineering**	**Semester**	**V**
Course Name	**Agricultural power equipment**	**Marks**	**50**
Course Code	**25AT51IA**	**Duration**	**90 Min**

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

Q No	Questions	Cognitive Levels	Course Outcomes	Marks
	Section -1			
1	a) State the purpose of farm mechanization. b) List the farm equipment manufacturer in India with the location.	L2 L3	1,2	4 6
2	a) State the purpose of steering in tractors. b) Sketch and label the continuous PTO drive.	L2 L3	1.2	4 6
	Section -2			
3	a) State the necessity of Cage wheel. b) Explain the importance of hydraulic system in tractors.	L2 L3	2	4 6
4	Explain the methods of crop production.	L3	2	10
	Section -3			
5	a) State the purpose of harrow plough. b) Sketch and label mould board plough.	L2 L3	3	4 6
6	Explain the construction and working of boom sprayer.	L3	3	10
	Section -4			
7	a) State the usage of drones in field monitoring and crop surveillance. b) Explain the working of cutter bar.	L2 L3	3	4 6
8	Explain the construction and working of power threshers with a neat sketch.	L3	3	10
	Section -5			
9	a) Discuss the causes of soil erosion. b) Explain theoretical field capacity and theoretical time per hectare.	L2 L3	4	4 6

10	Explain the methods to calculate depreciation.	L3	4	10

12. Model Theory Question Paper-3

Program	**Automobile Engineering**	**Semester**	**V**
Course Name	**Agricultural power equipment**	**Marks**	**50**
Course Code	**25AT51IA**	**Duration**	**90 Min**

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

Q No	Questions	Cognitive Levels	Course Outcomes	Marks
	Section -1			
1	c) State the scope of farm mechanization. d) Explain the purpose of ballasting of tyre.	L2 L3	1,2	4 6
2	c) Classify the farm equipment based on their application. d) Sketch and label articulated steering.	L2 L3	1,2	4 6
	Section -2			
3	a) List the methods of crop production. b) Sketch and label independent PTO drive.	L2 L3	2	4 6
4	Explain the construction of cage wheel with a neat sketch.	L3	2	10
	Section -3			
5	c) Discuss broadcasting and placement fertilizer applications. d) Sketch and label the parts of a cultivator.	L2 L3	3	4 6
6	a) State the purpose of rotary plough. b) List the essential components of harvesting combine and their functions.	L2 L3	3	4 6
	Section -4			
7	Explain the usage of drones in agriculture.	L3	3	10

8	Explain the construction and working of power threshers with a neat sketch.	L3	3	10
Section -5				
9	Explain the measures to control landslide.	L3	4	10
10	Explain the components of operating cost estimation.	L3	4	10

13. Equipment List:

SL., No	**Equipment Name**	**Specification**	**Quantity**
1.	Farm Tractor.		1
2.	Power Tiller.		1
3.	Tractor gear box	Gear box with PTO shaft	1 Each
4.	Final Drives with differential.	Single reduction, double reduction and planetary	1 Each
5.	Tractor disc Brakes		2 sets
6.	Hydraulic Power steering	Integrated	2 sets
7.	All implements and attachments.		1 set each.
8.	Drone with attachments		2 sets.

Government of Karnataka
DEPARTMENT OF TECHNICAL EDUCATION

Program	**AUTOMOBILE ENGINEERING**	**Semester**	V
Course Name	ALTERNATIVE ENERGY TECHNOLOGY	**Type of Course**	Integrated
Course Code	**25AT51IB**	**Contact Hours**	8 hours/week
Teaching Scheme	L: T:P: 4:0:4	**Credits**	6
CIE Marks	50	**SEE Marks**	50 (Theory)

1. **Rationale:** The alternative energy technology course aims to highlight sustainable energy resources as fossil fuels are becoming extinct. The course would provide students with the knowledge, skills, and understanding necessary to navigate and contribute to this energy transformation.

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

CO-01	Appreciate the importance of alternative energy sources.
CO-02	Evaluate Hydropower and wind energy as viable alternatives to conventional energy sources
CO-03	Asses solar energy as a viable alternative to conventional energy sources
CO-04	Appraise tidal and geothermal as viable alternatives to conventional energy sources
CO- 05	Determine Nuclear and biogas as viable alternatives to conventional energy sources

3. Course Content:

WEEK	CO	PO	Theory	Practice
1	1	1,7	**Introduction to Energy and Environmental Issues** • Energy Concepts • Energy Consumption and Global Trends • Environmental Impact of Fossil Fuels • The Need for Alternative Energy • Renewable vs. Non-renewable energy sources	• Prepare a report on alternative energy sources utilized around your locality.

2	2	1,5,7	**Hydro Power Plants** • Introduction • Construction and working of hydroelectric power generation • Types, Features of Run-of-river, Storage, Pumped-storage • Components of hydro powerplants- List • Advantages and disadvantages of Hydro power plants.	• Construct a working model of hydropower plant.
3	2	1,5,7	**Wind Energy** • Introduction, Principles of wind energy conversion. • Wind turbine - Need, Types, Construction and working of Horizontal-axis, and Vertical-axis wind turbine. • Advantages and disadvantages of Wind turbines	• Practice to measure the wind speed • Fabricate the wind direction indicator
4	2	1,5,7	**Wind Energy** • **Construction of Wind turbine components- Blades, Gearbox, Generator, Controller** • **Grid integration of wind energy and storage options.**	• Fabricate a small wind turbine
5	3	1,5,7	**Solar Energy** • Introduction, Working principle • Types of Solar energy technology, Construction and working of photovoltaic (PV) cells. • Solar panel- Need, types, Composition, and efficiency of different types of solar panels	• Practice on checking of voltage output of solar panel. • Practice on connecting solar panels in series and parallel and check the voltage outputs.
6	3	1,5,7	**Solar Power** • Describe -Grid-connected and off-grid solar power systems, Comparison. • **Solar energy storage- Need, Types.** • **Advantages and disadvantages of solar energy**	• Visit the nearby solar power stations and prepare a report on type of storage.

			• **Applications of solar energy in industries and homes**	
7	3	1,5,7	**Solar thermal power plant** • Introduction, Working principle of solar thermal power plant, Types. • Working principle of Parabolic Trough Systems, Central Receiver (Power Tower) Systems, Parabolic Dish Systems, Linear Fresnel Reflector Systems. • Advantages and disadvantages of Solar Thermal Power Plants	• Construct a working model of a solar energy receiver.
8	4	1,5,7	**Tidal Energy** • Introduction, Fundamentals of Tide, Technologies for Harnessing Tidal Energy. • Concept and key components of Tidal Stream Systems, Tidal Lagoons and Dynamic Tidal Power. • Construction and working of Horizontal and vertical axis tidal turbine	• Case study on Types of tidal power generation
9	4	1,5,7	**Steam Generation** • Boilers - Introduction, Need, Types, Construction and working of Fire tube and water tube. • Boiler mountings and accessories – List, Construction of Water level indicator, safety valve, blowoff valve, pressure relief valve, economizer	• Identification of boiler components. • Service the pressure relief valve, water level indicator
10	4	1,5,7	**Geothermal energy** • Introduction, Geology and Geothermal Resources. • Geothermal Energy Technologies- Types, Construction and Working of Geothermal Power Plants- Dry Steam Power Plants, Flash Steam Power Plants. • **Geothermal heat pumps- Need, Construction and working of a geothermal heat pump.**	• Practice to simulate the extraction of geothermal energy and demonstrate the concept of geothermal wells. • Prepare a report on environmental impacts of geothermal energy production, particularly in terms of water usage and land disruption.
11	4	1,5,7	**Geothermal energy** • Enhanced Geothermal Systems (EGS)- Need, Construction and working.	• Demonstration of video on Different types of geo thermal power stations

			• Geothermal District Heating and Cooling – Need, Construction and working. • Application of Geothermal energy • Challenges and Future of Geothermal Energy Technologies	and prepare a report.
12	5	1,5,7	**Nuclear Energy** • **Introduction, Types of nuclear energy- Concept of Nuclear Fission and Nuclear Fuson.** • **Construction and Working of Fission reactor nuclear power plant.** • **Advantages and disadvantages**	• Case study on failure of nuclear power plants worldwide.
13	5	1,5,7	**Bio Gas** • **Introduction,** Working principle of bio-gas plant. • Biogas plant – Types, Construction and working of floating drum type and fixed dome biogas plant. • Advantages and disadvantages of biogas	• Construct a working model of Bio plant

***** *Note to the SEE QP setter- SEE Question paper is to be prepared based on the applications given in the Week's contents*

4. References

Sl. No.	Author(s)	Title of Books	Publication/Year
1	GD Rai	**Wind Energy: Fundamentals, Resource Analysis and Economics**	Khanna Publishers, 2011
2	Thomas Ackermann	**Wind Power in Power Systems**	Wiley, 2005
3	S. S. Rattan	**Power System Protection and Switchgear**	Tata McGraw-Hill, 2002
4	Michael J. Branover	**Wind Turbines: Fundamentals, Technologies, Application**	Elsevier, 2009
5	David A. E. A. O.	**Renewable Energy: Power for a Sustainable Future**	Oxford University Press, 2013

5. CIE Assessment Methodologies

Sl. No	CIE Assessment	Test Week	Duration (minutes)	Max. Marks	
1.	CIE-1Theory Test	4	90	50	Average of all CIE=50 Marks
2.	CIE-2 Practice Test	7	180	50	
3	CIE-3 Theory Test	10	90	50	
4.	CIE-4 Practice Test	13	180	50	
5	CIE-5 Portfolio evaluation – Graded Exercises + Activities (through Rubrics)	1-13		50	
				Total	**50 Marks**

6. IE Theory Test model question paper

Program	AUTOMOBILE ENGINEERING			**Semester -** V	
Course Name	ALTERNATIVE ENERGY TECHNOLOGY			**Test**	I/III
Course Code	**25AT51IB**	**Duration**	90 min	**Marks**	50
Name of the Course Coordinator:					
Note: Answer any one full question from each section. Each full question carries equal marks.					

Q. No	Questions	CL	CO	Marks
	Section - 1			
1	a. List the Environmental Impact of Fossil Fuels	L3	1	10
	b. Explain the construction and working of hydroelectric power generation.	L3	2	10
	c. List the need for alternative energy	L3	1	5
2	a. List the difference between renewable and non-renewable energy sources.	L3	1	5
	b. List the components of hydropower plants	L3	2	5
	c. Explain the global energy consumption trends.	L3	1	10
	d. List the Advantages and disadvantages of Hydro power plants.	L3	2	5
	Section - 2			
3	a. Explain the construction and working of Horizontal axis wind turbine	L3	2	10
	b. Explain the construction and working of wind turbine blades	L3	2	10
	c. List the types of wind turbine	L3	2	5
4	a. Explain the construction and working of Vertical axis wind turbine	L3	2	10
	b. Explain the construction and working of wind turbine generator	L3	2	10
	c. List the advantages and disadvantages of wind turbines	L3	2	5

Signature of the Course Coordinator **HOD** **IQAC Chairman**

7. CIE Practice Test model question paper

Program	AUTOMOBILE ENGINEERING			**Semester**	**V**
Course Name	ALTERNATIVE ENERGY TECHNOLOGY			**Test**	**II**
Course Code	**25AT51IB**	**Duration**	**180 min**	**Marks**	**50**
Name of the Course Coordinator:					
Note: Answer any one question from each section. Each question carries 25 marks					

	Questions	**CO**	**Marks**
1.	• Practice on the checking of the voltage output of the solar panel • Conduct an Experiment to measure the wind speed **OR** • Prepare a feasible report regarding the power generation by Waste Management in your college campus. • Practice connecting solar panels in series and parallel and check the voltage outputs	**3** **2** **2** **3**	**50**
Scheme of assessment: a) Procedure writing- 3+3=6 b) Conduction-10, troubleshoot-3/calculation-3, results-2, 10+3+2 (15 x 2 experiments = 30) c) Viva voce - 10 d) Portfolio evaluation of practical record – 4			**50**

Course Coordinator **HOD**

8. Suggestive Activities for Tutorials:

The List is 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. (Max 2 activities)

Sl. No.	**Suggestive Activities for Tutorials**
01	Fabricate a small windmill, demonstrate its operation, and prepare a report
02	Construct a circuit diagram for charging a battery for solar power
03	Construct a plant model to extract flue gasses from the bio mass.
04	Construct equipment to convert solar energy to electricity.
05	Construct equipment to convert solar energy to heat energy.
06	Construct a equipment to convert stored energy in the water dam into electricity.

9. Rubrics for Assessment of Activity (Qualitative Assessment)

Sl. No.	Dimension	Beginner	Intermediate	Good	Advanced	Expert	Students Score
		2	4	6	8	10	
1	Collection of data/ Material	Limited information	Collects basic information	Collects more information	Collects developed information	Collects a great deal of information	8
2	Quality of data	Irrelevant	Less relevant	Needs improvement	Satisfactory	Very relevant	6
3	Quality of report	Not planned	Less organized	Moderately organized	Organized	As per the standards	4
4	Timely submission	Late submission	Submits after due date	Submits after reminders	Submit after a reminder	On time submission	2
5	Data references	No references.	Irrelevant references.	Given References not from authentic source.	Given references are from authenticated sources.	Enough authenticated references are given.	6
	Example: Total Marks= (8+6+4+2+6) =26						**26/50**

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

10. SEE- Model Theory Question Paper -1

Program	AUTOMOBILE ENGINEERING	**Semester**	**V**
Course Name	ALTERNATIVE ENERGY TECHNOLOGY	**Marks**	**50**
Course Code	**25AT51IB**	**Duration**	**90 Min**

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

Q No	**Questions**	**Cognitive Levels**	**Course Outcomes**	**Marks**
	Section -1			
1	a. List the need for alternative energy. b. List the advantages of hydropower plant	L3	1,2	5+5
2	a. List the difference between Renewable vs. Non-renewable energy sources b. Sketch and label the parts of the hydroelectric power plant.	L3	1,2	5+5
	Section -2			
3	a. Explain the Construction and working of Horizontal-axis wind turbine	L3	2	10
4	a. Explain the construction of the wind turbine gearbox.	L3	2	10
	Section -3			

5	a. Explain and compare the Grid connected and off grid solar power system	L3	3	5+5
6	a. Explain the construction and working of photovoltaic (PV) cells.	L3	3	10
Section -4				
7	a. Explant the **Construction and working of a geothermal heat pump**	L3	4	10
8	a. Explain the construction and working of Geothermal District Heating and Cooling	L3	4	10
Section -5				
9	a. List the advantages of nuclear energy b. List the advantages and disadvantages of bio gas.	L3	5	5+5
10	a. Explain the Construction and working of fixed dome type	L3	5	10

11. SEE- Model Theory Question Paper -2

Program	AUTOMOBILE ENGINEERING	**Semester**	**V**
Course Name	ALTERNATIVE ENERGY TECHNOLOGY	**Marks**	**50**
Course Code	**25AT51IB**	**Duration**	**90 Min**

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

Q No	**Questions**	**Cognitive Levels**	**Course Outcomes**	**Marks**
Section -1				
1	a. List the advantages and disadvantages of Hydo power plant. b. Compare renewable and non-renewable energy sources	L3	1,2	5+5
2	a. Explain the features of pumped storage b. List the need for alternative energy.	L3	1,2	5+5
Section -2				
3	a. Explain the Construction and working of Vertical-axis wind turbine	L3	2	10
4	b. Explain the construction of a Wind turbine controller	L3	2	10
Section -3				
5	a. List the types of solar energy storage b. List the advantages and disadvantages of solar thermal power plants	L3	3	5+5
6	a. Explain the types and compositions of solar panels	L3	3	10

Section -4				
7	a. Explant the Construction and working of Vertical axis tidal turbine	L3	4	10
8	a. Explain the Construction and working of fire tube	L3	4	10
Section -5				
9	a. List the advantages of bio gas b. Draw the schematic diagram of biogas plant and label the parts	L3	5	5+5
10	a. Explain the **Construction and Working of Fission reactor nuclear power plant.**	L3	5	10

12. SEE- Model Theory Question Paper -3

Program	AUTOMOBILE ENGINEERING	**Semester**	**V**
Course Name	ALTERNATIVE ENERGY TECHNOLOGY	**Marks**	**50**
Course Code	**25AT51IB**	**Duration**	**90 Min**

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

Q No	**Questions**	**Cognitive Levels**	**Course Outcomes**	**Marks**
Section -1				
1	c. Explain the environmental impact of fossil fuels d. Draw the layout of the hydroelectric power plant and label the parts	L3	1,2	5+5
2	c. List the difference between Renewable vs. Non-renewable energy sources d. List the benefits of Alternative energy	L3	1,2	5+5
Section -2				
3	b. Explain the Construction and working of Horizontal-axis wind turbine	L3	2	10
4	b. Explain the construction of the wind turbine controller.	L3	2	10
Section -3				
5	b. Advantages and disadvantages of Solar Thermal Power Plants Explain the composition and efficiency of different types of solar panels.	L3	3	5+5
6	b. Explain the construction and working of a parabolic trough system	L3	3	10

Section -4				
7	a. Describe the principle behind the use of tides to generate electricity. b. List the applications of geothermal energy	L3	4	5+5
8	a. Explain the construction and working of Enhanced Geothermal Systems (EGS)	L3	4	5+5
Section -5				
9	a. Describe the concept of nuclear fission and nuclear Fuson b. List the Advantages and disadvantages of bio gas	L3	5	5+5
10	a. Explain the Construction and working of floating drum type	L3	5	10

13. Equipment/software list with Specifications for a batch of 30 students

Sl. No.	Particulars Required	Specifications	Quantity
1	Anemometer	Digital anemometer with range 0-30 m/s and accuracy ±0.1 m/s	2
2	Wind Vane	Mechanical or digital wind vane with 360° rotation	2
3	Wind Turbine Model	Small-scale wind turbine with adjustable blades and rotor speed	1
4	Tachometer	Digital tachometer for measuring the rotational speed of the turbine	1
5	Power Meter	Digital power meter for measuring electrical output from the turbine	1
6	Fire Extinguisher	Dry powder fire extinguisher suitable for electrical fires	2
7	First Aid Kit	Complete first aid kit for emergencies	1
8	Solar radiation meter	Instantaneous irradiance measurements up to 1400 w/m2	1
9	Pyranometer	Maximum Operational Irradiance 0 to 4000 W / m2	1
10	Turbine models	Vertical axis and Horizontal axis	1 each
11	Biogas working model	-	1
12	Geothermal working model	-	1
13	Nuclear reactor working model	-	1

Government of Karnataka
DEPARTMENT OF TECHNICAL EDUCATION

Program	**Automobile Engineering**	**Semester**	**V**
Course Name	**Vehicle Management and Estimation**	**Type of Course**	Integrated
Course Code	**25AT51IC**	**Contact Hours**	8 hours/week
Teaching Scheme	L: T:P-4:0:4	**Credits**	6
CIE Marks	**50**	**SEE Marks**	**50 (Theory)**

1. **Rationale:** Vehicle management, and estimation are fundamental for organizations that rely on a fleet of vehicles for operations, transportation, logistics, service delivery, or any other function. Properly managing and maintaining vehicles, along with accurately estimating their costs and performance, reduce operational costs, and extend the lifespan of the vehicles.

