

**VI Semester**

Subject Code	SUBJECT	HOURS PER WEEK			
		Theory hours	Drawing hours	Practical hours	Total hours
4020610	Industrial Engineering and Management	6	-	-	6
4020620	E Vehicle Technology & Policy	4	-	-	4
<b>Elective II Theory</b>					
4020631	Industrial Robotics and 3D Printing	5	-	-	5
4020632	Refrigeration and Air Conditioning	5	-	-	
4020633	Automobile Technology	5	-	-	
4020640	Solid Modelling Practical	-	-	6	6
<b>Elective II Practical</b>					
4020651	Industrial Robotics and 3D Printing Practical	-	-	5	5
4020652	Refrigeration and Air Conditioning Practical	-	-	5	
4020653	Automobile Technology Practical	-	-	5	
4020660	Project Work and Internship	-	-	6	6
		15	-	17	32
Extra / Co-Curricular activities					
Library		-	-	-	1
Physical Education		-	-	-	2
<b>TOTAL</b>					<b>35</b>

**VI Semester**

Subject Code	SUBJECT	Marks			Minimum marks for pass	Duration of ExamHours
		Internal Assessment	* Board Examination	Total		
4020610	Industrial Engineering and Management	25	100	100	40	3
4020620	E Vehicle Technology & Policy #	25	100	100	40	3
<b>ELECTIVE – II THEORY</b>						
4020631	Industrial Robotics and 3D Printing	25	100	100	40	3
4020632	Refrigeration and Air Conditioning	25	100	100		
4020633	Automobile Technology	25	100	100		
4020640	Solid Modelling Practical	25	100	100	50	3
<b>ELECTIVE – II PRACTICAL</b>						
4020651	Industrial Robotics and 3D Printing Practical	25	100	100	50	3
4020652	Refrigeration and Air Conditioning Practical	25	100	100		
4020653	Automobile Technology Practical	25	100	100		
4020660	Project Work and Internship	25	100	100	50	3

\* Examinations will be conducted for 100 Marks and will be converted 75 Marks.

**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 : 1020 Diploma in Mechanical Engineering  
Subject Code : 4020610  
Semester : VI  
Subject Title : Industrial Engineering and Management

**TEACHING AND SCHEME OF EXAMINATION**

No of weeks per semester: 16 weeks

Subject	Instructions		Examination			
	Hours / Week	Hours / Semester	Marks			Duration
Internal Assessment			Board Examinations	Total		
4020610 Industrial Engineering and Management	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 No	Topics	Hours
I	Plant Engineering and Plant Safety	18
II	Work Study, Method Study and Work Measurement	18
III	Principles, Personnel Management and Organizational Behavior:	19
IV	Financial and Material Management	18
V	Engineering Ethics and Human Values	16
Test and Model Exam		07
<b>Total</b>		<b>96</b>



<b>II</b>	<p><b>Work Study, Method Study and Work Measurement</b></p> <p><b>Chapter: 2.1: Work Study:</b> Productivity – Standard of living – method of improving productivity – Objectives – Importance of good working conditions. <span style="float: right;"><b>4</b></span></p> <p><b>Chapter: 2.2: Method Study:</b> Definition – Objectives – Selection of a job for method study – Basic procedure for conduct of method study – Tools used – Operation process chart, Flow process chart, two handed process chart, Man Machine chart, String diagram and flow diagram. <span style="float: right;"><b>6</b></span></p> <p><b>Chapter: 2.3: Work Measurement:</b> Definition – Basic procedure in making a time study – Employees rating factor – Application of time allowances – Rest, Personal, Process, Special and Policy allowances – Calculation of standard time – Problems – Basic concept of production study – Techniques of work measurement - Ratio delay study, Synthesis from standard data, analytical estimating and Pre determined Motion Time System (PMTS). <span style="float: right;"><b>8</b></span></p>
<b>III</b>	<p><b>Principles, Personnel Management and Organizational Behavior:</b></p> <p><b>Chapter: 3.1: Principles of Management:</b> Definition of management – Administration - Organization – F.W. Taylor’s and Henry Fayol’s Principles of Management – Functions of Manager – Directing – 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) – Enterprises Resource Planning (ERP) – Activity Based Management (ABM) – Global Perspective – Principles and brief description. <span style="float: right;"><b>7</b></span></p> <p><b>Chapter: 3.2: Personnel Management:</b> Responsibility of human resource management – Selection procedure – Training of workers – Apprentice training – On the job training and vestibule school training – Job evaluation and merit rating – objectives and importance – wages and salary administration – Components of wages – Wage fixation – Type of wage payment – Halsey’s 50% plan, <span style="float: right;"><b>7</b></span></p>

	<p>Rowan's plan and Emerson's efficiency plan – Problems.</p> <p><b>Chapter: 3.3: Organizational behavior:</b> Definition – organization - Types of Organization – Line, Staff, Taylor's Pure functional types – Line and staff and committee type – Organizational Approaches, individual behavior - causes - Environmental effect - Behavior and Performance, Perception - organizational implications.</p>	<b>5</b>
<b>IV</b>	<p><b>Financial and Material Management</b></p> <p><b>Chapter: 4.1: Financial Management:</b> 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 – Problems.</p> <p><b>Chapter: 4.2: Material Management:</b> 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 - Introduction – Purchasing procedure – Store keeping – Bin card.</p>	<b>9</b>  <b>9</b>
<b>V</b>	<p><b>Engineering Ethics and Human Values</b></p> <p><b>Chapter: 5.1: Engineering Ethics:</b> 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 judgement - Kohiberg's stages of moral development - value based ethics - engineers as managers, consultants and leaders - environmental ethics - computer ethics - Intellectual Property Rights (IPRs).</p> <p><b>Chapter: 5.2: Human values :</b> Morals – values – integrity - service learning - civic virtue - respect for others - living peacefully - caring – sharing – honesty - courage - valuing time cooperation - commitments – empathy - selfconfidence – character - stress management.</p>	<b>9</b>  <b>7</b>

**Reference Books :**

1. Industrial Engineering and Management, O.P. Khanna, Revised Edition Publications (P) Ltd – 2004, 67/4 Madras House, Daryaganj, New Delhi– 110002.
2. Engineering Economics and Management, T.R. Banga& S.C. Sharma, McGraw Hill Edition. 2 – 2001, New Delhi.
3. Herald Koontz and Heinz Wehrich, Essentials of Management, McGraw Hill Publishing Company, Singapore International Edition. Latest
4. Govindarajan .M, Natarajan. S, Senthilkumar V.V, Engineering ethics, prentice hall of India New Delhi, 2004.
5. Management, Aglobal perspective, Heinz Wehrich, Harold Koontz, 10<sup>th</sup> Edition, McGraw Hill International Edition. Latest.
6. Essentials of Management,4<sup>th</sup> Edition, Joseph L. Massie, Prentice - Hall of India, New Delhi 2004.
7. S.Chandran, Organizational Behaviours, Vikas Publishing House Pvt. Ltd. Latest
8. M.Govindarajan and S.Natarajan, Principles of Management, Prentce Hall of India Pvt.Ltd. New Delhi. Latest.
9. Charles B. Fledderman, Engineering ethics, pearson prentice hall, New Jersey, 2004.

