TAMILNADU GOVERNMENT POLYTECHNIC COLLEGE, (Autonomous), MADURAI- 11

N - 20 SCHEME

DIPLOMA IN MECHANICAL ENGINEERING

(Implemented from the Academic Year 2021 – 2022 onwards)

V Semester

Subject Code	SUBJECT	Marks			Minimum marks for pass	Duration of ExamHours
		Internal Assessment	* End Semester Examination	Total		
4020510	Design of Machine Elements	25	100	100	40	3
4020520	Thermal Engineering – II	25	100	100	40	3
ELECTIVE – I THEORY						
4020531	Computer Integrated Manufacturing	25	100	100	40	3
4020532	Green Energy and Energy Conservation	25	100	100		
4020533	Mechatronics	25	100	100		
4020540	Process Automation Practical	25	100	100	50	3
4020550	Thermal Engineering Practical	25	100	100	50	3
ELECTIVE – I PRACTICAL						
4020561	Computer Integrated Manufacturing Practical	25	100	100	50	3
4020562	Green Energy and Energy Conservation Practical	25	100	100		
4020563	Mechatronics Practical	25	100	100		
4020570	Entrepreneurship & Startup #	25	100	100	50	3

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

TAMILNADU GOVERNMENT POLYTECHNIC COLLEGE, (Autonomous), MADURAI- 11

N - 20 SCHEME

DIPLOMA IN MECHANICAL ENGINEERING (PART TIME)

(Implemented from the Academic Year 2021 – 2022 onwards)

FIFTH SEMESTER

Subject Code	Subject	HOURS PER WEEK			
		Theory	Tutorial/ Drawing	Practical	Total
4020410	Fluid Mechanics and Fluid Power	4	-	-	4
4020510	Design of Machine Elements	4	-	-	4
4020620	E Vehicle Technology & Policy	3	-	-	3
4020350	Machine Drawing and CAD Practical	-	2	2	4
4020450	Strength of Materials and Fluid Mechanics Practical	-	-	3	3
TOTAL		**11**	**2**	**5**	**18**

TAMILNADU GOVERNMENT POLYTECHNIC COLLEGE, (Autonomous), MADURAI- 11

N - 20 SCHEME
DIPLOMA IN MECHANICAL ENGINEERING (SANDWICH)
(Implemented from the Academic Year 2021 – 2022 onwards)

FIFTH SEMESTER

Subject Code	SUBJECT	HOURS PER WEEK			
		Theory hours	Drawing hours	Practical hours	Total hours
4020410	Fluid Mechanics and Fluid Power	5	-	-	5
4020430	Electrical Drives and Controls	5	-	-	5
4020520	Thermal Engineering – II	5	-	-	5
Elective I Theory					
4020531	Computer Integrated Manufacturing	5	-	-	5
4020532	Green Energy and Energy Conservation	5	-	-	
4020533	Mechatronics	5	-	-	
4020450	Strength of Materials and Fluid Mechanics Practical	-	-	3	3
4020470	Electrical Drives and Control Practical	-	-	3	3
4020550	Thermal Engineering Practical	-	-	3	3
Elective I Practical					
4020561	Computer Integrated Manufacturing Practical	-	-	3	3
4020562	Green Energy and Energy Conservation Practical	-	-	3	
4020563	Mechatronics Practical	-	-	3	
		20	-	12	32
Extra / Co-Curricular activities					
Library		-	-	-	1
Physical Education		-	-	-	2
TOTAL					**35**

TAMILNADU GOVERNMENT POLYTECHNIC COLLEGE, (Autonomous), MADURAI- 11

N - 20 SCHEME

DIPLOMA IN MECHANICAL ENGINEERING

(Implemented from the Academic Year 2021 – 2022 onwards)

Course Name : 1020 Diploma in Mechanical Engineering

Subject Code : 4020510

Semester : V

Subject Title : Design of Machine Elements

TEACHING AND SCHEME OF EXAMINATION

No of weeks per semester: 16 weeks

Subject	Instructions		Examination			
4020510 Design of Machine Elements	Hours / Week	Hours / Semester	Marks			Duration
			Internal Assessment	End Semester Examinations	Total	
	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	Engineering Materials and Joints	18
II	Design Of Shafts, keys and Couplings	18
III	Design of Flat Belts and V-Belts	18
IV	Design of Bearings & Spur Gears	18
V	Computer Aided Design (CAD) and Geometrical Modelling	17
Test and Model Exam		7
Total		**96**

RATIONALE:

The main objective of Machine Design is to create new and better machine components to improve the existing one. A mechanical engineer should have thorough knowledge of design of machine elements to avoid the failure of machines or components.

OBJECTIVES:

- Design sleeve and cotter joint, knuckle joint and Welded joints
- Design shafts, keys and couplings required for power transmission.
- Compare the different types of couplings.
- Design flat and V-belt for power transmission.
- Study the various types of bearings and their applications.
- Design journal bearings.
- Design Spur gear.
- Role of CAD in design and analysis.

4020510 DESIGN OF MACHINE ELEMENTS

DETAILED SYLLABUS

Contents: Theory

Unit	Name of the Topics	Hours
I	**Engineering Materials and Joints** **Chapter: 1.1:** General Considerations in Machine Design. Engineering materials - Factors affecting selection of material – BIS designation of Ferrous materials – Preferred number - Factor of safety and allowable stress – Stresses: Tension, Compression, Shear, Bearing pressure Intensity, Crushing, bending and torsion - problem. Creep strain and Creep Curve- Fatigue, S-N curve, Endurance Limit - Stress Concentration – Causes & Remedies. Theories of Elastic Failures – Principal normal stress theory, Maximum shear stress theory & maximum distortion energy theory. **Chapter: 1.2:**	10 8

	Joints: Design of sleeve and cotter joint, knuckle joint and welded joint.	
II	**Design Of Shafts, Keys and Couplings** **Chapter: 2.1:** **Shafts:** Design of shafts subjected to – twisting moment – bending moment – combined twisting and bending moments – fluctuating loads – design of shafts based on rigidity. **Chapter: 2.2:** **Keys:** Types of keys - design of sunk keys only - Effect of keyways on shaft - problems. **Couplings:** Requirements of good couplings – types - design of - rigid protected type flange couplings - marine couplings – pin type flexible coupling (Description only).	9 9
III	**Design of Flat Belts and V-Belts:** **Chapter: 3.1:** **Flat Belts:** Types of belts - materials for belt –- types of belt drives – Speed ratio – effect of slip - length of flat belts –Tension Ratio $T1/T2=e^{\mu\theta}$ – centrifugal tension - power transmitted – condition for maximum power - transmission – Initial Tension - problems - design procedure of flat belts - design of flat belt based on manufacturer's data only – problems. **Chapter: 3.2:** V-belt drive - comparison with flat belt drive - designation of V-belts – length of belt - power transmitted – Design of V-belt using manufacturer's data only – Problem.	9 9
IV	**Design of Bearings & Spur Gears** **Chapter: 4.1:** **Bearings:** Classifications of bearings – sliding contact and rolling contact bearings - radial and thrust bearings - roller bearing – types - Designation of ball bearings - materials used for bearings - journal bearings - heat generated - heat dissipated - cooling oil requirement – problems - design of journal bearings – Problems. (Design based on approved data books only.).	10

	Chapter: 4.2: **Spur Gears:** Gear drives - Types of gears - applications - materials - spur gear terminology - design of spur gear based on Lewis and Buckingham equation (design procedure only) - speed reducer – types.	8
V	**Computer Aided Design (CAD) and Geometric Modelling** **Chapter: 5.1:** CAD – Roles of CAD in design – Development and uses - Applications – Advantages – Product cycle – Design process: Shigley Model - Pahl and Beitz Model – Sequential Engineering – Concurrent Engineering – 2D and 3D Transformation. **Chapter: 5.2:** Geometric Modelling: Solid modelling – entities – advantages and disadvantages – Boolean operations - Boundary representation – Constructive Solid Geometry – Comparison – Finite Element analysis – Steps.	9 8

Reference Book:

- Machine Design, Pandya & Shah, Edn. 1995, Charotar Publishing House.
- Machine Design, T. V. Sundararajamoorthy & N. Shanmugam, Revised Edition June-2003-Anuradha Publications.
- Design Data Book – by PSG College of Technology, DPV Printers.
- A text book of Machine Design, R.S. Khurmi & J.K.Gupta, Edn. 18,Eurosia Publishing House Pvt. Limited.
- Machine Design, Bandari,
- Theory and Problems of Machine Design, Holowenko, Laughlin, Schaum's outline series.
- R.Radhakrishnan, and S.Subramanian, "CAD/CAM/CIM", New Age International Pvt Limited.