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

CO-01	Comply with organization structure of fleet, Traffic Rules, and Regulations.
CO-02	Practice the process of maintaining different records related to service station for efficient management.
CO-03	Appreciate the importance of regular inspections and maintenance schedules to ensure vehicle reliability, performance, and longevity.
CO-04	Estimate the repair and replacement cost for automobile components.

3. **Course Content:**

WEEK	**CO**	**PO**	**Theory**	**Practice**
1	**1**	**1,6**	**Fleet management:** Introduction, structure of fleet organization, Organization structure -Line organization, Functional organization, Flat organization, Hierarchical Structure.	Visit the nearest Transport service depot and prepare a layout of the organization structure.
2	**1**	**1,6**	Fleet organization structure at depot level, administrative setup of District transport undertaking, administrative setup of state transport undertaking, EPKM, CPKM, route, vehicle schedule, trip, dead mileage	Visit the nearest Transport service depot and prepare a report on EPKM, CPKM, and Dead mileage.

3	**1**	**1,7**	Motor Vehicle Act License- Driving license & conductor license – Procedure of obtaining License- Geared, LMV, commercial vehicles, PSV Badge. Procedure of obtaining international driving License. Traffic signs- Classification- Informatory, Cautionary, and mandatory. Road markings and Kerb Markings. Motor vehicle insurance - Need, types.	Prepare a report on different types of traffic signs. Visit the nearest RTO office and collect the different types of forms available and the procedure to obtain the Vehicle Registration and Different types of Permits.
4	**1**	**1,7**	Number plates and its sizes – HSRP- Importance, Types - Whiteboard, Yellow board, green board, Black board, red board, blue Board, Number plates with upward arrow, Red with India's emblem, VIN – Importance, vehicle insurance – Introduction, Types. Scrapping of vehicle- Introduction, Procedure.	Prepare a report on the necessity and importance of different types of number plates. Practice on Evaluation of second-hand vehicle.
5	**2**	**1,7**	**Stores**: Introduction, purpose of store keeping, duties of the storekeeper, Methods of storing – Shelf Storage, Bin Storage, Pallet Racking, Rack and Pinion (Cantilever) Storage, Drive-In / Drive-Through Racking, Vertical Lift Modules (VLM). Bin card, indent, Invoice and Return Indent.	Visit the nearest service station and prepare a report on the store and methods of storage. Prepare a model layout on the tools and equipment available in your workshop and affix in proper order as per the storage method.
6	**2**	**1**	Service Station: Introduction, Types, Factors to start new service station, service station layouts, service station records.	Visit the nearest service stations and draw the layout. Estimate the tools and Equipment required to start a service station. (Ex: High pressure washing and lubrication unit, Wheel alignment and tyre replacement centre, A/C Reconditioning center, etc)
7	**3**	**1,2**	**Vehicle maintenance:** Introduction, Necessity of maintenance, Types – Periodic, Preventive and Breakdown Maintenance, Vehicle inspection	Prepare a PDI checklist for delivery of 2-wheeler and 4-wheeler vehicles.

			checklists, vehicle inspection reports-PDI. log books, Job cards, and Workshop activities.	Prepare a case study on preventive and breakdown maintenance of vehicles.
8	**3**	**1,2**	**Estimation:** Introduction to estimation & costing – aims of estimating – qualities of an estimator – procedure of estimating – sources of error in estimation – constituents of estimation.	Solve simple problems on estimation and costing.
9	**3**	**1,2**	**Costing:** Objectives of costing, elements, and components of costing - Direct Costs, Indirect Costs (Overheads), Fixed Costs, Variable Costs. The difference between estimation & costing.	Solve simple problems on estimation and costing.
10	**3**	**1,2**	**Depreciation**: Introduction to depreciation and obsolescence, causes of depreciation, methods of calculating depreciation – Straight line method, Declining balance method, sum of years digits method, problems on Straight-line method.	Evaluate a vehicle considering depreciation and other factors to sell a vehicle. Evaluate a vehicle considering depreciation and other factors to buy a vehicle.
11	**4**	**1,2**	**Repair estimation**: Procedure of preparing repair and replacement estimation of Engine components – Head gasket replacement, Cylinder head reconditioning, Timing belt replacement and adjustment, Valve reconditioning, Cooling system overhaul, and Lubrication system overhaul.	Prepare a repair estimation for Head gasket replacement. Prepare a repair estimation for Cylinder head reconditioning. Prepare a repair estimation for Radiator reconditioning.
12	**4**	**1,2**	Procedure of preparing repair estimation of Transmission system – Clutch overhaul, Gearbox overhaul, final drive overhaul. Electrical system – Servicing of Alternator and Starter motor.	Prepare a repair estimation for Clutch overhauling. Prepare a repair estimation for Gearbox overhauling. Prepare a repair estimation for starter motor reconditioning.
13	**4**	**1,2**	Procedure of preparing repair and replacement estimation of Body and Paint – Dent repair, Fender replacement, Full paint job, Bumper repair, Door repair, Windshield	Prepare a repair estimation for Fender replacement Prepare a repair estimation for Full body paint for a Car. Prepare a repair estimation for

			replacement.	Windshield replacement of a Car.

4. References:

Sl. no	Title of book	Author	Publisher
1.	Industrial Organization and Engineering Economics	T.R.Banga & S C Sharma	Khanna.Publishers
2.	Industrial Management and Engineering Economics	O.P.Khanna	Khanna publishers
3.	Safety Management in Industry	Krishnan's V	Jaico Publishing House, Bombay, 1997
4.	Vehicle Transport Management	S.L.Bhandarkar	Dhanapath Rai & Co
5.	The central Motor Vehicles Rules 1989 (2001 Edition)	Edited By: Sathpal Puliani	Karnataka Law Journal Publications Bangalore
6.	The central Motor Vehicles Rules 1989 (2005 Edition)	Edited By: Sathpal Puliani	Karnataka Law Journal Publications Bangalore
7.	Automobile engineering	G.B.S. Narang	Khanna publishers
8.	Automobile engineering	C.P. Nakara	Dhanapath Rai
9.	Estimation & costing	T.R. Banga & S.C. Sharma	Khanna Publications

Rubrics for Portfolio evaluation Level of Achievement						
Assessment Parameter		**Excellent (10)**	**Very Good (8)**	**Fair (6)**	**Poor (4)**	**Score**
AP1	**Organization of Report and Timely Submission**	Lab report is well organized as directed and submitted on time	Lab report is well organized but not submitted on time	Report contains few errors and not submitted on time them	Poor organization and late submission	
AP2	**Knowledge of Tools and Procedures**	Demonstrates deep knowledge of tools and procedures; answer the related questions with explanations and elaboration	Adequate knowledge of most tools and procedures; answer the related questions, but fails to elaborate	Superficial knowledge of tools and procedures; able to answer only some of the related basic questions	Lack of information about most of the tools and procedures; cannot even answer basic related questions	
AP3	**Team Working Skills**	Positive in interacting with all group members, encourages such interaction in others, and always sensitive to the abilities and feelings of others' contributions; Actively helps to identify group goals and works effectively to meet them in assigned roles	Interacts with all group members spontaneously and contributes in a way that is sensitive to the abilities and feelings of others; Demonstrates commitment to group goals and carries out assigned roles effectively	Interacts with other group members if prompted, but sometimes expresses opinions which are insensitive to the abilities and feelings of others; Demonstrates commitment to group goals, but has difficulty performing assigned roles	Rarely interacts within a group, even with prompting, and shows frequent lack of sensitivity to others' feelings and abilities in opinions expressed; Shows little commitment to group goals and fails to perform assigned roles	
AP4	**Result Analysis and Data Interpretation**	Excellent insight and well-focused results and discussion; Data completely and appropriately interpreted and no overinterpretation	Adequate insight but missed some important points in results and discussion; Interpreted most data correctly but some conclusions may be suspect or over-interpreted	Little insight and analysed only the most basic points; Interpreted some data correctly but significant errors, omissions still present.	No insight and entirely missed the point of the experiment; Little or no attempt to interpret data or overinterpreted data.	
AP5	**Task Management**	Very Effective in managing the assigned task and allow experimenter(s) to achieve all goals	Somewhat effective in managing the assigned tasks and allow experimenter(s) to achieve most goals.	Somewhat ineffective in managing the assigned task and allow experimenter(s) to achieve only few goals.	Very ineffective and would not allow experimenters to achieve any goals	

5. CIE Assessment Methodologies:

Sl. No	CIE Assessment	Test Week	Duration (minutes)	Max marks	
1.	CIE-1TheoryTest	4	90	50	Average of all CIE=50 Marks
2.	CIE-2Practice Test	7	180	50	
3	CIE-3TheoryTest	10	90	50	
4.	CIE-4Practice Test	13	180	50	
5	CIE-5 Portfolio evaluation of all the activities through Rubrics	1-13		50	
				Total	

6. SEE - Theory Assessment Methodologies

Sl. No	SEE – Theory Assessment	Duration (minutes)	Max marks	Min marks to pass
1.	Semester End Examination-Theory	90	50	20

16. CIE Theory Test model question paper

Program	**Automobile Engineering**			**Semester -V**	
Course Name	**Vehicle Management and Estimation**			**Test**	**I/III**
Course Code	**25AT51IC**	**Duration**	**90 min**	**Marks**	**50**
Name of the Course Coordinator:					
Note: Answer any one full question from each section. Each full question carries equal marks.					

QN	Questions	CL	CO	Marks
	Section - 1			
1	a) State the Trip and dead mileage b) Explain organization structure of state transport undertaking with block diagram. c) List the advantages and disadvantages of Line organization.	L2 L3 L2	C1	5 10 10
2	a) State route and vehicle schedule b) Explain the organisational structure of the district transport undertaking with a block diagram. c) List the advantages and disadvantages of Functional	L2 L3 L2	C1	5 10 10

	organization.			
	Section – 2			
3	a) Discuss the necessity of registration of vehicles. b) State the different types of Permits c) Explain the procedure to obtain the learner's driving license. d) Explain comprehensive insurance	L3 L2 L3 L3	C1	5 5 10 5
4	a) State the different types of number plates. b) Explain the procedure of scrapping of vehicle c) Explain the procedure of obtaining PSV Badge d) Identify the following Traffic signs i) ii) iii) iv) v) 	L2 L3 L3 L3	C1	5 5 5 10

Signature of Course Coordinator **HOD** **IQAC Chairman**

17. CIE Practice Test model question paper

Program	**Automobile Engineering**			**Semester**	**V**
Course Name	**Vehicle Management and Estimation**			**Test**	**II/IV**
Course Code	**25AT51IC**	**Duration**	**180 min**	**Marks**	**50**
Name of the Course Coordinator:					
Questions				**CO**	**Marks**
1. Identify the different number plates and list the specifications of the same. 2. Draw the layout of service station visited during the practice session. OR 3. Identify the different traffic signs from the chart and discuss the importance of it. 4. Discuss the procedure of handling the indent, Invoice and return indent in stores.				**1** **2** **1** **2**	**50**
Scheme of assessment: a) Procedure writing- 3+3=6 b) Conduction-10, troubleshoot-3/calculation-3, results-2, 10+3+2 (15 x 2 experiments = 30) c) Viva voce - 10 d) Portfolio evaluation of practical record – 4					
				Total Marks	**50**

Signature of Course Coordinator **HOD** **IQAC Chairman**

18. **Suggestive Activities for Tutorials**:

The List is 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

Sl.No.	Suggestive Activities for Tutorials
01	Prepare a physical model of the service station.
02	Prepare a Model of Traffic signs and road signs.
03	Visit the nearest workshop and observe the process of vehicle receiving for servicing by the service advisor; Prepare a report on it.
04	Prepare a report on the tools and equipment required to start a two-wheeler service station.
05	Visit the nearest workshop and prepare a report on the process of warranty claim.
06	Prepare a report on insurance claims for motor vehicle

19. Rubrics for Assessment of Activity (Qualitative Assessment)

Sl. No.	Dimension	Beginner	Intermediate	Good	Advanced	Expert	Students Score
		2	4	6	8	10	
1	Collection of data/ Material	Limited information	Collects basic information	Collects more information	Collects developed information	Collects a great deal of information	8
2	Quality of data	Irrelevant	Less relevant	Needs improvement	Satisfactory	Very relevant	6
3	Quality of report	Not planned	Less organized	Moderately organized	Organized	As per the standards	4
4	Timely submission	Late submission	Submits after due date	Submits after reminders	Submit after a reminder	On time submission	2
5	Data references	No references.	Irrelevant references.	Given References not from authentic source.	Given references are from authenticated sources.	Enough authenticated references are given.	6
	Example: Total Marks=(8+6+4+2+6)=26						**26/50**

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

20. SEE–Model Theory Question Paper-1

Program	**Automobile Engineering**	**Semester**	**V**
Course Name	**Vehicle Management and Estimation**	**Marks**	**50**
Course Code	**25AT51IC**	**Duration**	**90 Min**

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

Q No	Questions	Cognitive Levels	Course Outcomes	Marks
	Section -1			
1	a) List different types of organization structures. b) Draw the block diagram of Line organization	L2	C1	10
2	a) State the meaning of Trip and dead mileage b) Explain the fleet organization structure at depot level	L2	C1	10
	Section -2			
3	a) Explain the procedure to obtain the LMV driving license. b) List the types of number plates.	L3	C1	10
4	a) Identify the following Traffic signs i) ii) iii) iv) v)  b) Explain the types and importance of insurance.	L3	C1	10
	Section -3			
5	a) State the different methods of storing. b) Draw a layout of a service station and mark the position of different divisions.	L3	C2	10
6	a) Explain the Drive-Through Racking storage system b) List the factors to be considered for starting a new service station.	L3	C2	10
	Section -4			
7	a) List the different types of maintenance and explain anyone. b) List the different types of calculating depreciation and explain anyone.	L2	C3	10
8	a) Explain the Job card and Log books b) List the factors of costing and explain the Fixed cost.	L2	C3	10
	Section -5			
9	a) List the different methods of depreciation. b) Explain the procedure of preparing repair estimation of Final drive overhauling.	L3	C3, C4	10

10	a) Calculate the cost of depreciation for a car using the straight-line method. Initial value of the car is 12 Lakhs, Life of the car is 17 years, Scrap value is 1 Lakh. b) Explain the procedure of preparing repair estimation of valve reconditioning.	L3	C3, C4	10

21. Model Theory Question Paper-2

Program	**Automobile Engineering**	**Semester**	**V**
Course Name	**Vehicle Management and Estimation**	**Marks**	**50**
Course Code	**25AT51IC**	**Duration**	**90 Min**

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

Q No	Questions	Cognitive Levels	Course Outcomes	Marks
	Section -1			
1	a) Draw a block diagram of the Functional organization structure b) State the meaning of Vehicle schedule and Route	L2	C1	10
2	a) State the meaning of EPKM and CPKM b) Explain the fleet organization structure at the district level	L2	C1	10
	Section -2			
3	a) Explain the procedure to obtain the LMV learning license. b) List the importance of yellow and green number plates	L3	C1	10
4	a) Classify the traffic signs and list their importance. b) Explain the procedure to obtain international driving license.	L3	C1	10
	Section -3			
5	a) List the methods of storing. b) Draw a layout of a service station and mark the position of different divisions.	L3	C2	10
6	a) Explain the VLM storage. b) Explain the importance of indent, invoice and Return indent	L3	C2	10
	Section -4			
7	a) Explain the preventive service b) List the objectives of costing	L2	C3	10
8	a) List the different methods of depreciation b) List the qualities of an estimator	L2	C3	10
	Section -5			

9	a) Explain the procedure for the overhauling of the lubrication system. b) Explain the procedure for the replacement of the timing belt.	L3	C3, C4	10
10	c) Calculate the cost of depreciation for a car using the straight-line method. Initial value of the car is 10 Lakhs, Life of the car is 15 years, Scrap value is 2 Lakh. d) Explain the procedure for the replacement of Windshield	L3	C3, C4	10

22. Model Theory Question Paper-3

Program	**Automobile Engineering**	**Semester**	**V**
Course Name	**Vehicle Management and Estimation**	**Marks**	**50**
Course Code	**25AT51IC**	**Duration**	**90 Min**

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

Q No	Questions	Cognitive Levels	Course Outcomes	Marks
	Section -1			
1	a) State the meaning of EPKM and CPKM b) Draw the block diagram of Flat organization	L2	C1	10
2	a) State the meaning of Route and dead mileage b) Explain the fleet organization structure at state level	L2	C1	10
	Section -2			
3	a) Explain the procedure to obtain a commercial vehicle driving license. b) State the abbreviation and importance of HSRP number plate	L3	C1	10
4	a) List the different types of road markings b) Explain the procedure to scrap a vehicle	L3	C1	10
	Section -3			
5	a) State the purpose of storekeeping and duties. b) Draw a layout of a service station and mark the position of different divisions.	L3	C2	10
6	a) Explain the Shelf storage and bin storage system b) List the factors to be considered for starting a new service station.	L3	C2	10
	Section -4			
7	a) Explain the periodic service b) List the aims of estimation	L2	C3	10
8	a) List the importance of Log books and job cards b) List the sources of errors in estimation	L2	C3	10

Section -5				
9	a) List the different methods of depreciation b) Explain the procedure for replacement of Head gasket.	L3	C3, C4	10
10	e) Calculate the cost of depreciation for a car using the straight-line method. Initial value of the car is 8 Lakhs, Life of the car is 15 years, Scrap value is 1 Lakh. f) Explain the procedure for the replacement of Fender.	L3	C3, C4	10

Program	Automobile Engineering	Semester	V
Course Name	Manufacturing Technology	Type of Course	Integrated
Course Code	25AT52IA	Contact Hours	07 hours/Week
Teaching Scheme	L: T:P, 3:0:4	Credits	5
CIE Marks	50	SEE Marks	50 (Practice)

23. **Rationale:** This subject is designed to expose the student to wide range of manufacturing process including machining, moulding, casting, welding, and additive manufacturing. This exposure opens up opportunities for the student to work in various manufacturing industries.

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

CO-01	Perform the different metal-cutting operations using conventional machines.
CO-02	Perform different metal joining operations using standard tools and procedure.
CO-03	Perform surface finishing and casting-related activities using appropriate tools and procedures.
CO-04	Perform different operations on CNC machines and 3D printing machine.