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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 : 1020 Diploma in Mechanical Engineering

Subject Code : 4020620

Semester : VI

Subject Title : E Vehicle Technology & Policy

**TEACHING AND SCHEME OF EXAMINATION**

No of weeks per semester: 16 weeks

Subject	Instructions		Examination			
	Hours / Week	Hours / Semester	Marks			Duration
Internal Assessment			Board Examinations	Total		
4020620 E Vehicle Technology & Policy	4	64	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	Environmental impact and history, Types of Electric vehicles	12
II	Electric vehicle, Electrical Propulsion System	12
III	Energy Storages, Charging System, Effects and Impacts	11
IV	Electric Mobility Policy Frame Work	11
V	Tamilnadu E-Vehicle Policy 2019	11
Test and Model Exam		7
<b>Total</b>		<b>64</b>

**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.

**4020620 E Vehicle Technology & Policy**

**DETAILED SYLLABUS**

**Contents: Theory**

Unit	Name of the Topics	Hours
I	<b>Environmental impact and history:</b> Environmental impact of conventional vehicle - Air pollution – Petroleum resources – History of Electric vehicles & Hybrid Electric Vehicles - Conventional drive train system – Rear Wheel, Front Wheel and All wheel - Parts of Drive train system	6
	<b>Types of Electric Vehicles:</b> Introduction to Battery Electric Vehicle (BEV) – Definition BEV – Necessity BEV – Different between BEV and Conventional Vehicle -	6



	Scope and Applicability of EV Policy – ARAI Standards for Electric Vehicle – AIS 038, AIS 039 & AIS 123 - Key Performance Indicator - Global impact – Trends and Future Developments	
V	<b>Tamil Nadu E-Vehicle Policy 2019</b> 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 – City building codes – Capacity Building and Skilling – Charging structure – implementing agencies – Research & Development and Business Incubation – Recycling Ecosystem – Battery and EVs	11

**Reference Books**

1. Modern Electric, Hybrid Electric and Fuel Cell Vehicles, Mehrdad Ehsani, Yimin Gao, Sebastien E.Gay, Ali Emadi, CR Press, London, New York.
2. 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
3. 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.
4. Electric Vehicles: A future Projection CII October 2020 report.
5. Design and analysis of aluminum/air battery system for electric vehicles, Shaohua Yang, Harold Knickle, Elsevier.
6. Propelling Electric Vehicles in India, Technical study of Electric Vehicles and Charging Infrastructure
7. ZERO EMISSION VEHICLES (ZEVs): TOWARDS A POLICY FRAMEWORK – NTI Aayog.
8. FASTER ADOPTION OF ELECTRIC VEHICLES IN INDIA: PERSPECTIVE OF CONSUMERS AND INDUSTRY, The Energy and Resources Institute, New Delhi.
9. India EV Story: Emerging Opportunities by Innovation Norway.
10. Automotive Industry Standards – AIS 038, AIS 039 & AIS 123 – Manual

**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 : 1020 Diploma in Mechanical Engineering

Subject Code : 4020631

Semester : VI

Subject Title : Industrial Robotics and 3D Printing

**TEACHING AND SCHEME OF EXAMINATION**

No of weeks per semester: 16 weeks

Subject	Instructions		Examination			
	Hours / Week	Hours / Semester	Marks			Duration
Internal Assessment			Board Examinations	Total		
4020631 Industrial Robotics and 3D Printing	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	Fundamentals of Robot Technology	12
II	Drive Systems, End Effecters, Sensors and Machine Vision System	12
III	Robot Programming, Robot Applications in Manufacturing	12
IV	Introduction and Design for Additive Manufacturing	18
V	Additive Manufacturing Processes	19
Test and Model Exam		07
<b>Total</b>		<b>80</b>

**RATIONALE:**

Rapid industrialization and globalization needs industries to be more competitive and deliver cost effective quality products. This needs industries to implement flexible manufacturing systems where Robotic technology plays major role. Hence study of robotic technology is very essential.

3D printing is often utilized when manufacturers need to create a product accurately, quickly and at a low quantity. This has lead to 3D printers being brought in to prototype industrial robots, helping to aid the development of better, more efficient robots in the industrial sector.

**OBJECTIVES:**

- Understand fundamentals of robotics
- Acquire knowledge structure and elements of robot
- Gain knowledge on controller and various drives used in robotics
- Develop knowledge on role of sensors and vision system
- Acquire skill to program and control robot
- Understand to adopt robot to various industrial applications.
- To acquire the knowledge on 3D Printing and design principles for additive manufacturing
- To understand the principles of latest manufacturing processes in Additive manufacturing

**4020631 Industrial Robotics and 3D Printing**  
**DETAILED SYLLABUS**

Contents: Theory

Unit	Name Of The Topic	Hours
I	<b>Fundamentals of Robot Technology</b> Introduction – History of robot– Definitions– Basic configuration of Robotics – Robot Components – Manipulator, End effector, Driving system, Controller and Sensors – Degrees of freedom – Links and joints – Types of joints – Joint notation scheme – Pitch, Yaw, Roll – Classification of robots – Work envelope and Work Volume – Effect of structure on Control ,Work envelop and Work volume- Introduction to PUMA robot- Robot controller –	12

	Configuration - Four types of controls – Open loop and closed loop controls – Speed of response and stability – Precision of movements: Spatial resolutions, accuracy and repeatability.	
<b>II</b>	<p><b>Drive Systems, End Effecters, Sensors and Machine Vision System</b></p> <p>Pneumatic drives – Hydraulic drives – Mechanical drives – Electrical drives – Stepper motors, DC Servo motors and AC Servo motors– Applications and Comparisons of Drives. End effecters – Grippers – Mechanical Grippers, Magnetic Grippers, Vacuum Grippers- Selection and design considerations in robot gripper- Requirements of Sensors – Position sensors: LVDT, Resolvers, Optical encoders- Proximity sensors: Inductive, Capacitive, Ultrasonic and Optical proximity sensors- Touch Sensors – Range Sensors- Machine Vision System: Sensing &amp; Digitizing Image Data – Image Processing and Analysis - Application</p>	12
<b>III</b>	<p><b>Robot Programming, Robot Applications In Manufacturing</b></p> <p>Forward kinematics, Inverse kinematics and differences – Forward kinematics and Reverse kinematics of manipulators with Two and Three degrees of freedom – Derivations. Robot programming –Lead through programming, Textual programming – Teach Pendant for Robot system– Robot programming languages – Motion commands, Sensor commands, End effector commands. Robot applications – Material handling-Spot welding – Arc welding – Spray painting – Assembling – Finishing-AGV-RGV.</p>	12
<b>IV</b>	<p><b>Introduction and Design for Additive Manufacturing</b></p> <p><b>Introduction to Additive Manufacturing</b></p> <p>Additive Manufacturing – 3D Printing – Rapid prototyping – Overview – Need – Additive manufacturing Vs CNC Machining - Development of Additive Manufacturing Technology – Principle of AM Process – Generalised Additive Manufacturing Process Chain - Classification - Benefits – Direct and Indirect process, Prototyping, Manufacturing and Tooling</p>	9

