SIXTH SEMESTER

Col. No.	Subject Code	Subject	Hours Per Week			
			Theory	Drawing	Practical	Total
1	4021610	Hybrid Electrical Vehicle and Policies	6	-	-	6
2	4021620	Industrial Management and Transport Engineering	5	-	-	5
Elective Theory - II						
3	4020531	Computer Integrated Manufacturing *	5	-	-	5
	4021632	Heavy Vehicle Engineering	5	-	-	
	4021633	Heating Ventilation and Air Conditioning Systems	5	-	-	
4	4021640	Hybrid Electrical Vehicle Practical	-	-	5	5
Elective Practical - II						
5	4020561	Computer Integrated Manufacturing Practical *	-	-	5	5
	4021652	Heavy Vehicle Engineering Practical	-	-	5	
	4021653	Heating Ventilation and Air Conditioning Systems Practical	-	-	5	
6	4021660	Project work & Internship	-	-	6	6
			16	-	16	32
Extra / Co-Curricular activities		Physical Education	-	-	-	2
		Library	-	-	-	1
Total						35

* Common with Mechanical Engineering

VI Semester

Subject Code	Subject	Marks			Minimum marks for pass	Duration of Exam Hours
		Internal Assessment	Board Examination #	Total		
4021610	Hybrid Electrical Vehicle and Policies	25	100	100	40	3
4021620	Industrial Management and Transport Engineering	25	100	100	40	3
Elective Theory - II						
4020531	Computer Integrated Manufacturing *	25	100	100	40	3
4021632	Heavy Vehicle Engineering	25	100	100		
4021633	Heating Ventilation and Air Conditioning Systems	25	100	100		
4021640	Hybrid Electrical Vehicle Practical	25	100	100	50	3
Elective Practical - II						
4020561	Computer Integrated Manufacturing Practical *	25	100	100	50	3
4021652	Heavy Vehicle Engineering Practical	25	100	100		
4021653	Heating Ventilation and Air Conditioning Systems Practical	25	100	100		
4021660	Project Work & Internship	25	100	100	50	3

* Common with Mechanical Engineering

Examinations will be conducted for 100 marks and it will be reduced to 75 marks for result.

STATE BOARD OF TECHNICAL EDUCATION &TRAINING, TAMILNADU

DIPLOMA IN ENGINEERING / TECHNOLOGY SYLLABUS

N-SCHEME

(To be implemented for the students admitted from the year 2020 - 2021 onwards)

Course Name : 1021 Diploma in Automobile Engineering
Subject Code : 4021610
Semester : VI
Subject Title : Hybrid Electrical Vehicle and Policies

TEACHING AND SCHEME OF EXAMINATION

No of weeks per semester: 16 weeks

Subject	Instructions		Examination			
			Marks			Duration
	Hours / Week	Hours / Semester	Internal Assessment	Board Examinations	Total	
4021610 Hybrid Electrical Vehicle and Policies	6	96	25	100*	100	3 Hrs.

* Examinations will be conducted for 100 marks and it will be reduced to 75 marks for result.

Topics and Allocation of Hours

UNIT	TOPIC	TIME
I	Environmental impact and history & Electric vehicle Types	18
II	Battery Operated Electric Vehicle	18
III	Hybrid Electric Vehicle	18
IV	Battery System & Power Converters for EV's	18
V	Electric Mobility Policy Frame work India &Tamil Nadu E-vehicle Policy 2019	17
Test & Revision		7
Total		96

RATIONALE:

The world is transitioning to cleaner mobility options with the aim at improving air quality and reducing dependency on fossil fuels. Electric Vehicles (EVs) have emerged a popular clean mobility choice to reduce emissions. EVs are powered fully or partially by batteries, they can help to reduce dependence on fossil fuels also air quality. Tamil Nadu is one of the most advanced states in India. Tamil Nadu has a highly developed industrial eco-system and is very strong in sectors like automobiles and auto-components. Many globally renowned companies have setup their manufacturing facilities in Tamil Nadu. Due the rapid depletion of fossil fuel and increase in fuel cost, environmental pollution, the shift to clean transport is necessary. This subject introduced by keeping all the above factors.

OBJECTIVES:

- To learn the environmental impact and history of Electric Vehicles.
- To understand the concept of Electric Vehicle and its types.
- To study the configurations of Electric Vehicles
- To acquire knowledge about Energy Storages, Charging System, Effects and Impacts.
- To appreciate the Electric Mobility Policy Frame work India and EV Policy Tamil Nadu 2019.

4021610 HYBRID ELECTRICAL VEHICLE AND POLICIES

DETAILED SYLLABUS

Contents: Theory

Unit	Name of the Topics	Hours
I	**ENVIRONMENTAL IMPACT AND HISTORY & ELECTRIC VEHICLE TYPES** Environmental impact and history: Environmental impact of conventional vehicle - Air pollution – Petroleum resources – History of Electric vehicles & Hybrid Electric Vehicles – Need for Electric Vehicle – Major Components of Electric Vehicle	6
	Electric vehicle Types: Introduction to Battery Electric Vehicle (BEV) – Definition BEV – Necessity BEV – Different between BEV and Conventional Vehicle - Advantages of BEV - Block diagram of BEV – Hybrid electric Vehicle (HEV) - Plug-in Hybrid Electric Vehicle (PHEV) – Fuel Cell Electric Vehicle (FCEV)	7
	Drive Arrangement: According to drive arrangement Types – Conventional type – No Transmission type – No differential type – In Wheel Motor type	5
II	**BATTERY OPERATED ELECTRIC VEHICLE (BEV)** BEV: Configurations of Electric Vehicle – Performance of Electric Vehicles – Tractive Effort in Normal Driving – energy consumption.	4
	Electric Propulsion Systems: Types of EV motors - DC motor drives – Permanent Magnetic Brush Less DC Motor Drives (BLDC) – Principles, Construction and Working – Hub motor Drive system – Merits and Demerits of DC motor drive, BLDC motor drive	7
	Other Control System for EV: Electronics Power Steering – Torque Sensor – EPS Motor – Advantages of Electronics Power Steering – Suspension System – Semi Tailing arm type, Trailing arm, Air Suspension, Regenerative Suspension System – Braking System for EV	7

III	**HYBRID ELECTRIC VEHICLE (HEV)** HEV: Hybrid Electric Vehicle – Advantages, Disadvantages – Components of Hybrid Electric Vehicle – IC Engine, Electric Motor, Controller, DC/DC Converter, Transmission, Batteries – Working of Hybrid Vehicle – Starting, Braking, Cruising, Passing. Types of Hybrid Vehicle: Hybridisation – Micro Hybrid, Mild Hybrid, Fully Hybrid – Advantages, Disadvantages & its Applications Drive Configuration: Series Hybrid – Control Strategies, Advantages & Disadvantages, Configuration - Parallel Hybrid – Electric motor fixed with an Electric motor to the crankshaft, Control Strategies, Advantages & Disadvantages, Configuration – Split Power Hybrid	7 3 8
IV	**BATTERY SYSTEM & POWER CONVERTERS FOR EV'S** Battery: Electrochemical Batteries – Battery Technologies – Construction and working of Lead Acid Batteries, Nickel Based Batteries and Lithium Based Batteries - Role of Battery Management System (BMS) – Battery pack development Technology – Cell Series and Parallel connection to develop battery pack Battery Charging Techniques: Battery Charging techniques - Constant current and Constant voltage, Trickle charging – Battery Swapping Techniques – DC charging – Wireless charging – Maintenance of Battery pack – Latest development in battery chemistry Power Converters: Role of Power Converters – Block diagram of Power Converters in EV – Types of Power Converters – DC to DC Converter, Inverter and Rectifier	7 6 5
V	**ELECTRIC MOBILITY POLICY FRAME WORK INDIA &TAMIL NADU E-VEHICLE POLICY 2019** Electric Mobility Policy Frame work India: Government of India Electric Mobility Policy Frame work – Global Scenario of EV adoption – Electric mobility in India – National Electric Mobility Mission Plan 2020 – Action led by Original Equipment Manufacturers – Need of EV Policy –	9

	Advantage of EV Eco system – Scope and Applicability of EV Policy. Tamil Nadu E-vehicle Policy 2019: Vehicle Population in Tamil Nadu – Objectives of EV Policy – Policy Measures – Demand side incentives – Supply side incentives to promote EV manufacturing – Revision of Transport Regulation of EV – Charging structure – implementing agencies – R&D and Business Incubation – Recycling Ecosystem – Battery and EVs	**8**

Reference Books

1. A.K Babu, Electric & Hybrid Vehicle, Khanna Publication, New Delhi – 2018 Edition
2. Iqbal Husian, Electric and Hybrid Vehicle Design Foundamentals, CRC Press, Boca Raton, Florida
3. Modern Electric, Hybrid Electric and Fuel Cell Vehicles, Mehrdad Ehsani, Yimin Gao, Sebastien E.Gay, Ali Emadi, CR Press, London, New York.
4. Comparison of Electric and Conventional Vehicles in Indian Market: Total Cost of Ownership, Consumer Preference and Best Segment for Electric Vehicle (IJSR), Akshat Bansal, Akriti Agarwal
5. A Comprehensive Study of Key Electric Vehicle (EV) Components, Technologies, Challenges, Impacts, and Future Direction of Development (MDPI), Fuad Un-Noor, Sanjeevikumar Padmanaban, Lucian Mihet-Popa, Mohammad Nurunnabi Mollah and Eklas Hossain.
6. Electric Vehicles: A future Projection CII October 2020 report.
7. Design and analysis of aluminum/air battery system for electric vehicles, Shaohua Yang, Harold Knickle, Elsevier.
8. Propelling Electric Vehicles in India, Technical study of Electric Vehicles and Charging Infrastructure

Reference Web Link / Video

Topic	Website	Link
Fundamentals of Electric vehicles: Technology & Economics	NPTEL	https://nptel.ac.in/courses/108/106/108106170/
Electric vehicles	IIT DELHI	https://www.youtube.com/watch?v=L2HbpEMfryM&list=PLp6ek2hDcoNCROoQbG05xNfiBEY7492Vn

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STATE BOARD OF TECHNICAL EDUCATION &TRAINING, TAMILNADU
DIPLOMA IN ENGINEERING / TECHNOLOGY SYLLABUS

N-SCHEME

(To be implemented for the students admitted from the year 2020 - 2021 onwards)

Course Name : 1021 Diploma in Automobile Engineering
Subject Code : 4021620
Semester : VI
Subject Title : Industrial Management and Transport Engineering

TEACHING AND SCHEME OF EXAMINATION

No of weeks per semester: 16 weeks

Subject	Instructions		Examination			
			Marks			Duration
	Hours / Week	Hours / Semester	Internal Assessment	Board Examinations	Total	
4021620 Industrial Management and Transport Engineering	5	80	25	100*	100	3 Hrs.