25. Course Content

WEEK	CO	PO	Theory	Practice
1	1	1,4,7	Introduction to lathe-classification of lathe-construction and working of centre lathe, operations performed on lathe-facing, cantering, plain turning.	Identify types of lathes. Identify parts of centre lathe. Practice on facing, centring and plain turning.
2	1	1,4,7	Lathe operations-taper turning, thread cutting, knurling, drilling and boring.	Practice on taper turning, thread cutting, knurling, drilling and boring process.
3	1	1,4	Introduction to drilling machine-types-construction and working of bench drilling machine, Construction and working of pillar drilling machine.	Identification of types of drilling machines. Identify parts of drilling machine. Drilling, boring, counter boring, counter sinking, and tapping.
4	1	1,4	Introduction to milling machine-types-construction and working of horizontal milling machine. Operation- face milling, slot milling, gear milling.	Identification of types of milling machine, identification of parts of horizontal milling machine, Practice the process of surface milling, slot milling, and gear milling.
5	1	1,4	Introduction to grinding- types of grinding machine-construction and working of surface grinder,	Identification of type of grinding machine. Practice the process of surface grinding

			cylindrical grinder and center less grinder.	and cylindrical grinding.
6	**2**	**1,4**	Welding-concept-types-arc welding process-applications, gas welding process-applications, Types of flames and their applications, List the common defects, reasons and remedies.	Identification of arc welding machine parts. Practice on fabrication of T-joint, but joint, lap joint. Identification of gas welding equipment. Practice generation of different flames. Practice on joining two metal sheets using gas welding process.
7	**2**	**1,4**	TIG welding process-applications, MIG welding process-applications, resistance arc welding (Seam and spot)-applications, electron beam welding-applications.	Identify the parts of TIG, MIG, resistance welding, equipment. Practice the process of TIG and resistance welding process.
8	**3**	**1,4**	Casting process-concept-types-sand mold casting-applications, centrifugal casting-applications, die casting-applications, investment casting-applications.	Practice the process of Mould sand preparation. Practice the process of Mold making of round, square and hexagonal shape with centre hole. Practice the process of producing any one above mentioned casting shape.
9	**3**	**1,4**	Patterns-types-materials for patterns, casting defects-prevention methods. Surface finishing process-buffing, polishing, electroplating and lapping.	Practice the process of producing a pattern with all allowances. Practice the process of buffing using proper tools and procedure. Practice the process of lapping process with proper tools and procedure.
10	**4**	**1,4,7**	Introduction to CNC machines-merits and demerits. Cartesian coordinate system (X, Y, Z axes). Machine vs. part coordinates. Zero points and reference points. Axis movements (absolute, incremental). CNC Programming Basics-G-codes and M-codes. Turning programs-Simple programs on linear interpolation, facing, plain turning, step turning, chamfering, taper turning without using standard cycles,	Identify the parts of typical CNC lathe and milling machine. **Machine Setup**: Workpiece holding (clamps, vises *or* chucks, collets). Tool selection and mounting. Setting up the machine (zeroing, tool offsets). Simulation or execution of the facing, plain turning, step turning, chamfering and taper turning.
11	**4**	**1,4,7**	Turning programs- Simple programs on circular interpolation, write a program for a component consisting of all the above-mentioned features.	Simulation or execution of the program written for the given component as per the drawing.
12	**4**	**1,4,7**	Milling programs- Simple programs on linear and circular interpolation, write a program for a component consisting of linear and circular slots.	Simulation or execution of the program written for the given component with above linear and circular slot features.

13	**4**	**1,4,7**	Introduction to additive manufacturing-types-merits and demerits, working of fusion deposition modelling-applications, merits and demerits, Stereolithography-working-merits and demerits, working of Selective Laser Sintering-applications-merits and demerits.	Practice on creating a 3D model of the object to be printed. Practice on converting a 3D model format into . stl format. Practice on producing the 3D model using FDM process. Practice on finishing the 3D model printed.

26. References:

Sl. No	**Title of Books**	**Author**	**Publications**
1	Elements of Workshop Technology Vol-I	Hajra Choudry	Media Promoters & Publishers Pvt Ltd.
2	Elements of Workshop Technology Vol-II	Hajra Choudry	Media Promoters & Publishers Pvt Ltd.
3	Manufacturing Technology-1	P.C Sharma	S. CHAND Publications.
4	Work shop technology	R.S KHURMI & J.K GUPTA	S. CHAND Publications.
5	Production technology	O P Khanna	Dhanpath rai publication
6	Fundamental Principles of Manufacturing Processes	Leo Alting, Robert H. Todd and Dell K. Allen	Industrial press
7	Modern Manufacturing Processes	James Brown	Industrial press

17. **Rubrics for Portfolio evaluation** **Level of Achievement**						
Assessment Parameter		**Excellent (10)**	**Very Good (8)**	**Fair (6)**	**Poor (4)**	**Score**
AP1	**Organization of Report and Timely Submission**	Lab report is well organized as directed and submitted on time	Lab report is well organized but not submitted on time	Report contains few errors and not submitted on time them	Poor organization and late submission	
AP2	**Knowledge of Tools and Procedures**	Demonstrates deep knowledge of tools and procedures; answer the related questions with explanations and elaboration	Adequate knowledge of most tools and procedures; answer the related questions, but fails to elaborate	Superficial knowledge of tools and procedures; able to answer only some of the related basic questions	Lack of information about most of the tools and procedures; cannot even answer basic related questions	
AP3	**Team Working Skills**	Positive in interacting with all group members, encourages such interaction in others, and always sensitive to the abilities and feelings of others' contributions; Actively helps to identify group goals and works effectively to meet them in assigned roles	Interacts with all group members spontaneously and contributes in a way that is sensitive to the abilities and feelings of others; Demonstrates commitment to group goals and carries out assigned roles effectively	Interacts with other group members if prompted, but sometimes expresses opinions which are insensitive to the abilities and feelings of others; Demonstrates commitment to group goals, but has difficulty performing assigned roles	Rarely interacts within a group, even with prompting, and shows frequent lack of sensitivity to others' feelings and abilities in opinions expressed; Shows little commitment to group goals and fails to perform assigned roles	
AP4	**Result Analysis and Data Interpretation**	Excellent insight and well-focused results and discussion; Data completely and appropriately interpreted and no overinterpretation	Adequate insight but missed some important points in results and discussion; Interpreted most data correctly but some conclusions may be suspect or over-interpreted	Little insight and analysed only the most basic points; Interpreted some data correctly but significant errors, omissions still present.	No insight and entirely missed the point of the experiment; Little or no attempt to interpret data or overinterpreted data.	
AP5	**Task Management**	Very Effective in managing the assigned task and allow experimenter(s) to achieve all goals	Somewhat effective in managing the assigned tasks and allow experimenter(s) to achieve most goals.	Somewhat ineffective in managing the assigned task and allow experimenter(s) to achieve only few goals.	Very ineffective and would not allow experimenters to achieve any goals	

27. CIE Assessment Methodologies

Sl. No	CIE Assessment	Test Week	Duration (minutes)	Max marks	
1.	CIE-1TheoryTest	4	90	50	Average of all CIE=50 Marks
2.	CIE-2Practice Test	7	180	50	
3	CIE-3TheoryTest	10	90	50	
4.	CIE-4Practice Test	13	180	50	
5	CIE-5 Portfolio evaluation of all the activities through Rubrics	1-13		50	
				Total	**50 Marks**

28. SEE – Practice Assessment Methodologies

Sl. No	SEE – Practice Assessment	Duration (minutes)	Max marks	Min marks to pass
1.	Semester End Examination-Practice	180	50	20

29. CIE Theory Test model question paper

Program	**Automobile engineering**			**Semester -V**	
Course Name	**Manufacturing Technology**			**Test**	**I/III**
Course Code	**25AT52IA**	**Duration**	**90 min**	**Marks**	**50**
Name of the Course Coordinator:					
Note: Answer any one full question from each section. Each full question carries equal marks.					

Q. No	**Questions**	**Cognitive Level**	**Course Outcome**	**Marks**
	Section - 1			
1	a) List the classification of lathe. 5m b) Explain the taper turning process by swelling compound rest method. 10m c) Explain the construction and working of the bench drilling machine. 10m	L2 L3 L3	1	25
2	a) Explain the slot milling process. 5m b) Explain the construction and working of the pillar drilling machine. 10m c) Draw a neat sketch of the lathe and label the parts. 10m	L2 L3 L3	1	
	Section - 2			
3	a) Describe the process of thread cutting. 5m b) Explain the turning, facing and centering operations in the lathe. 10m c) Explain the process of slot milling and face milling. 10m	L2 L3 L2	1	25
4	a) Explain the difference between facing and turning. 5m b) Explain the construction and working of the horizontal milling machine. 10m c) Describe the knurling and boring operation on a lathe. 10m	L2 L3 L2	1	

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.

Signature of the Course Coordinator **HOD** **IQAC**

30. CIE Practice Test model question paper

Program	Automobile engineering			**Semester**	V
Course Name	Manufacturing Technology			**Test**	II/IV
Course Code	**25AT52IA**	Duration	180 min	**Marks**	50
Name of the Course Coordinator:					

Questions	**Marks**
5) Perform operations on a lathe as per the given sketch. 6) Perform drilling and counter boring operation as per the given dimension. OR 7) Perform operations on a lathe as per the given sketch. 8) Perform face milling operation by setting of job on a milling machine.	50
Scheme of assessment: a) Procedure writing- 3+3=6 b) Conduction-15 (15 x 2 experiments = 30) c) Viva voce - 10 d) Portfolio evaluation of practical record – 4	**50**
Total Marks	**50**

Signature of the Course Coordinator **HOD** **IQAC**

8. Suggestive Activities for Tutorials:

The List is an Example and not inclusive of all possible activities of the course. Students and Faculty are encouraged to choose activities that are relevant to the topic. Two activities, each for 50 marks should be evaluated with proper rubrics.

Sl.No.	**Suggestive Activities for Tutorials**
01	Prepare a detailed report on various holding devices on a lathe.
02	Prepare a report on belt grinder.
03	Prepare a report on plasma welding process.
04	Fabricate a multi piece pattern.
05	Visit a nearby industry and prepare a report on advanced manufacturing processes adopted.
06	Visit a nearby bakery and prepare a report on 3D printing technology used in the bakery.
07	Prepare a report on various additive manufacturing process used in Automotive components.

31. Rubrics for Assessment of Activity (Qualitative Assessment)

Sl. No.	Dimension	Beginner	Intermediate	Good	Advanced	Expert	Student sScore
		2	4	6	8	10	
1	Collection of data/ Material	Limited information	Collects basic information	Collects more information	Collects developed information	Collects a great deal of informatio n	8
2	Quality of data	Irrelevant	Less relevant	Needs improvement	Satisfactory	Very relevant	6
3	Quality of report	Not planned	Less organized	Moderately organized	Organized	As per the standards	4
4	Timely submission	Late submission	Submits after due date	Submits after reminders	Submit after a reminder	On time submissio n	2
5	Data references	No references.	Irrelevant references.	Given References not from authentic source.	Given references are from authenticate d sources.	Enough authenticat ed references are given.	6
	Example: Total= (8+6+4+2+6=26)						**26/50**

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

32. Equipment/softwarelistwithSpecificationforabatchof30students

Sl.No.	Particulars	Specification	Quantity
01	Center lathe	20inch chuck capacity, 2hp 3phase motor	10
02	Drilling machine	Bench type and pillar drilling machine	1 each
03	Milling machine	Table size 1320x360mm	1
04	Surface grinding machine	Table size- 300x750mm	1
05	Cylindrical grinding machine	Distance between centers- 600mm	1
06	Arc welding equipment	CO2 arc welding	2
07	Gas welding equipment		2
08	3D printing machine	FDM Type	2
09	CNC Trainer lathe		1
10	CNC Trainer milling machine		1

Government of Karnataka
DEPARTMENT OF TECHNICAL EDUCATION

Program	**Automobile Engineering**	**Semester**	**V**
Course Name	**Construction equipment and special vehicles**	**Type of Course**	Integrated
Course Code	**25AT52IB**	**Contact Hours/Week**	07
Teaching Scheme	L: T:P. 3:0:4	**Credits**	05
CIE Marks	**50**	**SEE Marks**	**50 (Practice)**

1. Rationale: Studying Construction Equipment and Special Vehicles as a subject stem from the growing importance of machinery in modern construction, infrastructure development, and heavy industries. Construction projects whether roads, bridges, buildings, or other large-scale developments require specialized equipment to ensure efficiency, safety, and quality.

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

CO-01	Classify equipment based on their function in construction projects
CO-02	Perform the servicing of undercarriage and control system components.
CO-03	Perform the servicing of levelling and loading equipment.
CO-04	Perform the servicing of material handling equipment.

2. **Course Content:**

WEEK	**CO**	**PO**	**Theory**	**Practice**
1	**1**	**1,6,7**	Fundamentals of Earth Movers- Earth Moving Operations, Classification of Earth Moving Equipment based on application. Difference between Construction and Mining process. Key factors affecting load carrying capacity of earth moving equipment.	Identification of different types of construction equipment based on applications. Prepare a report comparing mining and earthmoving equipment.
2	**2**	**1,4**	Tyre and tracked vehicles - advantages and disadvantages, Construction, and the functions of undercarriage components of crawler tractors.	Identification of parts of the tracked vehicle undercarriage components. Perform the Maintenance activities of undercarriage components.

3	**2**	**1,4**	Steering mechanism- types, Construction and working- Hydraulic Power Steering, Differential Steering.	Identification of different parts of different steering system Servicing of Hydraulic power steering system.
4	**2**	**1,4**	**Tracked vehicle steering systems:** Construction and working of - Clutch /brake steering system, planetary steering system, Articulated Steering.	Servicing of Clutch/ brake steering system Servicing of Articulated steering system
5	**3**	**1,4**	Dozers-need, Types, construction and working of Crawling dozers, wheel dozers. Construction and working of blade operating mechanism. Motor grader-need, construction and working of blade operating mechanism.	Identification of parts of dozer, identification of parts of dozer blade operating mechanism. Servicing of dozer blade hydraulic operating mechanism. Identification of parts of motor grader.
6	**3**	**1,4**	Power shovels-need, Types, construction and working of Cable-Operated Shovels**,** Trenchers. Applications of each type. Excavators-need, Types, Construction and working of Bucket and Turret operating mechanism of excavators.	Identification of parts of bucket operating mechanism (both hydraulic and rope). Servicing of hydraulic system in excavator. Servicing of bucket operating mechanism (both hydraulic and rope).
7	**3**	**1,4**	Loaders-Need, Types, Construction and Working - Wheel Loaders (Front-End Loaders), Backhoe Loaders, Articulated Loaders, advantages of each type.	Identification of parts of bucket operating mechanism. Servicing of bucket operating mechanism.
8	**3**	**1,4**	Scrapers- need, types, Construction and working of Motor Scraper, Wheel Tractor Scrapers. Advantages of each type.	Identification of parts of blade operating mechanism. Servicing of blade operating mechanism.
9	**4**	**1,4**	Compaction equipment-need, types, Rollers- types, Construction and working of Vibratory Rollers, Static roller, Sheep foot roller, pneumatic rollers, Tandem rollers. Advantages of each type.	Identification of parts of roller. Servicing of the steering system of tandem roller. Practice the process of ballasting of rollers.
10	**4**	**1,4**	Cranes-need, types, Construction and working of Derrick crane, mobile cranes, traveler crane overhead cranes and Tower cranes.	Identification of parts of cranes. Servicing of winch and boom operating mechanism.
11	**4**	**1,4**	Crushers-need, Types, Construction and working of Jaw Crusher, Impact crusher, Roller crusher.	Identification of parts of crushers. Visit a nearby field where the crushers are used and make a report on the types of crushers and their applications.
12	**4**	**1,4**	Feeders- need, application; Screening Equipment- need, application; Handling Equipment- need, application; Batching and Mixing Equipment- Need, application; Ready-Mix concrete equipment- need, application Concrete pouring equipment- need, application.	Visit a nearby construction site and prepare a report on how to handle, mix, and pour concrete using different equipment.
13	**4**	**1,4**	Front end loader- need, Types, Construction and working of wheel type and crawler type, Application.	Identification of parts of front-end loader and fork lifter. Practice on lubrication of front-end loader

			Fork lifter- Need, Types, Construction and working of Internal combustion types, Application.	and fork lifter.

3. **References:**

Sl., NO	Title of the book	Author
1	Construction equipment and its management.	S.C. Sharma
2	On and with the earth	Jagman Singh
3	Farm machinery and mechanism	Donald R. hunt and L. W. garner
4	Diesel equipment- volume I and II	Erich Schulz
5	On and with the earth	Jagman Singh,

4. **CIE Assessment Methodologies**

Sl. No	CIE Assessment	Test Week (At the End Of)	Duration (minutes)	Max marks	
1.	CIE-1TheoryTest	4	90	50	Average of all CIE=50 Marks
2.	CIE-2Practice Test	7	180	50	
3	CIE-3TheoryTest	10	90	50	
4.	CIE-4Practice Test	13	180	50	
5	CIE-5 Portfolio evaluation of all the activities through Rubrics	1-13		50	
				Total	**50 Marks**

Rubrics for Portfolio evaluation Level of Achievement						
Assessment Parameter		**Excellent (10)**	**Very Good (8)**	**Fair (6)**	**Poor (4)**	**Score**
AP1	**Organization of Report and Timely Submission**	Lab report is well organized as directed and submitted on time	Lab report is well organized but not submitted on time	Report contains few errors and not submitted them	Poor organization and late submission	
AP2	**Knowledge of Tools and Procedures**	Demonstrates deep knowledge of tools and procedures; answer the related questions with explanations and elaboration	Adequate knowledge of most tools and procedures; answer the related questions, but fails to elaborate	Superficial knowledge of tools and procedures; able to answer only some of the related basic questions	Lack of information about most of the tools and procedures; cannot even answer basic related questions	
AP3	**Team Working Skills**	Positive in interacting with all group members, encourages such interaction in others, and always sensitive to the abilities and feelings of others' contributions; Actively helps to identify group goals and works effectively to meet them in assigned roles	Interacts with all group members spontaneously and contributes in a way that is sensitive to the abilities and feelings of others; Demonstrates commitment to group goals and carries out assigned roles effectively	Interacts with other group members if prompted, but sometimes expresses opinions which are insensitive to the abilities and feelings of others; Demonstrates commitment to group goals, but has difficulty performing assigned roles	Rarely interacts within a group, even with prompting, and shows frequent lack of sensitivity to others' feelings and abilities in opinions expressed; Shows little commitment to group goals and fails to perform assigned roles	
AP4	**Result Analysis and Data Interpretation**	Excellent insight and well-focused results and discussion; Data completely and appropriately interpreted and no overinterpretation	Adequate insight but missed some important points in results and discussion; Interpreted most data correctly but some conclusions may be suspect or over-interpreted	Little insight and analysed only the most basic points; Interpreted some data correctly but significant errors, omissions still present.	No insight and entirely missed the point of the experiment; Little or no attempt to interpret data or overinterpreted data.	
AP5	**Task Management**	Very Effective in managing the assigned task and allow experimenter(s) to achieve all goals	Somewhat effective in managing the assigned tasks and allow experimenter(s) to achieve most goals.	Somewhat ineffective in managing the assigned task and allow experimenter(s) to achieve only few goals.	Very ineffective and would not allow experimenters to achieve any goals	

5. **CIE -1 Theory Test model question paper**

Program	**Automobile Engineering**			**Semester - V**	
Course Name	**Construction equipment and special vehicles**			**Test**	**I/III**
Course Code	**25AT52IB**	**Duration**	**90 min**	**Marks**	**50**
Name of the Course Coordinator:					
Note: Answer one full question from each section. Each full question carries equal marks.					