	<p><b>Design for Additive Manufacturing</b></p> <p>Design tools: Data processing - CAD model preparation – STL file - Part orientation and support structure generation - Model slicing - Tool path generation. Design for Additive Manufacturing: Concepts and objectives - AM unique capabilities - DFAM for part quality improvement – strategies – Design Rules – Quality aspects – Software for AM – MIMICS, etc.</p>	9
<b>V</b>	<p><b>Additive Manufacturing Processes</b></p> <p><b>Photo polymerization and Powder Bed Fusion Processes</b></p> <p>Photo polymerization: SLA - Photo curable materials - Process - reaction rates – scan patterns - Advantages and Applications. Powder Bed Fusion: SLS - Process description - powder fusion mechanism – material feed system - Process Parameters - Materials and Applications. Electron Beam Melting</p>	7
	<p><b>Extrusion Based And Sheet Lamination Processes</b></p> <p>Extrusion Based System: FDM – Introduction - Basic Principle – plotting and path control - Materials - Applications and Limitations - Bio-extrusion. Sheet Lamination Process: LOM – Materials - Gluing or Adhesive bonding - Thermal bonding – Ultrasonic AM.</p>	5
	<p><b>Printing Processes And Beam Deposition Processes</b></p> <p>Droplet formation technologies - Continuous mode - Drop on Demand mode - Three Dimensional Printing – Advantages – Bio- plotter - Beam Deposition Process: LENS- Process description - Material delivery - Process parameters – Materials – Benefits.Applications of AM technologies in Automotive, Manufacturing, Architectural, Healthcare, and Consumer products.</p>	7

**Reference Books:**

1. Industrial Robotics – Technology, Programming and Applications, P.Groover, MCGraw Hill, 2001
2. Chua C.K., Leong K.F., and Lim C.S., “Rapid prototyping: Principles and applications”, Third edition, World Scientific Publishers, 2010.



3. Ian Gibson, David W. Rosen, Brent Stucker “Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing” Springer, 2010.
4. Robotics Control, Sensing, Vision and Intelligence, Fu.K.S.Gonzalez.R.C., and Lee C.S.G, McGraw-Hill Book Co., 1987
5. Robotics for Engineers, Yoram Koren, McGraw-Hill Book Co., 1992
6. Robotics and Image Processing, Janakiraman.P.A, Tata McGraw-Hill, 1995
7. Andreas Gebhardt “Understanding Additive Manufacturing: Rapid Prototyping, Rapid Manufacturing” Hanser Gardner Publication 2011.
8. Kamrani A.K. and Nasr E.A., “Rapid Prototyping: Theory and practice”, Springer, 2006.
9. Liou L.W. and Liou F.W., “Rapid Prototyping and Engineering applications: A tool box for prototype development”, CRC Press, 2007.
10. Tom Page, “Design for Additive Manufacturing” LAP Lambert Academic Publishing, 2012.
11. Amit Bandyopadhyay, and Susmita Bose, “Additive Manufacturing”, CRC Press.
12. John O Milewski., “Additive Manufacturing of Metals: From Fundamental Technology to Rocket Nozzles, Medical Implants, and Custom Jewellery”, Springer Series in Materials Science
13. Sabrie Soloman. “Additive Manufacturing: Advanced Manufacturing Technology in 3d Print Deposit”
14. David Ian Wimpenny and Pulak M Pandey, “Advances in 3D Printing and Additive Manufacturing Technologies”
15. Andreas Gebhardt, Hanser, “Understanding Additive Manufacturing”

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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 : 1020 Diploma in Mechanical Engineering  
Subject Code : 4020632  
Semester : VI  
Subject Title : Refrigeration and Air-Conditioning

**TEACHING AND SCHEME OF EXAMINATION**

No of weeks per semester: 16 weeks

Subject	Instructions		Examination			
	Hours / Week	Hours / Semester	Marks			Duration
Internal Assessment			Board Examinations	Total		
4020632 Refrigeration and Air-Conditioning	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	Refrigeration System And Refrigeration Equipments	15
II	Vapour Compression Refrigeration System And Vapour Absorption Refrigeration System	15
III	Refrigerant Flow Controls, Refrigerants And Lubricants, Applications Of Refrigeration	15
IV	Psychrometry And Comfort Air Conditioning	14
V	Air Conditioning Systems And Cooling Load Calculations	14
	Test and Model Exam	7
	<b>TOTAL</b>	<b>80</b>

**RATIONALE:**

Requirement of human comfort, maintenance of machines and preserving Perishables through air conditioning is very essential. Hence learning the study of refrigeration principles, refrigeration system, Concept of air-conditioning and methods of facilitates quality design of air conditioners are essential.

**OBJECTIVES:**

- Explain the working of open and closed air system of refrigeration.
- Describe the working and construction of compressors used for air-conditioning
- Explain the vapour compression refrigeration system.
- Explain the vapour absorption refrigeration system.
- Compare the properties and applications of various refrigerants.
- Define the parameters used for air conditioning.
- To Use the psychometric chart.
- Estimate the cooling load for the given requirement.
- Explain the industrial application of refrigeration.