TAMILNADU GOVERNMENT POLYTECHNIC COLLEGE, (Autonomous), MADURAI- 11

N - 20 SCHEME

DIPLOMA IN MECHANICAL ENGINEERING

(Implemented from the Academic Year 2021 – 2022 onwards)

Course Name : 1020 Diploma in Mechanical Engineering
Subject Code : 4020520
Semester : V
Subject Title : Thermal Engineering - II

TEACHING AND SCHEME OF EXAMINATION

No of weeks per semester: 16 weeks

Subject	Instructions		Examination			
			Marks			Duration
	Hours / Week	Hours / Semester	Internal Assessment	End Semester Examinations	Total	
4020520 Thermal Engineering - II	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	Formation and Properties of Steam & Thermodynamic Processes of Vapour	15
II	Steam Boilers and Performance Of Boiler	15
III	Thermal Power Plant and Steam Turbines and Condensers	15
IV	Conventional Sources of Energy and Nuclear Power Plant	13
V	Air Compressors and Gas Turbines	15
Test and Model Exam		7
Total		**80**

RATIONALE:

This subject is one of the core subjects. Diploma engineers have to work with various power producing and power absorbing devices. This subject will enable students to establish foundation required to operate and maintain the devices. This subject emphasizes on steam boilers and allied components that are used in industrial sectors. Thermal power plants are still contributing major share in electricity production in India.

OBJECTIVES:

- Define various types of steam.
- Explain the working of Boiler.
- Compare various types of Boilers.
- Familiarize boiler mounting and accessories.
- Describe various circuits used in the thermal power plant.
- Explain working of steam turbine and condensers.
- Compare conventional energy sources with Non-Conventional Sources of energy.
- Explain working of nuclear power plant.

4020520 THERMAL ENGINEERING - II

DETAILED SYLLABUS

Contents: Theory

Unit	Name of the Topic	Hours
I	**Formation and Properties of Steam & Thermodynamic Processes of Vapour** Steam - Properties – formation of steam– saturation temperature – enthalpy of water – enthalpy of evaporation – conditions of steam – wet, dry and superheated steam - dryness fraction – enthalpy of wet, dry and superheated steam - advantages of superheated steam - Property diagrams – p-v diagram - T-H	10

	diagram – T-V diagram – T-S diagram - phase diagram-H-S diagram – P-H diagram – critical conditions of water – specific volume of water and steam – density of steam – external work done during evaporation – internal latent heat – internal energy of steam – entropy of water and steam – steam tables - Mollier chart – Description only. Determination of dryness fraction of steam – bucket calorimeter - combined separating and throttling calorimeters - problems. Expansion processes of steam - constant volume, constant pressure, constant temperature, hyperbolic, polytrophic, isentropic and throttling processes – problems.	5
II	**Steam Boilers And Performance Of Boilers** Introduction -Classification of boilers – comparison of fire tube and water tube boilers– high pressure boilers – advantages of high pressure boilers - BHEL high pressure boilers – boiler mountings and function- construction and working – boiler accessories and function - construction and working – comparison of mountings and accessories – feed water treatment – internal and external treatments - starting boiler from cold condition – safety precautions in boiler operation – clauses of Indian boiler act. Evaporation rate - actual, equivalent and factor of evaporation – boiler efficiency – factors influencing boiler efficiency - boiler power - problems – boiler plant - efficiency of economizer and super heater - problems – boiler trial – heat losses in a boiler- heat balance sheet – problems.	10 5

III	**Thermal Power Plant And Steam Turbines and condensers** Selection of site for thermal power plant -Layout of thermal power plant – fuel and ash circuit – water and steam circuit – air and flue gas circuit – cooling water circuit – merits and demerits of thermal power plant — air pollution by thermal power plants – pollutants, effects and control – cyclone separator – wet scrubber – electrostatic precipitator – control of No_2 and SO_2.fiudised bed combustion- thermal and noise pollution. Basic steam power cycles – Carnot, Rankine and modified Rankine cycles. Classification of steam turbine-Impulse and reaction turbines- Difference - necessity of compounding – Methods of compounding – special turbines. Steam condensers – elements of condensing plant – classification of condensers – jet condenser – surface condensers – Comparison of jet and surface condensers – sources of air in condenser – condenser vacuum – vacuum efficiency – condenser efficiency - mass of cooling water required – mass of air present – number of tubes – simple problems.	5 5 5
IV	**Conventional Sources Of Energy And Nuclear Power Plant** Conventional sources of energy – layout of hydel and diesel power plants – merits and demerits. Nuclear fuels –fissile and fertile fuels – Nuclear fission and fusion – chain reaction – radio activity – layout of nuclear power plant – merits and demerits – Nuclear reactors -Components–Reactor Core -moderators – control rods – coolant – reflectors – biological shield-Reactor Vessels-Classification of Reactor- pressurized water reactor – boiling water reactor – Candu type reactor – fast breeder reactor — effect of nuclear radiation – Fuel Cycle –Site selection – Safety-Floating Nuclear Power Plants-Uranium Enrichment – Methods-disposal of nuclear wastes- comparison of nuclear power plants with thermal power plants- Nuclear Power Plant in India.	3 12

V	**Air Compressors And Gas Turbines** Air Compressors-uses of compressed air – classifications of Air compressor – reciprocating compressor - single stage reciprocating compressor – compression processes – power required to drive the compressor (Neglecting clearance Volume) – clearance volume and its effects – volumetric efficiency –power required to drive the compressor with clearance volume – problems – multi stage compression – merits and demerits - work input – ratio of cylinder diameters for minimum work input. Rotary compressors – Roots blower - vane blowers – centrifugal and axial flow air compressors. Gas turbines – uses - classifications – merits and demerits of gas turbines -constant pressure combustion gas turbine – gas turbine with – intercooler –reheater - regenerator -effects – closed cycle gas turbines - merits and demerits of open and closed cycle gas turbines Jet propulsion -turbojet engines– merits and demerits – turbo propeller engines – merits and demerits – ramjet – merits and demerits – Rocket engines – solid propellant rocket -applications of rockets.	6 5 4

Reference Books:

1. Thermal Engg, R.K . Rajput , ,8th Edition, Laxmi publications Pvt Ltd , New Delhi.
2. Applied Thermodynamics, P.K. Nag, ,2nd Edition, TATA Mcgraw – Hill Publishing Company, New Delhi .
3. Thermal Engineering, R.S. Khurmi and J.K. Gupta, 18th Edition,S.Chand & Co,NewDelhi
4. Thermal Engineering ,P.L Ballaney , 24th Edition ,Khanna Publishers,New Delhi.
5. Thermal Engineering ,B.K. Sarkar , 3rd Edition , Dhanpat Rai & Sons New Delhi .
6. Applied Thermodynamics, Domkundwar and C.PKothandaraman, 2ndEdition Khanna publishers, New Delhi.

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TAMILNADU GOVERNMENT POLYTECHNIC COLLEGE, (Autonomous), MADURAI- 11

N - 20 SCHEME

DIPLOMA IN MECHANICAL ENGINEERING

(Implemented from the Academic Year 2021 – 2022 onwards)

Course Name : 1020 Diploma in Mechanical Engineering
Subject Code : 4020531
Semester : V
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	End Semester 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 CAD/CAM.	**3**

	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 – welding - spray coating - assembly and inspection.	**5** **3** **6**

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.

TAMILNADU GOVERNMENT POLYTECHNIC COLLEGE, (Autonomous), MADURAI- 11

N - 20 SCHEME

DIPLOMA IN MECHANICAL ENGINEERING

(Implemented from the Academic Year 2021 – 2022 onwards)

Course Name : 1020 Diploma in Mechanical Engineering

Subject Code : 4020532

Semester : V

Subject Title : Green Energy and Energy Conservation

TEACHING AND SCHEME OF EXAMINATION

No of weeks per semester: 16 weeks

Subject	Instructions		Examination			
			Marks			Duration
4020532 Green Energy and Energy Conservation	Hours / Week	Hours / Semester	Internal Assessment	End Semester Examinations	Total	
	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 Energy, Geothermal energy, Wind energy	15
II	Bio mass energy, Solar Energy	15
III	Photovotaic (PV)	15
IV	PV Technologies, Applications	14
V	Energy conservation	14
Test and Model Exam		7
Total		**80**

RATIONALE:

There is an ever increasing demand for energy in spite of the rising prices of oil & other fossil fuel / depletion of fossil fuels. Energy demand, in particular electricity production has resulted in creation of fossil fuel based power plants that let out substantial greenhouse gas / carbon emission into the atmosphere causing climate change and global warming. We have various forms of renewable energy sources viz., Wind, Solar, Biomass, Biogas, etc. Municipal and Industrial wastes could also be useful sources of energy while ensuring safe disposal. This subject is introduced to learn about the major renewable energy sources and more focus on the PV module solar energy. The government act and guidelines are discussed for the benefit of the Diploma Engineers.

OBJECTIVES:

1. Study about the fundamentals of Energy.
2. Study of construction and principle of Wind energy, Solar energy, Geo thermal and Bio energy.
3. Understand the solar energy.
4. Understand the PV design and its components.
5. Study the energy conservation process.
6. Understand the Government Policies and Acts.
7. Study the TEDA projects in Tamil Nadu.