Q. No	**Questions**	**Cognitive Level**	**Course Outcome**	**Marks**
	Section - 1			
1	a) List the classification of earth moving equipment. 5m b) Explain the construction and working of articulated steering. 10m c) List the key factors affecting load carrying capacity of earth moving equipment. 10m	L1 L2 L3	1,2	25
2	a) List the advantages and disadvantages of tyre and tracked vehicles. 5m b) Explain the differential steering in tractors. 10m c) Explain the construction and working of clutch/break steering system. 10m	L1 L2 L3	1,2	
	Section - 2			
3	a) List the different earth moving operations. 5m b) List and explain the functions of undercarriage components of a crawler tractor. 10m c) Explain the construction and working of planetary gear steering system with a neat sketch.	L1 L2 L3	1,2	25
4	a) List the differences between construction and mining. 5m b) Explain construction of track roller and idler. 10m c) Explain hydraulic power steering with a neat sketch. 10m	L1 L2 L3	1,2	

6. **CIE Practice Test model question paper:**

Program	**Automobile Engineering**			**Semester**	**V**
Course Name	**Construction equipment and special vehicles**			**Test**	**II/IV**
Course Code	**25AT52IB**	**Duration**	**180 min**	**Marks**	**50**
Name of the Course Coordinator:					
Questions				**Marks**	
51 Service the given hydraulic power steering system. **OR** 52 Service the given articulated steering system.				**50**	
53 Service the given bucket operating mechanism of a power shovel. **OR** **54** Service the given dozer blade operating mechanism.					
Scheme of assessment: a) Procedure writing. 3+3=6 b) Conduction/ Trouble shoot/ Calculation and result=10+3+2 =15(15x2Exp=30) c) Viva -voce 10M d) Portfolio evaluation of practical record 4M					
Total Marks				**50**	

Signature of the Course Coordinator **HOD** **IQAC**

7. **Suggestive Activities for Tutorials**:

The List is an Example and not inclusive of all possible activities of the course. Students and Faculty are encouraged to choose activities that are relevant to the topic

Sl.No.	**Suggestive Activities for Tutorials**
01	Visit nearby road construction site and prepare a report on construction equipment used.
02	Visit nearby bridge construction site and prepare a report on construction equipment used.
03	Prepare a report on tracked vehicle undercarriage components.
04	Visit an apartment construction and prepare a report on different types of cranes used.
05	Prepare a report on different hydraulic systems used in construction equipment.

Note: two activities, each activity for 50 marks with proper rubrics.

8. **Rubrics for Assessment of Activity (Qualitative Assessment)**

Sl. No.	Dimension	Beginner	Intermediate	Good	Advanced	Expert	Students Score
		2	4	6	8	10	
1	Collection of data/ Material	Limited information	Collect basic information	Collect more information	Collects developed information	Collects a great deal of information	
2	Quality of data	Irrelevant	Less relevant	Needs improvement	Satisfactory	Very relevant	
3	Quality of report	Not planned	Less organized	Moderately organized	Organized	As per the standards	
4	Timely submission	Late submission	Submits after due date	Submits after reminders	Submit after a reminder	On time submission	
5	Data references	No references.	Irrelevant references.	References not from authentic source.	Given references are from authenticated sources.	Enough authenticated references are given.	
	Example: Average Marks= (8+6+4+2+6=26)						

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

9. **Equipment/software list with Specification for a batch of 30 students.**

Sl.No.	Particulars	Quantity
1.	Hydraulic system of excavators.	2
2.	Hydraulic cylinders	2
3.	**Engine Diagnostic Tools** (Scanner tools)	1
4.	**Welding Machines** (for structural repairs)	2
6.	Torque Wrenches	2
7.	**Pneumatic Tools** (Air tools, impact wrenches, etc.)	2
8.	Battery chargers	2
9.	Battery testers	2
10.	**Lifting Equipment** (Hoists, Sling sets, and Ramps)	3
11.	**Workbenches** and **Toolboxes**	4
12.	Mini cranes	2
13.	**Multimeters** (for electrical diagnostics)	2
14.	Hydraulic system trainer kit	2
15.	Pneumatic system trainer kit	2
16.	Final drive hydraulic pump, hydraulic motors, hydraulic actuators	2 numbers each

Government of Karnataka
DEPARTMENT OF TECHNICAL EDUCATION

Program	**Automobile Engineering**	**Semester**	**V**
Course Name	**Electric and Hybrid Vehicles**	**Type of Course**	Integrated
Course Code	**25AT52IC**	**Contact Hours**	7 Hours/Week
Teaching Scheme	L: T:P, 3:0:4	**Credits**	5
CIE Marks	**50**	**SEE Marks**	**50 (Practice)**

1. **Rationale:** The world of mobility is changing rapidly and electric and hybrid vehicles are at the forefront of this revolution. Learning about electric and hybrid vehicles is incredibly relevant in today's world due to the growing need for sustainable transportation solutions. The automotive industry is rapidly shifting towards electrification, making it crucial for engineers and professionals to understand the principles and technologies behind these vehicles. Studying electric and hybrid vehicles provides a deep understanding of electric motors, power electronics, battery systems, and control strategies, which are essential for designing, developing, and maintaining these vehicles. This provides lot of opportunities in design, manufacturing and maintenance of electric and hybrid vehicles.

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

CO-01	Compare the operating principles, performance characteristics, and environmental impacts of various electric, hybrid, and conventional vehicle power trains to choose appropriate technologies for the specific purpose.
CO-02	Diagnose common faults in battery and battery management systems using appropriate testing equipment and procedures.
CO-03	Diagnose common faults in electric and hybrid vehicle subsystems, such as, electric motors using appropriate testing equipment and diagnostic procedures.
CO-04	Model basic electric and hybrid drive systems, including motor selection, power converter design, and control strategies, using appropriate software tools and engineering principles.

3. **Course Content**

WEEK	**CO**	**PO**	**Theory**	**Practice**
1	1	1, 4	**Introduction to EV**: • Introduction to electric vehicles - history and evolution of electric vehicles. • Comparison between I.C Engine vehicles and Electric vehicles. • Present market trends. Benefits and Challenges of EV's. • Polices in India – Incentives, PLI (Production Linked	• Prepare a report on comparison of ICE vehicle and EV vehicle of same make and model (ex: Tata Nexon ICE vs Tata Nexon EV). • Prepare a report on ARAI rules and regulations on EVs. Compare different electric vehicle using their specifications.

			Incentive) scheme.	
2	2	1	• Battery swapping policy. Special E-mobility zone. • Electric vehicle registration. Road tax exemptions and subsidies. • Driving license policies for EV. Number plate policies for EV. • ARAI regulations for EV.	Visit the nearest RTO office and prepare a report on EV registration, driving license and number plate policy of EVs.
3	2	1, 4	• Types of EVs. Components of EV. Working of EV with its layout. • **Battery**-introduction-types. Lithium-ion battery-types-construction and working Lithium polymer battery. • Types of lithium-ion cell architecture -cylindrical, pouch type, prismatic type-merits and demerits of each type. • Construction and working of Aluminum air battery.	• Identification of components of 2-wheeled and 3-wheeled EV. Check cell voltage, Ampere-hour capacity of a Lithium-ion cell using standard procedure. • Check the state of charge of a Lithium cell by measuring its voltage and temperature. • Identify the cell capacities by colour codes.
4	2	1, 4,5	• **Battery pack** - selection criteria. Battery packs construction. • Battery management system – functions. Layout of a BMS - functions of key components. • State of charge and state of health. Battery cell balancing-active and passive. • Recycling and disposal of EV batteries.	• Practice to build battery pack with series and parallel configuration. • Practice on replacing the battery pack in two-wheelers with safety measures.
5	2	1, 4	• **Fuel cells** – types. Layout out of fuel cell vehicle with function of each component. Fuel cell operating principle. • Construction and working of Proton exchange membrane type of fuel cell. • Comparison of fuel cell vehicles with ICE vehicles and battery vehicles. • Production of hydrogen using electrolysis of water method and biomass gasification.	• Identification of components of fuel cell electric vehicle. Removal and refitting of components of fuel cell vehicle. Troubleshooting of fuel cell. • Practice on production of hydrogen using electrolysis of water method.
6	3	1, 4	• **EV Charging technologies**: Introduction to Grid-to-Vehicle (G2V), Vehicle-to-Grid (V2G) and Vehicle-to-Buildings (V2B) operations.	• Diagnosis and remedy for charger not responding or charger not delivering expected current. • Determine charging efficiency

			• Bi-directional EV charging systems. Charging speed and efficiency. • Charging standards and connectors. • Charging infrastructures.	under different condition of battery charge and battery health conditions.
7	3	1, 4	• Basic charging system block diagram. Types of EV charging – AC and DC charging • Levels of charging - 1, 2, and fast DC charging. Merits and demerits. • Charging challenges. Smart charging. • Future of EV charging – wireless charging, ultra-fast charging V2G integration.	• Practice on different modes of battery charging following standard safety procedures. • Calculate the cost of charging an EV and determine the electricity rate per kWh.
8	3	1, 4	• **Motors-**types. Construction and working of synchronous motor. • Construction and working of brushless DC motor. • Control of BLDC motor drives- torque control and speed control. • Torque and speed control of synchronous motor. Selection and sizing of motor.	• Testing and servicing of BLDC motor and synchronous motor. • Build a circuit to control speed and torque of BLDC and synchronous motor. Troubleshoot BLDC and synchronous motors.
9	3	1, 4	• **Brakes for EVs** – Types – construction and working of regenerative braking. • Plugging type braking and dynamic braking in EVs. • Modes of regenerative braking. Merits and demerits. • Brake pedal feel in EV. Future trends in EV braking.	• Identify components of regenerative braking system. Adjust the pedal to vary the intensity of regenerative braking and brake feel. • Diagnose, repair, and test regenerative braking.
10	3	1, 4	• **Electric vehicle drives train configuration-**types. Layout of front wheel drive, rear wheel drive and all-wheel drive. • Layout and working of conventional motor-clutch-gearbox-differential, motor-fixed gear-differential. • Dual motor configuration, in-wheel motor and fixed planetary gear • Two in-wheel motor configuration. Independent wheel drive.	• Identify type of drive train used in EVs. Build a Simple EV drive train model using electric motor, gears, wheels, battery, and a controller. • Troubleshooting and servicing of different types of drive trains.

11	3	1, 4,5	• **Introduction to hybrid vehicle**-types-components. Hybrid vehicle transmission system. • Layout and working of series, parallel hybrid and power split hybrid. Merits and demerits of each type. • Hybrid vehicle control strategies. • Hybrid vehicle environmental impact and sustainability.	• Identify the type of hybrid vehicle and identify components of hybrid vehicle. • Simulation of Hybrid Vehicle Power trains
12	3	1, 4	• **Power flow control**-need. Modes of hybrid vehicle operation. • Torque and speed coupling in hybrid vehicles. • Methods of connection between motor and engine in parallel hybrid-single shaft - double shaft and split-axle configuration (through-the-road). Merits and demerits of each type. Considerations in choosing different connection methods. • Challenges in real time implementation of power flow modes.	• Identify the type of connection between the engine and the motor. • Removal and refitting of motor and engine connection mechanism in a hybrid vehicle.
13	4	1, 3, 6	Construct a virtual or physical model of series and parallel hybrid vehicle drive train and demonstrate the different working modes OR Model the electric vehicle by using simulation software and analyze the EV performance parameters such as speed, torque, top speed reached, distance traveled, SOC, regenerative braking effort, current & voltage for different drive cycles, electric drives & power rating.	

4. References:

Sl. No	Title of Books	Author	**Publications**
1	Modern Electric, Hybrid Electric and Fuel Cell Vehicles	Mehrdad Ehsani, Yimin Gao and Ali Emadi	CRC Press
2	Hybrid Electric Vehicles, Principles and Applications with practical perspective	Chris Mi	Wiley publications
3	Modern Electric, Hybrid Electric and Fuel cell vehicles, Fundamentals, theory and Design	Mehrdad Ehasani	CRC Press
4	Energy Storage Systems	Alfred Rufer	CRC Press
5	Permanent Magnet Brushless Dc Motor Drives and Controls	Chang Liang Xia	Wiley 2012
6	Electric and Hybrid Vehicles	Tom Denton	Routledge
7	Electric Vehicle Propulsion Drives and Charging Systems	Kundan Kumar, Ambrish Devanshu, Sanjeet K. Dwivedi	CRC Press

8	Smart Charging Solutions for Hybrid and Electric Vehicles	Sulabh Sachan, P. Sanjeevikumar, Sanchari Deb	Wiley
9	Hybrid Electric Vehicles and Regenerative Braking	J. Song	Applied and Computational Engineering, Volume 26
10	Greening India's Automotive Sector: EV Policies, Categories, and Subnational Trends	Centre for Energy Finance (CEF)	2022 Publication

18. **Rubrics for Portfolio evaluation** **Level of Achievement**						
Assessment Parameter		**Excellent (10)**	**Very Good (8)**	**Fair (6)**	**Poor (4)**	**Score**
AP1	**Organization of Report and Timely Submission**	Lab report is well organized as directed and submitted on time	Lab report is well organized but not submitted on time	Report contains few errors and not submitted on time them	Poor organization and late submission	
AP2	**Knowledge of Tools and Procedures**	Demonstrates deep knowledge of tools and procedures; answer the related questions with explanations and elaboration	Adequate knowledge of most tools and procedures; answer the related questions, but fails to elaborate	Superficial knowledge of tools and procedures; able to answer only some of the related basic questions	Lack of information about most of the tools and procedures; cannot even answer basic related questions	
AP3	**Team Working Skills**	Positive in interacting with all group members, encourages such interaction in others, and always sensitive to the abilities and feelings of others' contributions; Actively helps to identify group goals and works effectively to meet them in assigned roles	Interacts with all group members spontaneously and contributes in a way that is sensitive to the abilities and feelings of others; Demonstrates commitment to group goals and carries out assigned roles effectively	Interacts with other group members if prompted, but sometimes expresses opinions which are insensitive to the abilities and feelings of others; Demonstrates commitment to group goals, but has difficulty performing assigned roles	Rarely interacts within a group, even with prompting, and shows frequent lack of sensitivity to others' feelings and abilities in opinions expressed; Shows little commitment to group goals and fails to perform assigned roles	
AP4	**Result Analysis and Data Interpretation**	Excellent insight and well-focused results and discussion; Data completely and appropriately interpreted and no overinterpretation	Adequate insight but missed some important points in results and discussion; Interpreted most data correctly but some conclusions may be suspect or over-interpreted	Little insight and analysed only the most basic points; Interpreted some data correctly but significant errors, omissions still present.	No insight and entirely missed the point of the experiment; Little or no attempt to interpret data or overinterpreted data.	
AP5	**Task Management**	Very Effective in managing the assigned task and allow experimenter(s) to achieve all goals	Somewhat effective in managing the assigned tasks and allow experimenter(s) to achieve most goals.	Somewhat ineffective in managing the assigned task and allow experimenter(s) to achieve only few goals.	Very ineffective and would not allow experimenters to achieve any goals	

5. CIE Assessment Methodologies

Sl. No	CIE Assessment	Test Week	Duration (minutes)	Max marks	
1.	CIE-1 Theory Test	4	90	50	Average of all CIE=50 Marks
2.	CIE-2 Practice Test	7	180	50	
3	CIE-3 Theory Test	10	90	50	
4.	CIE-4 Practice Test	13	180	50	
5	CIE-5 Portfolio evaluation of all the activities through Rubrics	1-13		50	
				Total	**50 ar ks**

6. SEE – Practice Assessment Methodologies

Sl. No	SEE – Practice Assessment	Duration (minutes)	Max marks	Min marks to pass
1.	Semester End Examination-Practice	180	50	20

7. CIE Theory Test model question paper

Program	**Automobile Engineering**			**Semester -V**	
Course Name	**Electric and Hybrid Vehicles**			**Test**	**I/III**
Course Code	**25AT52IC**	**Duration**	**90 min**	**Marks**	**50**
Name of the Course Coordinator:					
Note: Answer any one full question from each section. Each full question carries equal marks.					

Q. No	Questions	Cognitive Level	Course Outcome	Marks
	Section - 1			
1	a) Explain the Construction and working of Aluminum air battery 10M b) Explain PLI scheme. 5M c) Explain battery swapping policy for EV. 10M	L3 L2 L2	2 1 2	25
2	a) State the challenges for implementing EV policy in India. 5M b) Explain road tax exemptions and subsides for EVs. 10M c) Write number plate policy and registration policy for EVs. 10M	L2 L2 L3	1 2 2	

Section - 2				
3	a) List the Comparison between I.C Engine vehicles and Electric vehicles. 5M b) Explain the working of Lithium ion polymer battery with a sketch. 10M c) Write the functions of key components of a BMS with a layout. 10M	L2 L2 L3	1 2 2	25
4	a) Explain cylindrical, pouch, prismatic architecture of Lithium ion battery with a neat sketch 10M b) List the benefits and challenges of EV's. 5M c) Compare active cell and passive cell balancing. 10M	L2 L2 L3	2 1 2	
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.				

Signature of the Course Coordinator **Signature of the HOD** **Signature of the IQAC Chairman**

8. CIE Practice Test model question paper

Program	**Automobile Engineering**			**Semester**	
Course Name	**Electric and Hybrid Vehicles**			**Test**	**II/IV**
Course Code	**25AT52IC**	**Duration**	**180 min**	**Marks**	**50**
Name of the Course Coordinator:					
Questions				**Marks**	
9) Construct a model to build battery pack with series and parallel configuration. 10) The EV charger is not responding or the charger is not delivering expected current. Diagnose the fault with proper remedies OR 11) Replace a battery pack of the given EV with proper safety measures. **12)** Determine charging efficiency under different environmental, battery charge and battery health conditions.				**50**	
Scheme of assessment for 1 and 3 experiments: Procedure-03M, conduction-10M, tabular column and results-05M, total 3+10+5=18M					**18**
Scheme of assessment for 2 and 4 experiments: Procedure-03M, conduction-10M, tabular column and results-05M, total 3+10+5=18M					**18**
Common parameters: Viva-10M					**10**
Portfolio evaluation-04M					**04**
				Total Marks	**50**

Signature of the Course Coordinator **Signature of the HOD**

9. Suggestive Activities:

The list is an example and not inclusive of all possible activities of the course. Students and Faculty are encouraged to choose activities that are relevant to the topic. Two activities, each for 50 marks should be evaluated with proper rubrics.

Sl.No.	Suggestive Activities
01	Visit your nearest RTO and collect information regarding registration of EV, driving policy of EV, number plate policy of EV and prepare a report.
02	Explore the differences between various types of EV batteries and prepare a presentation on their findings on key attributes like energy density, charge times, and environmental impact.
03	Measure the battery voltage, charge it to full capacity, and then discharge it using a resistive load while tracking the current and voltage drop. Calculate the capacity of the battery.
04	Using an online simulation tool or BMS software, simulate the charging and discharging of a battery pack.
05	Give presentation on different types of fuel cells used in EVs.
06	Use wireless charging technology to charge a small toy car to show how inductive charging works without physical connections by placing the car on the charging pad.
07	Prepare a presentation and report on the latest advancements in EV charging infrastructure.
08	Prepare a report on different motors used in EVs with their advantages and disadvantages.
09	Prepare a presentation on how much energy can be recovered during regenerative braking and the impact of this on the overall efficiency of electric vehicles.
10	Using simulation software, show how the **motor, fixed gear system** and **differential** work together to drive the wheels of an electric vehicle.
11	Build a simple hybrid vehicle model using toy car chassis, small DC motor and additional motor to simulate the IC engine and demonstrate how a hybrid vehicle works.
12	Prepare a presentation on single shaft and double shaft configurations connections of motor and engine showing how the motor responds to changes in load and speed.
13	Simulate electric vehicle systems using simulation software and show the working of EV components.