* Examinations will be conducted for 100 marks and it will be reduced to 75 marks for result.

Topics and Allocation of Hours

Unit	Topic	Hrs.
I	Principles of Management and Personnel Management	15
II	Financial management and Material Management	15
III	Goods Transport, Passenger Transport and Costing in Road Transport	15
IV	Motor Vehicles Act, Taxation, Insurance and Traffic rules & signs	14
V	Engineering Ethics and Human Values	14
Test & Revision		7
Total		80

Rationale

The Automobile technicians can play key role in management of transport organization. The transport industry provided good employment opportunities for Diploma in Automobile engineer as service engineer, fleet supervisor and depot supervisor. The automobile technician requires in-depth knowledge of motor vehicle act, rules, record keeping, estimation and valuation of vehicle, standard operating procedures. This subject imparts knowledge on principles of management, personnel management, financial management and material management.

Objective

- To learn the principles of Management and personnel management.
- To study about the financial management and material management.
- To learn the Goods and Passenger transport operations.
- To study about the motor vehicles act.
- To learn the principles of engineering ethics and human value

4021620– INDUSTRIAL MANAGEMENT AND TRANSPORT ENGINEERING

DETAILED SYLLABUS

Unit	Name of the Topics	Hours
I	**PRINCIPLES OF MANAGEMENT AND PERSONNEL MANAGEMENT** **1.1: Principles of Management** Definition of management – Organization – F.W. Taylor's and Henry Fayol's Principles of Management – Functions of Manager – Leadership – Types of Leadership – Qualities of a good leader. Motivation: Positive and negative motivation. Modern management techniques: Management Information Systems – Strategic management – SWOT Analysis - Business Process Re-engineering (BPR) – Activity Based Management (ABM) – Global Perspective – Principles and brief description. **1.2: Personnel Management** Responsibility of human resource management – Selection procedure – Training of workers – Apprentice training – On the job training. Job evaluation and merit rating – objectives and importance – wages and salary administration – Components of wages – Wage fixation – Type of	**6** **5**

	wage payment – Halsey's 50% plan, Rowan's plan and Emerson's efficiency plan. **1.3: Organizational behavior** Definition – organization – Types of Organization – Taylor's Pure functional types – Line and staff and committee type – Organizational Approaches - individual behavior - causes - environmental effect - Behavior and Performance, Perception - organizational implications.	**4**
II	**FINANCIAL MANAGEMENT AND MATERIAL MANAGEMENT** **2.1: Financial Management** Fixed and working capital – Resources of capital – shares preference and equity shares – debentures – Type of debentures – Public deposits, Factory costing – direct cost – indirect cost – Factory overhead – Selling price of a product – Profit – Problems. Depreciation – Causes – Methods - Straight line, sinking fund and percentage on diminishing value method. **2.1: Material Management** Objectives of good stock control system – ABC analysis of inventory – Procurement and consumption cycle – Minimum Stock, Lead Time, Reorder Level - Economic order quantity – problems – supply chain management - Purchasing procedure – Store keeping – Bin card.	**8** **7**
III	**GOODS TRANSPORT, PASSENGER TRANSPORT AND COSTING IN ROAD TRANSPORT** **3.1: Goods Transport** Simple layout of garages and depot for goods transport vehicle – Material Handling equipment - Scheduling of goods transport - Management Information System (MIS) in goods transport operation - transshipments and subcontracting - Storage & transportation of petroleum products. **3.2: Passenger Transport** Administrative set up of a passenger Transport organization, traffic investigation to improve services – peak hour demands – Application of C.P.M in evaluation of shortest operating distance of vehicle. Classification of vehicles: express, limited stop, relief services. Fare structure, Fare table calculation, and Fare collection methods - vehicle	**5** **8**

	schedule in city service – drivers and conductors duty schedules – ticket system, trip sheet – incentive schemes for improving the service. **3.3: Costing in Road Transport** Total cost, fixed cost, variable cost, running cost, overheads – control of costs – different methods.	**2**
IV	**MOTOR VEHICLES ACT, TAXATION, INSURANCE AND TRAFFIC RULES & SIGNS** **4.1: Motor Vehicles Act** Motor Vehicle act - Definition – Licensing of drivers and conductors - procedure for registering a new vehicle - fitness certificate - issue of non-road worthy certificate – Inspection of transport vehicle - inspection of accidents and recording – enforcement of emission norms. Permit: Public service vehicle permit - Goods carriage permit - National Permit - Contract carriage permit. Licensing taxies and buses – offences - penalties and procedure. **4.2: Taxation** Structure - method of laying taxation - Goods vehicle taxation - passenger vehicle taxation - tax exemption - one / life time taxation. Toll tax reasons and operational management. **4.3: Insurance:** Types of Insurance - accident claims and settlement - duty of driver in case of accident. **4.4: Traffic rules & signs** Traffic rules - Traffic signs - road signs - road safety norms.	**7** **3** **2** **2**
V	**ENGINEERING ETHICS AND HUMAN VALUES** **5.1: Engineering Ethics** Definition - engineering ethics - personal and business ethics - duties and rights - engineering as a profession – core qualities of professional practitioners - environment and their impact - code of ethics - procedure for solving ethical conflicts – ethical Judgment - Kohiberg's stages of moral development - value based ethics - engineers as managers, consultants and leaders - environmental ethics - computer ethics - Intellectual Property Rights (IPRs).	**8**

	5.2: Human values morals – values – integrity - service learning – civic virtue - respect for others - living peacefully - caring – sharing –honesty - courage - valuing time cooperation - commitments – empathy - self-confidence – character - stress management.	**6**

Reference Book

1. O.P.Khanna, Industrial Engineering and Management, Revised Edition – 2004, Dhanpat Rai, Publications(P)Ltd.
2. T.R.Banga & S.C.Sharma, Engineering Economics and Management, McGraw Hill.
3. Heinz Weihrich, Harold Koontz, Management, A global perspective, McGraw Hill international edition 1994.
4. Joseph L.Massie, Essentials of Management, 4th Edition, Prentice-Hall of India.
5. Goods vehicle Operation– Dunbar.
6. Bus Operation – Dunbar.
7. Tamilnadu Motor Vehicle Act 1989.
8. John Duke - Fleet Management – McGraw-Hill Co. USA -1984
9. S.Chandran, Organizational Behaviours, Vikas Publishing House Pvt. Ltd. Latest
10. M.Govindarajan and S.Natarajan ,Principles of Management ,Prentce Hall of India Pvt.Ltd. New Delhi.Latest.
11. Charles B. Fledderman, Engineering ethics, pearson prentice hall, New Jersey, 2004.

Reference Web Link / Video

Topic	Website	Link
Industrial Engineering	NPTEL	https://nptel.ac.in/courses/112/107/112107142/
Ethics in Engineering Practice	NPTEL	https://nptel.ac.in/courses/110/105/110105097/
Humanities and Social Sciences - Exploring Human Values	NPTEL	https://nptel.ac.in/courses/109/104/109104068/

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STATE BOARD OF TECHNICAL EDUCATION &TRAINING, TAMILNADU

DIPLOMA IN ENGINEERING / TECHNOLOGY SYLLABUS

N - SCHEME

(To be implemented for the students admitted from the year 2020 - 2021 onwards)

Course Name : 1021 Diploma in Automobile Engineering
Subject Code : 4020531
Semester : VI
Subject Title : Computer Integrated Manufacturing

TEACHING AND SCHEME OF EXAMINATION

No of weeks per semester: 16 weeks

Subject	Instructions		Examination			
			Marks			Duration
	Hours / Week	Hours / Semester	Internal Assessment	Board Examinations	Total	
4020531 Computer Integrated Manufacturing	5	80	25	100*	100	3 Hrs.

* Examinations will be conducted for 100 marks and it will be reduced to 75 marks for result.

Topics and Allocation of Hours

Unit No	Topics	Hours
I	Computer Aided Design	15
II	Computer Aided Manufacturing	14
III	CNC programming	16
IV	FMS, AGV, AS/RS, Robotics	14
V	Advanced concepts of CIM	14
	Test and Model Exam	7
	Total	**80**

RATIONALE:

As per the latest requirements in the Industries this enables to learn the various concepts of Computer Aided Design and Manufacturing. They are able to operate CNC machines and write part program. They are able to understand the advanced concepts adopted in automated industries.