4020532 GREEN ENERGY AND ENERGY CONSERVATION

DETAILED SYLLABUS

Contents: Theory

UNIT	Name of the Topics	Hrs.
I	**Fundamentals of Energy, Geothermal energy, Wind energy Energy:** Introduction – Energy need and trends - Forms of Energy – First Law of Thermodynamics - Second Law of Thermodynamics – energy requirement and supply – Fossil fuels and climate changes – need of renewable energy sources – Current renewable energy uses – Renewable energy policies in India.	5
	Geothermal energy: Introduction – Essential characteristic –	4

	Sources – Power Plants – Single flash power plant – double flash power plant – Flow diagram and principle only. **Wind energy:** Introduction – energy conversion – site selection considerations – Components of wind energy conversion system – Classification. Wind mill: Horizontal axis machines - Vertical axis machines – working principle, advantages and disadvantages. Schemes for electric generation.	6
II	**Bio mass energy, Solar Energy** **Bio mass energy:** Introduction – conversion technologies: Wet processes – dry processes. Bio gas generation – factors affecting the bio gas generation – classification of bio gas plants – Bio gas plant – construction - advantages and disadvantages. Materials used for bio gas generation – factors to be considered for the selection of site. **Solar Energy:** Introduction – Sun's energy: advantages – conversion challenges– The Sun-Earth movement - Solar radiation - Different angles - optimal angle for fixed collector, in summer and winter. Sun tracking - measuring instruments of solar radiation – methods to estimate solar radiation.	7 8
III	**Photovotaic (PV)** Photovotaic (PV): Semiconductors as solar cell – types of unit cells - electronic arrangement of silicon atom – intrinsic semiconductor – extrinsic semiconductor – Description only. P-N junction diode - forward bias - reverse bias. Solar cell - characteristics - description of short circuit current, open circuit voltage, fill factor and efficiency - losses in solar cells. Growth of solar PV and silicon (Si) requirement – production of metallurgical grade (MGS) – production of electronic grade (EGS) – Production of Si wafers: ingot making - monocrystalline - multicrystalline – wafer dicing. Si sheets. Solar grade silicon (SoG) – refining processes – Si usage in Solar PV. Process flow of commercial Si cell technology – Description of saw damage removal and surface texturing, diffusion process, thin-film layers for	6 9

	anti reflection coating and surface passivation, metal contacts and their deposition.	
IV	**PV Technologies, Applications** PV Technologies: Thin film Technologies – materials for thin film technologies – Thin film deposition techniques: Physical vapour deposition – Evaporation – Sputtering. Chemical vapour deposition – Low pressure – plasma enhanced. Advantages of thin film Si solar cell technologies. Solar cell structures – substrate arrangement – superstrate arrangement. Solar PV module: series and parallel connections of cells – mismatch in cell / module- Design and structure of PV module. Batteries for PV systems – factors affecting battery performance – DC to DC converters – Charge controllers – DC to AC converter (inverter) (Description only). Applications: Flat plate collector - concentrating solar collectors – solar pond – solar water heating – space heating and cooling – solar pumping – solar cooking – solar green house. principle and applications only.	6 3 5
V	**Energy conservation** Energy conservation act 2001 - Power of state government to facilitate and enforce efficient use of energy and its conservation - Finance, Accounts and Audit of bureau - Penalties and Adjudication – Appellate tribunal for energy conservation – Energy Conservation Guidelines for Industries by BEE, Govt of India - Guide lines – heating, cooling and heat transfer – waste recovery and usage – conversion of heat to electricity – Prevention of energy loss due to heat radiation and electric resistance – Industry energy management system. Net-metering policies – Tamil Nadu Energy Development Agencies – Projects in Tami Nadu: Solar energy, Bio energy and Wind energy – Tamil Nadu Solar policy 2019.	14

Reference Books

1. Non Conventional Energy Sources, G.D.Rai, Khanna Publishers.
2. Non Conventional Energy Sources and Utilisation, R.K.Rajput, S.Chand & Company Ltd.
3. Renewable Energy, Stephen Peake, Oxford press
4. Non Conventional Energy Resources, B.H.Khan, Tata Mc Graw Hill.
5. Industrial energyconservation- D. A. Ray- Pergaman Press
6. Energy resource management, Kirpal Singh Jogi, Sarup and sons.
7. Solar Photovltaics, Chetan Singh Solanki, PHI Learning Pvt. Ltd.
8. Renewable Energy Engineering and Technology, V V N Kishore, TERI.
9. Principles of Solar Engineering, D.Yogi Goswami, Frank Kreith, Jan F.Kreider, Taylor & Francis.
10. Energy conservation act 2001, Government of India.
11. Energy Conservation Guidelines for Industries, Bureau of energy Efficiency, Ministry of Power, Government of India.
12. Tamil Nadu Solar policy 2019

13) https://teda.in/achievements/solar-energy-4/

14) https://teda.in/achievements/bio-energy-2/

15) https://teda.in/achievements/wind-energy-2/

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TAMILNADU GOVERNMENT POLYTECHNIC COLLEGE, (Autonomous), MADURAI- 11

N - 20 SCHEME

DIPLOMA IN MECHANICAL ENGINEERING

(Implemented from the Academic Year 2021 – 2022 onwards)

Course Name : 1020 Diploma in Mechanical Engineering

Subject Code : 4020533

Semester : V

Subject Title : Mechatronics

TEACHING AND SCHEME OF EXAMINATION

No of weeks per semester: 16 weeks

Subject	Instructions		Examination			
			Marks			Duration
	Hours / Week	Hours / Semester	Internal Assessment	End Semester Examinations	Total	
4020533 Mechatronics	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	Introduction, Sensors & Transducers	15
II	Actuation systems	14
III	Basic system models, Input / Output systems	14
IV	Programmable Logic Controller	14
V	Design examples & advanced applications In Mechatronics	16
Test and Model Exam		7
Total		**80**

RATIONALE:

As per the latest requirements in the automation industries this enables to learn the various concepts of automation components. They are able to write program, and operate PLCs. They are able to select the electronic components for various industry applications.

OBJECTIVES:

- Explain the working of sensors and transducers
- Acquire knowledge about actuation systems
- Explain the system models and I/O systems
- Write program and operate PLCs
- Explain the applications of mechatronics

4020533 MECHATRONICS

DETAILED SYLLABUS

Contents: Theory

Unit	Name of the Topics	Hours
I	**Introduction, Sensors & Transducers** Introduction – Systems – Measurement Systems – Control Systems – Microprocessor Based Controllers. Examples – Mechatronics approach. Measurement System terminology – Displacement, Position & Proximity Sensors – Velocity and Motion Sensors – Force Sensors – Fluid Pressure Sensors – Flow Sensors – Liquid Level Sensors – Temperature Sensors – Light Sensors – Selection of Sensors – Calibration of sensors.	**15**
II	**Actuation Systems** Mechanical Actuation Systems – Types of motion – Freedom and constraints – Loading – Gear Trains – Pawl & Ratchet – Belt & Chain drive – Bearing – Selection – Ball & Roller bearings – Mechanical aspects of motor selection. Electrical Actuation Systems – Switches & Relays – Solenoids – D.C Motors – A.C. Motors – Stepper Motors – Specification and control of	**7** **7**

	stepper motors – Servomotors: D.C Servomotor and A.C Servomotor. Pneumatic & Hydraulic Systems – Power supplies – DCV – PCV – Cylinders – Rotary actuators.	
III	**Basic System Models, Input/Output Systems** Mathematical Model – Introduction to mathematical model – Mechanical System building blocks – Electrical System building blocks – Fluid System building blocks – Thermal System building blocks. System Model – Engineering Systems – Rotational – Translational Systems – Electro-Mechanical System – Hydro- Mechanical System. Interfacing – Input/Output ports – Interface requirements: Buffers, Handshaking, Polling and interrupts, Serial interfacing – Introduction to PIA – Serial communications interface – Example of interfacing of a seven-segment display with a decoder.	**14**
IV	**Programmable Logic Controller** Definition – Basic block diagram and structure of PLC – Input/Output processing – PLC Programming: Ladder diagram, logic functions, latching and sequencing – PLC mnemonics – Timers, internal relays and counters – Shift registers – Master and jump controls – Data handling – Analog input/output – Selection of PLC – sample ladder programs.	**14**
V	**Design Examples & Advanced Applications In Mechatronics** Design process stages – Traditional Vs Mechatronics designs – Possible design solutions: Timed switch, Wind- screen wiper motion, Bath room scale – Case studies of mechatronics systems: A pick-and-place robot, Car park barrier, Car engine management system, Automatic Camera and Automatic Washing Machine. Sensors for condition monitoring systems of production systems – Examples of monitoring methods: Vibration monitoring, Temperature monitoring, Wear behavior monitoring – Mechatronics control in automated manufacturing: Monitoring of manufacturing processes, On-line quality monitoring, Model-based systems, Hardware-in-the-loop simulation, Supervisory control in manufacturing inspection, Integration of heterogeneous systems.	**16**

REFERENCES BOOKS:

1. W.Bolton, “Mechatronics”, 2nd Edition 2001, Pearson Education, New Delhi.
2. R.K.Rajput, A Text Book of Mechatronics, 1st Edition 2007, S.Chand & Co. Ltd., New Delhi.
3. HMT, “Mechatronics”, 1st Edition 1998, Tata McGraw Hill, New Delhi.
4. Devdas Shetty & Kolk, “Mechatronics System Design”, 1st Reprint, 2001, PWS Publishing Co., Boston.
5. James H.Harter, “Electromechanics”, 1st Edition 2003, Prentice-Hall of India, New Delhi.
6. M.D.Singh & J.G.Joshi, “Mechatronics”, 1st Edition 2006, Prentice-Hall of India, New Delhi.