10. Rubrics for Assessment of Activity (Qualitative Assessment)

Sl. No.	Dimension	Beginner	Intermediate	Good	Advanced	Expert	Student sScore
		2	4	6	8	10	
1	Collection of data/ Material	Limited information	Collects basic information	Collects more information	Collects developed information	Collects a great deal of information	8
2	Quality of data	Irrelevant	Less relevant	Needs improvement	Satisfactor y	Very relevant	6
3	Quality of report	Not planned	Less organized	Moderately organized	Organized	As per the standards	4
4	Timely submission	Late submission	Submits after due date	Submits after reminders	Submit after a reminder	On time submission	2
5	Data references	No references.	Irrelevant references.	Given References not from authentic source.	Given references are from authenticat ed sources.	Enough authenticat ed references are given.	6
	Example: Total= (8+6+4+2+6=26)						**26/50**

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

11. SEE- Model Practice Question Paper

Program	**Automobile Engineering**		**Semester**	
Course Name	**Electric and Hybrid Vehicles**	**Course Code: 25AT52IC**	**Duration**	**180 min**
Questions			**Marks**	
3. Test, troubleshoot and service the given BLDC motor used in EV. 4. Construct a model to build battery pack with series and parallel configuration. OR 3. Test, troubleshoot and service the given synchronous motor used in EV. **4.** Replace a battery pack of the given EV with proper safety measures.			**50**	
Scheme of assessment for 1 and 3 experiments: Procedure-03M, conduction-10M, tabular column and results-05M, total 3+10+5=18M **Scheme of assessment for 2 and 4 experiments:** Procedure-03M, conduction-10M, tabular column and results-05M, total 3+10+5=18M **Common parameters:** Viva-10M Portfolio evaluation-04M				**18** **18** **10** **04**
			Total Marks	**50**

3) Signature of the Examiner **2) Signature of the Examiner**

12. Equipment/softwarelistwithSpecificationforabatchof30students

Sl.No.	Particulars	Specification	Quantity
01	Electric Vehicle – 2-wheeler	Motor Power 1200 – 1800 W Motor Type – BLDC Drive Type - Hub Motor Battery Type - Li-ion Battery Capacity 72 V/26 Ah	1
02	Electric Vehicle – 4-wheeler	Engine Type – 3 Phase Induction Motor Max Power – 25.5 BHP @3750 rpm Max Torque – 53 Nm@ 0-3500 rpm	1
02	Hybrid Electric Vehicle – 4-wheeler	Power train Configuration: Parallel System Battery Capacity: **1 kWh to 2 kWh.** Electric Motor Power Output **30 kW to 80 kW.** Transmission Type CVTs	1
03	Battery testing kit	Voltage 6 V to 60 V	
04	Lithium Battery Pack.	Nominal Voltage – 12.8 V Nominal Current – 32 A Capacity 20Ah-100 Ah	1
05	Lithium-Ion Battery Charger	Input Voltage: 180-250 V AC Output Voltage: DC 54.6V Application: Suitable for 48V E-Bike Batteries Output Current: 3-4 A	
06	Hydrogen Fuel Cell	Output range 50 kW to 150 kW Hydrogen fuel consumption 0.8 to 1.5 kg Fuel Cell Stack Voltage 40V to 100V Operating Temperature -20°C to 40°C	1
07	Brushless DC Motor	Power Rating 5 kW to 200 kW Voltage Range 48V to 400V Torque 10 Nm and 50 Nm Speed Range3,000 RPM to 20,000 RPM Motor Type - Permanent Magnet	2
08	AC Synchronous motors	Power rating 5 to 50 KW Voltage rating 48 V to 220V Torque 10N-m to 50N-m Motor speed 1500-5000rpm	2
09	Electric motor performance testing setup	With ammeter, multimeter and speed measurement setup	1

Government of Karnataka
DEPARTMENT OF TECHNICAL EDUCATION

Program	**Automobile Engineering**	**Semester**	**V**
Course Name	**Python for Automobile engineers.**	**Type of Course**	Integrated
Course Code	**25AT53IA**	**Contact Hours**	07 hours/week
Teaching Scheme/week	L: T:P, 3:0:4	**Credits**	5
CIE Marks	**50**	**SEE Marks**	**50 (Practice)**

1. **Rationale:** Knowledge of Python programming for Automobile engineers is essential to increase the productivity and efficiency by automating tasks, getting insights from data, data visualization, optimization of design, and simulation of engineering problems.

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

CO-01	Choose, Install and setup the appropriate development environment of python.
CO-02	Write simple programs using different data types and operators of python to solve simple automobile engineering related problems.
CO-03	Construct simple programs using different python programming concepts such as control flows, list, arrays and functions to solve simple automobile related problems.
CO-04	Develop programs using different additional libraries such as NumPy, SymPy, and Matplotlib to solve automobile engineering related problems and visualize the data and results.

3. **Course Content**

WEEK	**CO**	**PO**	**Theory**	**Practice**
1	1	1,4	Introduction to python, History of python, Feature of python. Python distributions, python applications, python IDE. Down loading python and installing python.	Prepare a report on use of python in automobile engineering domain. Downloading and installing python from official website. Practice the use of built in IDLE of python.
2	1	1,4	Features of anaconda distribution. Features of Jupiter notebook. Best practices of python programming. Importance of indentation and comments. Character set used in python, Tokens-	Download anaconda distribution of the python and list its features, set up Jupiter notebook. Write a simple program to show the syntax of writing comments. Write the simple program to the show the errors with improper use

			concept, types, Keywords, Identifiers, rules to name an identifier, literals or values-types, operators, punctuators, Variables	of indentation. (Use IDLE or any other interpreter for python) Simple programs to show the use of identifiers, literals, operators, punctuators, and variables.
3	2	1,3,4	Input and output functions, concept-syntax, Data -concept-types-string, integers, complex numbers and Boolean, Type casting-concept-type casting syntax to convert different data types.	Write a simple program to input a string and output it. Write simple programs to input and output string data, integer data, float data and complex number data. Write simple programs to show converting one data type to other data type.
4	2	1,3,4	Operators-concept-types, arithmetic operators-concept-types, comparison/relational operators-concept-types, logical operators-concept-types	Simple programs to show the syntax of arithmetic operators, relational operators and logical operators.
5	2	1,3,4	Assignment operators-concept-types, string operators-concept-types-operator precedence-concept-need.	Simple programs to show the syntax of assignment operators, and string operators, simple programs to show the importance of operator precedence.
6	3	1,3,4	Control-flows-concept-types-conditional statement-if statement-concept-syntax, if-else statement-concept-syntax, nested if statements-concept-syntax	Simple programs to show the syntax of if statement, if-else statement and nested if statements.
7	3	1,3,4	Control flows-loops-concept-types-while loop-concept-syntax, for loop-concept-syntax, range function-concept-syntax, else and break-concept and syntax. Nested while and for loops-concept and syntax.	Simple programs to show the syntax for while loop, for loop, for loop with range function, else and break statements. Simple programs to show the syntax of nested while and for loops.
8	3	1,3,4	Data collection-concept-types, Lists-concept-syntax of creating lists, creating list from tuple, set, and string-concept-syntax, accessing list elements, unpacking list-concept-syntax, changing list elements-concept-syntax, functions used with list-count (), index (), reverse (), sort ()-concept-syntax.	Simple programs to show the syntax of creation of list, accessing list elements, unpacking of list elements, and functions used with lists.
9	3	1,3,4	Arrays in python-concept-syntax to create single row and multi-dimensional arrays. Compare lists and arrays, length of array, sum of elements of array. Addition of two arrays. Scalar multiplication of arrays, dot multiplication of two multidimensional arrays.	Simple programs to show the syntax and process of addition and subtraction of two arrays. Simple programs to show the syntax and process of scalar multiplication and dot multiplication of arrays.
10	3	1,3,4	Functions-concept-syntax of defining	Simple programs to show syntax

			and calling functions, recursive functions concept-syntax, modules-concept-syntax of creating and importing modules, packages-concept-creating and using packages.	and process of defining functions and calling functions, modules and packages.
11	4	1,3,4	Sym-Py module-concept-syntax to find limits of expressions, first differentiation and second differentiation of expressions, syntax to find indefinite and definite integral of expressions.	Simple programs to show syntax and process of finding limits, first derivation, second derivation, indefinite integral and definite integral.
12	4	1,3,4	Num-Py module-applications, Sci-Py module-applications, matplotlib module-applications. Importing the modules	Simple program to show the syntax of finding sum, mean and standard deviation of data set. Draw the P-V diagrams for constant pressure, constant volume and isentropic process.
13	4	1,3,4	Syntax to create single line chart, multi-line chart, single bar chart, multi bar chart, scatter chart, controlling each parameter of the chart.	Write a program to draw shear force and bending moment diagrams for different conditions. Write the program to draw thermodynamic process and cycles of different IC engines.

Note; To explain the programs use automobile engineering related data and expressions.

4. References:

Sl. No	Title of Books	Author	Publications
1	Introduction to Python Programming	S. Gowrishankar and A. Veena	Chapman and Hall/CRC
2	Python Programming	Dr. Jisu Elsa Jacob and Bharath Viswam S	S.K. Kataria & Sons
3	Python Programming	Rupesh Nasre	All India Council for Technical Education (AICTE)
4	Python Programming: A Modular Approach.	Vijay Joshi	Pearson Education India
5	Python Programming	Reema Thareja	Oxford University Press
6	Python for mechanical and aerospace engineers	by Alex Kenan	Wiley India.
7	Mechanical Engineering Essentials with python (12 books)	Jamie Flux	Kindle editions

5. LIST SOFTWARES/WEBSITES

1. https://www.aboutmech.com/2021/09/python-for-mechanical-engineers.html
2. https://matplotlib.org/stable/tutorials/index
3. https://www.geeksforgeeks.org/matplotlib-tutorial/
4. https://www.geeksforgeeks.org/numpy-linear-algebra/
5. https://www.geeksforgeeks.org/multiplication-two-matrices-single-line-using-numpy-python/?ref=lbp

6. https://www.geeksforgeeks.org/how-to-do-calculus-with-python/
7. https://www.askpython.com/python/examples/calculus-in-python
8. https://sean-fitzpatrick.github.io/CalcLabs/sympy.html
9. https://youtu.be/3RxoTim2PgM
10. https://www.amazon.in/Python-Programming-Mechanical-Engineers-Abdellatif-ebook/dp/B0CJQ1F5HZ

6. Rubrics for Portfolio evaluation

Assessment Parameter		Level of Achievement				
		Excellent (10)	**Very Good (8)**	**Fair (6)**	**Poor (4)**	**Score**
AP1	**Organization of Report and Timely Submission**	Lab report is well organized as directed and submitted on time	Lab report is well organized but not submitted on time	Report contains few errors and not submitted on time them	Poor organization and late submission	
AP2	**Knowledge of Tools and Procedures**	Demonstrates deep knowledge of tools and procedures; answer the related questions with explanations and elaboration	Adequate knowledge of most tools and procedures; answer the related questions, but fails to elaborate	Superficial knowledge of tools and procedures; able to answer only some of the related basic questions	Lack of information about most of the tools and procedures; cannot even answer basic related questions	
AP3	**Team Working Skills**	Positive in interacting with all group members, encourages such interaction in others, and always sensitive to the abilities and feelings of others' contributions; Actively helps to identify group goals and works effectively to meet them in assigned roles	Interacts with all group members spontaneously and contributes in a way that is sensitive to the abilities and feelings of others; Demonstrates commitment to group goals and carries out assigned roles effectively	Interacts with other group members if prompted, but sometimes expresses opinions which are insensitive to the abilities and feelings of others; Demonstrates commitment to group goals, but has difficulty performing assigned roles	Rarely interacts within a group, even with prompting, and shows frequent lack of sensitivity to others' feelings and abilities in opinions expressed; Shows little commitment to group goals and fails to perform assigned roles	
AP4	**Result Analysis and Data Interpretation**	Excellent insight and well-focused results and discussion; Data completely and appropriately interpreted and no overinterpretation	Adequate insight but missed some important points in results and discussion; Interpreted most data correctly but some conclusions may be suspect or over-interpreted	Little insight and analysed only the most basic points; Interpreted some data correctly but significant errors, omissions still present.	No insight and entirely missed the point of the experiment; Little or no attempt to interpret data or overinterpreted data.	
AP5	**Task Management**	Very Effective in managing the assigned task and allow experimenter(s) to achieve all goals	Somewhat effective in managing the assigned tasks and allow experimenter(s) to achieve most goals.	Somewhat ineffective in managing the assigned task and allow experimenter(s) to achieve only few goals.	Very ineffective and would not allow experimenters to achieve any goals	

7. CIE Assessment Methodologies

Sl. No	CIE Assessment	Test Week	Duration (minutes)	Max marks	
1.	CIE-1TheoryTest	4	90	50	Average of all CIE=50 Marks
2.	CIE-2Practice Test	7	180	50	
3	CIE-3TheoryTest	10	90	50	
4.	CIE-4Practice Test	13	180	50	
5	CIE-5 Portfolio evaluation of all the activities through Rubrics	1-13		50	
				Total	

8. SEE – Practice Assessment Methodologies

Sl. No	SEE – Practice Assessment	Duration (minutes)	Max marks	Min marks to pass
1.	Semester End Examination-Practice	180	50	20

9. CIE Theory Test model question paper

Program	**Automobile engineering**			**Semester -V**	
Course Name	**Python for Automobile Engineers**			**Test**	**I/III**
Course Code	**25AT53IA**	**Duration**	**90 min**	**Marks**	**50**
Name of the Course Coordinator:					
Note: Answer any one full question from each section. Each full question carries equal marks.					

Q. No	**Questions**	**Cognitive Level**	**Course Outcome**	**Marks**
	Section - 1			
1	a) List the features and applications of Python 10M b) List different IDE's available for Python. 05M c) Explain the features of Anaconda Python distribution and Jupiter note book. 10M	L2 L2 L2	1 1 2	25
2	a) Explain the tokens, keywords and identifiers in python. 10M b) List different arithmetic and relational operators used in Python. 10M c) Explain the need and syntax of indentation and comments. 05M	L2 L2 L2	1 2 1	
	Section - 2			
3	a) Explain the meaning of literals or values in Python and list different types. 10M b) Explain the meaning of type casting with example and proper syntax. 10M c) List different data types used in Python. 05M	L3 L3 L2	1 3 3	25
4	a) Explain the importance and process of operator prevenance in Python 10M b) List different assignment operators used in Python with their function. 10M c) Explain the input and output functions of Python with their syntax. 05M	L3 L3 L2	1 3 3	

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.

Signature of the Course Coordinator **Signature of the HOD** **Signature of the IQAC Chairman**

10. CIE Practice Test model question paper

Program	**Automobile engineering**			**Semester**	**V**
Course Name	**Python for Automobile Engineers.**			**Test**	**II/IV**
Course Code	**25AT53IA**	**Duration**	**180 min**	**Marks**	**50**
Name of the Course Coordinator:					

Questions	**CO**	**Marks**
13) Write, debug and run the program to collect the bore diameter and stroke length data of an engine and calculate capacity of an engine and compression ratio. 14) Write a program to collect gear ratios, final drive number of teeth, wheel radius and engine speed and calculate vehicle speed for each gear using for loop. OR 15) Write a program to collect the brake drum diameter, rope diameter, engine speed, load on brake drum in kg, mean effective pressure, stroke length, bore diameter, number of cylinders to find engine BHP, IHP and mechanical efficiency. **16)** Write a program to collect the data about coefficient of road adhesion, wheel base, center of gravity height, distance between front wheel center and CG of vehicle and type of drive, find acceleration for each drive condition and find best type of drive using if statement.	**1** **3** **1** **3**	**50**
Scheme of assessment for 1 and 3 experiments: Written program-10M, entering the program into IDE-03M, debug and results-05M, total 10+03+5=18M **Scheme of assessment for 2 and 4 experiments:** Written program-10M, entering the program into IDE-03M, debug and results-05M, total 10+03+5=18M **Common parameters:** Viva-10M Portfolio evaluation-04M		**18** **18** **10** **04**
	Total Marks	**50**

Signature of the Course Coordinator **Signature of the HOD**

11. Suggestive Activities for Tutorials:

The List is an Example and not inclusive of all possible activities of the course. Students and Faculty are encouraged to choose activities that are relevant to the topic. Two activities, each for 50 marks should be evaluated with proper rubrics.

Sl.No.	Suggestive Activities for Tutorials
01	Collect the information of different integrated development environments of Python, compare and prepare a report.
02	Collect the information on different additional libraries of python, compare and prepare a report.
03	Collect the information on different data types of python and prepare a report.
04	Collect the vehicle speed data in an array format and find minimum, maximum, and average speed of vehicle.
05	Collect the load-elongation data from an UTM and plot a stress-strain diagram.
06	Collect any various engine performance data, find different engine performance parameters and draw the different engine performance curves.