OBJECTIVES:

- Acquire knowledge in the field of Computer aided Design
- Explain the various concepts of Computer Aided manufacturing
- Write part program for manufacturing components in CNC machines
- Explain the concepts of automatic material handling and storage systems and robotics
- Explain the advanced concepts of CIM

DETAILED SYLLABUS

Contents: Theory

Unit	Name of the Topics	Hours
I	**Computer Aided Design** Computer Aided Design: Introduction – definition – Shigley's design process – CAD activities – benefits of CAD - CAD software packages – point plotting, drawing of lines, Bresenham's circle algorithm, Transformations: 2D & 3D transformations – translation, scaling, rotation and concatenation. Geometric modelling: Techniques - Wire frame modelling – applications – advantages and disadvantages. Surface modelling – types of surfaces – applications – advantages and disadvantages – Solid modelling – entities – advantages and disadvantages – Boolean operations - Boundary representation – Constructive Solid Geometry – Comparison. Graphics standard: Definition – Need - GKS –IGES – DXF. Finite Element Analysis: Introduction – Development - Basic steps – Advantages.	6 6 3
II	**Computer Aided Manufacturing** CAM – Definition - functions of CAM – benefits of CAM. Introduction of CIM – concept of CIM - evolution of CIM – CIM wheel – Benefits – integrated	3

	CAD/CAM. Group technology: Part families - Parts classification and coding - coding structure – Opitz system, MICLASS system and CODE System. Process Planning: Introduction – Computer Assisted Process Planning (CAPP) – Types of CAPP - Variant type, Generative type – advantages of CAPP. Production Planning and Control (PPC): Definition – objectives - Computer Integrated Production management system – Master Production Schedule (MPS) – Capacity Planning – Materials Requirement Planning (MRP) – Manufacturing Resources Planning (MRP-II) – Shop Floor Control system (SFC) - Just In Time manufacturing philosophy (JIT) - Introduction to Enterprise Resources Planning (ERP).	6 5
III	**CNC Programming** NC in CAM, tooling for CNC – ISO designation for tooling – CNC operating system. Programming for CNC machining – part program - Manual part programming - coordinate system – Datum points: machine zero, work zero, tool zero - reference points - NC dimensioning – G codes and M codes – linear interpolation and circular interpolation - CNC program procedure - sub-program – canned cycles - stock removal – thread cutting – mirroring – drilling cycle – pocketing. Rapid prototyping: Classification – subtractive – additive – advantages and applications – materials – Virtual machining.	16
IV	**FMS, AGV, AS/RS, Robotics** FMS: Introduction – FMS components – FMS layouts – Types of FMS: Flexible Manufacturing Cell (FMC) – Flexible Turning Cell (FTC) – Flexible Transfer Line (FTL) – Flexible Machining System (FMS) – benefits of FMS - introduction to intelligent manufacturing system. Material handling in CIM environment: Types – AGV: Introduction – AGV - working principle – types – benefits. AS/RS – working principle –types – benefits. Robotics: Definition – robot configurations – basic robot motion – robot programming method – robotic sensors – end effectors – mechanical grippers – vacuum grippers – robot programming concepts - Industrial applications of Robot: Characteristics - material transfer and loading –	5 3 6

	welding - spray coating - assembly and inspection.	
V	**Advanced Concepts Of CIM** Concurrent Engineering: Definition – Sequential Vs Concurrent engineering – need of CE – benefits of CE. Quality Function Deployment (QFD): Definition – House of Quality (HOQ) – advantages – disadvantages. Steps in Failure Modes and Effects Analysis (FMEA) – Value Engineering (VE) – types of values – identification of poor value areas – techniques – benefits. Guide lines of Design for Manufacture and Assembly (DFMA). Product Development Cycle: Product Life Cycle - New product development processes. Augmented Reality (AR) – Introduction - concept – Applications.	**14**

REFERENCES BOOKS:

1. R.Radhakrishnan, and S.Subramanian, “CAD/CAM/CIM”, New Age International Pvt. Ltd.
2. Mikell P.Groover, and Emory Zimmers, “CAD/CAM”, Jr.Prentice Hall of India Pvt., Ltd.
3. Dr.P.N.Rao, “CAD/CAM Principles and Applications,”, Tata Mc Graw Hill Publishing Company Ltd.
4. Ibrahim Zeid, “Mastering CAD/CAM”, Tata McGraw-Hill Publishing Company Ltd., New Delhi.
5. Mikell P. Groover, “Automation, Production Systems, and Computer-Integrated Manufacturing”, Pearson Education Asia.
6. Yoram Koren, “Computer control of manufacturing systems,”, McGraw Hill Book.
7. Chris Mcmahon and Jimmie Browne, “CAD/CAM – Principle Practice and Manufacturing Management”, Addision Wesley England, Second Edition,2000.
8. Dr.Sadhu Singh, “Computer Aided Design and Manufacturing,”, Khanna Publishers, NewDelhi, Second Edition,2000.
9. S.Kant Vajpayee, “Principles of Computer Integrated Manufacturing,”, Prentice Hall of India, 1999.
10. David Bed worth, “Computer Integrated Design and Manufacturing,”, TMH, 1998.

STATE BOARD OF TECHNICAL EDUCATION &TRAINING, TAMILNADU

DIPLOMA IN ENGINEERING / TECHNOLOGY SYLLABUS

N-SCHEME

(To be implemented for the students admitted from the year 2020 - 2021 onwards)

Course Name : 1021 Diploma in Automobile Engineering
Subject Code : 4021632
Semester : VI
Subject Title : Heavy Vehicle Engineering

TEACHING AND SCHEME OF EXAMINATION

No of weeks per semester: 16 weeks

Subject	Instructions		Examination			
			Marks			Duration
	Hours / Week	Hours / Semester	Internal Assessment	Board Examinations	Total	
4021632 Heavy Vehicle Engineering	5	80	25	100*	100	3 Hrs.

* Examinations will be conducted for 100 marks and it will be reduced to 75 marks for result.

Topics and Allocation of Hours

UNIT	TOPIC	TIME
I	Truck classifications, Shop Safety and Operations	14
II	Electrical Systems	15
III	Transmission System	15
IV	Drive Shafts, Steering system	14
V	Suspension Systems, Wheels and Tires, Brake systems	15
Test & Revision		7
Total		80

RATIONALE:

For the decades a shortage of truck technicians existed throughout the world. The job opportunities and rates of pay in the trucking industry are increased. Good truck technicians are in high demand. The skill required of the truck technician is that of being a lifelong learner to keep abreast of the fast-changing technology of this industry. Considering the above factors this subject is introduced.

OBJECTIVES:

- Explain the basic truck classifications.
- Describe the safety warnings in the work area.
- List some common tools used in heavy truck repair.
- Define the role of a battery in a vehicle electrical system.
- Identify the components of a charging system.
- Troubleshoot truck electrical circuit components.
- Describe the electronic components.
- Understand the operation and maintenance of the clutch.
- Identify the standard transmissions.
- Describe the automatics transmissions.
- Describe the components and operation of steering systems.
- Explain the wheels and tires.
- Define the Brakes systems.

4021632 HEAVY VEHICLE ENGINEERING

DETAILED SYLLABUS

Contents: Theory

Unit	Name of the Topics	Hours
I	**TRUCK CLASSIFICATIONS, SHOP SAFETY AND OPERATIONS**	
	1.1: Truck classifications	**6**
	By Weight – By Wheel Number – Major Manufacturers – Components of Heavy Duty Truck – Career Opportunities for Heavy Duty Truck Technicians.	
	1.2: Shop Safety and Operations	**8**
	Personal Safety - Work Area Safety – Fire Safety – Hazardous Materials	

	– Handling and Disposal of Hazardous Waste. Tools: Hand Tools – Power Tools – Measuring Tools. Fasteners: Grades and Glasses – Fastener Replacement – Repairing Damaged threads – Riveting. Preventive Maintenance – Driver Inspection Report - Commercial Vehicle Safety Alliance Standard Inspection Procedure – PM Trailer Inspection Guide – Federal Inspection regulations – Lubricants – Winterizing.	
II	**ELECTRICAL SYSTEMS** Electrical Motor and Generator principle – Coils – Transformers and Solenoids – Battery Operating Principles – Battery Ratings – Battery Maintenance – Battery Testing: Visual Inspection – State of charge test – Battery load test. Charging Battery – Slow Charging and Fast Charging – Charging Safety – Jump Starting – Battery Storage and Recycling Procedure – Alternator: Construction – Operation. Starting Systems – Lighting Systems – Head lights – Adjustment – Replacement – Dimmer switch – Trailer circuit connector – Panel component – Rapid checking of a truck electrical circuit. Electronic Service tools (EST) – Flash or Blink codes – Prolink 9000 – SAE / ATA J 1587 / J 1708 / J 1939 Codes and Protocols – Electrical Wiring, Connector and Terminal repair.	**8** **4** **3**
III	**TRANSMISSION SYSTEM** **3.1: Clutch** Clutch Function – Components – Clutch Brakes – Clutch Linkages – Trouble shooting – Periodic Maintenance – Clutch Adjustment – Clutch Linkage inspection and adjustment – Clutch Servicing – Clutch Inspection – Clutch installation. **3.1: Gear box** Gears – Gear Train configurations – Gear shift Mechanisms – Gear shift Lever – Counter shaft gear train – Air operated gear shift system – Eighteen Speed Transmission – Thirteen Speed transmissions – Deep reduction Transmissions – Transfer Cases – Power Take off Unit. **3.3: Transmission** Transmission Servicing – Lubrication – Preventive Maintenance Inspection- Trouble Shooting – Overhauling the transmission – Torque	**3** **5** **7**