TAMILNADU GOVERNMENT POLYTECHNIC COLLEGE, (Autonomous), MADURAI- 11

N - 20 SCHEME

DIPLOMA IN MECHANICAL ENGINEERING

(Implemented from the Academic Year 2021 – 2022 onwards)

Course Name : 1020 Diploma in Mechanical Engineering
Subject Code : 4020540
Semester : V
Subject Title : Process Automation Practical

TEACHING AND SCHEME OF EXAMINATION

No of weeks per semester: 16 weeks

Subject	Instructions		Examination			
			Marks			Duration
	Hours / Week	Hours / Semester	Internal Assessment	End Semester Examinations	Total	
4020540 Process Automation 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.

OBJECTIVES:

- Design and operate pneumatic circuits.
- Design and operate fluid power circuits
- Use PLC system and its elements for process control
- Familiarize the working of function blocks in PLC
- Use ON-Delay timer to control a motor
- Use OFF-Delay timer to control a motor
- Use counter function block (Up counter and Down counter)
- Control the automatic operation of pneumatic cylinder using PLC
- Record of work to be prepared.

Exercises

PART A

Pneumatics Lab.

1. Direct operation of single and double acting cylinder.
2. Operation of double acting cylinder with quick exhaust valve.
3. Speed control of double acting cylinder using metering-in and metering-out circuits.
4. Automatic operation of double acting cylinder in single cycle - using limit switch.

Hydraulics Lab.

5. Direct operation of double acting cylinder.
6. Direct operation of hydraulic motor.
7. Speed control of double acting cylinder metering-in and metering-out control.

PART B

PLC Lab.

1. Direct operation of a motor using latching circuit.
2. Operation of a motor using 'AND' logic control.
3. Operation of a motor using 'OR' 'control.
4. On-Delay control of a motor and Off -Delay control of a motor.
5. Automatic operation of a Double acting cylinder-single cycle - forward, time delay, return.
6. Automatic operation of Double acting cylinder-Multi cycle.
7. Sequential operation of double acting cylinder and a motor.

AUTONOMOUS EXAMINATION

Note:

- All the experiments in both sections should be completed. Two experiments will be given for examination by selecting one exercise from PART A and one exercise from PART B.
- 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.
- 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

Part A:		**45**
Procedure / Circuit diagram	10	
Identification of Components	15	
Connection and execution	20	
Part B:		**45**
Procedure / Circuit diagram	10	
Ladder diagram / Programming	25	
Execution	10	
Viva Voce		**10**
Total		**100**

LIST OF EQUIPMENTS (For 30 Students)

1. Pneumatic Trainer Kit – 3 Nos
   (All Cylinders, Control Valves, Limit switches and other accessories)
2. Hydraulics Trainer Kit – 2 No.
   (All Cylinders, Control Valves, Limit switches and other accessories)
3. PLC kit – 3 Nos.
4. Computer with software – 10 Nos.

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TAMILNADU GOVERNMENT POLYTECHNIC COLLEGE, (Autonomous), MADURAI- 11

N - 20 SCHEME

DIPLOMA IN MECHANICAL ENGINEERING

(Implemented from the Academic Year 2021 – 2022 onwards)

Course Name : 1020 Diploma in Mechanical Engineering
Subject Code : 4020550
Semester : V
Subject Title : Thermal 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	End Semester Examinations	Total	
4020550 Thermal Engineering 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.

OBJECTIVES:

- Determine the flash and fire point and viscosity of oil.
- Draw the valve timing diagram of petrol and diesel engines.
- Draw the port timing diagram of petrol and diesel engines.
- Conduct performance test on petrol and diesel engines.
- Prepare heat balance sheet for an IC engine.
- Conduct of C.O.P of Refrigerators.
- Determine the volumetric efficiency of the Air Compressor.

Experiments:

PART - A

1. Determine flash and fire point of the given oil using open cup and closed cup apparatus.
2. Determine the absolute viscosity of the given lubricating oil using Redwood viscometer.
3. Determine the absolute viscosity of the given lubricating oil using Say bolt viscometer.
4. Port timing diagram of two stroke petrol Engine
5. Valve time diagram for four stroke petrol Engine.
6. Valve time diagram for four stroke diesel engines.

PART - B

1. Load test (Performance test) on Four Stroke Petrol Engine.
2. Load test (Performance test) on Four Stroke diesel Engine.
3. Morse test on Multi-cylinder petrol engine.
4. Heat balance test on Four Stroke Diesel / Petrol Engine.
5. Volumetric efficiency of Air Compressor.
6. Determination of COP of Refrigeration System.

AUTONOMOUS EXAMINATION

Note:

- All the experiments in both sections should be completed. Two experiments will be given for examination by selecting one exercise from PART A and one exercise from PART B.
- 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.
- 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

Part A:		**35**
Observation and Tabular Column	5	
Calculations	20	
Result / Graph	10	
Part B:		**55**
Observation and Tabular Column	10	
Formulae, Calculations	30	
Result / Graph	15	
Viva Voce		**10**
Total		**100**

LIST OF EQUIPMENTS (For 30 students)

1. Open cup apparatus - 2 Nos.
2. Close cup apparatus - 2 Nos.
3. Redwood viscometer - 2 Nos.
4. Say bolt viscometer - 2 Nos.
5. Four stroke petrol engine Model - 2 Nos.
6. Four stroke diesel engine Model - 2 Nos.
7. Two stroke petrol engine Model - 2 Nos.
8. Four stroke Petrol Engine Test rig - 1 No.
9. Four stroke Diesel engine Test rig - 1 No.
10. Multi -cylinder petrol engine test rig - 1 No.
11. Air compressor test rig – 1 No.
12. Refrigeration Test rig – 1 No.
13. Measuring instruments - Required quantity
14. Consumables - Required quantity

TAMILNADU GOVERNMENT POLYTECHNIC COLLEGE, (Autonomous), MADURAI- 11

N - 20 SCHEME

DIPLOMA IN MECHANICAL ENGINEERING

(Implemented from the Academic Year 2021 – 2022 onwards)

Course Name : 1020 Diploma in Mechanical Engineering
Subject Code : 4020561
Semester : V
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	End Semester 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.