12. Rubrics for Assessment of Activity (Qualitative Assessment)

Sl. No.	Dimension	Beginner	Intermediate	Good	Advanced	Expert	Student sScore
		2	4	6	8	10	
1	Collection of data/ Material	Limited information	Collects basic information	Collects more information	Collects developed information	Collects a great deal of information	8
2	Quality of data	Irrelevant	Less relevant	Needs improvement	Satisfactor y	Very relevant	6
3	Quality of report	Not planned	Less organized	Moderately organized	Organized	As per the standards	4
4	Timely submission	Late submission	Submits after due date	Submits after reminders	Submit after a reminder	On time submission	2
5	Data references	No references.	Irrelevant references.	Given References not from authentic source.	Given references are from authenticat ed sources.	Enough authenticat ed references are given.	6
	Example: Total= (8+6+4+2+6=26)						**26/50**

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

13. . SEE- Model Practice Question Paper

Program	**Automobile engineering**		**V**
Course Name	**Python for Automobile Engineers.**	**Course Code: 25AT53IA**	**Duration 180 min**
Questions			**Marks**
5. Collect the data about bore diameter, stroke length, engine speed, brake drum diameter, load on engine in kg, calorific value of fuel, fuel consumed, test duration, and find BP of engine, brake thermal efficiency of engine and BSFC using Python programming skills. 6. Collect the data of BP, torque, mechanical efficiency, and BSFC reading at different engine speeds using array and for loop and draw BPVs Speed, Torque Vs speed, Mechanical efficiency Vs Speed and BSFC Vs speed in a single graph. OR 5. Collect data on different vehicle speeds using an array, co-efficient of air resistance, cross sectional area of vehicle, co-efficient of road resistance, weight of vehicle. Use for or while loop to find air and rolling resistance at different vehicle speeds. 6. Input two 3X3 arrays and find their dot multiplication and determinant of the resulted matrix.			**50**
Scheme of assessment for any one the question: Written program-10M, entering the program into IDE-03M, debug and results-05M, total 10+03+5=18M For two questions, 18X2 = 36 **Common parameters:** Viva-10M Portfolio evaluation-04M			**36** **10** **04**
			50

4) Signature of the Examiner **2) Signature of the Examiner**

14. Equipment/softwarelistwithSpecificationforabatchof30students

Sl.No.	Particulars	Specification	Quantity
01	Desktop Computer.	Latest generation intel i5 or AMD equivalent desktop with 16 GB ram, 512 GB SSD, 24-inch LED Display, with Nvidia or AMD Graphics card with Microsoft 11 OS. And Office 2024	10
02	UPS	5KVA Sine wave UPS	1
03	Laser jet/ Ink tank printers.	Scanner, Wi-Fi enabled, 12-15 PPM	1

Government of Karnataka
DEPARTMENT OF TECHNICAL EDUCATION

Program	AUTOMOBILE ENGG	**Semester**	V
Course Name	Industrial Automation	**Type of Course**	Integrated
Course Code	**25AT53IB**	**Contact Hours**	7hours/week
Teaching Scheme	L: T:P: 3:0:4	**Credits**	5
CIE Marks	50	**SEE Marks**	50 (Practice)

1. Rationale:

In today's manufacturing landscape, industries are rapidly transitioning towards complete automation. Small and medium-sized enterprises are increasingly adopting PLC (Programmable Logic Controller) and Human Machine Interface (HMI) technologies for data acquisition and process control. Industrial automation systems are used to monitor and control processes, machines, or devices in a computerized manner, typically handling repetitive tasks. These systems are designed to function autonomously, reducing the need for human intervention and improving efficiency across the industry. The benefits of this technology include higher production rates, increased productivity, more efficient material usage, better product quality, improved safety, shorter workweeks for labor, and reduced factory lead times. Automation engineers are responsible for designing, programming, simulating, and commissioning automated machinery and plant-wide processes to perform various functions. Depending on the size of the organization, the engineer may take on all or part of these responsibilities. It is essential for diploma engineers to acquire knowledge of both PLC and other automation technologies, as these are the backbone of industrial automation.

This course is designed to introduce the fundamental theoretical and practical concepts of automation technologies, helping students develop the operational competencies needed in this field. As a result, it serves as a foundational course for diploma engineers who wish to specialize in industrial automation.

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

CO-01	**Select** the appropriate sensor, actuator and other hardware components for a given automation application.
CO-02	**Integrate** various hardware components to implement a specified automation system.
CO-03	**Develop** ladder program for simple automation applications.
CO-04	**Appreciate** the application of automation concepts and technologies used in Industry 4.0.

***Note**: Course Coordinators may define their own Course Outcomes (COs) based on the TLP they follow*

3. Course Content

WEEK	CO	PO	Theory	Practice
1	4	1,2,4	**Introduction to Industrial Automation** • History of Industrial Automation (Industry 1.0 to Industry 4.0) • Benefits of Industrial Automation /Need of Automation in Industry • Types of Industrial Automation- fixed, programmable, flexible (*give at least one example for each.)* • Standards used in industrial automation (ISO, IEC, JIC) • Basic Components of Automation System with block diagram	Study the following appliances/ automation systems and identify various elements used and their function • Air conditioning System • Washing Machine • Automatic Bottling System • Automatic Packaging System Write the **Block Diagram** for each of the above application by highlighting the importance of sensor/actuator and controller used.
2	1,2	1,2,4	**Sensors and Transducers** • Classification of Sensors • Analog and Digital Sensors • Performance Terminology of Sensors • IEC standard Symbols for Switches/ Sensors *(Refer Reference No. 11)* **Types of Sensors** - Working Principle & Industrial Applications with circuit for each of the following *(Refer CIE Questions)* a. Switches and Push buttons b. Limit Switches c. Proximity Sensors d. Position/Displacement Sensor	Interfacing following **Industrial grade** switches with simple circuits for basic automation tasks • Push Buttons • Toggle Switches (all types) • Emergency Stop • Rotary Switches • Key Switch • Limit Switches **Note**: Give an industrial scenario for each of these where specific switches are essential.
3	1,2	1,2,4	**Types of Sensors** (*Refer CIE Questions)* e. Pressure Switches f. Liquid Level detectors g. Photoelectric Sensors/ switches h. Encoders i. Temperature Sensors j. Strain Gauges k. Fluid Flow Measurement l. Smart Sensors m. Speed Sensors	Interfacing following sensors with simple circuits for basic automation tasks without using controller • Float Sensor • Proximity - Inductive, Capacitive and Optical (PNP & NPN) • Magnetic Reed Switch (used in Pneumatics)

4	1,2	1,2,4	**Actuators** • IEC standard Symbols for Actuators • Working Principle and Applications of Following devices a. Solenoid Actuators: Water Solenoid, Pneumatic Direction Control Valves (DCVs) b. Vacuum generators & Pneumatic Gripper c. Relays: SPST, SPDT, DPST and DPDT	Interfacing following Actuators with simple circuits for basic automation tasks **without using controller.** • Use Water Solenoids and Float switches to maintain Water Level in a tank. • Actuate DAC using double solenoid 5/2 DCV (Electro Pneumatics) & Push Buttons • Run 12VDC Geared Motor clockwise/Counter Clockwise direction using two relays and Push Buttons.
5	1,2	1,2,4	**Electric Motors** a. DC Motors & DC Servo Motors b. Stepper Motor c. Synchronous Motors d. Servo Motors e. Motor Drivers: Stepper Drivers, Servo Drivers, Variable Frequency Drives (VFDs)	Interfacing following Motors with motor Drivers for basic automation tasks without using controller • DC Geared Motors with Driver • Stepper Motor with Driver & Pulse Generator. • AC Motors with VFD
6	3	1,2,4	**Programmable Logic Controller (PLC)** • History of PLC • Relay Logic Circuits • Need of PLC for Industrial Automation • PLC Block Diagram • Opto–Isolators • Need of Sink and Source type Wiring • Types of PLC based on outputs • Functions of Analog to Digital Converters (ADCs) & Digital to Analog Converter (DACs)	• Demonstrate Relay Logic Circuit for AND/OR/NAND logics using 2 push buttons, relays and a light • PLC Hardware & Architecture • Memory Organization • Familiarize with PLC - CPU, IO Modules, Power Supply, Communications, IO Devices • Wiring the PLC • Leading PLC manufacturers in global market
7	3	1,2,4	**PLC Programming Fundamentals** • Types of PLC Programming Languages • Ladder Programming • Standard IEC Symbols (Programming) • Basic Ladder Diagram –Rails, Rungs, Branch • NC, NO Contacts and Coil • Need of Push Button for Industrial Application	Develop a Ladder diagram to switch ON/OFF light using following • AND, OR, NOT, NAND, NOR & XOR Logic ***Note**: Construct the above logics using* *a. NO/NC contacts* *b. Logical Instruction blocks* • "Automatic door opening" using optical sensor

8	3	1,2,4	**Programming Concepts** • Latching - Latching and Unlatching Instructions • Internal Relays /Memory Bits– Variable Declaration • Interlocks and Trips: Types and Need of Interlocks (Demonstrate using three level alarm system) • Controlling Stepper Motor using PWM Instruction Block	Develop a ladder diagram for the following logic using Latching Circuit, Latching Instructions, Internal Relays/Bits • Three level Safety Alarm System • Automation of two Pneumatics cylinders in sequence • Forward and Reverse stepper motor using Driver: Use PWM instruction block in Ladder Programming
9	3	1,2,4	**Programming Concepts** • Timer TON, TOFF • Timer: Sequencing, Cascading • Counters: CTD, CTU, CTUD • **Math** Instructions: *, +, -, /, MOD, Neg • Simulate: Subtract the current liquid level from the tank capacity to calculate available space using level gauge. • **Compare** Instruction: <,>, <=,>=, =, <> • Simulate: Compare the temperature of a process with a set point to control an output using LM35 Sensor.	Develop PLC ladder diagram and interface the following Logics • Two tanks supplying liquids simultaneously to mixer based on requirement using timer instruction block. • For counting the number of items moving on a conveyor belt • Car Parking Barrier using Up Down Counter (CTUD).
10	3	1,2,4	**Programming Concept- Reading Analog inputs** □ Instruction Blocks: Conversion of any variable to bool, int, real etc. □ SCALER Instruction Block	Develop a ladder diagram & Interface the following • To measure the water level using Level Gauge (Analog Input): Use "Any to Real" and "SCALAR" instruction blocks • Lift for three floors • Traffic Light Programming
11	3	1,2,4	**PLC Pneumatics/ Hydraulics** • Importance of PLC Pneumatics/Hydraulics • Sensors & Actuators used in Pneumatic/ Hydraulics circuits • Functions and features of pneumatic drives- Guided cylinders, rod less linear drives and rotary drives. • Vacuum Generator and Gripper • Industrial Application of PLC pneumatics.	• Develop ladder diagram and operate pneumatic actuation for the following logics a. Cylinder Sequencing Circuit using Reed Switches b. Clamp/unclamp based on timing. • Pneumatic gripper to pick up objects from a conveyor belt and place them in specific bins.

12	4	1,2,4	**Modern Tools and Control Systems used in Industrial Automation** • **HMI**: Human-Machine Interface, Sample HMI Screens • **SCADA**: Features, Typical SCADA Systems- Petroleum Refining, Water Purification, Chemical Plant. • **PAC**: Programmable Automation Controller- Benefits over PLC • **DCS**: Distributed Control System • **RTU**: Remote Terminal Unit	**Case studies -** Visit any one of the following industries and prepare a concise report on their operations: • Milk Packing Unit • Paint Industry • Food Packing Industries • Drinking Water Bottling Unit **Note**: Collect information about SCADA, HMI, DCS, PAC, RTU or any other automation system used in the industry. *(Refer Reference No. 10)*
13	4	1,2,4	**Technologies driving Industry 4.0** • IIoT, Cyber Security • Artificial Intelligence, Machine Learning • Big Data, Augmented Reality • Digital Twin, Block Chain	Demonstrate following IoT application using Arduino/ Raspberry-Pi board • Arduino IoT Program for Controlling an LED • Arduino IoT Program for Reading Temperature and Humidity using DHT11/DHT22 Sensor

4. References:

Sl. No.	Author	Title of Books	Publication/ Year
1	Mikell P. Groover	Automation, Production Systems and Computer - Integrated Manufacturing	4th Edition, Pearson Education, 2016
2	W. Bolton	Programmable logic Controllers	6th Edition, Newnes Publisher, 2015
3	Jacob Fraden	Hand book of Modern Sensors, Physics, Designs and Applications	4th ed. Springer-Verlag New York Inc., 2014
4	Austin Hughes And Bill Drury	Electric Motors and Drives	4th Edition, Newnes Publisher, 2013
5	Hugh Jack	Automating Manufacturing Systems with PLC	Publisher: Lulu, 2009
6	Shimon Y. N	Springer Handbook of Automation	Springer 2009
7	A_Boyer	SCADA: Supervisory Control and Data Acquisition	4th Ed, International Society of Automation, 2016
8	Rajesh Mehra & Vikrant Vij	PLCs & SCADA - Theory and Practice	1st Ed, Laxmi Publications Private Limited, 2019
9	Samuel Greengard	The Internet of things	The MIT Press, 2015
10	Web Link : *https://www.industrialautomation.us/case-studies/* as on 02/10/2024		

11	Web Link : *https://symbols.radicasoftware.com /230/layout* as on 02/10/2024

5. CIE Assessment Methodologies

Sl. No	CIE Assessment	Test Week	Duration (minutes)	Max. Marks	
1.	CIE-1 Theory Test	4	90	50	Average of all CIE=50 Marks
2.	CIE-2 Practice Test	7	180	50	
3	CIE-3 Theory Test	10	90	50	
4.	CIE-4 Practice Test	13	180	50	
5	CIE-5 Portfolio evaluation of all the Graded exercises (25 Marks) and Activities (25 Marks) through Rubrics	1-13		50	
				Total	**50 arks**

5. SEE – Practice Assessment Methodologies

Sl. No	SEE – Practice Assessment	Duration (minutes)	Max. Marks	Min. Marks to Pass
1.	Semester End Examination-Practice	180	50	20

6. CIE Theory Test Model Question Paper

Program	Automobile Engineering			**Semester -** V	
Course Name	Industrial Automation			**Test**	I/III
Course Code	**25AT53IB**	**Duration**	90 min	**Marks**	50
Name of the Course Coordinator:					
Note: Answer any one full question from each section. Each full question carries equal marks.					
Section - 1					
1	a. Describe how decisions are made at various levels of industrial automation. Give an example of how field-level systems and management-level systems work together to improve production efficiency.		Apply	CO4	5
	b. In an automatic beverage bottle-filling system, explain the functions of different sensors, actuators, and controllers employed, along with a block diagram.		Apply	CO4	5
	c. Discuss the advantages and disadvantages of fixed automation versus flexible automation in a manufacturing setting. Provide an example of a scenario where each type would be most beneficial.		Apply	CO4	5
	d. Discuss the role of limit switches in automated machinery. Identify a specific application where limit switches are critical and explain how they contribute to the overall functionality of the system.		Apply	CO1	5

	e. Give an industrial scenario for each of the following switches where specific switches are essential i) Push Buttons ii) Key Switch	Apply	CO1	5
2	a. Describe how industrial automation improves quality control in the manufacturing process. Provide a case where automation has been successfully applied to reduce defects.	Apply	CO4	5
	b. In a simple automatic food packaging system, explain the functions of different sensors, actuators, and controllers employed, along with a block diagram.	Apply	CO4	5
	c. Discuss the benefits and drawbacks of fixed and programmable automation in manufacturing processes. Provide an example for each type that illustrates when it would be most advantageous to use.	Apply	CO4	5
	d. Discuss the importance of position or displacement sensors in an industrial automation setup. Provide a practical example where these sensors significantly impact the performance of a manufacturing process.	Apply	CO1	5
	e. Give an industrial scenario for each of the following switches where specific switches are essential i) Toggle Switch ii) Emergency Stop	Apply	CO1	5
Section – 2				
3	a. In a hydraulic system, explain how a pressure switch can be used to monitor pressure levels. Design a simple circuit that activates an alarm if the pressure exceeds a specified threshold.	Apply	CO1	5
	b. In a water tank system, how can liquid level detectors be employed to maintain optimal water levels? Create a simple circuit that controls a pump to fill the tank when the water level is low and turns it off when the level is adequate.	Apply	CO1	5
	c. In a packaging line, describe the application of photoelectric sensors for detecting the presence of products. Design a circuit that triggers a conveyor belt when a product is detected, considering the need for timely operation.	Apply	CO1	5
	d. In a food processing plant, explain the role of temperature sensors in ensuring product safety. Design a circuit that activates a cooling system when temperatures exceed a certain level, considering the requirement for rapid response.	Apply	CO1	5
	e. In a sewage treatment plant, how can float sensors be implemented to manage waste levels? Create a simple circuit that activates a pump to remove waste when a certain level is detected, considering space and environmental constraints	Apply	CO1	5
4	a. In an automated assembly line, how can proximity sensors be used to detect the presence of parts? Create a circuit that triggers an action (e.g., starting a machine) when a part is detected, considering the need for quick cycle times.	Apply	CO1	5
	b. In an automated material handling system, how can proximity sensors improve safety? Design a circuit that stops machinery if a person is detected within a hazardous area, ensuring worker safety.	Apply	CO1	5
	c. In a conveyor belt system, explain how limit switches can prevent jamming. Create a circuit that stops the conveyor when a limit switch is triggered due to a blockage, focusing on operational continuity.	Apply	CO1	5

	d. In a water distribution system, how can fluid flow measurement ensure system integrity? Design a circuit that alerts operators when flow rates are outside acceptable limits, considering the need for real-time monitoring.	Apply	CO1	5
	e. In a refrigeration unit, describe the role of temperature sensors in maintaining optimal conditions. Design a circuit that turns on the compressor when the temperature rises above a set point	Apply	CO1	5
***Note for the Course coordinator**: Each question may have two or three or four or five subdivisions. Optional questions in each section carry the same weightage of marks, cognitive level and course outcomes.*				

Signature of the Course Coordinator **Signature of the HOD** **Signature of the IQAC Chairman**

8. CIE Practice Test model question paper

Program	Automobile Engineering			**Semester**	**V**
Course Name	Industrial Automation			**Test**	**II**
Course Code	**25AT53IB**	**Duration**	**180 min**	**Marks**	**50**
Name of the Course Coordinator:					
Note: Answer any one question from each section. Each question carries 25 marks					

	Questions	**CO**	**Marks**
	Section-I		
1.	a. Design a circuit using push buttons (Start/Stop) to control the operation of a conveyor belt. Use relays to handle the load without using a controller. b. Design a basic automation circuit using an inductive proximity sensor to detect metal objects. c. Create a circuit using a float sensor to control the water level in a tank. Use a water solenoid valve to automatically fill the tank when the level drops below a set point. d. Design a basic emergency stop switch circuit that shuts down a press machine upon pressing the button. e. Design a simple circuit using a float switch and a relay to automatically control the pump.	**1,2**	**25**
	Section-II		
2.	a. Design a pneumatic circuit to automatically reverse a double-acting cylinder (DAC) using a magnetic reed switch, push button, 5/2 double solenoid valve, and other essential pneumatic components. b. Design a circuit using a VFD (Variable Frequency Drive) to control the speed of an AC motor driving the conveyor belt. c. Design a circuit that controls a stepper motor using a pulse generator for accurate positioning of items on a conveyor. d. Develop a relay-based control circuit for a conveyor belt system that starts and stops based on input from a proximity sensor (Inductive). Include an emergency stop button to ensure safety during operation, simulating a scenario where metal objects are detected on the conveyor.	**1,2**	**25**

Scheme of Assessment for Section I & II	CO	
a. Select the appropriate sensor, actuator and other hardware components for a given automation application. ***Note**: Includes Aim of the practical, List of Components Required*	1	10 x 2
b. Integrate various hardware components to design and implement automation circuits. ***Note**: Includes Explanation, Procedure writing, Circuit diagram using IEC standard Symbols, Execution and Inference/Result writing*	2	10 x 2
c. Viva		10
Total Marks		**50**

Signature of the Course Coordinator **Signature of the HOD**

9. CIE Practice Test model question paper

Program	Automobile Engineering			**Semester**	**V**
Course Name	Industrial Automation			**Test**	**IV**
Course Code	**25AT53IB**	**Duration**	**180 min**	**Marks**	**50**
Name of the Course Coordinator:					
Note: Answer any one question from each section. Each question carries 25 marks					

	Questions	CO	Marks
	Section-I		
1.	a. For an automatic door system using an optical sensor, select the appropriate sensor, actuator, and other necessary hardware components. Develop a ladder program that controls the door's opening and closing. b. Design a pneumatic system that automates the sequencing of two cylinders. Identify the suitable sensors and actuators for this application and integrate them into a functional system. Write a ladder program for cylinder sequencing. c. For a three-level safety alarm system, select the appropriate sensors and internal relays to trigger alarms based on certain conditions. Develop a ladder program using latching instructions. d. Select and interface the required components for a water level monitoring system using an analog level gauge. Write a ladder program using "Any to Real" and "SCALAR" instruction blocks to measure and display the water level. e. For a mixer system where two tanks supply liquids simultaneously, select the proper sensors, actuators, and timers to control the flow. Develop a ladder program using timers for this automation.	**1,2**	**25**
	Section-II		
2.	a. Design an automation system for controlling a conveyor belt. Choose the appropriate hardware to count items moving on the belt and then develop a ladder program to manage the counting. b. For a lift system that operates between three floors, identify the necessary sensors, actuators, and other hardware. Develop a ladder program to control the	**1,2**	**25**

	lift's movement, including the detection of floor levels. c. Select the sensors and actuators for controlling a traffic light system at an intersection. Integrate the components and write a ladder program to manage the light sequencing based on a timer. d. For a car parking barrier system, identify the necessary sensors, actuators, and timer instruction blocks. Develop a ladder program to automate the opening and closing of the barrier. e. Develop an automation system for a pneumatic gripper that picks objects from a conveyor belt and places them in bins. Select and integrate the appropriate sensors, actuators, and hardware, then write a ladder program for the gripper's operation.		
Scheme of Assessment for Section I & II		**CO**	
a. Select the appropriate sensor, actuator and other hardware components for a given automation application. ***Note**: Includes Aim of the practical, List of Components Required*		1	10 x 2
b. Integrate various hardware components to design and implement automation circuits. ***Note**: Includes Explanation, Procedure writing, Circuit diagram using IEC standard Symbols, Execution and Inference/Result writing*		2	10 x 2
c. Viva			10
	Total Marks		**50**

Signature of the Course Coordinator Signature of the HOD

10. Suggestive Activities for Tutorials:

The list is an example and not inclusive of all possible activities of the course. Student and Faculty are encouraged to choose activities (minimum six) that are relevant to the topic.