	converter Components. Automatic Transmissions – Simple Planetary Gear Sets – Components – Working principle – Compound Planetary Gear Sets – Four Speed Transmission Power Flows – Five Speed Transmission Power Flows – Hydraulic control Four Speed transmission - Hydraulic control Five Speed transmission - Hydraulic Retarders – Electronic Control transmissions.	
IV	**DRIVE SHAFTS AND STEERING SYSTEM** **4.1: Drive Shafts** Construction – Drive shaft inspection – Drive Axles – Differential Gearing Types – Single Reduction Axle – Double Reduction Axle- Tandem Drive Axle – Drive Axle Failures. **4.2: Steering system** Components – Steering system inspection – Front-End Alignment – Toe – Caster – Camber – Kingpin inclination – Turning angle – Ackerman Geometry – Axle Alignment – Electronic Alignment Equipment – Steering Axle Inspection – Overhaul – Manual Steering Gears – Power Steering Systems – Air Assisted Steering Systems – Electronically Variable Steering – Load Sensing power Steering.	**5** **9**
V	**SUSPENSION SYSTEMS, WHEELS AND TIRESANDBRAKE SYSTEMS** **5.1: Suspension Systems** Types – Front Suspension – Rear Suspension – Single axle spring suspension – tandem axle spring suspension – Spring suspension with shock absorbers – Equalizing beam suspension system: Leaf spring type – rubber cushion type – Air spring suspensions – components – Air spring mechanics – Cab Air Suspension. **5.2: Wheels and Tires** Cast Spoke wheel – Disc wheel – wide base wheel – Tires: Types – Radial – Bias – Tire Size – Tire care and maintenance – Tire, rim and Wheel Service – Tire and rim Safety – Spoke wheel installation – Disc Wheel Installation – Wheel and Tire Balancing – Wheel hubs, Bearings and Seals – Wheel Bearing Adjustment	**5** **5**

	5.3: Brake systems Air Brake System – Components - Truck air brake system – Trailer air brake system. Hydraulic Brake systems – Components – Hydraulic Drum Brake – Air Over Hydraulic Brake systems – Hydraulic Brake Service Procedures – ABS Components – Automatic Traction Control Systems – Fifth Wheel.	**5**

Reference Books

1. Heavy Duty Truck Systems, Ian Andrew Norman, Sean Bennett, John A.Corinchck, Delmar, Thomson Learning.
2. Tire and Vehicle Dynamics, Hans B. Pacejka, SAE International
3. Brake Technology Handbook, Kartheinz Bill, Bert J Breuer, SAE International
4. Vehicular Engine Design, Kevin L Hoag, SAE International
5. Handbook of Automotive Engineering, Ulrich W.Seiffert, Hans Hermann Bracess, SAE International
6. Advanced Hybrid Power trains for Commercial Vehicles, Haoran Hu, Simon Baseley, Rudolf M Smaling, SAE International

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STATE BOARD OF TECHNICAL EDUCATION &TRAINING, TAMILNADU

DIPLOMA IN ENGINEERING / TECHNOLOGY SYLLABUS

N-SCHEME

(To be implemented for the students admitted from the year 2020 - 2021 onwards)

Course Name : 1021 Diploma in Automobile Engineering
Subject Code : 4021633
Semester : VI
Subject Title : Heating Ventilation and Air Conditioning Systems

TEACHING AND SCHEME OF EXAMINATION

No of weeks per semester: 16 weeks

Subject	Instructions		Examination			
			Marks			Duration
	Hours / Week	Hours / Semester	Internal Assessment	Board Examinations	Total	
4021633 Heating Ventilation and Air Conditioning Systems	5	80	25	100*	100	3 Hrs.

* Examinations will be conducted for 100 marks and it will be reduced to 75 marks for result.

Topics and Allocation of Hours

UNIT	TOPIC	TIME
I	Basics of Air-Conditioning and Refrigeration Systems	15
II	Psychrometry and Air-Conditioning Systems	15
III	Cooling and Heating Load Calculations and Analysis	15
IV	Air Routing, Temperature Control and Servicing	14
V	Automobile Air-Conditioning Systems	14
	Test & Revision	7
Total		80

Rationale

All the automobile are vehicles are equipped with Air Conditioning. Hence the fundamental knowledge of air Conditioning is most essential for an automobile. This course will help in understanding the principle of Refrigeration, Air-Conditioning and Psychrometry properties and also understanding the duct and ventilation design.

Objectives

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

- To understand the components of the automotive air-conditioning and their functions
- To understand the recent developments in this field
- To present a problem oriented in-depth knowledge of Automotive air conditioning
- To address the underlying concepts and methods behind Automotive air conditioning

4021633 HEATING VENTILATION AND AIR CONDITIONING SYSTEMS

DETAILED SYLLABUS

Contents: Theory

Unit	Name of the Topics	Hours
I	**BASICS OF AIR-CONDITIONING AND REFRIGERATION SYSTEMS** Introduction - Types of Refrigeration Systems – Working principle of vapour Compression Refrigeration System, vapour Absorption Refrigeration System. Applications. Coefficient of Performance - Ton of Refrigeration - Simple problems. Refrigerants: Primary and Secondary Refrigerants - Classification of Refrigerants - Properties - Commonly used refrigerants - Alternative refrigerants - Eco-friendly Refrigerants - Applications of Refrigerants. Major Refrigerants used in Automobile Air-conditioning system.	**8** **7**
II	**PSYCHROMETRY AND AIR-CONDITIONING SYSTEMS** Psychrometry – Basic Terminology - Psychrometric Mixtures - Psychrometric Tables and Charts - Psychrometric Processes - Comfort Charts - Simple problems in Psychrometric Processes - Factors Affecting Comfort Temperature and Effective Temperature.	**8**

	Air-Conditioning System Layouts. - Central Air-conditioning systems - System Components – Compressor – Evaporator – Condenser - Expansion Devices - Receiver dryer - Fan Blowers - Heating System. Switch and Electrical Wiring Circuit. Air Distribution Systems: Distribution ducting - Sizing - Supply duct - Return Duct - Type of Grills - Diffusers, Ventilation - air Noise Level - Layout of Duct Systems for Automobiles.	7
III	**COOLING AND HEATING LOAD CALCULATIONS AND ANALYSIS** Load Calculations and Analysis. Design considerations for achieving desired room conditions with respect to prevailing outside/environment conditions. Factors affecting the load on Refrigeration and Air-conditioning Systems. Cooling and Heating Load Calculations. Load calculations for Automobiles. Problems on Cooling and Heating Load Calculations. Effect of Air-conditioning load on Engine Performance in terms of loss of available Peak Torque/Power and Fuel Consumption.	7 8
IV	**AIR ROUTING, TEMPERATURE CONTROL AND SERVICING** Air Routing and Temperature Control: Objectives of the Dashboard Re-circulating Unit - Automatic Temperature Control - Controlling Flow - Control of Air-handling systems and Air Flow Through – Evaporator Care. Air-Conditioning Service: Air-Conditioner Maintenance and Service - Removing and replacing Components. Compressor Service. Testing, Diagnosis and Trouble Shooting of Air-conditioning system. Refrigerant Gas Charging Procedure and Servicing of Heater System.	7 7
V	**AUTOMOBILE AIR-CONDITIONING SYSTEMS** Automotive Heaters - Manually Controlled and Automatically Controlled Air-conditioner and Heater System. Common controls such as thermostats, Humidistat, Control Dampers, Pressure Cut-outs, Relays Automatic temperature control. Automobile Air-conditioning - Air conditioning for Passengers - Isolated Vehicles - Refrigerated Transport Vehicles. Applications related with Very Low Temperatures - Location of Air-conditioning Components in a Car – Schematic Layout of a Vehicle Refrigeration System	7 7

Reference Books

1. Automotive Air conditioning, William H Crouse and Donald L Anglin, McGraw Hill Inc.
2. Air Conditioning, Paul Lang, C.B.S. Publisher & Distributor, Delhi.
3. Automotive Air-Conditioning, Paul Weiser – Reston Publishing Co.
4. Automotive Air Conditioning, Goings,L.F., American Technical services
5. Automotive Air Conditioning, McDonald,K.L., Theodore Audel series
6. Automotive Air Conditioning, Paul Weisler, Reston Publishing Co. Inc.

STATE BOARD OF TECHNICAL EDUCATION &TRAINING, TAMILNADU

DIPLOMA IN ENGINEERING / TECHNOLOGY SYLLABUS

N-SCHEME

(To be implemented for the students admitted from the year 2020 - 2021 onwards)

Course Name : 1021 Diploma in Automobile Engineering
Subject Code : 4021640
Semester : VI
Subject Title : Hybrid Electrical Vehicle Practical

TEACHING AND SCHEME OF EXAMINATION

No of weeks per semester: 16 weeks

Subject	Instructions		Examination			
			Marks			Duration
	Hours / Week	Hours / Semester	Internal Assessment	Board Examinations	Total	
4021640Hybrid Electrical Vehicle Practical	5	80	25	100*	100	3 Hrs.

* Examinations will be conducted for 100 marks and it will be reduced to 75 marks for result.

RATIONALE:

Electric Vehicles (EVs) have emerged a popular clean mobility choice to reduce emissions. EVs are powered fully or partially by batteries, they can help to reduce dependence on fossil fuels also air quality. Tamil Nadu is one of the most advanced states in India. Tamil Nadu has a highly developed industrial eco-system and is very strong in sectors like automobiles and auto-components. Many globally renowned companies have setup their manufacturing facilities in Tamil Nadu. This subject introduced by keeping all the above factors.