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**4020632 REFRIGERATION AND AIR-CONDITIONING  
 DETAILED SYLLABUS**

Unit	Name Of The Topic	Hours
I	<b>REFRIGERATION SYSTEM</b> Thermodynamic state of a pure substances - modes of heat transfer – laws of heat transfer – mechanisms of production of cold – unit of refrigeration – types of refrigeration – reversed Carnot cycle-C.O.P of heat engine–heat pump– refrigerating machine – principle of working of open and closed air system of refrigeration – Advantages and disadvantages – problems. <b>REFRIGERATION EQUIPMENTS</b> Compressor – principle of working and constructional details of reciprocating and rotary compressors, hermetically and semihermetically sealed compressors – condensers – principle of working and constructional details of air cooled and water cooled	15

	<p>Condensers, evaporative condensers - advantages and disadvantages - natural and forced draught cooling towers. Evaporators – natural circulation and forced circulation type - principle of working constructional details.</p>	
II	<p><b>VAPOUR COMPRESSION REFRIGERATION SYSTEM</b></p> <p>Principle of working of vapour compression system – analysis of vapour compression cycle using T-s diagram and p-H diagram- refrigerating effect - compression work – C.O.P – effect of superheating and under cooling – problems – effect of evaporative pressure – condenser pressure – liquid – vapour refrigeration heat exchangers – advantages and disadvantages of superheating and Under cooling – use of flash chamber and accumulator.</p> <p><b>VAPOUR ABSORPTION REFRIGERATION SYSTEM</b></p> <p>Simple absorption system – Electrolux system – Solar absorption system - absorption system comparison with Mechanical (Compression) refrigeration system.</p>	15
III	<p><b>REFRIGERANT FLOW CONTROLS, REFRIGERANTS AND LUBRICANTS AND APPLICATION OF REFRIGERATION</b></p> <p>Capillary tube - automatic expansion valve – thermostatic expansion valve - solenoid valve - evaporator pressure regulator – suction pressure regulator - selection of a refrigerant - properties and Applications of following refrigerants SO<sub>2</sub>, CH<sub>4</sub>, F11, F12, F22, and NH<sub>3</sub> – lubricants used in refrigeration and their applications, Cryogenics.</p> <p><b>APPLICATIONS OF REFRIGERATION</b></p> <p>Slow freezing – quick freezing – cold storage – frozen storage freeze drying – dairy refrigeration – ice cream cabinets – ice making – Water cooler, milk cooler, bottle cooler – frost free refrigeration.</p>	15
IV	<p><b>PSYCHROMETRY AND COMFORT AIR CONDITIONING</b></p> <p>Definitions of dry air, moist air, water vapour, Avogadro's law, Dalton's law of partial pressure – dry and wet bulb temperature -</p>	14

	dew point – humidity – specific and absolute – relative humidity - degree of saturation – enthalpy of moist air - adiabatic saturation of air by evaporation of water – psychometric chart and its uses – psychometric processes – sensible heating and cooling – humidifying and heating – dehumidifying and cooling – adiabatic cooling with humidification – total heating or cooling processes – sensible heat factor – by pass factor with simple problems – Governing optimum effective temperature – comfort chart - design consideration.	
V	<p><b>AIR CONDITIONING SYSTEMS</b></p> <p>Equipment for air conditioning and insulation factors – airpurification – temperature control – humidity control – dry and wet filters - centrifugal dust collector – air washer humidifier – dehumidifier – fans and blowers – grills and registers – summer and winter air conditioning, window type air conditioner – split type air conditioner system – properties of ideal insulator, types of insulating materials – air distribution and duct systems – tools and Installation, servicing and maintenance of R &amp; AC systems.</p> <p><b>COOLING LOAD CALCULATIONS</b></p> <p>Different heat sources – conduction heat load – radiation Load of sun – occupants load – equipment load – infiltration air load– miscellaneous heat sources – fresh air load – simple problems.</p>	14

Reference books:

1. Refrigeration and air conditioning, P.L. Ballaney, Khanna Publishers, 2B, North Market, Naisarak, New Delhi 110 006.
2. Refrigeration and air conditioning, V.K. Jain,
3. Industrial Refrigeration Hand Book, Wilbert F. Steocker
4. A course in refrigeration and air conditioning, Domkundwar,
5. Principles of refrigeration, Dossat ,
6. Home refrigeration and air conditioning, Audels, Theo. Audel & Co. publisher, 199 Edn. 49, West 23<sup>rd</sup> Street, New York. – 1998
7. Refrigeration and air conditioning, C.P Arora,
8. Cryogenic systems Randell Fd Barron.

**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 : 1020 Diploma in Mechanical Engineering

Subject Code : 4020633

Semester : VI

Subject Title : Automobile Technology

**TEACHING AND SCHEME OF EXAMINATION**

No of weeks per semester: 16 weeks

Subject	Instructions		Examination			Duration
	Hours / Week	Hours / Semester	Marks			
Internal Assessment			Board Examinations	Total		
4020633 Automobile Technology	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	Automobile Engines	14
II	Fuel Feed Systems and Alternative fuels	14
III	Transmission and Power Trains	15
IV	Automobile Chassis	15
V	Electrical Equipment & Hybrid Electric Vehicles	15
Test and Model Exam		07
<b>Total</b>		<b>80</b>

**RATIONALE:**

Automobile is one of the key areas of development in India facilitated by Multinational Companies. As Automobile is the Major sources of employing man power a thorough knowledge on Automobile Engine construction and its functioning is required with due consideration on pollution control.

**OBJECTIVES:**

- Explain about the constructional details of an Automobile engine including cooling and lubrication system.
- Describe fuel feed systems for petrol and diesel engines with all devicesinvolved in it.
- Explain the construction and functional features of the power transmission systems and various parts involved in it.
- Explain the functions of different types of steering, suspension and brake systems.
- Describe the different types of chassis and their functions.
- Familiarize electrical and electronic equipments used in automobile.
- To understand the emerging trends of electric vehicles, hybrid electric vehicles and solar vehicles.
- To know the automobile emissions and its effects on environment.

**4020633 AUTOMOBILE TECHNOLOGY  
DETAILED SYLLABUS**

Contents: Theory

Unit	Name Of The Topic	Hours
I	<b>Automobile Engines</b> Basic Engine Components – Functions , types , materials and construction of –Cylinder block – Crankcase – oil pan - Cylinder head – Gaskets – cylinder liners– Comparison of liners – Piston – piston rings – types of compression rings and oil control rings – piston pin – Connecting rod - methods of connecting piston and Connecting rod – Crankshaft – flywheel – Cam shaft – Valve and Valve mechanism – L-I-F-T.Cooling systems – purpose – types –	14