Sl. No.	Suggestive Activities for Tutorials
01	Visit a nearby washing machine, refrigerator, or air conditioning repair shop. Observe and study the system's various components. Record a video showing the operation and components, and upload it to Google Classroom or any other platform as directed by the course coordinator. Additionally, prepare a handwritten report (maximum 200 words) that includes a block diagram of the system, illustrating how the components are interconnected, with a focus on sensors, actuators, and controllers.
02	Create a ladder logic program to automate a "Water Level Controller" using Open PLC software. Implement the program on an **Arduino Board** and interface it with the necessary hardware components to demonstrate its operation. *Reference:* Open PLC Project Guide
03	Develop a simple relay circuit to switch ON/OFF an LED using Tinker CAD online simulation software. *Refere*nce: *Tinker CAD*

04	Design a ladder diagram to measure room temperature using an LM35 temperature sensor and demonstrate the interfacing process.
05	Write a **Python program** to switch a 5V LED on and off using a **Raspberry Pi GPIO** pin. Reference: https://www.youtube.com/watch?v=IP-szuon2Bk
06	Write a **Python program** to turn an LED ON when the temperature (read from a sensor like DHT11) exceeds a certain threshold and OFF otherwise using a **Raspberry Pi GPIO** pin.
07	Prepare a PowerPoint presentation on a proximity sensor manufactured by a selected company. The presentation should include at least 10 slides. *Note: The course coordinator may assign each student a specific company and sensor type.*
08	Visit one of the following industries: Milk Packing Unit, Paint Industry, Food Packing Industry, or Drinking Water Bottling Unit. Prepare a concise report detailing the automation systems used, including SCADA, HMI, DCS, PAC, RTU, or any other system. **Note**: Collect information about SCADA, HMI, DCS, PAC and RTU or any other automation system used in the Industry. Reference**.**www.industrialautomation.us/case-studies/ as on 02/10/2024

11. Rubrics for Assessment of Activity (Qualitative Assessment)

Sl. No	Dimension	Unsatisfactory	Satisfactory	Good	Very Good	Excellent	Student's Score
		10	20	30	40	50	
1	Understanding of Components/ Systems	Limited understanding of system components and their functions	Basic understanding with some key details missing	Clear understanding with proper explanation of components	In-depth understanding with ability to explain component relationships	Comprehensive understanding with deep insights into system operation	20
2	Technical Skills/ Implementation	Struggles with basic implementation of tasks	Able to implement tasks with some assistance or errors	Can complete tasks independently with minor errors	Completes tasks accurately with minimal assistance	Demonstrates advanced technical skills with flawless execution	30
3	Report/ Presentation Quality	Report/presentation lacks clarity and detail	Provides basic information, but lacks depth or organization	Well-organized report/ presentation with clear details	Clear, concise, and in-depth with appropriate diagrams	Highly professional presentation with comprehensive details and critical insights	40
4	Creativity and Problem Solving	Limited creativity or problem-solving in the approach	Shows some creativity but limited problem-solving skills	Demonstrates a creative approach with good problem solving	Highly creative approach with strong problem-solving abilities	Exceptional creativity and innovative problem-solving, with original insights	20
	Average Marks=(20+30+40+20)/4=30						**30/50**

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

12. SEE- Model Practice Question Paper

Program	Diploma in Automobile Engineering		**Semester**	**V**
Course Name	Industrial Automation	**Course Code: 25AT53IB**	**Duration**	**180 min**
Note*: Answer any one question*				

Questions	CO	Marks
***Note**: During the SEE, All questions will be distributed among the group. Each student will be assigned one of the following questions by the examiner, without offering any choice.* 1. For an automatic door system using an optical sensor, select the appropriate sensor, actuator, and other necessary hardware components. Develop a ladder program that controls the door's opening and closing. 2. Design a pneumatic system that automates the sequencing of two cylinders. Identify the suitable sensors and actuators for this application and integrate them into a functional system. Write a ladder program for cylinder sequencing. 3. For a three-level safety alarm system, select the appropriate sensors and internal relays to trigger alarms based on certain conditions. Develop a ladder program using latching instructions. 4. Select and interface the required components for a water level monitoring system using an analog level gauge. Write a ladder program using "Any to Real" and "SCALAR" instruction blocks to measure and display the water level. 5. For a mixer system where two tanks supply liquids simultaneously, select the proper sensors, actuators, and timers to control the flow. Develop a ladder program using timers for this automation. 6. Design an automation system for controlling a conveyor belt. Choose the appropriate hardware to count items moving on the belt and then develop a ladder program to manage the counting.	**1,2**	**50**
7. For a lift system that operates between three floors, identify the necessary sensors, actuators, and other hardware. Develop a ladder program to control the lift's movement, including the detection of floor levels. 8. Select the sensors and actuators for controlling a traffic light system at an intersection. Integrate the components and write a ladder program to manage the light sequencing based on a timer. 9. For a car parking barrier system, identify the necessary sensors, actuators, and timer instruction blocks. Develop a ladder program to automate the opening and closing of the barrier. 10. Develop an automation system for a pneumatic gripper that picks objects from a conveyor belt and places them in bins. Select and integrate the appropriate sensors, actuators, and hardware, then write a ladder program for the gripper's operation.		
Scheme of Assessment		
a. Select the appropriate sensor, actuator and other hardware components for a given automation application. ***Note:** Includes Aim of the practical, List of Components Required*	CO1	5
b. Integrate different hardware components with a Programmable Logic Controller (PLC) for a specified automation system. ***Note:** Includes Explanation, Procedure writing and Circuit diagram using IEC standard Symbols in addition to PLC integration with input and output components.*	CO2	10
c. Develop ladder program for given automation applications, download and automating the system ***Note:** Includes ladder programming and result writing in addition to automating the given problem.*	CO3	25
d. Viva		10

Total Marks	**50**

1) Signature of the Examiner **2) Signature of the Examiner**

13. Equipment/software list with Specification for a batch of 30 students

Sl. No.	Particulars	Specification	Qty.
01	Computers	Latest Configuration	10
02	Programmable Logic Controller (PLC)	Minimum 12, 24V DC Inputs, 4 configurable analog input with thermistor voltage reference out, 7 24V DC Source Output, 1 Analog Output, Embedded Ethernet Port and RS-232/485 non-isolated Serial port, Embedded RTC, MicroSD Card support and minimum 2 Plug-In slots.	10
03	24 VDC Power Supply	24 V, 10A DIN Rail Mountable	10
04	12 VDC Power Supply	12 V, 5 A, DIN Rail Mountable	10
05	Push Button	Push Button Industrial Grade with NO and NC Elements- 22 mm diameter	50
06	Key Switch	Key Switch with NO and NC Elements - 22 mm diameter	5
07	Rotary Switch	2/3 Position Rotary Switches with NO Elements - 22 mm diameter	15 Each
08	Emergency Stop	Industrial Grade Mushroom Types switch with NC element -22 mm diameter	10
09	Toggle Switch	2/3 Position Toggle Switch	5 Each
10	Float Sensor	Float Sensor for Water Level detection	10
11	Buzzer	24VDC, 22mm	04
12	Level Gauge	Analog Water Level Gauge (minimum 30 cm Height)	02
13	Limit Switches	Industrial Grade Roller Type/lever operated Limit Switch (NO/NC)	10
14	Proximity Sensors (PNP Only)	Inductive, Capacitive and Optical Proximity Sensors (Available Size M8/M12/M18/M30 diameter)	20 Each
15	Pneumatic Reed Switch	Pneumatic Magnetic Reed Switch NO/NC, Used in Pneumatic Cylinder	10
15	Water Solenoids	24 VDC water Solenoid	10
16	Geared Motor	DC Geared Motor	10
17	Pneumatic Cylinder	20 mm bore 100/150 mm stroke	6
18	Twin Cylinder	Dual rod cylinder with guide function for pick & place applications, 10/12 mm rod diameter, 125 mm stroke length	2
19	Direction Control Valve (DCV)	5/2 Single Solenoid DCV	2

20	Direction Control Valve(DCV)	5/2 Double Solenoid DCV	2
21	Direction Control Valve(DCV)	3/2 single Solenoid DCV	2
22	Pneumatic vacuum Generator	0.5 to 10 BAR	2
23	Vacuum Suction Cup Gripper	Round, oval, and bellow shaped	2
24	Stepper Motor	NEMA 23 Stepper motor 10kg/cm, 4 wired	4
25	Stepper Driver	TB6600 Stepper Motor Driver Controller 4A 9~42V TTL 16 Micro-Step	4
26	Pulse Generator	Stepper Motor Driver Controller 8A Dual Mode Function Signal Generator, 1Hz-150KHz PWM Motor Speed Regulation/LCD Pulse Frequency Cycle Module Adjustable Driver Module Signal Generator	2
27	AC Motor	3 Phase AC Motors	1
28	Variable Frequency Drive(VFD)	AC drive which offer a power rating of 0.4...22 kW (0.5...30 Hp) with global voltage classes of 100...600V, provide a variety of motor control and flexible mounting options.	1
29	Lift Model	The trainer must be a miniature model of a three/four-layer elevator, fully replicating real elevator functions with easy PLC interfacing. It provides hands-on training in PLC programming, sensor integration, position control, and sequential logic control for elevator automation systems.	1
30	Conveyor Model	The trainer should feature a DC geared motor-operated flat belt conveyor, 3.5-inch width and minimum 2 feet length, easily interfaced with PLC. It provides hands-on training in PLC programming, motor control, and automation processes, simulating real-world conveyor operations.	1
31	Car Parking Barrier	The trainer should be a miniature model of a car parking barrier system with functional entry and exit arms, similar to those at toll plazas, easily interfaced with PLC. It should also include car full indicators that activate when parking capacity is reached.	1
32	Automatic Door Open Close System	The trainer should be a miniature model of an Automatic Door Open-Close System powered by a DC-geared motor, incorporating optical sensors and limit switches for accurate motion detection and control. The model should be easily interfaced with a PLC, providing hands-on training in motor control, sensor integration, and sequential logic operations.	1
33	Mixer Model	The trainer should be a miniature model of an industrial Mixer System with water solenoids for precise control in each jar. It should feature PLC-interfaced controls for automatic or manual operation of the mixing cycles.	1
34	Raspberry Pi Board	Raspberry Pi 5 Model 8GB, Processor-64-bit Arm Cortex-A76 CPU RAM: 8GB LPDDR4 SDRAM with power supply	5
35	Arduino Board	Uno R3 Board with Power Supply	5

Government of Karnataka
DEPARTMENT OF TECHNICAL EDUCATION

Program	Automobile Engineering	**Semester**	V
Course Name	IIOT (Industrial Internet of Things)	**Type of Course**	Integrated
Course Code	**25AT53IC**	**Contact Hours**	7Hours/ Week
Teaching Scheme	L: T:P: 3:0:4	**Credits**	5
CIE Marks	50	**SEE Marks**	50 (Practice)

1. **Rationale:** The Industrial Internet of Things (IIoT) is transforming industries by integrating digital technologies, advanced sensors, and communication networks. The convergence of physical and digital systems has revolutionized manufacturing and other sectors, making processes smarter and more efficient. For Mechanical Engineering students, learning IIoT equips them with the knowledge to design, implement, and maintain systems for data acquisition, analysis, and automation in real-time industrial environments. Additionally, the application of IIoT in automobiles, including connected car technologies, smart sensors, and safety systems, provides real-world relevance for students aspiring to work in manufacturing or automotive industries. This course covers foundational IIoT concepts, sensors, automation, and their applications, aligning well with Industry 4.0.

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

CO-01	**Apply** IIoT technologies to design and implement smart industrial systems, integrating sensors, actuators, and automation to enhance efficiency, productivity, and predictive maintenance.
CO-02	**Develop and integrate** IoT-based monitoring and control systems for industrial and automotive applications, utilizing real-time data acquisition, cloud computing, and analytics to optimize performance.
CO-03	**Implement** IIoT-driven safety and efficiency solutions in automobiles, including connected car technologies, ADAS, ABS, and vehicle-to-vehicle communication to enhance road safety and automation.
CO-04	**Analyze and process** IIoT-generated data using cloud platforms, edge computing, and AI-driven analytics to improve decision-making, energy efficiency, and sustainability in industrial systems.

3. Course Content

WEEK	CO	PO	Theory	Practice
1	1	1,3, 4	• **Introduction to IoT & IIoT –** the evolution of IoT & IIoT, Fundamentals, architecture, and key differences between IoT and IIoT**.** • **Applications of IoT & IIoT** – Smart homes, healthcare, agriculture, industrial automation, and manufacturing (Write a block diagrams and data flow lines for each)	**IoT & IIoT Hardware Platforms** • Industry-grade or IIoT (Siemens PLCs, Rockwell Automation, NI Compact RIO etc). • Consumer-grade boards or IoT (Arduino, Raspberry Pi, ESP32, pcDuino, Beaglebone black, Cubie board, Jetson, Google Coral, etc.). • Sensors & Actuators in IIoT & IoT
2	1	1,3 ,4	• **Arduino & Raspberry pi**- Introduction to IoT Architecture using Raspberry Pi and Arduino , Setting up Raspberry Pi or Arduino environment. • **Key Components of IIoT Systems**- Sensors and Actuators, Connectivity/ Communication protocols, Data Processing, IoT Platforms (like ThingSpeak, IBM Watson IoT, and Microsoft Azure)	• Block diagram of an IIoT-based system for Agricultural Greenhouse, Cold Storage Monitoring, and Heating & Ventilation Control, etc highlighting key parameters to be measured and controlled. • Interfacing a DHT11 temperature and humidity sensor with a Raspberry Pi/Arduino, reading sensor data, and sending it to a cloud service (e.g., ThingSpeak) for visualization and analysis (Refer Experiment No.1)

3	1	1,3,4	**Introduction to Communication Protocols in IIoT** • MQTT, CoAP, and HTTP, Challenges in IIoT Communication. • Overview, Working and Advantages of MQTT (Message Queuing Telemetry Transport), CoAP (Constrained Application Protocol),	• Setting up IoT communication on Raspberry Pi using MQTT, (Refer Experiment No.2) • Setting up IoT communication on Arduino using CoAP Protocol, (Refer Experiment No.3)
4	1	1,3,4	• HTTP (Hyper-Text Transfer Protocol) protocols. • Security in IIoT Communication- Importance of Security, Encryption, Authentication and Authorization	• Setting up IoT HTTP, Communication for IIoT Data Collection. (Refer Experiment No.4) • Secure IoT Communication using SSL/TLS. (Refer Experiment No. 5)
5	2	2,3,4	**Smart Factory Concept and IIoT Integration in Manufacturing** • Core Components of Smart Factories – Cyber-Physical Systems (CPS), Sensors and Actuators, Robotics and Automation • Importance of IIoT Applications in Manufacturing – Predictive Maintenance, Production Line Monitoring and Optimization, Quality Control and Assurance, Energy Management.	Importance of IIoT Applications in Manufacturing • Setting up IIoT Systems for Predictive Maintenance. (Refer Experiment No.6) • Production Line Monitoring with IoT. (Refer Experiment No. 7)
6	2	2,3,4	• The integration of IIoT and robotics in smart manufacturing, focusing on automated assembly lines, smart warehousing, real-time monitoring, and data-driven efficiency optimization. • Technologies Enabling Smart Factories - Cloud Computing and Big Data, Cyber-security, Edge Computing, AI and Machine Learning	• Develop a prototype for an **automated assembly line**, integrating IIoT sensors for real-time monitoring. • Quality Control System Using IIoT (Refer Experiment No.8) • Energy Consumption Monitoring in Manufacturing. (Refer Experiment No. 9)
7	4	4,5,7	**Cyber-security in IIoT**: • **Data encryption, Authentication mechanisms, firewall protection, and Network security**. • Overview of **cyber-security standards (iso 27001, iec 62443)** for industrial automation.	• Implementing secure IIoT communication by encrypting sensor data using AES encryption on a Raspberry Pi and transmitting it securely to a cloud platform for protected data exchange and monitoring (Refer Experiment No. 4 & 10)

8	4	4,5,7	**Edge Computing in IIoT:** • Importance, benefits, and applications in industrial environments. • Comparison between Edge Computing and Cloud Computing in IIoT.	• Implement edge-based IIoT processing using a Raspberry Pi for real-time industrial data analysis, enabling local preprocessing, reduced latency, and optimized bandwidth usage before transmitting data to the cloud. (Refer Experiment No. 11)
9	3	4, 5	**IIoT in Automotive Industry:** • Overview, Key IIoT Technologies in Automotive – Sensors, Connectivity, Cloud Platforms. • Rain sensors, Anti-lock Braking, Air Pressure Monitoring System	• Simulation of Vehicle-to-Vehicle (V2V) Communication Using Raspberry Pi (Refer Experiment No. 12)
10	3	4, 5	• **Connected Cars:** Concept and Benefits, Vehicle-to-Vehicle (V2V) Communication, Vehicle-to-Infrastructure (V2X) Communication	• Implementation of Lane Departure Warning (LDW) System with Camera and Sensors (Refer Experiment No. 13)
11	3	4, 5	▪ **Advanced Driver Assistance Systems (ADAS):** Lane Departure Warning (LDW), Adaptive Cruise Control (ACC), Automatic Emergency Braking (AEB), Blind Spot Detection (BSD), Role of IIoT in ADAS.	• Designing Adaptive Cruise Control (ACC) System with IoT Sensors (Refer Experiment No. 14) • Building a Smart Parking System Using IoT Sensors. (Refer Experiment No. 15)
12	4	4,5,7	**Role of Cloud Computing in IIoT** • **Key Features of Cloud in IIoT**- Scalability, Advanced Analytics & AI, Remote Monitoring & Control, Remote Monitoring & Control, Centralized Data Management • **Cloud Computing Architecture in IIoT** - Service provider, Storage, Applications.	• Implementing Cloud-Based Data Storage for IIoT Systems (Refer Experiment No. 16)
13	2	2,3,4	**Implementing IIoT in a Real-World Application** • Importance of IIoT in various industries - Healthcare, Smart Cities, Agriculture, Energy, etc. • Identifying real-world problems that can be solved using IIoT • Selection of appropriate sensors, communication protocols, and cloud platforms	• Develop a prototype using Raspberry Pi/ Arduino with cloud connectivity • Present their solution with a working demo and project report