OBJECTIVES:

- To learn and practice the charging systems of Electric Vehicles.
- To understand the concept of Electric Vehicle components.
- To study the configurations of Electric Vehicles and assemble.
- To acquire knowledge about Energy Storages, Charging System, Effects and Impacts.

4021640 HYBRID ELECTRICALVEHICLEPRACTICAL

Exercises

Part – A

1. Test the Lead acid Battery on Open Circuit Voltage, Hydrometer and High Discharge Tests.
2. Construct and test battery back for an Electric Vehicle. (Test the batter pack supply to glow the Head lamp)
3. Test buck converter (DC to DC converter)
4. Test the Inverter circuit (DC to AC Converter)
5. Test the BLDC motor with triggering angle or Throttle control
6. Test the battery charger unit and note the various charging parameter

Part – B

1. Assemble and test the wiring harness for two-wheeler accessories
2. Identify and test EV components (Controller, Throttle, EV motor, Power ON Key & brake)
3. Test the Lead acid battery by using Battery voltage tester or Current Tester and indicate the status
4. Assemble and test E-bicycle with wiring harness
5. Assemble and test E-Bike with central drive mechanism (Chain drive) wiring harness
6. Assemble and test E-Auto rickshaw with differential and wiring harness

BOARD EXAMINATION

Note:

- All the exercises/experiments in both sections should be completed. Two exercises/experiments will be given for examination by selecting one from PART A and one from PART B.
- All the exercises/experiments should be given in the question paper and students are allowed to select by a lot or Question paper issued from the DOTE should be followed.
- All regular students appearing for first attempt should submit record notebook for the examination.

- The external examiner should verify the availability of the facility for the batch strength before commencement of practical examination.
- The external examiner should verify the working condition of machineries / equipments before commencement of the board practical examination.

DETAILLED ALLOCATION OF MARKS

Sl. No.	Description	Max.Marks
PART A		
1	Procedure / Observation	15
2	Test report	30
PART B		
3	Procedure / Explanation	15
4	Assemble / Test Report	30
5	Viva-voce	10
Total		100

LIST OF EQUIPMENT / TOOLS/MACHINERY'S REQUIRED

(for a batch of 30 students)

Sl. No.	Machines / Tools / Equipments	Quantity
1.	Lead acid battery	8 No's
2.	Battery Load tester	2 No's
3.	Buck Converter (5 V or 24 V or 48 V)	2 No's
4.	Battery Charger Unit with Lead Acid battery	2 No's
5.	Inverter Trainer Kit	1 No
6.	BLDC motor control Trainer kit	1 No
7.	Two wheeler Wiring Harness board or kit	1 No
8.	E – Bicycle kit or Accessories 24V DC Controller	2 No's

	24 V DC motor Throttle Brake Power ON key Head lamp with Horn	
9.	E – Bike kit or Accessories 48 V BLDC Controller 500W or 750 W, 48 V BLDC motor Throttle Brake Power ON key Display Board Head lamp with Horn Left & Right Indicator	2 No's
10.	500 W or 750 W, 48 V BLDC motor with differential arrangement	1 No
11.	**Consumable: -** Battery Cell - 1.5 V or 3.65 V Soldering Iron Flux De-solder gun or Solder wick Lead **Tools** Continuity Tester Line Tester Multi-meter Hydrometer Screw Drive set Spanner set	As per requirement (LS)

STATE BOARD OF TECHNICAL EDUCATION &TRAINING, TAMILNADU

DIPLOMA IN ENGINEERING / TECHNOLOGY SYLLABUS

N – SCHEME

(To be implemented for the students admitted from the year 2020 – 2021 onwards)

Course Name : 1021 Diploma in Automobile Engineering
Subject Code : 4020561
Semester : VI
Subject Title : Computer Integrated Manufacturing Practical

TEACHING AND SCHEME OF EXAMINATION

No of weeks per semester: 16 weeks

Subject	Instructions		Examination			
			Marks			Duration
	Hours / Week	Hours / Semester	Internal Assessment	Board Examinations	Total	
4020561 Computer Integrated Manufacturing Practical	4	64	25	100*	100	3 Hrs.

* Examinations will be conducted for 100 marks and it will be reduced to 75 marks for result.

RATIONALE:

As per the latest requirements in the Industries this enables to learn the various concepts of Computer Integrated Manufacturing. They are able to write part program and able operate CNC lathe and Milling machines. They are able to understand the advanced concepts adopted in CIM.

OBJECTIVES:

- Acquire knowledge in the field of Computer Integrated Manufacturing
- Create 3D Solid models of machine components using modelling software
- Execute and perform machining operations in CNC Lathe and CNC Milling machines.

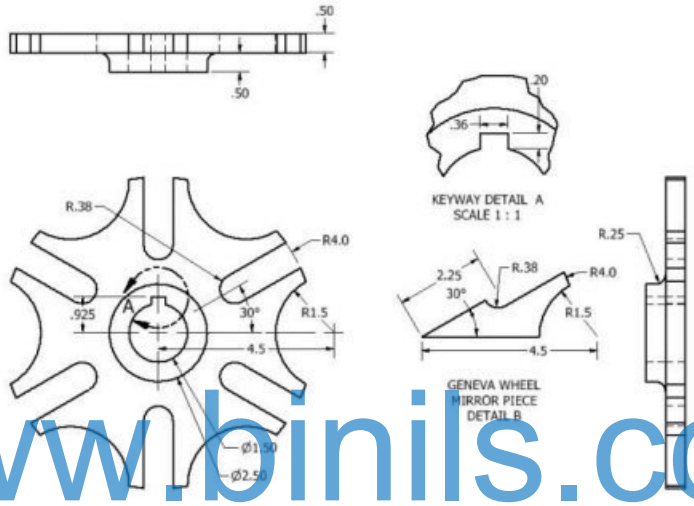
DETAILED SYLLABUS

Contents: Practical

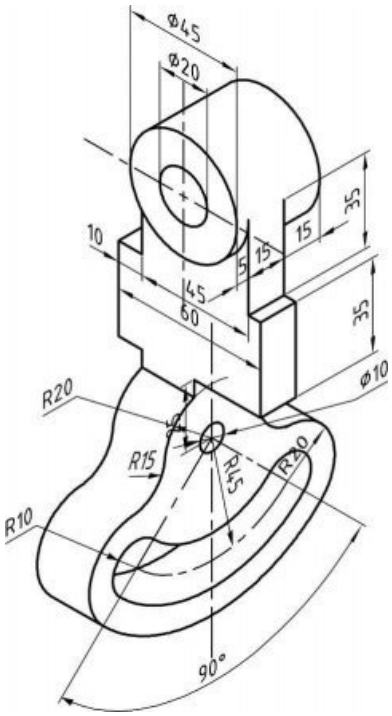
PART A: SOLID MODELLING

Introduction to Part modelling - Datum Plane – constraint – sketch – dimensioning – extrude – revolve – sweep – blend – protrusion – extrusion – rib – shell – hole – round – chamfer – copy – mirror – assembly – align – orient – drawing and detailing –creating assembly views