	air and water cooling systems – merits and demerits –pump assisted water cooling systems –components – water pump, fan - thermostat – types - radiator –types –pressure cap - troubles in cooling system. Lubrication systems – purpose – types of lubricants – additives – Service rating of oil – types of lubricating systems - Full pressure system – techniques of cylinder and piston lubrication – oil filters – full flow and bypass filter systems - Troubles in lubrication system.	
II	<p><b>Fuel Feed Systems And Alternative fuels</b></p> <p>Requirements of good fuel-Types of fuel feed systems- S.U. Electrical fuel pump – fuel filter – Air cleaners – types- petrol injection –merits and demerits – DTSI – VTI – CCVTI – PGMFI – MPFI system. Layout of diesel and petrol fuel feed system – single acting fuel feed pump – fuel injection pumps – Construction and working of distributor type pump – CRDI system - fuel injectors – types – Single &amp; Multi hole – pintle and pintaux - fuel filters – primary and secondary filters.</p> <p>Alcohol, Hydrogen, Compressed Natural Gas, Liquefied Petroleum Gas and Bio Diesel - Properties, Suitability, Merits and Demerits - Engine Modifications</p>	12 3
III	<p><b>Transmission And Power Trains</b></p> <p>General arrangement of power transmission system – Arrangement of front engine rear drive – rear engine rear drive – front engine front drive - four wheel drive – applications – clutch – function – Components – Types - Single plate ,multi plate and diaphragm spring clutch – fluid coupling – Clutch troubles and their causes.</p> <p>Gear box – purpose – various resistance to motion – types of gear boxes –constant mesh and synchromesh-gear box troubles and their causes.</p> <p>Drive line – propeller shaft – Universal joint – Cross type only – slip joint – final drive – function – types of gear arrangement – straight &amp; spiral Bevel , Hypoid ,Worm and Worm Wheel – merits , demerits</p>	5 3 7

	and application – Hotch kiss drive –Torque tube drive – radius rod. Differential – purpose – Construction and operation – Self locking and non slip differential – Differential troubles and their Causes – Semi floating, three quarter floating and full floating rear axles.	
IV	<p><b>Automobile Chassis</b></p> <p>Front axle – Types – Stub axle – Types – Steering system – Ackermann Principle of Steering – Wheel alignment – Factors – Camber , Caster , King pin inclination , Toe in and Toe out on turns - Steering linkages – Steering gears –Cam and double roller ,recirculating ball type , Rack and Pinion – Steering troubles and causes – power steering – Necessity – types – Layout of any one type – Collapsible Steering system.</p> <p>Suspension system – Functions – Type of springs – Leaf , coil and Torsion bar– Front suspension systems – independent front suspension –merits and demerits – types – rear end suspension – Air suspension - shock absorber –purpose – telescopic type – construction and working.</p> <p>Brake system – functions – classification of brakes – drum brakes – leading shoe and trailing shoe – Self energizing action – hydraulic brake – brake bleeding - Air assisted hydraulic brakes – Air brake – layout , functions of each component and application only – disc brakes – construction and working – comparison of disc and drum type – brake troubles and their causes – anti lock Brake system.</p> <p>Wheels – types of wheels – brief description and applications – tyres – function– construction of tyres – cross and radial ply tyres – comparison.</p>	<p>7</p> <p>3</p> <p>3</p> <p>2</p>

V	<p><b>Electrical Equipment &amp; Hybrid Electric Vehicles</b></p> <p>Battery – lead acid battery – Nickel alkaline battery – construction – battery rating – charging - testing – starting circuit - construction and operation of starter motor – starting motor drives – over running clutch and Bendix drive – construction and operation – solenoid switch - Charging circuit – alternator construction and operation – regulators – Dynamo.</p> <p>Ignition system – Types – High tension magneto – electronic ignition – Ignition system troubles and remedies. Lighting system – circuit – Head light – Aiming and adjustment – sealed beam head lights – directional signal circuits – fluorescent lamp - Horn circuits – Wind screen wiper.</p> <p>Introduction: Concept and environmental importance of EVs, HEVs and solar vehicles. Electric vehicles: Layout, construction and working. Hybrid electric vehicles: Types, layout, hybridization factor, plug in hybrid electric vehicles, fuel efficiency analysis. Challenges and future scope of EVs and HEVs. EMISSION STANDARDS: Euro I, II, III and IV norms, Bharat Stage II, III, IV norms. Motor Vehicle Act.</p>	6
		5
		4

**Reference Books:**

1. Automobile Engineering, G.B.S.Narang, Khanna Publishers, NewDelhi.
2. AutomotiveMechanics,William H.crouse and Donald .L. Anglin, Tata McGraw– Hill Publishing CompanyLtd, NewDelhi.
3. The Automobile, Harbans Singh Reyat, S.Chand &Co Ltd, NewDelhi
4. Vehicle and Engine technology. Vol. I,HeinzHeisler, , ELBS
5. Automotive Mechanics,Joseph Heitner, East–west Press (P) Ltd, NewDelhi
6. Internal Combustion engines, M.L.Mathur &R.P.Sharma, Dhanpat Rai & Sons,
7. Modern Electric, Hybrid Electric and Fuel Cell Vehicles, Mehrdad Ehsani, Yimin Gao, Sebastien E.Gay, Ali Emadi, CR Press, London, New York
8. Electric & hybrid Vehicle, A.K.babu, Khanna Publications, New delhi.

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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 : 1020 Diploma in Mechanical Engineering  
Subject Code : 4020640  
Semester : VI  
Subject Title : Solid Modelling Practical

**TEACHING AND SCHEME OF EXAMINATION**

No of weeks per semester: 16 weeks

Subject	Instructions		Examination			Duration
	Hours / Week	Hours / Semester	Marks			
Internal Assessment			Board Examinations	Total		
4020640 Solid Modelling Practical	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:**

A Mechanical Engineering Diploma Engineer is expected to possess a thorough understanding of drawing, which includes clear visualization and proficiency in reading and interpreting a wide variety of production drawing. The market driven economy demands frequent changes in product design to suit the customer requirements. The introduction of this subject is to provide hands on experience in sketching and modeling of the industrial components using any one of the Computer Aided Design and Modelling packages. The aim of this subject is to help the student to attain the industry identified competency through practice in CAD software.

**OBJECTIVES:**

- Prepare 2D Drawing using sketcher or part modelling of any parametric CAD software.
- Generate 3D Solid models from 2D sketch or part modelling of any parametric CAD software.
- Prepare assembly of part models using assembly of any parametric CAD software.
- Generate orthographic views of 3D solid models/assemblies using drafting of any parametric software.
- Plot a drawing for given part model/assembly.

**DETAILED SYLLABUS**

Contents: Practical

**Introduction**

Parametric CAD software – sketch – elements – entities: line – circle – arc – ellipse – polygon – text – dimensions – sketch tools – fillet – chamfer – offset – trim – extend – mirror – rotate – block. Partmodelling – reference planes – reference point – reference axes – co-ordinate system – extrude – revolve – swept – helix and spiral – lofts – dome – shell – draft – rib – wrap – intersect – holes – patterns. Assembly – approaches – mate – coincident – sub assembly – rebuild – isolate. Drawing views – Save – Plot – model view – exploded view – projected view – section view – import – export – Appearance – rendering.

**Exercises**

PART A: Draw the given 3D drawing using 3D modelling commands.

1. Model 1
2. Model 2
3. Model 3
4. Model 4
5. Model 5
6. Model 6

PART B: Draw the part models and assemble the components using 3D modelling.