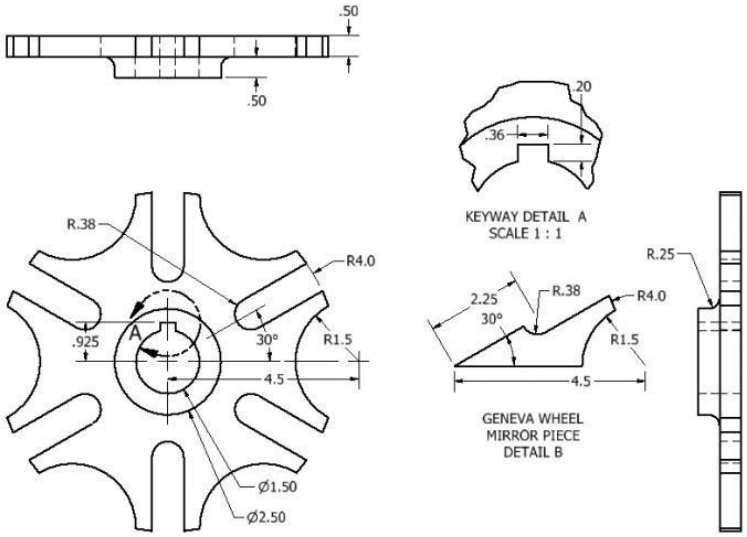
DETAILED SYLLABUS

Contents: Practical

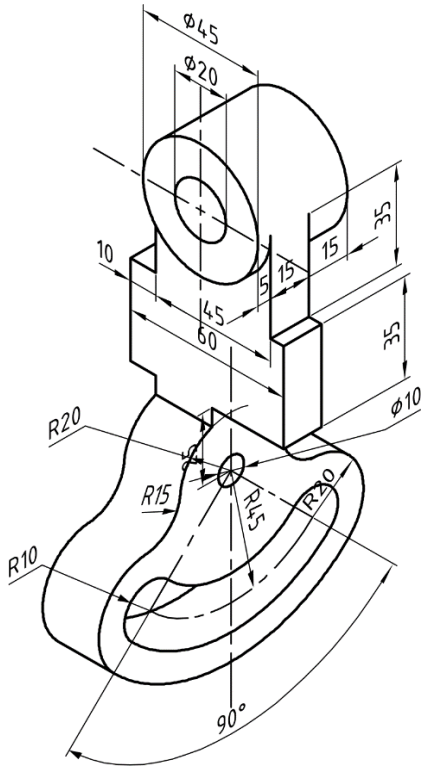
PART A: SOLID MODELLING

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

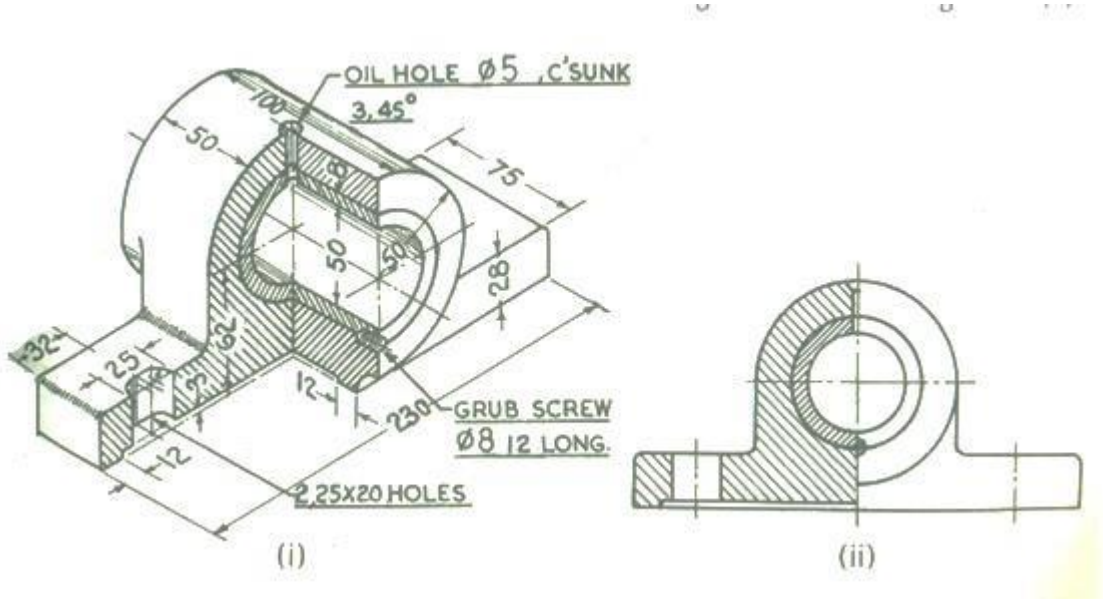
Exercise No. 1. Geneva Wheel



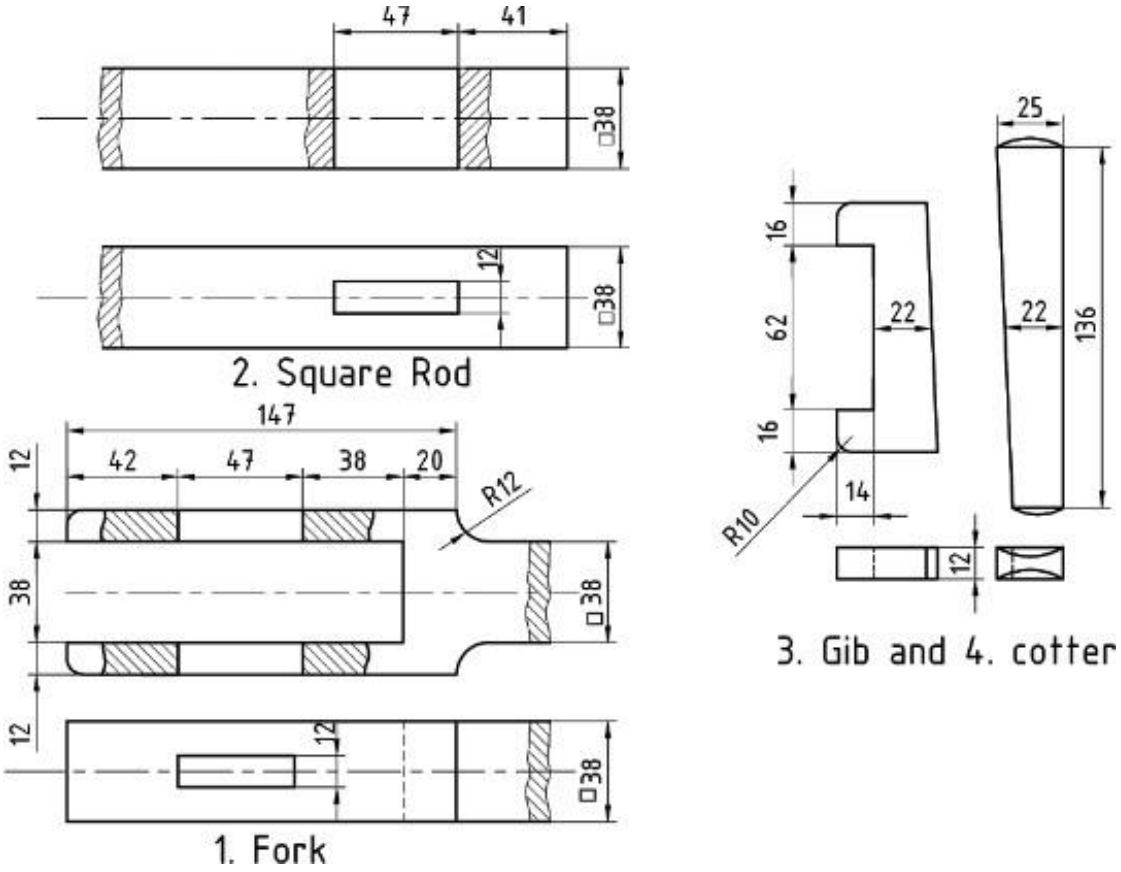
Exercise No. 2. Bearing Block



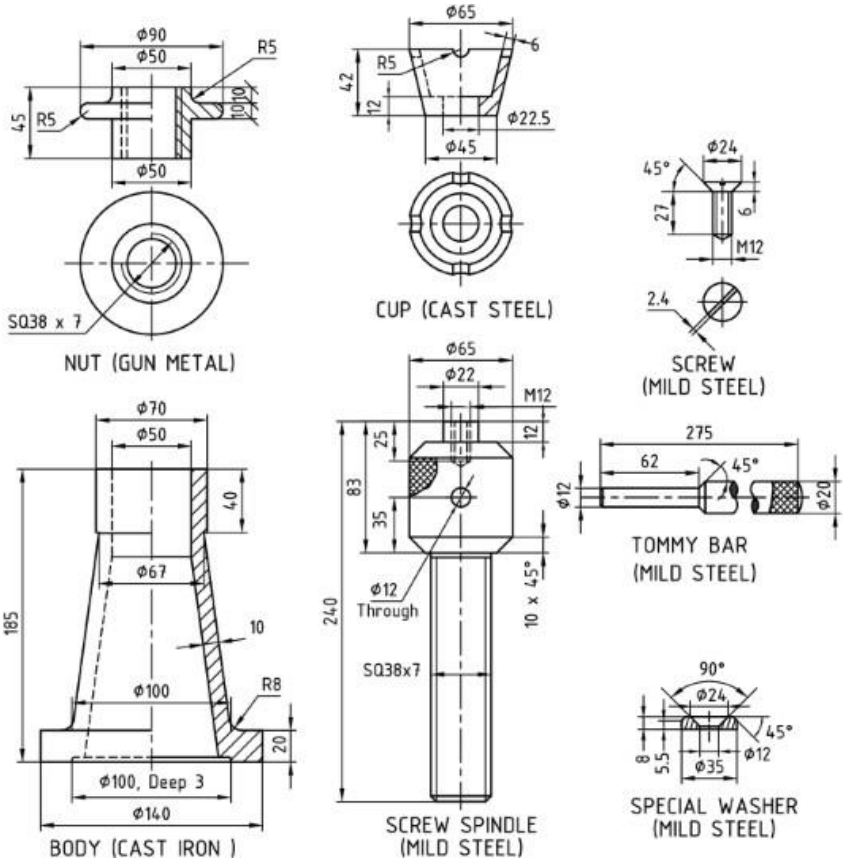
Exercise No. 3. Bushed bearing



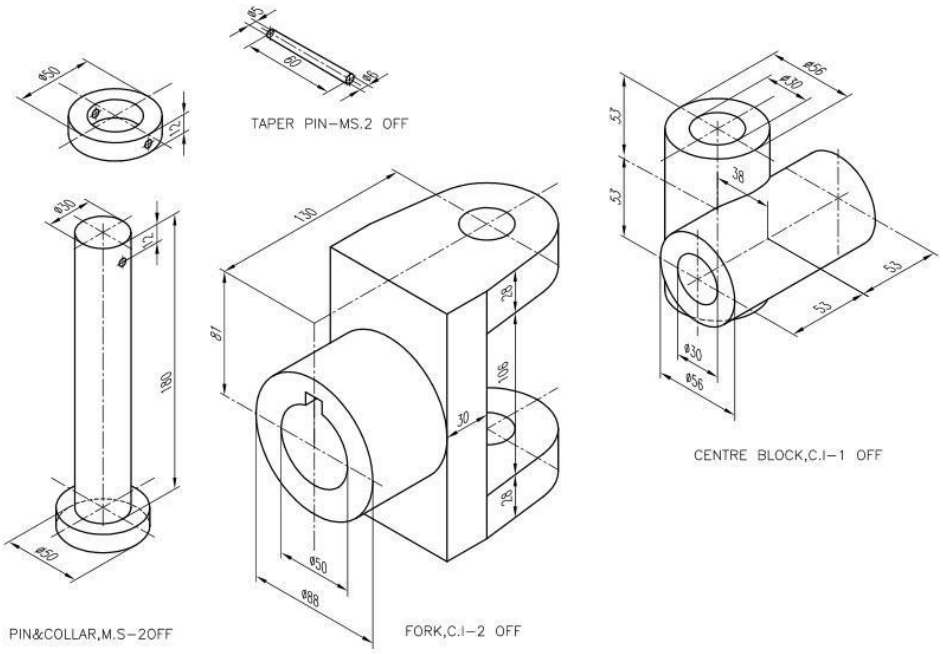
Exercise No. 4. Gib and Cotter joint



Exercise No. 5. Screw Jack



Exercise No. 6. Universal Coupling



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

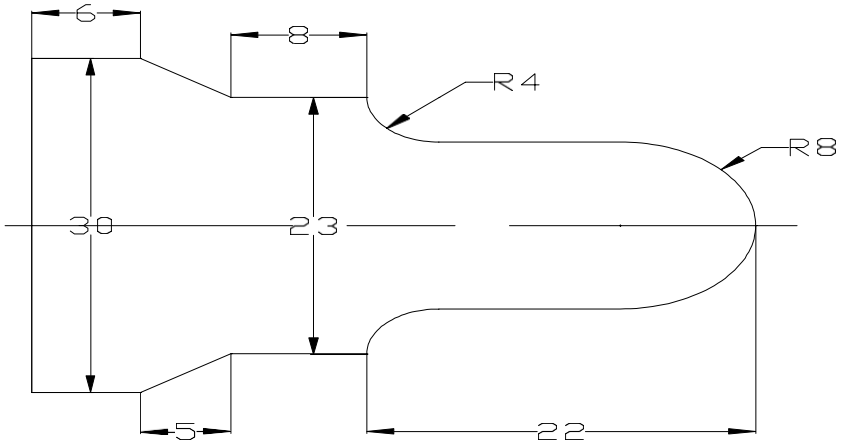
PART B: CNC Programming and Machining

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.

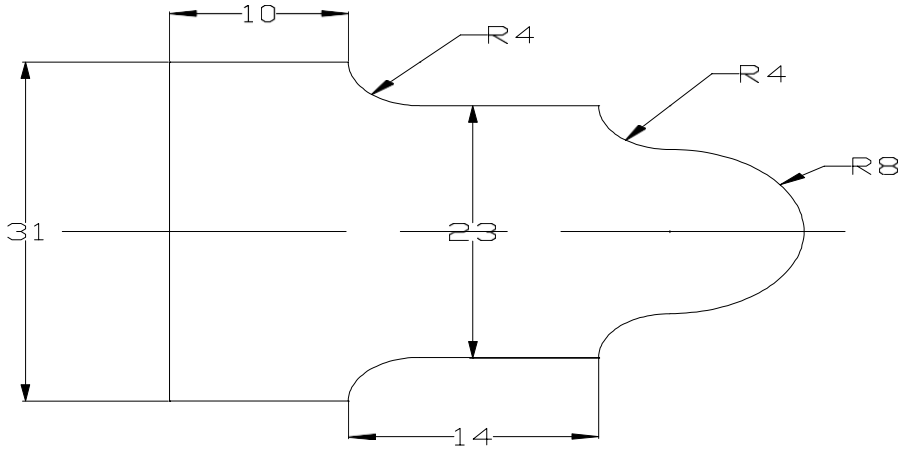