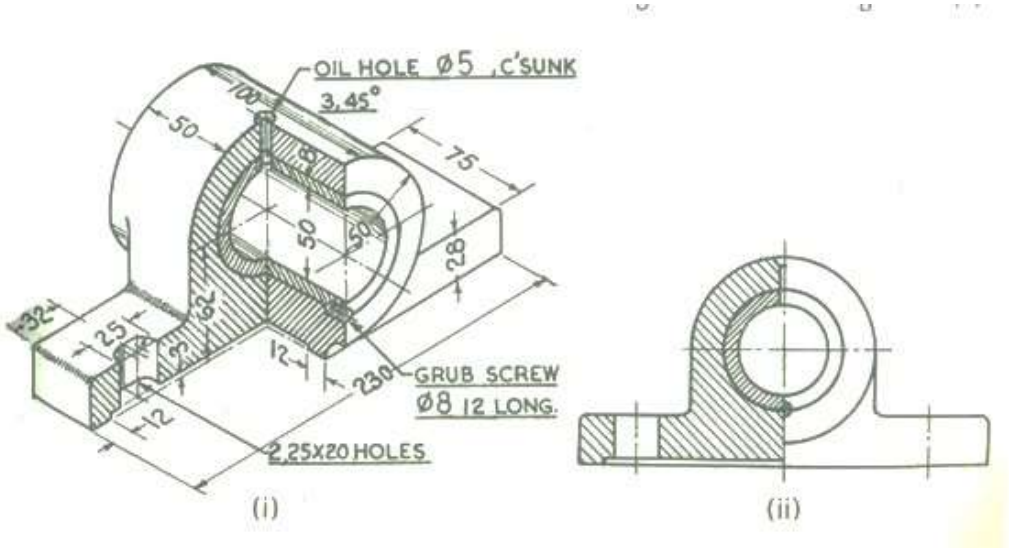
Exercise No. 1. Geneva Wheel



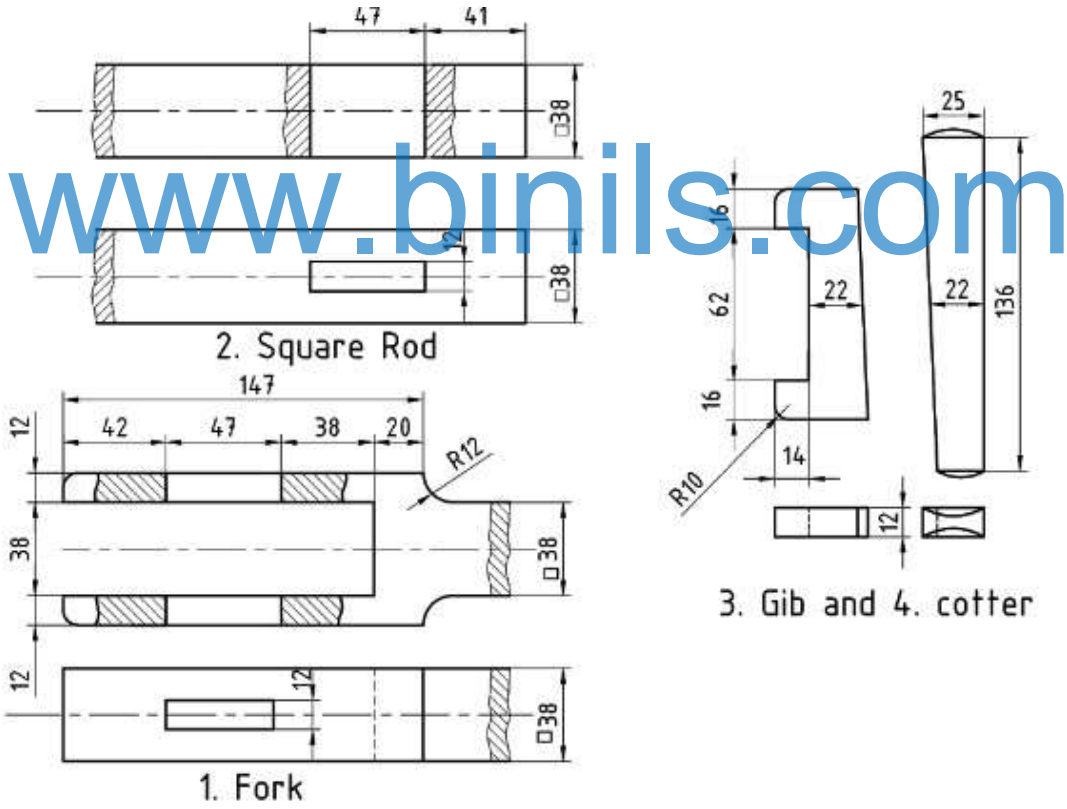
Exercise No. 2. Bearing Block



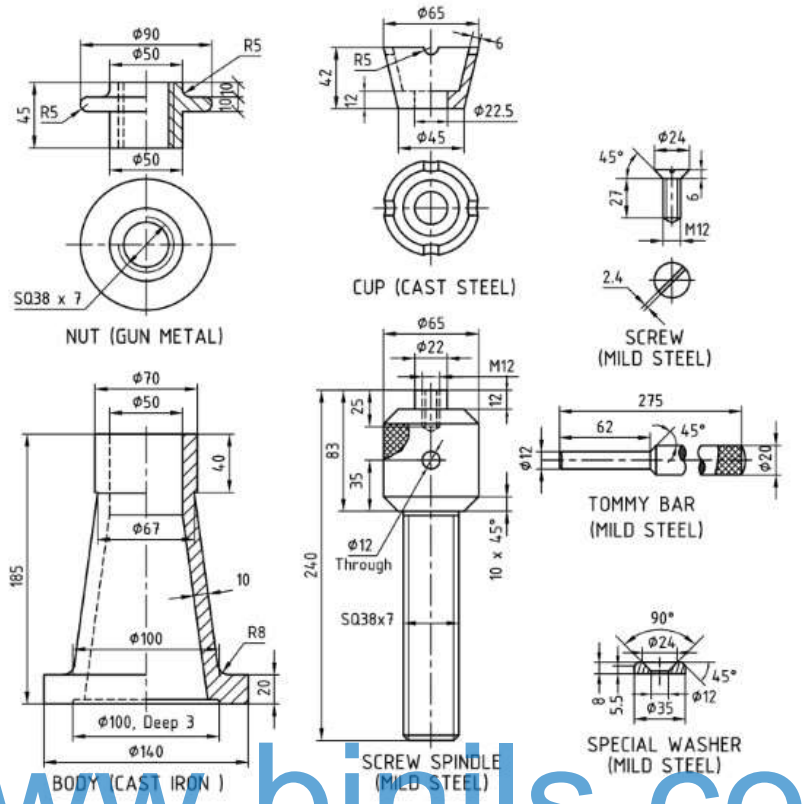
Exercise No. 3. Bushed bearing



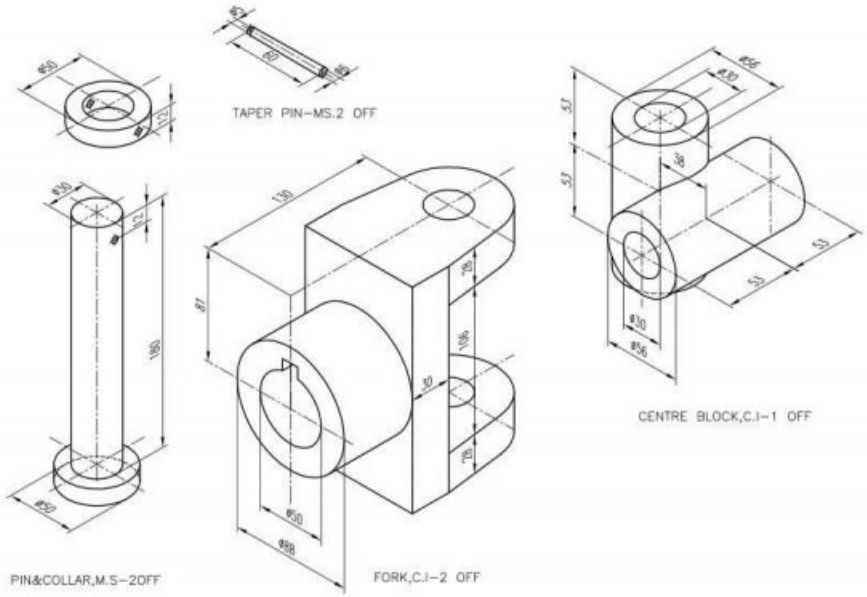
Exercise No. 4. Gib and Cotter joint



Exercise No. 5. Screw Jack



Exercise No. 6. Universal Coupling



Note: Print the orthographic view and sectional view from the above assembled 3D drawing.

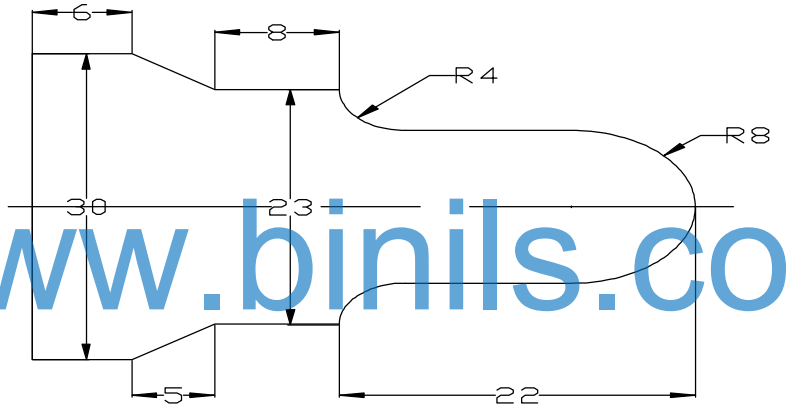
PART B: CNC Programming and Machining

Introduction: 1. Study of CNC lathe, milling. 2. Study of international standard codes: G-Codes and M-Codes 3. Format – Dimensioning methods. 4. Program writing – Turning simulator – Milling simulator, IS practice – commands menus. 5. Editing the program in the CNC machines. 6. Set the machine and execute the program in the CNC machines.

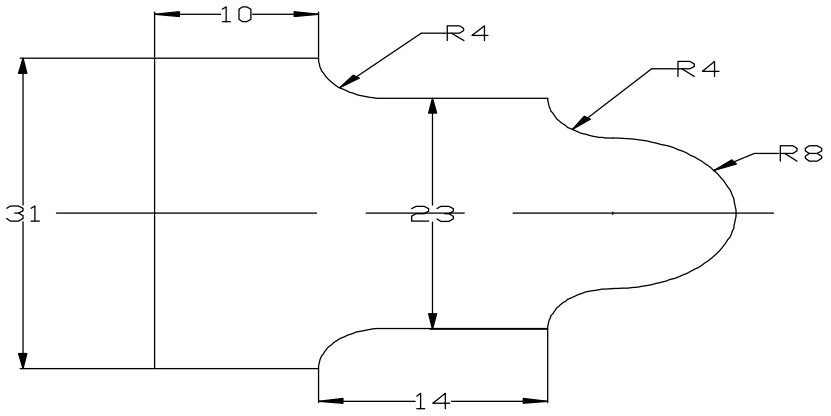
Note: Create and edit the part program in the simulation software for verification of the part program. Enter / tranfer the program to make the component in the CNC machine.