1. Revolving Centre

2. Tail stock
3. Machine Vice
4. Crane hook
5. Petrol Engine Connecting Rod
6. Pipe Vice

### Board Examination

Note: All the exercises should be completed All the exercises should be given for examination, the students are permitted to select by lot or the question paper from DOTE should be followed. Record note book should be submitted during examination.

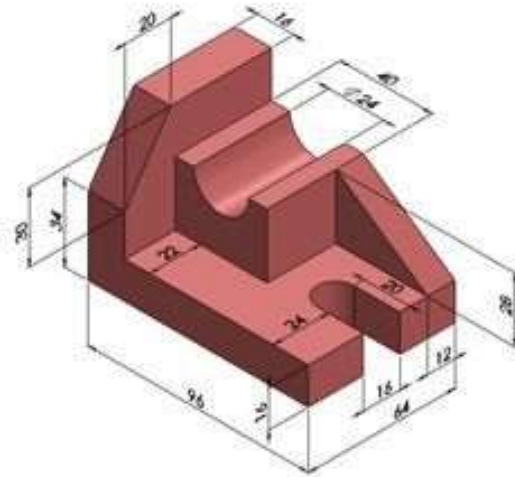
Two exercises will be given for examination by selecting one exercise in each PART. The printout of exercises of the student work should be submitted with answer paper and the same have to be evaluated as per the allocation.

### DETAILED ALLOCATION OF MARKS

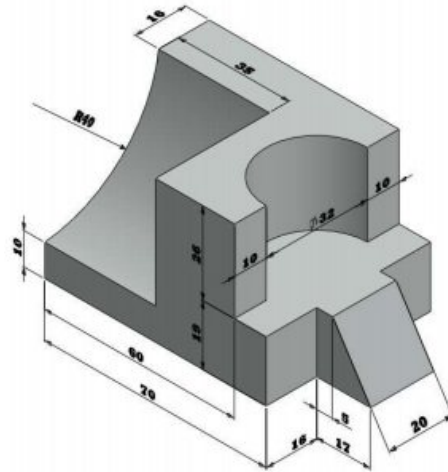
Sl. No.	Performance Indicator	Marks
Part A – 3D Component Modelling		
1	Sketching	15
2	3D Modelling	15
Part B – Assemble Drawing Modelling		
3	Sketching / Part modelling	20
4	Assembly	30
5	Solid Model / Views	10
6	Viva voce	10
Total		100

**Exercises**

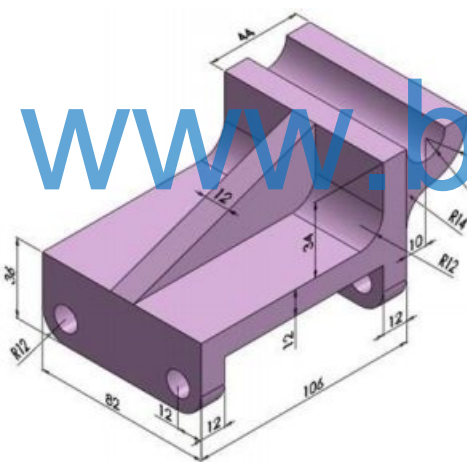
PART A: Draw the given 3D drawing using 3D modelling commands.



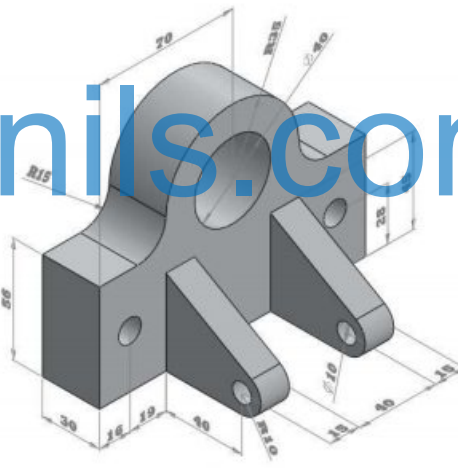
Model 1



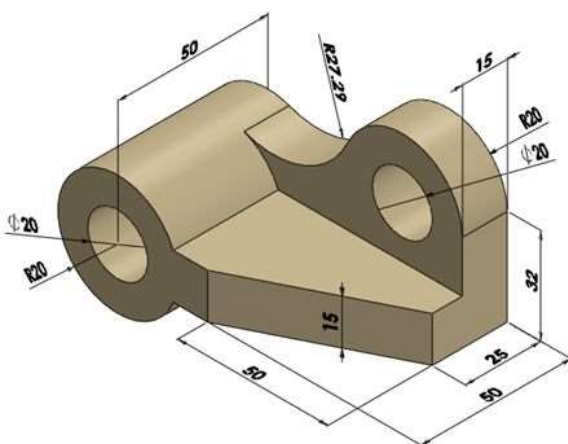
Model 2



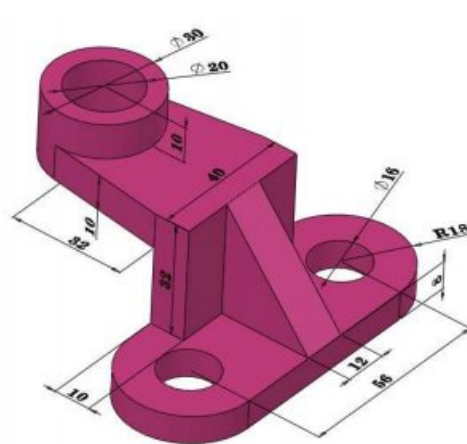
Model 3



Model 4



Model 5



Model 6



**LIST OF EQUIPMENTS**

**(To accommodate a batch of 30 students in Practice / Board Examinations)**

Personal computer	:	30 Nos.
Laser Printer	:	1 No.
Software	:	GUI System Software
	:	Modelling package – Sufficient to the strength.

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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 : 1020 Diploma in Mechanical Engineering  
Subject Code : 4020651  
Semester : VI  
Subject Title : Industrial Robotics and 3D Printing Practical

**TEACHING AND SCHEME OF EXAMINATION**

No of weeks per semester: 16 weeks

Subject	Instructions		Examination			
	Hours / Week	Hours / Semester	Marks			Duration
Internal Assessment			Board Examinations	Total		
4020651 Industrial Robotics and 3D Printing 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.