Note: Create and edit the part program in the simulation software for verification of the part program. Enter / tranfer the program to make the component in the CNC machine.

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

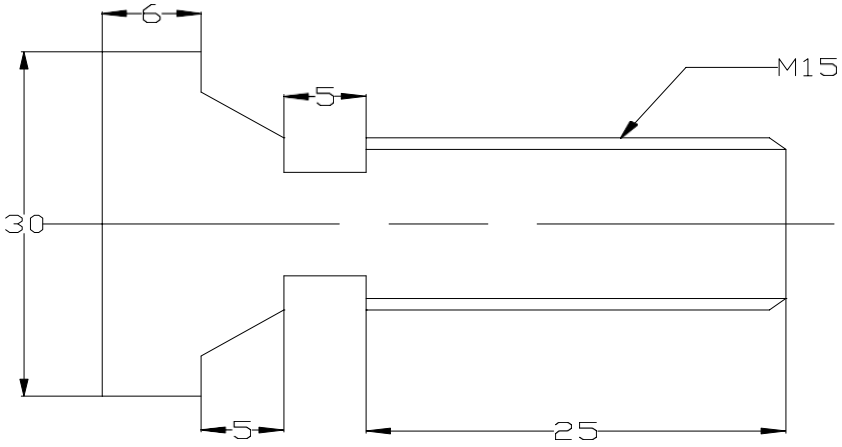
1. Using Linear and Circular interpolation - Create a part program and produce component in the Machine.



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



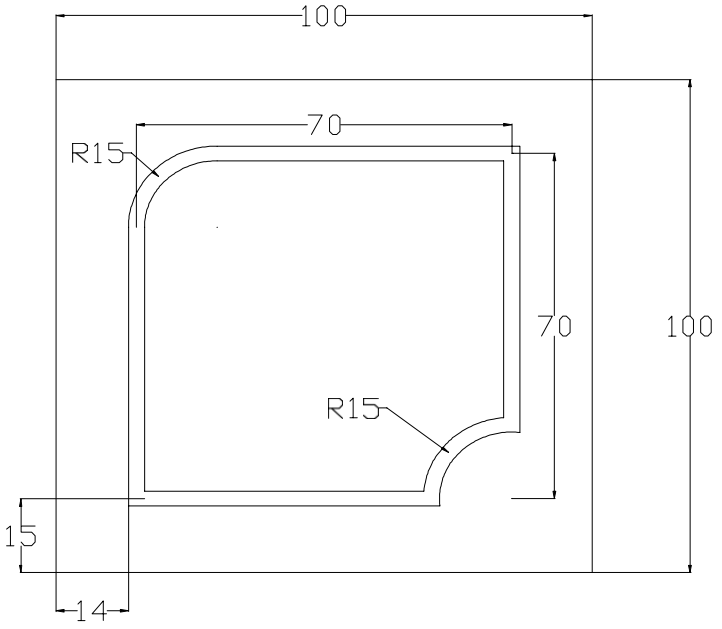
3. Using canned cycle - Create a part program for thread cutting, grooving and



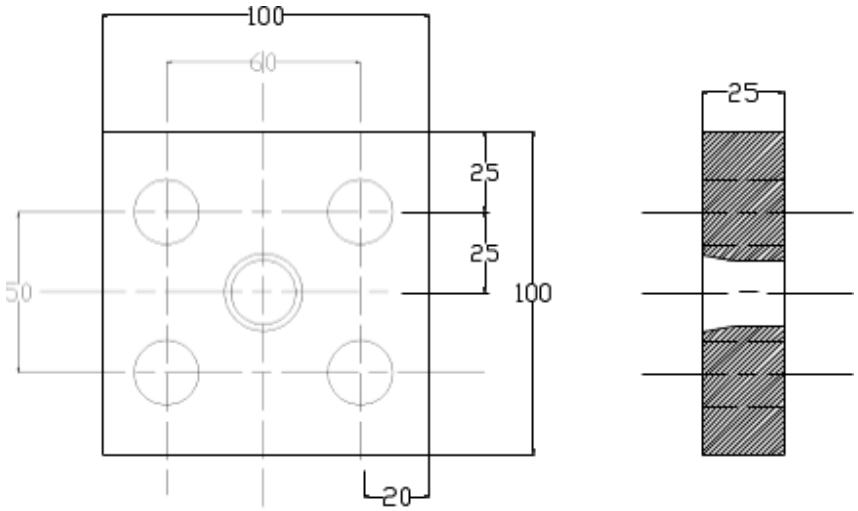
produce component in the Machine.

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

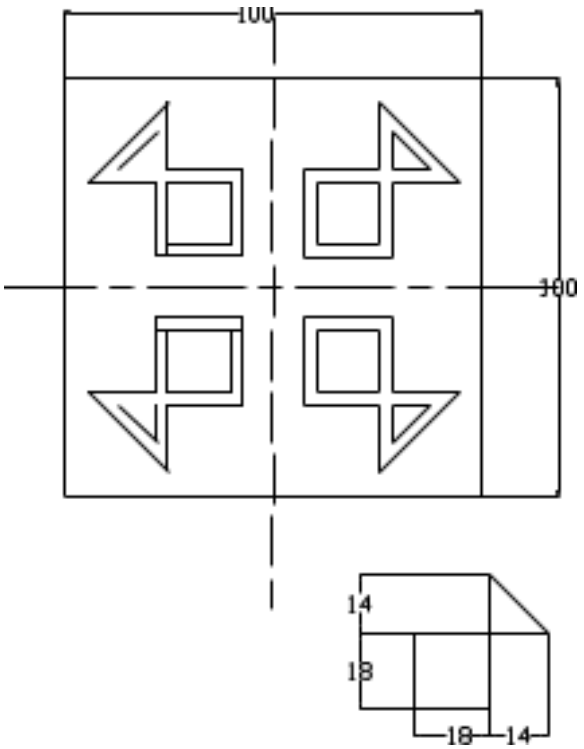
4. Using Linear interpolation and Circular interpolation – Create a part program for grooving and produce component in the Machine.