CNC Turning Machine Material: M.S / Aluminium / Acrylic fibre / Plastic

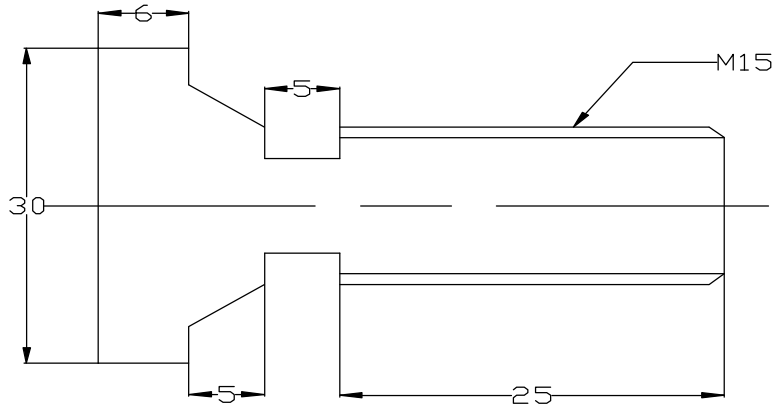
1. Using Linear and Circular interpolation - Create a part program and produce component in the Machine.



2. Using Stock removal cycle – Create a part program for multiple turning operations and produce component in the Machine.

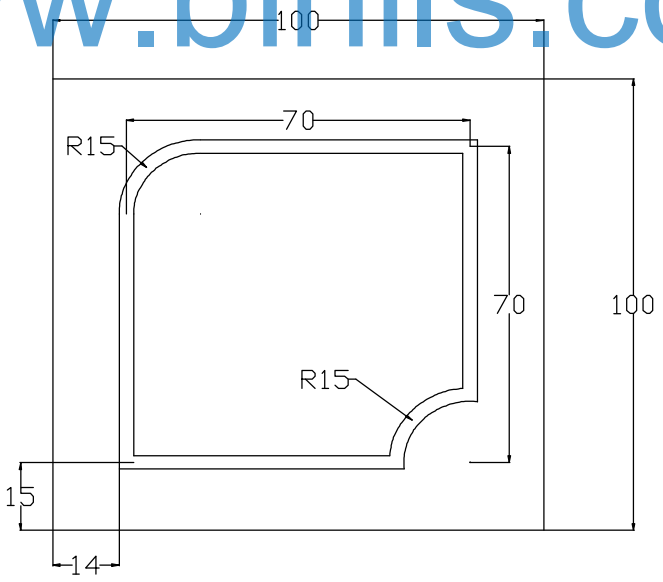


3. Using canned cycle - Create a part program for thread cutting, grooving and produce component in the Machine.

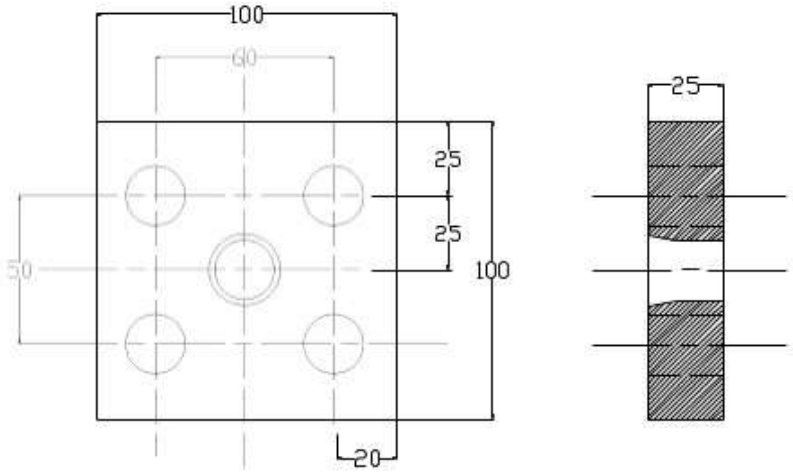


CNC Milling Machine Material: M.S / Aluminum / acrylic fibre / plastic

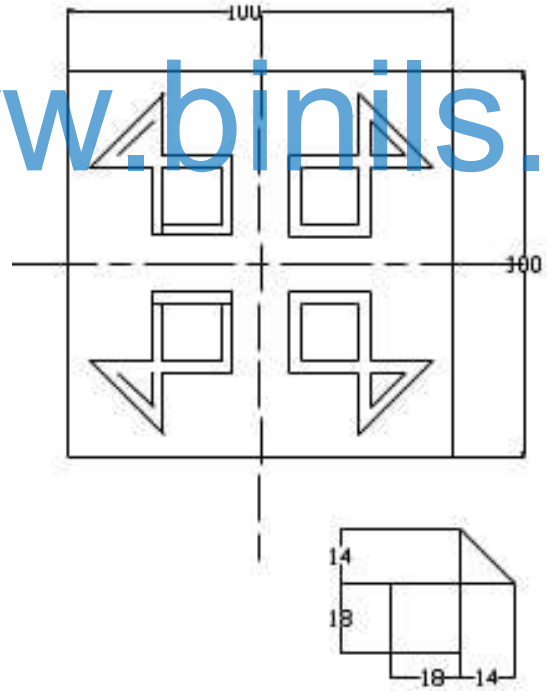
4. Using Linear interpolation and Circular interpolation – Create a part program for grooving and produce component in the Machine.



5. Using canned cycle - Create a part program for drilling, tapping, counter sinking and produce component in the Machine.



6. Using subprogram - Create a part program and produce component in the Machine.



BOARD EXAMINATION

Note:

- All the exercises in both sections should be completed. Two exercises will be given for examination by selecting one exercise from PART A and one exercise from PART B.
- All the exercises should be given in the question paper and students are allowed to select by a lot or question paper issued from the DOTE should be followed.
- All regular students appearing for first attempt should submit record notebook for the examination.
- The external examiner should verify the availability of the facility for the batch strength before commencement of practical examination.
- The external examiner should verify the working condition of machinery's / equipment before commencement of practical examination.

Note: Part A: The given component drawing should be created and solid modelling after assembly should be printed and submitted along with the answer paper for evaluation by the external examiner.

Part B: The program for the given component should be written in the answer paper. The program should be entered in the CNC machine and the component should be submitted for evaluation by the external examiner. The machined component should be kept under the custody of examiner.

Allocation of marks for Board Examination

PART A: Solid Modelling

Creation of sketch	: 15
Modelling	: 25
Accuracy	: 5

PART B: CNC Programming

Program writing	: 15
Setting	: 10
Editing and Machining	: 20
Viva voce	: 10
Total Marks	: 100

LIST OF EQUIPMENTS (For 30 students)

1. Personal computer - 30 Nos.
2. 3D Solid Modelling and Simulation software - Sufficient to the strength
3. CNC Lathe –2 Nos.
4. CNC Mill –2 Nos.
5. Consumables - Sufficient quantity
6. Laser / Inkjet Printer – 1 No.

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STATE BOARD OF TECHNICAL EDUCATION &TRAINING, TAMILNADU
DIPLOMA IN ENGINEERING / TECHNOLOGY SYLLABUS

N-SCHEME

(To be implemented for the students admitted from the year 2020 - 2021 onwards)

Course Name : 1021 Diploma in Automobile Engineering
Subject Code : 4021652
Semester : VI
Subject Title : Heavy Vehicle Engineering Practical

TEACHING AND SCHEME OF EXAMINATION

No of weeks per semester: 16 weeks

Subject	Instructions		Examination			
			Marks			Duration
	Hours / Week	Hours / Semester	Internal Assessment	Board Examinations	Total	
4021652 Heavy Vehicle Engineering Practical	5	80	25	100*	100	3 Hrs.

* Examinations will be conducted for 100 marks and it will be reduced to 75 marks for result.

RATIONALE:

For the decades a shortage of truck technicians existed throughout the world. The job opportunities and rates of pay in the trucking industry are increased. Good truck technicians are in high demand. The skill required of the truck technician is that of being a lifelong learner to keep abreast of the fast-changing technology of this industry. Considering the above factors this subject is introduced.

OBJECTIVES:

Students are able to

- Explain the basic truck classifications.
- Describe the safety warnings in the work area.
- List some common tools used in heavy truck repair.
- Define the role of a battery in a vehicle electrical system.
- Identify and practice with the components of a charging system.
- Troubleshoot truck electrical circuit components to list the causes and failure.
- Understand the operation and maintenance of the clutch linkage system.

- Describe the automatic transmissions.
- Describe the components and operation of steering systems.
- Define the Brakes systems and list the symptoms, causes and remedies.
- Learn the usage of wheel aligner

4021652 HEAVY VEHICLE ENGINEERING PRACTICAL

Exercise:

1. Check the charging system of a heavy vehicle. List the causes of charging system failure.
2. Check the starting system of a vehicle. Prepare the list of problem occurs and mention the possible causes, tests and remedies.
3. Check the head light of a vehicle for i) adjustment, ii) replacement and iii) bulb replacement.
4. Check the windshield wiper of a vehicle. List the symptoms, causes and remedy.
5. Inspect the clutch linkage system and clutch of a heavy vehicle. List the failure and possible causes and remedy/adjustment.
6. Inspect the standard transmission of a heavy vehicle. Carry out the preventive maintenance inspection on standard transmission.
7. Inspect the drive shaft of a heavy vehicle. List the failure and possible causes and remedy/adjustment.
8. Inspect the power steering system of a heavy vehicle. . List the failure and possible causes and remedy/adjustment.
9. Check, measure and adjust the caster, chamfer, king pin inclination, toe-in and toe-out using Wheel alignment.
10. Inspect the suspension system of a heavy vehicle. Carry out the preventive maintenance inspection.
11. Check the air disc brake system of a heavy vehicle. List the symptoms, causes and remedy.
12. Check the hydraulic brake system of a heavy vehicle. List the symptoms, causes and remedy.