**Objectives**

- Study of Robot / Study of robot simulation software
- To study the components required.
- To study the techniques of programming for various industrial manufacturing applications.
- Prepare a record of work done.
- Acquire knowledge in the field of Additive Manufacturing
- Explain the various concepts of Solid Modelling
- Create STL files to manufacture components using 3D Printer

**4020651 INDUSTRIAL ROBOTICS AND 3D PRINTING PRACTICAL  
DETAILED SYLLABUS**

Contents:

3D Printing : Getting to know the User Interface of the Modelling software – Home Screen – Navigating the main Screen – Options Bar – Application Menu & Quick Access Toolbar – Describe the function of a sketch - Describe the various types of sketches. Create sketches of 3D models. Basic Modelling Considerations – Describe part creation within the design process. Add placed features to existing parts. Create complex shapes by sweeping or lofting profiles. Assemblies - Managing the assemblies - Assemble a mechanical piece of equipment using constraints. STL files – introduction – conversion of parts from other file formats to STL file – Additive Manufacturing – types of 3D Printers – orientation and positioning of parts - producing 3D working models using 3D Printers.

**Exercises**

**PART A - Robot Programming**

1. Position recording using Cartesian co-ordinate system - (No. of positions - 9)
2. Position recording using Polar co-ordinate system - (No. of positions - 9)
3. Pick and place the objects - No. of objects - 6)
4. Pick and stack the objects - (No. of objects - 6)
5. Spray painting practice - (Area - 300mm x 300mm)
6. Spot welding practice - (No. of spots - 9)
7. Arc welding practice – (Length of weld 50 mm)
8. Assembling practice - (Minimum 3 Components)
9. Profile cutting practice - (Complicated profile – combination of lines and arcs)

**PART B - 3D Printing**

1. Create the model and produce the Gear Train in 3D printing.
2. Create the model and produce the Geneva Gear & Ratchet mechanism.

3. Create the model and produce the Slide-crank mechanism.

**Note:** Every student is asked to design and produce only one component of an assembly. After the completion of the product, individual parts are checked for its precision and matting in the assembly. Hence group exercises can be given. The models can be scaled according to the print area of the 3D Printer.

### Board Examination

Note: All the exercises should be completed All the exercises should be given for examination, the students are permitted to select by lot or the question paper from DOTE should be followed. Record note book should be submitted during examination.

Two exercises will be given for examination by selecting one exercise in each PART.

### DETAILED ALLOCATION OF MARKS

SI. No.	Performance Indicator	Marks
Part A – Robot Programming		
1	Robot Program	20
2	Simulate / Execution	30
3	Result	10
Part B – 3D Prinitng		
4	CAD - Modelling	15
5	3D Printing	15
6	Viva voce	10
Total		100

### LIST OF EQUIPMENTS

**(To accommodate a batch of 30 students in Practice / Board Examinations)**

Personal computer : 10 Nos.  
 6 Axis Robot : 1 No.  
 3D Printer : 1 No.  
 Software : GUI System Software  
                   : Modelling package / 3D Printer  
                   Sufficient to the strength.

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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 : 1020 Diploma in Mechanical Engineering  
Subject Code : 4020652  
Semester : VI  
Subject Title : Refrigeration and Air-Conditioning Practical

**TEACHING AND SCHEME OF EXAMINATION**

No of weeks per semester: 16 weeks

Subject	Instructions		Examination			Duration
	Hours / Week	Hours / Semester	Marks			
Internal Assessment			Board Examinations	Total		
4020652 Refrigeration and Air-Conditioning 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.

**OBJECTIVES:**

- Identify the various tools used in R & AC
- Demonstrate the construction and working of window air conditioner
- Demonstrate the construction and working of split type air conditioner
- Set parameters for comfortable operation of an air conditioner.
- Determine the C.O.P of air conditioner.
- Determine the capacity of window air conditioner.
- Describe the wiring of refrigerator and coolers.
- Perform servicing on air conditioner.

**Experiments:**

**PART A**

1. Determine the refrigerating effect, C.O.P and the compressor capacity of a open type system with any one expansion device. (Thermostatic expansion valve / Capillary tube / Automatic Expansion Valve)
2. Determine the C.O.P of sealed system by using electrical measurements.
3. Determine the capacity of a window air conditioner.
4. Determine the efficiency of a cooling tower.
5. Conduct Leak tests in a split air conditioning system, detect the failures and suggest the remedies. Conduct the Refrigerant Charge Test.
6. Conduct the flush test to remove the contaminants of refrigeration system and recharge.

**PART- B**

1. Study the various sizes of copper and steel tubing. To study the various tools used for operations.
2. Study and carry out the various operations on copper and steel tubing— Flaring, Swaging and Soldering methods used in R& A.C.
3. Study the methods to set and adjust the following a) Thermostats, b) Low pressure and high pressure cut-outs c) Thermostatic expansion valve d) Automatic Expansion Valve.
4. Conduct the service to change refrigerant into service cylinder from storage cylinder.
5. Conduct the service to pump down the system and to purge air from the system.
6. Conduct the service to check the oil level in the compressor and trace the common faults in R & A.C units and their remedies.



**BOARD EXAMINATION**

Note:

1. All the experiments in both sections should be completed. Two experiments will be given for examination by selecting one from PART A and one from PART B.
2. All the 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.
3. All regular students appearing for first attempt should submit record notebook for the examination.
4. The external examiner should verify the availability of the facility for the batch strength before commencement of practical examination.
5. The external examiner should verify the working condition of machinery's / equipment before commencement of practical examination.

**Detailed Allocation of Marks**

PART A

Procedure	-	10
Formulae / Observation	-	20
Calculation / Result	-	20

PART B

Description / Procedure	-	15
Tool handling	-	15
Conclusion / Report	-	10

Viva voce - 10

TOTAL - 100

**LIST OF EQUIPMENTS**

(To accommodate a batch of 30 students in Practice / Board Examinations)

**WORKING MODELS OF THE FOLLOWING WITH ARRANGEMENTS FOR CONDUCTING TESTS**

1. Refrigerator with test rig
2. Water cooler
3. Window A/C with test rig
4. Split A/C
5. Cooling tower

**WORKING MODEL OF THE FOLLOWING TO CONDUCT EXPERIMENTS**

1. Thermostat units
2. Cut off units
3. Thermostatic expansion valve unit
4. Automatic expansion valve unit
5. Sealed compressor with experimental setup

**TOOLS:**

1. Mechanics tool set
2. Tube cutter
3. Tube bender type
4. Tube bender spring
5. Swaging tool
6. Flaring block
7. Flaring nut
8. Pinching tool
9. Capillary tube testing gauge
10. Blow Lamp

**SERVICE TOOLS:**

1. Gas cylinder with receiver valve and key
2. Charging System
3. Blow lamp
4. Stem key
5. Spring remover
6. Service valve
7. 't' connector
8. High pressure gauge
9. Compound gauge
10. Leak detector
11. Soldering and Brazing kit.