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.



AUTONOMOUS 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 Autonomous 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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TAMILNADU GOVERNMENT POLYTECHNIC COLLEGE, (Autonomous), MADURAI- 11

N - 20 SCHEME

DIPLOMA IN MECHANICAL ENGINEERING

(Implemented from the Academic Year 2021 – 2022 onwards)

Course Name : 1020 Diploma in Mechanical Engineering
Subject Code : 4020562
Semester : V
Subject Title : Green Energy and Energy Conservation Practical

TEACHING AND SCHEME OF EXAMINATION

No of weeks per semester: 16 weeks

Subject	Instructions		Examination			
			Marks			Duration
	Hours / Week	Hours / Semester	Internal Assessment	End Semester Examinations	Total	
4020562 Green Energy and Energy Conservation 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.

Objectives:

- To demonstrate the I-V and P-V Characteristics of PV module .
- To show the effect of variation in tilt angle on PV module power.
- To study the characteristics of battery.
- To understand how a solar PV standalone system works
- To workout power flow calculations of standalone PV system AC load DC load with battery.
- To understand how to use various electrical measuring equipments.
- To study the different electrical parameters of a monocrystalline and polycrystalline silicon solar panel
- To study the effect of shading on the output of solar panel.
- To understand and determine the power flow in a solar DC system.

4020562 GREEN ENERGY AND ENERGY CONSERVATION PRACTICAL

DETAILED SYLLABUS

Experiments

PART A

1. Study and demonstrate the I-V and P-V Characteristics of PV module with varying radiation and temperature level.
2. Study and demonstrate the I-V and P-V characteristics of series and parallel combination of PV modules.
3. Study and demonstrate the effect of shading on module output power.
4. Do a shading analysis on the site where solar PV system needs to be setup.
5. Study the wind power generation status in Tamilnadu.
6. Study the biogas generation status in Tamilnadu.

PART B

1. Conduct experiment to show the effect of variation in tilt angle on PV module power.
2. Conduct the experiment to demonstrate the working of diode as Bypass diode and blocking diode.
3. Conduct the experiment to draw the charging and discharging characteristics of battery.
4. Conduct the experiment for the power flow calculations of standalone PV system of AC load with battery.
5. Conduct the experiment for the power flow calculations of standalone PV system of DC load with battery.
6. Conduct the experiment to determine the different electrical parameters of a monocrystalline and polycrystalline silicon solar panel.

AUTONOMOUS EXAMINATION

Note:

- 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.
- 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.
- 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.

ALLOCATION OF MARKS

Part - A			
Study explanation		**:**	**30**
Part - B		**:**	**60**
Procedure	15		
Observation / Reading / calculation	35		
Result	10		
Viva-voce		**:**	**10**
Total		**:**	**100**

Equipment / Tools Required (For 30 students)

S.No.	Description	Qty.
1	150 /160 Wp Polycrystalline Solar PV Modules	2 Nos.
2	340/350 Wp Mono crystalline Solar PV Modules	2 Nos.
3	80 / 90 Wp Thin film Solar PV Modules	2 Nos.
4	1000W/1500W Off-grid Grid Inverter with MPPT Charge Controller	1 No.
5	Solar Structure	1 No.
6	Wall mountable ACDB Box	1 No.
7	Earthing kit	3 No.
8	DC Wire , AC Wire, PVC items	1 No.
9	Accessories like MC4 connectors, Lugs, Screws etc	Sufficient quantity
10	Solar System Analyser	1 No.
11	Solar Power Meter	1 No.
12	Solar Module Analyser	1 No.
13	Thermal Imaging Camera	1 No.
14	Drill m/c, Multimeters, Clamp meters, Tools & Tackles, Safety gear	1 Set
15	Electrical Measuring Instruments	Sufficient Quantity
16	Shop Floor Tools	Sufficient Quantity

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N - 20 SCHEME

DIPLOMA IN MECHANICAL ENGINEERING

(Implemented from the Academic Year 2021 – 2022 onwards)

Course Name : 1020 Diploma in Mechanical Engineering

Subject Code : 4020563

Semester : V

Subject Title : Mechatronics Practical

TEACHING AND SCHEME OF EXAMINATION

No. of Weeks per Semester: 16 Weeks

Subject	Instructions		Examination			
	Hours/ Week	Hours/ Semester	Marks			Duration
			Internal Assessment	End Semester Examination	Total	
4020563 Mechatronics Practical	4	64	25	100*	100	3Hrs.

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

RATIONALE:

As per the latest requirements in the Industries this enables to learn the various concepts of industrial automation. They are able to write ladder logic program and able operate PLCs. They are able to understand the advanced concepts adopted in industrial automation.

OBJECTIVES:

- Acquire knowledge in the field of mechatronics
- Explain the various components of electro pneumatics and electro hydraulics
- Handle PLC, HMI, SCADA and DCS components

4020563 MECHATRONICS PRACTICAL

DETAILED SYLLABUS

ELECTRO PNEUMATICS: Introduction to Electro Pneumatics -Applications of pneumatics - Pneumatic and electro pneumatic controllers - Components and assemblies in the electrical signal control section: Power supply unit - Push button and control switches - Sensors for measuring displacement and pressure - Relays and contactors. Electrically actuated directional control valves - Construction and mode of operation - Functions - Electrical connection of solenoid coils. Procedure for developing a control system.

ELECTRO HYDRAULICS: Basic principles of electro hydraulics - Function and use of electrohydraulic components - Production and interpretation of standard hydraulic and electrical circuit diagrams

PROCESS CONTROL INSTRUMENTATION: Process control - Types of processes – Structure of control system – Controllers - Digital controllers – Types of process control – ON/OFF Control – Analog control – Digital control. Data Acquisition System - Objectives of DAS - Types of DAS: Single channel DAS – Multichannel DAS – Computer based DAS. Data Loggers - Block diagram of Data Loggers – Control facilities in Data Logger – Uses of Data Logger - Different stages of Direct Digital Control.

SCADA - Fundamental principles of modern SCADA systems - SCADA hardware - SCADA software - Landlines for SCADA - SCADA and local area networks - Modem used in SCADA systems - Remote terminal units. Human Machine Interface – components of HMI.

Distributed Control System - Parts of DCS – Layered structure of DCS – Communication options in DCS.Variable Frequency Drives - Construction, Working, Operation, Applications and Specifications

Experiments

PART A

(ELECTRO PNEUMATICS)

1. Direct control of a 3/2 NC Single solenoid valve and a 3/2 NO Single solenoid valve
2. Direct control of a 5/2 single solenoid valve and a 5/2 double solenoid valve
3. Simple circuit using OR Logic and AND Logic
4. Limit switch and proximity switch application circuits

(ELECTRO HYDRAULICS)

1. Sorting device using double acting cylinder, directly actuated, manually
2. Component selection on conveyor belt using double acting cylinder and directly actuated, manually
3. Lifting station using single acting cylinder and directly actuated, manually
4. Door control using double acting cylinder and interlocking

PART B

PROCESS CONTROL INSTRUMENTATION

1. Wiring practice of HMI
2. Design of HMI screen
3. HMI Configuration and Interfacing with PLC and PC
4. Configuring Alarms in SCADA
5. Real time project development and interfacing with PLC
6. Monitoring & Control of Pneumatic System using HMI

AUTONOMOUS 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.