BOARD EXAMINATION

Note:

- All the exercises should be completed before the Board Examinations. Any one exercise will be given for examination.
- All the exercises should be given in the question paper and students are allowed to select by a lot or Question paper issued from the DOTE should be followed.
- All regular students appearing for first attempt should submit record notebook for the examination.
- The external examiner should verify the availability of the facility for the batch strength before commencement of practical examination.
- The external examiner should verify the working condition of machinery's / equipment before commencement of practical examination.

DETAILLED ALLOCATION OF MARKS

Sl. No.	Description	Max. Marks
1	Procedure	10
2	Inspection / Diagnostic report	30
3	Symptoms and Causes report	25
4	Remedies / Maintenance report	25
5	Viva-voce	10
Total		100

LIST OF EQUIPMENT / TOOLS/MACHINERY'S REQUIRED

(for a batch of 30 students)

Sl. No.	Machines / Tools / Equipments	Quantity
1.	Battery Charging and testing kit	1 No.
2.	Heavy Vehicle	1 No.
3.	Transmission System Kit	1 No.
4.	Power Steering System kit	1 No.
5.	Wheel alignment kit	1 No.
6.	Air brake system kit	1 No.
7.	Differential kit	1 No.
8.	Suspension system kit	1 No.
9.	Hydraulic brake system Kit	1 No.
10.	Special tools – Sufficient quantity	Sufficient quantity
11.	Consumables	Sufficient quantity

STATE BOARD OF TECHNICAL EDUCATION &TRAINING, TAMILNADU

DIPLOMA IN ENGINEERING / TECHNOLOGY SYLLABUS

N-SCHEME

(To be implemented for the students admitted from the year 2020 - 2021 onwards)

Course Name : 1021 Diploma in Automobile Engineering

Subject Code : 4021653

Semester : VI

Subject Title : Heating Ventilation and Air Conditioning Systems Practical

TEACHING AND SCHEME OF EXAMINATION

No of weeks per semester: 16 weeks

Subject	Instructions		Examination			
			Marks			Duration
	Hours / Week	Hours / Semester	Internal Assessment	Board Examinations	Total	
4021653 Heating Ventilation and Air Conditioning Systems Practical	5	80	25	100*	100	3 Hrs.

* Examinations will be conducted for 100 marks and it will be reduced to 75 marks for result.

Rationale

All the automobile are vehicles are equipped with Air Conditioning. Hence the fundamental knowledge of air Conditioning is most essential for an automobile. This course will help in understanding the principle of Refrigeration, Air-Conditioning and Psychrometry properties and also understanding the duct and ventilation design.

Objectives

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

- To understand the components of the automotive air-conditioning and their functions
- To understand the recent developments in this field
- To present a problem oriented in-depth knowledge of Automotive air conditioning
- To conduct various tests in Automotive air conditioning systems.
- To learn the layout of bus air-conditioning and its electric layout.
- To study about the refrigerant and practice leakage tests.
- To know the different sensors used in the HVAC system of automobile vehicles.

4021653 HEATING VENTILATION AND AIR CONDITIONING SYSTEMS PRACTICAL

Experiments:

PART A

1. Determine the refrigerating effect, C.O.P and the compressor capacity of open type system with any one expansion device. (Thermostatic expansion valve / Capillary tube / Automatic Expansion Valve)
2. Determine the capacity of a window air conditioner.
3. To evaluate the condition of the car air conditioner by using electrical measurements with (a)Thermostatic expansion valve (b) Magnetic clutch (c) Heater
4. Conduct Leak tests in a vehicle air conditioning system, detect the failures and suggest the remedies. Conduct the Refrigerant Charge Test.
5. Conduct the car A/c performance check. Identify the causes and its remedies.
6. Conduct the flush test to remove the contaminants of refrigeration system.

PART B

1. Draw the layout of a bus air conditioning system. Inspect, identify the maintenance requirements as per the service manual.
2. List the components of a car air-conditioning system. Identify the common issues, possible causes and suggest remedies.
3. Draw the circuit diagram to identify the sensors in the HVAC system of a vehicle. Write the diagnostic procedures for sensors.
4. Study the all-electric vehicle air conditioner. Study the refrigerant used in vehicle air conditioning.
5. Study the different types of evaporators. Serpentine evaporator, Plat & Fin Laminated Evaporator.
6. Study the A/c wiring circuit layout. Identify the protection devices to control.

Reference

1. Automotive Air Conditioning Training Manual, Automotive & Industrial Refrigerant Service Equipment, Ariazone.
2. Automotive Heating & Air conditioning Techbook, Mike Stubblefied, John H Haynes, Haynes Publications Inc.
3. HVAC system (Auto A/c) diagnostics manuals.
4. Hand Book of Airconditioning and Refrigeration, Shan K Wang, McGraw-Hill

BOARD EXAMINATION

Note:

- All the exercises/experiments in both sections should be completed. Two exercises/experiments will be given for examination by selecting one from PART A and one from PART B.
- All the exercises/experiments should be given in the question paper and students are allowed to select by a lot or Question paper issued from the DOTE should be followed.
- All regular students appearing for first attempt should submit record notebook for the examination.
- The external examiner should verify the availability of the facility for the batch strength before commencement of practical examination.

  The external examiner should verify the working condition of machineries / equipment before commencement of the board practical examination.

DETAILLED ALLOCATION OF MARKS

Sl. No.	Description	Max. Marks
PART A		
1	Procedure / Observation	10
2	Calculation / Failures	30
3	Result / Remedies	10
PART B		
4	Procedure / Explanation	10
5	Inspection / Diagnostic report	20
6	Remedies / Maintenance report	10
7	Viva-voce	10
Total		100

LIST OF EQUIPMENT / TOOLS / MACHINERY'S REQUIRED

(For a batch of 30 students)

Sl. No.	Machines / Tools / Equipment	Quantity
1.	Vapour Compression refrigeration test rig	1 No.
2.	Window air-conditioner test rig	1 No.
3.	Cooling tower arrangement	1 No.
4.	Car Air conditioning system test rig	1 No.
5.	Bus air conditioning kit	1 No.
6.	Sensors in the HVAC system of vehicle	1 No.
7.	Compressors used in Air conditioning system	1 No.
8.	Evaporators used in Air conditioning system	1 No.
9.	Vehicle A/c wiring circuit	1 No.
10.	Refrigeration charging system kit	1 No.
11.	Tools and spanners	Sufficient quantity
12.	Measuring and testing tools	Sufficient quantity
13.	Special tools	Sufficient quantity
14.	Consumables	Sufficient quantity

STATE BOARD OF TECHNICAL EDUCATION &TRAINING, TAMILNADU
DIPLOMA IN ENGINEERING / TECHNOLOGY SYLLABUS

N-SCHEME

(To be implemented for the students admitted from the year 2020 - 2021 onwards)

Course Name : 1021 Diploma in Automobile Engineering
Subject Code : 4021660
Semester : VI
Subject Title : Project Work and Internship

TEACHING AND SCHEME OF EXAMINATION

No of weeks per semester: 16 weeks

Subject	Instructions		Examination			
			Marks			Duration
	Hours / Week	Hours / Semester	Internal Assessment	Board Examinations	Total	
4020660 Project Work and Internship	6	96	25	100*	100	3 Hrs.

* Examinations will be conducted for 100 marks and it will be reduced to 75 marks for result.

RATIONALE:

This subject 'Project Work and Internship" is the continuation of the previous semester subjects. The students are to implement the detailed project plan, which they have prepared. This project are generally an integration of the various types of skills acquired during their course of study. Hence it is essential that students are given opportunity to develop and integrate the highly essential industry oriented competencies and skills. This subject builds up greater confidence to face in the world of work.

OBJECTIVES:

- Implement the theoretical and practical knowledge gained through the curriculum into an application suitable for a real practical working environment preferably in an industrial environment.
- Implement the planned activity as a team.
- Take appropriate decisions on collected information.
- Carryout cooperative learning through synchronous guided discussions within the class in key dates, asynchronous document sharing and discussions, as well as to prepare collaborative edition of the final project report.

Project Work and Internship:

The students of all the Diploma Courses have to do a Project Work as part of the Curriculum and in partial fulfillment for the award of Diploma by the State Board of Technical Education and Training, Tamil Nadu. In order to encourage students to do worthwhile and innovative projects, every year prizes are awarded for the best three projects i.e. institution wise, region wise and state wise. **The Project work must be reviewed twice in the same semester. The project work is approved during the V semester by the properly constituted committee with guidelines.**

a) Internal assessment mark for Project Work & Internship:

Project Review I	…	**10 marks**
Project Review II	…	**10 marks**
Attendance	…	**05 marks** (Award of marks same as theory subject pattern)
Total	…	**25 marks**

Proper record should be maintained for the two Project Reviews and preserved for one semester after the publication of Board Exams results. It should be produced to the flying squad and the inspection team at the time of inspection/verification.

b) Allocation of Marks for Project Work & Internship in Board Examinations:

Demonstration/Presentation	25 marks
Report	25 marks
Viva Voce	30 marks
Internship Report	20 marks
Total	**100* marks**

*Examination will be conducted for 100 marks and will be converted to 75 marks.

c) Internship Report:

The internship training for a period of two weeks shall be undergone by every candidate at the end of IV / V semester during vacation. The certificate shall be produced along with the internship report for evaluation. The evaluation of internship training shall be done along with final year “Project Work & Internship” for 20 marks. The internship shall be undertaken in any industry / Government or Private certified agencies which are in social sector / Govt. Skill Centres / Institutions / Schemes.

A neatly prepared PROJECT REPORT as per the format has to be submitted by individual student during the Project Work & Internship Board examination.