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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 : 1020 Diploma in Mechanical Engineering  
Subject Code : 4020653  
Semester : VI  
Subject Title : Automobile Technology Practical

**TEACHING AND SCHEME OF EXAMINATION**

No of weeks per semester: 16 weeks

Subject	Instructions		Examination			
	Hours / Week	Hours / Semester	Marks			Duration
Internal Assessment			Board Examinations	Total		
4020653 Automobile Technology 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.

**OBJECTIVES:**

- Identify the various tools and their applications used in Automobile.
- Dismantle and assemble parts of petrol engine.
- Dismantle and assemble parts of diesel engine.
- Service AC fuel pump, oil pump and water pump.
- Dismantle and assemble fuel injection pump..
- Dismantle and assemble steering gear box.
- Testing and charging of batteries.
- Overhauling of starter motor, alternator.
- Troubleshoot the electrical circuits in automobile.

## Exercises

### PART-A

1. Dismantling and assembling of four stroke petrol engine and identification of parts.
2. Removing camshaft, replacing timing gears, removing valves, lapping and adjusting valve clearance.
3. Removing, servicing and replacing of fuel pump, oil pump & water pump.
4. Removing, servicing & replacing MPFI system.
5. Dismantling and assembling of inline fuel injection pump / CRDI system.
6. Test a battery with specific gravity test and charge the battery with constant amperage / voltage method.

### PART-B

1. Removing and replacing of pressure plate and clutch plate, fingers adjustment
2. Dismantling, inspecting and assembling of constant mesh gear box and find out the gear ratios.
3. Dismantling, assembling and adjusting of steering gear box.
4. Dismantling, overhauling and assembling of starter motor / alternator
5. Trace the automobile electrical system with respect to battery coil ignition system
6. Trace the automobile electrical system with respect to (i) horn relay circuit, (ii) Wiper circuit & explain with neat circuit diagram.

**BOARD EXAMINATION**

Note:

1. All the exercises in both sections should be completed. Two exercises will be given for examination by selecting one from PART A and one from PART B.
2. 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.
3. All regular students appearing for first attempt should submit record notebook for the examination.
4. The external examiner should verify the availability of the facility for the batch strength before commencement of practical examination.
5. The external examiner should verify the working condition of machinery's / equipment before commencement of practical examination.

**Detailed Allocation of Marks**

PART A

Dismantling Procedure	-	20
Tools handling methods	-	15
Assembly / Report	-	10

PART B

Dismantling Procedure	-	20
Tools handling methods	-	15
Assembly / Report	-	10
Viva voce	-	10
TOTAL	-	100

**LIST OF EQUIPMENTS**

**(To accommodate a batch of 30 students in Practice / Board Examinations)**

1. Automobile Mechanic's tools-Complete Set
2. Internal circlip plier, bearing puller
3. Feeler gauge to check valve clearance, hammer and accessories
4. Compressor to supply high pressure air to clean oil and water filters.
5. 4 stroke petrol engine - with all accessories
6. 4 stroke Diesel engine - with all accessories
7. Engine cylinder with liner and cylinder bore dial gauge
8. Oil pump and water pump.
9. MPFI.
10. Inline Fuel Injection Pump
11. CRDI
12. Injectors.
13. Clutch set arrangement with tools
14. Complete gear box with tools
15. Complete steering arrangement
16. Battery and charging set up.
17. Measuring instruments
18. Consumables

**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 : 1020 Diploma in Mechanical Engineering  
Subject Code : 4020660  
Semester : VI  
Subject Title : Project Work and Internship

**TEACHING AND SCHEME OF EXAMINATION**

No of weeks per semester: 16 weeks

Subject	Instructions		Examination			
	Hours / Week	Hours / Semester	Marks			Duration
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 build 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 and Internship:**

Project Review I	...	<b>10 marks</b>
Project Review II	...	<b>10 marks</b>
Attendance	...	<b>05 marks</b> (Award of marks same as theory subject pattern)
<b>Total</b>	...	<b>25 marks</b>

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 and Internship in Board Examinations:**

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

\*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 and Internship Board examination.**

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**SANDWICH DIPLOMA COURSE - INDUSTRIAL TRAINING**

**4020480** Industrial Training I

**4020720** Industrial Training II

**1. Introduction**

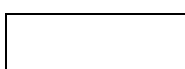
The main objective of the sandwich Diploma course is to mould a well-rounded technician acclimated with industrial environment while being a student in the institution.

The Sandwich Diploma Course study is pursued by students, in 7 Semesters of 3 ½ years duration, the subjects of 3years-Full Time Diploma Course being regrouped for academic convenience.

While in the 4<sup>th</sup> semester students under Industrial Training for 6 months (December through May). They also do course work in the institution for one day in a week, While in the 7<sup>th</sup> semester they undergo another spell of 6 months (June through November) Industrial training.

The Apprenticeship (Amendment) Act 1973 is followed in regulating the Industrial training procedure for Sandwich Course.

I SEM	II SEM	III SEM	IV SEM	V SEM	VI SEM	VII SEM
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Institutional Training



Industrial Training

**2. Attendance Certification**

Every month students have to get their attendance certified by industrial supervisor in the prescribed form supplied to them. Students have also to put their signature on the form and submit it to the institution supervisor. Regularity in attendance and submission of report will be duly considered while awarding the Internal Assessment mark.

### 3. Training Reports

The students have to prepare two types of reports:

- Weekly report in the form of diary to be submitted to the concerned staff in-charge of the institution. This will be reviewed while awarding Internal Assessment marks.
- Comprehensive report at the end of each spell which will be used for Board Examination.

#### 3.1 Industrial Training Diary

Students are required to maintain the record of day-to-day work done. Such record is called Industrial training Diary. Students have to write this report regularly. All days for the week should be accounted for clearly giving attendance particulars (Presence, absence, Leave, Holidays etc.). The concern Industrial supervisor is to check periodically these progress reports.

#### 3.2 Comprehensive Training Report

In addition to the diary, students are required to submit a comprehensive report on training with details of the organisation where the training was undergone after attestation by the supervisors. The comprehensive report should be incorporating study of plant/product/process/construction along with intensive in-depth study on any one of the topics such as processes, methods, tooling, construction and equipment, highlighting aspects of quality, productivity and system. The comprehensive report should be completed in the last week of Industrial training. Any data, drawings etc. should be incorporated with the consent of the Organisation.

#### a. Scheme of Evaluation

##### 1.1 Internal Assessment Marks

First Review (during 3 <sup>rd</sup> month)	: 10 marks
Second Review (during 5 <sup>th</sup> month)	: 10 marks
Attendance *	: 05 marks
	(Awarded same as in Theory)
Total	: 25 marks

1.2 Board Examination

Presentation about Industrial Training	: 20 marks
Comprehensive Training Report	: 30 marks
Viva-voce	: 25 marks
Total	: 75 marks

**\* For awarding marks to attendance, the Industrial Training attendance has to be considered.**

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