STATE BOARD OF TECHNICAL EDUCATION BIHAR

Scheme of Teaching and Examinations for

Vth SEMESTER DIPLOMA IN MECHANICAL ENGINEERING

(EffectivefromSession2020·21Batch)

THEORY

Sr. No.	SUBJECT	SUBJECT CODE	TEACHING SCHEME	EXAMINATION-SCHEME						
			Periods per Week	Hours of Exam.	Teacher's Assessment (TA) Marks A	Class Test (CT) Marks B	End Semester Exam(ESE) Marks C	Total Marks (A+B+C)	Pass Marks ESE	Pass Marks In The Subject	Credits
1.	Production & Operations Management	2025501	04	03	10	20	70	100	28	40	03
2.	Computer Aided Design & Manufacturing	2025502	04	03	10	20	70	100	28	40	03
3.	Automobile Engineering	2025503	03	03	10	20	70	100	28	40	03
4.	Elective-I		03	03	10	20	70	100	28	40	03
Refrigeration & Air-conditioning (2025504A)			Heat Transfer (2025504B)				Power Plant Engineering (2025504C)				
5.	Open Elective / COE		03	03	10	20	70	100	28	40	02
Industrial Engineering & Management (2025505A)			Farm Equipment & Farm Machinery (2025505B)				Artificial Intelligence (Basics) (2000505B)				
Internet of Things (Basics) (2000505C)			Drone Technology (Basics) (2000505D)				3D Printing & Design (Basics) (2000505E)				
Industrial Automation (Basics) (2000505F)			Electric Vehicles (Basics) (2000505G)				Robotics (Basics) (2000505H)				
		Total:· 17					**350**	**500**			**14**

PRACTICAL

Sr. No.	SUBJECT	SUB.JECT CODE	TEACHING SCHEME	EXAMINATION-SCHEME					
			Periods per Week	Hours of Exam.	Practical(ESE) Internal (PA)	Practical(ESE) External (ESE)	Total Marks	Pass Marks In the Subject	Credits
6.	CAD/CAM Lab	2025506	04 50% Physical 50% Virtual	03	15	35	50	20	02
7.	Elective lab-I	2025507	02 50% Physical 50% Virtual	03	07	18	25	10	01
Refrigeration & Air-conditioning Lab (2025507A)			Heat Transfer Lab (2025507B)				Power Plant Engineering Lab (2025507C)		
8.	Elective lab / COE Lab	2025508	06 50% Physical 50% Virtual	03	15	35	50	20	03
Automobile Engineering **Lab** (2025508A)			Farm Equipment & Farm Machinery **Lab** (2025508B)				Artificial Intelligence Lab (Basics) (2000508 B)		
Internet of Things Lab (Basics) (2000508 C)			Drone Technology Lab (Basics) (2000508D)				3D Printing & Design Lab (Basics) (2000508E)		
Industrial Automation Lab (Basics) (2000508F)			Electric Vehicles Lab (Basics) (2000508G)				Robotics Lab (Basics) (2000508H)		
		Total:– 12					**125**		06

TERMWORK

Sr. No.	SUBJECT	SUBJECT CODE	TEACHING SCHEME	EXAMINATION-SCHEME				
			Periods per Week	Marks of Internal (PA)	Marks of External (ESE)	Total Marks	Pass Marks in the Subject	Credits
9.	Summer Intern- ship-II (4 weeks)	2025509	-	15	35	50	20	02
10.	Major Project	2025510	02	07	18	25	10	01
11.	Course Under Moocs /Swayam/ Others	2021511	02	15	35	50	20	01
		Total:- 04				**125**		
Total Periods per week Each of duration One Hour		33		Total Marks = 750				24

PRODUCTION & OPERATIONS MANAGEMENT

Subject Code	Theory						Credits
2025501	No. of Periods Per Week			Full Marks	:	100	03
	L	T	P/S	ESE	:	70	
	04	—	—	TA	:	10	
	—	—	—	CT	:	20	

Course objectives:

- One of the most critical areas for success in any business enterprise is how Production and Operations are managed.
- To study the statistics, economics, finance, organizational behavior and strategy into a consolidated production and operation related decisions.
- To discuss the role of location strategy and the criteria for location decisions.
- To define quality and explain quality management, including TQM and itstools.

CONTENTS: THEORY

Unit	Name of Topics	Hrs
Unit-I	1.1 Process Planning and Process Engineering: Process Planning: Introduction, Function, Pre-requisites and steps in process planning, Factors affecting process planning, Make or buy decision, plant capacity and machine capacity. 1.2 Process Engineering: Preliminary Part Print Analysis: Introduction, Establishing the General Characteristics of work piece, determining the principal Process, Functional surfaces of the work piece, Nature of the work to be Performed, Finishing and identifying operations. 1.3 Dimensional Analysis: Introduction, types of dimensions, measuring the Geometry of form, Baselines, Direction of specific dimensions. Tolerance Analysis: Causes of work piece variation, Terms used in work piece dimensions, Tolerance stacks. Work piece Control: Introduction, Equilibrium Theories, Concept of location, Geometric Control, Dimensional control, Mechanical control.	**10**
Unit-II	2.1 Production Forecasting: Introduction of production forecasting, The strategic role of forecasting in supply chain, Time frame, Demand behavior, Forecasting methods-Qualitative and Quantitative, Forecast accuracy. 2.2 Scheduling: Introduction, Objectives in scheduling, Loading, Sequencing, Monitoring, Advanced Planning and Scheduling Systems, Theory of Constraints, Employee scheduling.	**10**
Unit-III	3.1 Break-Even Analysis: Introduction, Break-even analysis charts, Breakeven analysis for process, plant and equipment selection. 3.2 Aggregate Operations Planning: Aggregate production planning, Adjusting capacity to meet the demand, Demand management, Hierarchical and collaborative planning, Aggregate planning for services.	
Unit-IV	4.1 Assembly Line Balancing: Assembly lines, Assembly line balancing, Splitting tasks, Flexible and U- shaped line layouts, Mixed model line balancing, Current Thoughts on assembly lines, Computerized assembly line balancing.	**12**
Unit-V	5.1 Material Management: Introduction, Importance and objectives, Purchasing and Stores: policies and procedures, Vendor development, selection, analysis and rating.	**10**