ALLOCATION OF MARKS

PART A: Electro Pneumatic circuit / Electro Hydraulic circuit (by lot):

Circuit diagram	:	15
Components connections & execution	:	20
Output	:	10

PART B: Process Control Instrumentation

Circuit diagram	:	15
Execution &Programming	:	20
Output	:	10
Vivavoce	:	10
Total Marks	:	100

List of Equipment (For 30 students)

Electro Pneumatics:

1. Basic Pneumatic Trainer Kit with FRL Unit, Compressor and Accessories – 2 Nos
   - 3/2 NC Single Solenoid Valve - 2Nos
   - 3/2 NO Single Solenoid Valve - 2Nos
   - 5/2 Single Solenoid Valve - 2Nos
   - 5/2 Double Solenoid Valve - 2Nos
   - Limit Switch – 6 Nos
   - Proximity Sensor (Inductive, Capacitive & Optical) – Each 2 Nos
   - Single Acting Pneumatic Cylinder – 4 Nos
   - Double Acting Pneumatic Cylinder – 2 Nos
   - Power Supply Unit, Connecting Leads and Hoses – As per Requirements

Electro Hydraulics:

1. Basic Hydraulics Trainer Kit with Hydraulic Pump, Regulator and Hoses Accessories – 2 Nos
    - Double Acting Cylinder – 2 Nos
    - Single Acting Cylinder – 2 No
    - Manual Actuator Switch – 4 Nos
    - Material Sorting assembly set up – 1 No
    - Conveyor Assembly set up – 1 No
    - Lifting Station Assembly Set up – 1 No
    - Limit Switch - 4 Nos

Process Control Instrumentation:

- Programmable Logic Controller (PLC) with Software – 3 Nos
- Human Machine Interface (HMI) with Software - 3 Nos
- SCADA Software – 1 No or Integrated Software for PLC, HMI and SCADA)
- Personnel Computer – 3 Nos
- Water Tank Assembly set up with Level Sensor and Flow Controller (Actuator) to interface with PLC and HMI – 1 No

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TAMILNADU GOVERNMENT POLYTECHNIC COLLEGE, (Autonomous), MADURAI- 11

N - 20 SCHEME

DIPLOMA IN MECHANICAL ENGINEERING

(Implemented from the Academic Year 2021 – 2022 onwards)

Course Name : 1020 Diploma in Mechanical Engineering

Subject Code : 4020570

Semester V

Subject Title : Entrepreneurship & Startups

TEACHING AND SCHEME OF EXAMINATION

No. of Weeks per Semester: 16 Weeks

Subject	Instructions		Examination			
			Marks			Duration
	Hours/ Week	Hours/ Semester	Internal Assessment	End Semester Examination	Total	
4020570 Entrepreneurship & Startups	4	64	25	100*	100	3 Hrs.

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

Topics and Allocation of Hours

UNIT	Topic	Hours
1	Entrepreneurship – Introduction and Process	10
2	Business Idea and Banking	10
3	Start ups, E-cell and Success Stories	10
4	Pricing and Cost Analysis	10
5	Business Plan Preparation	10
Field visit and Preparation of case study report		14
Total		64

RATIONALE:

Development of a diploma curriculum is a dynamic process responsive to the society and reflecting the needs and aspiration of its learners. Fast changing society deserves changes in educational curriculum particularly to establish relevance to emerging socio-economic environments; to ensure equity of opportunity and participation and finally promoting concern for excellence. In this context the course on entrepreneurship and start ups aims at instilling and stimulating human urge for excellence by realizing individual potential for generating and putting to use the inputs, relevant to social prosperity and thereby ensure good means of living for every individual, provides jobs and develop Indian economy.

OBJECTIVES:

At the end of the study of 5th semester the students will be able to

- To excite the students about entrepreneurship
- Acquiring Entrepreneurial spirit and resourcefulness
- Understanding the concept and process of entrepreneurship
- Acquiring entrepreneurial quality, competency and motivation
- Learning the process and skills of creation and management of entrepreneurial venture
- Familiarization with various uses of human resource for earning dignified means of living
- Know its contribution in and role in the growth and development of individual and the nation
- Understand the formation of E-cell
- Survey and analyze the market to understand customer needs
- Understand the importance of generation of ideas and product selection
- Learn the preparation of project feasibility report
- Understand the importance of sales and turnover
- Familiarization of various financial and non financial schemes
- Aware the concept of incubation and starts ups

DETAILED SYLLABUS

Unit	Name of the Topics	Hours
1	**ENTREPRENEURSHIP – INTRODUCTION AND PROCESS** • Concept, Functions and Importance • Myths about Entrepreneurship • Pros and Cons of Entrepreneurship • Process of Entrepreneurship • Benefits of Entrepreneur • Competencies and Characteristics • Ethical Entrepreneurship • Entrepreneurial Values and Attitudes • Motivation • Creativity • Innovation • Entrepreneurs - as problem solvers • Mindset of an employee and an entrepreneur • Business Failure – causes and remedies • Role of Networking in entrepreneurship	10
2	**BUSINESS IDEA AND BANKING** • Types of Business: Manufacturing, Trading and Services • Stakeholders: Sellers, Vendors and Consumers • E- Commerce Business Models • Types of Resources - Human, Capital and Entrepreneurial tools • Goals of Business and Goal Setting • Patent, copyright and Intellectual Property Rights • Negotiations - Importance and methods • Customer Relations and Vendor Management • Size and Capital based classification of business enterprises • Role of Financial Institutions • Role of Government policy	10

	• Entrepreneurial support systems • Incentive schemes for State Government • Incentive schemes for Central Government	
3	**STARTUPS, E-CELL AND SUCCESS STORIES** • Concept of Incubation centre's • Activities of DIC, financial institutions and other relevance institutions • Success stories of Indian and global business legends • Field Visit to MSME's • Various sources of Information • Learn to earn • Startup and its stages • Role of Technology – E-commerce and Social Media • Role of E-Cell • E-Cell to Entrepreneurship	**10**
4	**PRICING AND COST ANALYSIS** • Calculation of Unit of Sale, Unit Price and Unit Cost • Types of Costs - Variable and Fixed, Operational Costs • Break Even Analysis • Understand the meaning and concept of the term Cash Inflow and Cash Outflow • Prepare a Cash Flow Projection • Pricing and Factors affecting pricing • Understand the importance and preparation of Income Statement • Launch Strategies after pricing and proof of concept • Branding - Business name, logo, tag line • Promotion strategy	**10**
5	**BUSINESS PLAN PREPARATION** • Generation of Ideas, • Business Ideas vs. Business Opportunities	**10**

	• Selecting the Right Opportunity • Product selection • New product development and analysis • Feasibility Study Report – Technical analysis, financial analysis and commercial analysis • Market Research - Concept, Importance and Process • Marketing and Sales strategy • Digital marketing • Social Entrepreneurship • Risk Taking-Concept • Types of business risks	

REFERNCE BOOKS:

1. Dr. G.K. Varshney, Fundamentals of Entrepreneurship, Sahitya Bhawan Publications, Agra - 282002
2. Dr. G.K. Varshney, Business Regulatory Framework , Sahitya Bhawan Publications, Agra - 282002
3. Robert D. Hisrich, Michael P. Peters, Dean A. Shepherd, Entrepreneurship , McGraw Hill (India) Private Limited, Noida - 201301
4. M.Scarborough, R.Cornwell, Essentials of Entrepreneurship and small business management, Pearson Education India, Noida - 201301
5. Charantimath Poornima M. Entrepreneurship Development and Small Business Enterprises, Pearson Education, Noida - 201301
6. Trott, Innovation Management and New Product Development, Pearson Education, Noida - 201301
7. M N Arora, A Textbook of Cost and Management Accounting, Vikas Publishing House Pvt. Ltd., New Delhi-110044
8. Prasanna Chandra, Financial Management, Tata McGraw Hill education private limited, New Delhi
9. I. V. Trivedi, Renu Jatana, Indian Banking System, RBSA Publishers, Rajasthan
10. Simon Daniel, HOW TO START A BUSINESS IN INDIA, BUUKS, Chennai - 600018

11. Ramani Sarada, The Business Plan Write-Up Simplified - A practitioners guide to writing the Business Plan, Notion Press Media Pvt. Ltd., Chennai 600095.

AUTONOMOUS Examination –

Evaluation PatternInternal Mark Allocation

Assignment (Theory portion)*	-	10
Seminar Presentation	-	10
Attendance	-	5
Total	**-**	**25**

Note: * Two assignments should be submitted. The same must be evaluated and converted to 10 marks.

Guidelines for assignment:

First assignment – Unit I

Second assignment – Unit II

Guidelines for Seminar Presentation - Unit III

Each assignment should have five three marks questions and two five marks questions.

AUTONOMOUS EXAMINATION

Note

1. The students should be taught all units and proper exposure and field visit also arranged. All the portions should be completed before examinations.
2. The students should maintain theory assignment and seminar presentation. The assignment and seminar presentation should be submitted during the Autonomous Practical Examinations.
3. The question paper consists of theory and practical portions. All students should write the answers for theory questions (45 Marks)

and practical portions (55 Marks) should be completed for autonomous examinations.

4. All exercises should be given in the question paper and students are allowed to select by lot. If required the dimensions of the exercises may be varied for every batch. No fixed time allotted for each portion and students have liberty to do the examination for 3Hrs.
5. For Written Examination: theory question and answer: 45 Marks

   Ten questions will be asked for 3 marks each. Five questions from each unit 1 & 2. (10 X 3 = 30).

   Three questions will be asked for 5 marks each. One question from each unit 1, 2 & 3. (3 X 5 = 15)
6. For Practical Examination: The business plan/Feasibility report or Report on Unit 4 & 5 should be submitted during the autonomous practical examinations. The same have to be evaluated for the report submission (40 marks).

DETAILED ALLOCATION OF MARKS

Sl. No	Description	Marks
Part A	Written Examination - Theory Question and answer 10 questions x 3 marks = 30 marks 3 questions x 5 marks = 15 marks	45
Part B	Practical Examination – Submission on Business Plan/Feasibility Report or Report on Unit 4 & 5	40
Part C	Viva voce	15
	Total	100