			• Data analytics and visualization techniques for real-world IIoT applications	

4. List of Experiments

1. **Interfacing temperature and humidity sensors with Raspberry Pi/Arduino:** In this practical, students will interface a temperature and humidity sensor (DHT11) with Raspberry Pi/Arduino, read sensor data, and send it to a cloud platform (Thing Speak) for real-time monitoring.
2. **Setting up IoT Communication on Raspberry Pi using MQTT** : To implement an IoT-based automatic water level monitoring system using MQTT protocol for real-time data exchange between sensors and a pump controller.
3. **Setting up IoT Communication - CoAP Protocol with Arduino:** To implement the CoAP protocol on an Arduino device for smart home automation, enabling remote control of lighting systems via a CoAP server, while understanding request-response mechanisms and the advantages of lightweight UDP-based communication in IoT applications.
4. **HTTP Communication for IIoT Data Collection**: To implement HTTP-based communication on a Raspberry Pi/Arduino for real-time IIoT data collection, by sending liquid flow sensor data from a pipeline system to a web server (e.g., Thing Speak, Node-RED) for leak detection and flow monitoring.
5. **Secure IoT Communication using SSL/TLS:** To implement secure IIoT communication using SSL/TLS encryption by configuring an MQTT broker (Mosquitto) with certificate-based authentication, ensuring encrypted data transmission between Arduino in a smart factory environment, where machine status data is securely transmitted to a central monitoring system to prevent unauthorized access and data breaches.
6. **Setting up IIoT Systems for Predictive Maintenance**: To develop a predictive maintenance system using IIoT sensors and Raspberry Pi to monitor a motor's condition(e.g., vibration, temperature, speed), analyze real-time data on a cloud platform (e.g., Thing Speak), and detect abnormal trends for early failure prediction in industrial environments.
7. **Production Line Monitoring with IoT**: To simulate a smart production line by integrating IIoT sensors with a conveyor belt system, using Raspberry Pi to monitor motor speed, belt position, and efficiency, enabling real-time performance analysis and bottleneck identification for improved industrial automation.
8. **Quality Control System Using IIoT**: To develop an IIoT-based quality inspection system for an automated packaging line, utilizing weight sensors to detect defects, ensure compliance with specifications, and trigger real-time alerts or corrective actions for improved product consistency and efficiency.

9. **Energy Consumption Monitoring in Manufacturing**: To develop an IIoT-based energy management system for monitoring and analyzing real-time energy consumption in a manufacturing setup, enabling energy efficiency optimization and sustainability improvements through data-driven insights.
10. **Cyber-security in IIoT**: Implementing secure IIoT communication in a smart home environment by encrypting sensor data (e.g., door status, lighting, energy usage) using AES encryption on a Raspberry Pi and securely transmitting it to a cloud platform for real-time monitoring and automation.
11. **Edge Computing in IIoT:** In a smart warehouse, a Raspberry Pi is installed to monitor real-time inventory movement using RFID and weight sensors. The edge device processes local stock data, only sending critical updates (e.g., low stock alerts) to the cloud, thereby reducing network congestion, ensuring faster decision-making, and optimizing warehouse operations.

IIoT in the Automotive Industry:

12. **Simulation of Vehicle-to-Vehicle (V2V) Communication Using Raspberry Pi**:- To develop a simulated Vehicle-to-Vehicle (V2V) communication system using Raspberry Pi and wireless modules to exchange real-time traffic data, enabling hazard detection and enhancing vehicle safety
13. **Implementation of Lane Departure Warning (LDW) System with Camera and Sensors**: To develop a basic lane departure warning system using cameras and sensors to detect lane positions, process images, and alert drivers upon unintended lane deviations, enhancing road safety.
14. **Designing Adaptive Cruise Control (ACC) System with IoT Sensors**: To design a basic adaptive cruise control system using IoT sensors to monitor distance, adjust vehicle speed dynamically, and enhance safety by maintaining a safe following distance in varying traffic conditions.
15. **Building a Smart Parking System Using IoT Sensors**: - To develop a smart parking system using IoT sensors to detect available spaces, provide real-time occupancy data, and enhance parking efficiency through an IoT-based dashboard.
16. **Implementing Cloud-Based Data Storage for IIoT Systems** - Students will understand how to collect, process, and store IIoT data in the cloud. They will gain experience in cloud communication using MQTT and HTTP protocols. Learn real-time monitoring and analytics for industrial applications.

5. References:

Sl. No.	Author	Title of Books	Publication/ Year
1	Zaigham Mahmood (Ed.)	The Internet of Things in the Industrial Sector	Springer Publication, 1st Edition, 2017
2	Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat	Industrial Internet of Things: Cyber manufacturing System	Springer Publication, 1st Edition, 2017
3	Ismail Butun (Editor)	Industrial IoT Challenges, Design Principles, Applications, and Security	Springer Publications, 1st Edition, 2019
4	Alasdair Gilchrist	Industry 4.0: The Industrial Internet of Things	Apress Publications, 1st Edition, 2016

5	Rahul Dubey	An Introduction to Internet of Things: Connecting Devices, Edge Gateway, and Cloud with Applications	Cengage India Publication, 1st Edition, 2020
6	Perry Xiao	Designing Embedded Systems and the Internet of Things (IoT) with the ARM Mbed	Wiley, 1st Edition, 2018
7	Sudip Misra, Chandana Roy, Anandarup Mukherjee	Introduction to Industrial Internet of Things and Industry 4.0	CRC Press, 1st Edition, 2021
8	G. Veneri Antonio	Hands-on Industrial Internet of Things	Packt Publication, 1st Edition, 2018
9	David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry	IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things	CISCO Press, 1st Edition, 2017
10	Massimo Banzi, Michael Shiloh	Make: Getting Started with the Arduino	Shroff Publisher/Maker Media Publishers, 3rd Edition, 2021
11	Matt Richardson, Shawn Wallace	Getting Started with Raspberry PI	O'Reilly Media, Inc., 1st Edition, 2012

6. CIE Assessment Methodologies

Sl. No	CIE Assessment	Test Week	Duration (minutes)	Max. Marks	
1.	CIE-1 Theory Test	4	90	50	Average of all CIE=50 Marks
2.	CIE-2 Practice Test	7	180	50	
3	CIE-3 Theory Test	10	90	50	
4.	CIE-4 Practice Test	13	180	50	
5	CIE-5 Portfolio evaluation of all the Graded exercises (50 Marks) and Activities (50 Marks) through Rubrics	1-13		50	
				Total	50

7. SEE – Practice Assessment Methodologies

Sl. No	SEE – Practice Assessment	Duration (minutes)	Max. Marks	Min. Marks to Pass
1.	Semester End Examination-Practice	180	50	20

8. CIE Theory Test Model Question Paper

Program	Automobile Engineering			**Semester -** V	
Course Name	IIOT			**Test**	I/III
Course Code	**25AT53IC**	**Duration**	90 min	**Marks**	50
Name of the Course Coordinator:					
Note: Answer any one full question from each section. Each full question carries equal marks.					

Q. No.	Questions	Cognitive Level	Course Outcome	Marks
	Section - 1			
1	a. Compare and illustrate the differences between IoT and IIoT by writing a block diagrams of simple home automation system and a smart factory system using relevant components.	Apply	CO1	10
	b. Justify the selection of a suitable IIoT communication protocol (MQTT, CoAP, or HTTP) for a smart energy monitoring system in an industrial plant, considering factors like real-time data transfer, reliability, and network constraints.	Apply	CO1	10
	c. Explain with an example how an IIoT-based quality control system using image processing and sensors can help detect defective products on an assembly line.	Apply	CO1	5
2	a. Compare and illustrate how data flow and processing differ in IoT and IIoT by explaining a smart healthcare monitoring system and an industrial predictive maintenance system.	Apply	CO1	10
	b. Explain an MQTT-based IIoT system for monitoring and controlling a warehouse automation process, ensuring secure data transmission and real-time updates on machine performance.	Apply	CO1	10
	c. Explain with an example how an IIoT-based predictive maintenance system utilizing vibration and temperature sensors can detect potential machine failures and prevent downtime.	Apply	CO1	5
	Section – 2			
3	a. Design an IIoT-based system for an agricultural greenhouse with a block diagram, highlighting the key parameters to be measured and controlled for optimal growth conditions.	Apply	CO1	10
	b. **Design an IIoT-enabled robotic system** for an **automated assembly line** and explain how real-time monitoring and data analytics improve production efficiency	Apply	CO1	10
	c. Justify the importance of cybersecurity measures (encryption, authentication) in IIoT systems, using an example of a smart factory communication network.	Apply	CO1	5
4	a. Design an IIoT-based monitoring system for a cold storage facility with a block diagram, highlighting the key parameters to be measured and controlled for maintaining optimal storage conditions.	Apply	CO1	10
	b. **Develop a basic IIoT-integrated robotic solution** for **material handling in a smart warehouse,** highlighting how automation reduces errors and increases productivity.	Apply	CO1	10
	c. Justify the importance of edge computing in IIoT systems, using an example.	Apply	CO1	5
Note for the Course coordinator*: Each question may have two or three or four or five subdivisions. Optional questions in each section carry the same weightage of marks, cognitive level and course outcomes.*				

Signature of the Course Coordinator **Signature of the HOD** **Signature of the IQAC Chairman**

9. CIE Practice Test model question paper

Program	Automobile Engineering			**Semester**	**IV**
Course Name	IIOT			**Test**	**II**
Course Code	**25AT53IC**	**Duration**	**180 min**	**Marks**	**50**
Name of the Course Coordinator:					
Note: Answer any one question. Each question carries 50 marks					
Questions				**CO**	**Marks**

1.	**Setting up IIoT Systems for Predictive Maintenance**: To develop a predictive maintenance system using IIoT sensors and Raspberry Pi to monitor a motor's condition(e.g., vibration, temperature, speed), analyze real-time data on a cloud platform (e.g., Thing Speak), and detect abnormal trends for early failure prediction in industrial environments.	**1,2**	**50**
2.	**Production Line Monitoring with IoT**: To simulate a smart production line by integrating IIoT sensors with a conveyor belt system, using Raspberry Pi to monitor motor speed, belt position, and efficiency, enabling real-time performance analysis and bottleneck identification for improved industrial automation.	**1,2**	**50**
	Scheme of Assessment for Section I & II	**CO**	
a.	Develop the program for a given application, integrate with appropriate hardware ***Note**: Includes Aim of the practical, List of Components Required, program and wiring diagram*	**1,2**	30
b.	Execution and Accuracy and effectiveness of the output. ***Note**: Includes implementation and output*	**1,2**	20
	Total Marks		**50**

Signature of the Course Coordinator **Signature of the HOD**

11. Suggestive Activities for Tutorials:

The list is an example and not inclusive of all possible activities of the course. Student and Faculty are encouraged to choose activities (minimum six) that are relevant to the topic. Develop the rubrics to evaluate these activities.

Sl. No.	Suggestive Activities for Tutorials
01	**IIoT for Remote Patient Health Monitoring -** Deploying IoT-enabled wearable sensors to monitor heart rate, blood pressure, and oxygen levels. Using cloud platforms to send real-time health alerts to doctors and caregivers.
02	**IIoT-Enabled HVAC** -Using temperature and air quality sensors to optimize HVAC systems in office buildings. Automating heating/cooling adjustments based on occupancy and environmental conditions.
03	**Smart Street Lighting System Using IIoT**- Implementing motion and light sensors to control streetlights based on vehicle and pedestrian movement. Analyzing energy savings using real-time monitoring and adaptive brightness control
04	**IIoT in Smart Parking Systems**- Implementing ultrasonic sensors to detect available parking spaces in real-time. Using a mobile app or dashboard to display parking slot availability to drivers**.**
05	**IIoT-Based Smart Water Management in Buildings** -Using ultrasonic sensors and IoT to monitor water levels in tanks and automate pump control. Collecting data on water usage patterns for optimization and sustainability
06	**Smart Warehouse Management System** - Implementing RFID and IoT sensors for real-time inventory tracking and automated stock updates in a warehouse. Analyzing how edge computing can help reduce latency in stock monitoring.

11.**Rubrics for Assessment of Activity/ Case Study (Qualitative Assessment)**

Sl. No	Dimension	Unsatisfactory	Satisfactory	Good	Very Good	Excellent	Student's Score
		10	20	30	40	50	
1	Understanding of Concepts	Limited understanding of key automation concepts with minimal explanation.	Basic understanding of concepts but lacks depth in analysis.	Demonstrates a good grasp of concepts with relevant explanations.	Shows strong understanding with well-supported insights.	Exceptional comprehension with in-depth analysis and accurate technical explanations.	20
2	Technical Skills/ Implementation	Struggles with basic implementation of tasks	Able to implement tasks with some assistance or errors	Can complete tasks independently with minor errors	Completes tasks accurately with minimal assistance	Demonstrates advanced technical skills with flawless execution	30
3	Depth of Research and References	Minimal or no research; lacks credible references.	Limited research with few relevant references.	Good research with appropriate sources and citations.	Strong research with multiple credible references and detailed information.	Extensive research with high-quality references, demonstrating thorough investigation.	30
4	Report/ Presentation Quality	Report/presentation lacks clarity and detail	Provides basic information, but lacks depth or organization	Well-organized report/ presentation with clear details	Clear, concise, and in-depth with appropriate diagrams	Highly professional presentation with comprehensive details and critical insights	20
	Average Marks= (20+30+30+20)/4=25						**25/50**

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

12. SEE- Model Practice Question Paper

Program	Diploma in Automobile Engineering		**Semester**	**IV**
Course Name	IIoT	**Course Code: 25AT53IC**	**Duration**	**180 min**

Note*: Answer any one question*

Questions	CO	Marks
Note*: During the SEE, All questions will be distributed among the group. Each student will be assigned one of the following questions by the examiner, without offering any choice.* 1. Demonstrate how to interface a DHT11 sensor with Raspberry Pi/Arduino and send real-time temperature and humidity data to ThingSpeak. 2. Implement an MQTT-based automatic water level monitoring system to control a pump based on sensor data. 3. Develop a CoAP-based smart home automation system to remotely control lighting using an Arduino and a CoAP server. 4. Set up an HTTP-based communication system to transmit liquid flow sensor data from a pipeline system to a web server for leak detection. 5. Configure an MQTT broker with SSL/TLS encryption for secure machine status data transmission in a smart factory setup. 6. Develop a predictive maintenance system using IIoT sensors to monitor a motor's vibration and temperature, and analyze the data on ThingSpeak. 7. Implement an IIoT-based conveyor belt system to monitor motor speed and belt position for real-time production line efficiency analysis. 8. Design an IIoT-based quality inspection system for an automated packaging line using weight sensors to detect product defects. 9. Develop an IIoT-based energy monitoring system using power sensors to track and analyze real-time energy consumption in a manufacturing setup. 10. Implement AES encryption on a Raspberry Pi to securely transmit smart home sensor data (e.g., door status, lighting) to a cloud platform.	**1,2, 3,4**	**50**

11. Set up an edge computing system using Raspberry Pi in a smart warehouse to process inventory movement data before sending critical updates to the cloud. 12. Develop a simulated V2V communication system using Raspberry Pi to exchange real-time traffic data and detect hazards. 13. Design a lane departure warning system using a camera and sensors to detect lane positions and alert drivers upon unintended deviations. 14. Develop an adaptive cruise control system using IoT sensors to maintain a safe distance between vehicles by adjusting speed dynamically. 15. Implement a smart parking system using IoT sensors to detect available parking spaces and display real-time occupancy data on a dashboard. 16. Demonstrate how to collect, process, and store IIoT sensor data in the cloud using MQTT and HTTP protocols for real-time analytics.		
Scheme of Assessment		
a. Develop the program for a given application, integrate with appropriate hardware ***Note**: Includes Aim of the practical, List of Components Required, program and wiring diagram*	**1,2, 3,4**	30
b. Execution and Accuracy and effectiveness of the output. ***Note**: Includes implementation and output*	**1,2, 3,4**	20
Total Marks		**50**

Signature of the Examiner **2) Signature of the Examiner**

13. Equipment/software list with Specification for a batch of 30 students

Sl. No.	Particulars	Specification	Qty.
1	Microcontroller Board	Arduino Uno (ATmega328P, 14 Digital I/O, 6 Analog Inputs, USB Interface),	15
		Arduino Nano	10
2	Single-Board Computer	Raspberry Pi 5 Processor-Broadcom BCM2712, Quad-Core Cortex-A76 (64-bit) @ 2.4 GHz, GPU-VideoCore VII, supports OpenGL ES 3.1, Vulkan 1.2, RAM-4GB or 8GB LPDDR4X-4267 SDRAM	10
3	Sensors Kit	Includes DHT11 (Temperature & Humidity), Ultrasonic Sensor (HC-SR04), PIR Motion Sensor, IR Sensor, Soil Moisture Sensor, Water Level Sensor, Vibration Sensor, LDR, Gas Sensor (MQ-2), Current Sensor	15 Sets
4	Industrial IoT Sensors	Temperature (DS18B20), Pressure (BMP280), Air Quality (MQ135), Load Cell (Weight Sensor)	5 Each
5	Actuators	5V & 12V DC Motors, Servo Motors (SG90), Stepper Motors (28BYJ-48)	10 Each
6	Wireless Communication Modules	Wi-Fi (ESP8266/ESP32), Bluetooth (HC-05), LoRa Module, Zigbee	10 Each
7	Edge Computing Device	Nvidia Jetson Nano (Quad-Core Cortex-A57, 4GB RAM, AI Processing)	2
8	Power Supply Units	5V 2A & 12V 2A Adapters	10 Each
9	IoT Cloud Platform	ThingSpeak, AWS IoT, Google Cloud IoT, Azure IoT Hub	

10	Programming Software	Arduino IDE, Python (for Raspberry Pi), Node-RED, MQTT Broker (Mosquitto), CoAP Libraries	Free/ Open Source
11	Simulation Software	Proteus, Tinkercad, Factory I/O (for Smart Factory Simulation)	
12	Networking Equipment	Wi-Fi Router (Dual Band, 300 Mbps), Ethernet Switch (8 Ports)	2 Each
13	Breadboards & Jump Wires	400-Point Breadboards, Male-Female, Male-Male, Female-Female Jumper Wires	30 Sets
14	Miscellaneous	Resistors, Capacitors, LEDs, Transistors, LCD Display (16x2), Relay Modules	As Required