References:

1. Production and Operations Management – K. Aswathappa, K. Shridhara Bhat, Himalaya Publishing House, 2014.
2. Production and Operations Management – Shailendra Kale, McGraw Hill Educations(India) Private Limited,2013.
3. Production and Operations Management – R.Paneerselvam, PHI Learning Private Limited, 2013.
4. Operations Management – Joseph Monk, TMH Publishers, New Delhi, 2004.
5. Production and Operation Management - Ramakant khandelwal , FPH

Course outcomes:

At the end of the course, the student will be able to:

CO1 Define operations management and explain its relationship to productivity. And also understand tools and techniques.

CO2 Describe the importance of forecasting and explain the effective application of the different forecasting approaches and methods.

CO3 Explain layout strategy and how operations managers determine facility arrangements and size.

CO4 Describe how operations managers achieve a reasonable work environment and set expectations related to employee productivity.

CO5 Understand make-or-buy decisions, and the selection and integration of suppliers. And how much to order and when to order.

COMPUTER AIDED DESIGN AND MANUFACTURING

Subject Code	Theory						Credits
2025502	No. of Periods Per Week			Full Marks	:	100	03
	L	T	P/S	ESE	:	70	
	04		—	TA	:	10	
	—	—	—	CT	:	20	

Course objectives:

To understand concepts of drafting and modelling using CAD.

- To understand the need for integration of CAD and CAM.
- To understand the concepts of flexible manufacturing system.

CONTENTS: THEORY

Unit	Name of Topics	Hrs
Unit-I	**1.1 Fundamentals of CAD/CAM:** Automation; Design process; Application of computers for design; Benefits of CAD; Computer configuration for CAD applications; Design workstation; Graphic terminal. **1.2 CAD Software:** Definition of system software and application software; CAD database and structure. **1.3 Geometric modelling:** 3D-Wire frame modelling; Wire frame entities and their definitions; Interpolation and Approximation of curves; Concept of Parametric and Non-parametric representation of curves; Curve fitting techniques.	12
Unit-II	**2.1 Surface Modeling:** Algebraic and Geometric form; Parametric space of surface; Blending functions; Parametrization of surface patch; Subdividing; Cylindrical surface; Ruled surface; Surface of revolution; Spherical surface; Composite surface; Bezier surface; **2.2 Solid Modelling:** Definition of cell composition and spatial occupancy enumeration; Sweep representation; Constructive solid geometry; Boundary representations.	12
Unit-III	**3.1 NC Control Production Systems:** Numerical control; Elements of NC system; NC part programming; Methods of NC part programming; Manual part programming, Computer assisted part programming; Post processor; Computerized part program.	12
Unit-IV	**4.1 Group Technology:** Part families; Parts classification and coding; Production analysis; Machine cell design; **4.2 Computer aided process planning:** Retrieval type and Generative type; Machinability data systems; MRP and its Benefits.	12
Unit-V	**5.1 Flexible manufacturing system:** F.M.S equipment; Layouts; Analysis methods and benefits; Computer aided quality control. **5.2 Automated inspection**: Off-line, On-line, Contact, Non-contact; Coordinate measuring machines; Machine vision; CIM system and Benefits.	12

Reference Books:

1. **CAD/CAM Principles and Applications, P.N.Rao, Tata McGraw-Hill**
2. **Computer Aided Design and Manufacturing, Groover M.P. & Zimmers Jr, Prentice hall of India**
3. **CAD/CAM/CIM, Radha Krishna P. & Subramanyam, Wiley Eastern Ltd**

Course outcomes:

At the end of the course, the student will be able to:

CO1 Develop mathematical models to represent curves and surfaces and Model engineering components using solid modeling techniques.

CO2 Understand geometric transformation techniques in CAD.

CO3 Develop programs for CNC to manufacture industrial components.

CO4 Understand the application of computers in various aspects of Manufacturing viz., Design, Proper planning,

CO5 Manufacture in cost, Layout & Material Handling system.
Utilize Flexible manufacturing system tools.

AUTOMOBILE ENGINEERING

Subject Code	Theory						Credits
2025503	No. of Periods Per Week			Full Marks	:	100	03
	L	T	P/S	ESE	:	70	
	03	—	—	TA	:	10	
	—	—	—	CT	:	20	

Course objectives:

- To understand the basic structure and components of an automobile.
- To understand the concepts of cooling and lubricating systems.
- To understand the concepts of Ignition and transmission and steering systems.
- To understand the classification and necessity of suspension system.
- To identify different special vehicles.

CONTENTS: THEORY

Unit	Name of Topic	Hrs
Unit-I	**Introduction to basic structure of an automobile**: 1.1 Basic engine components; Cylinder block; Cylinder head; Gaskets; cylinder liners, types of cylinder liners; Piston and piston pin; piston rings, types of piston rings; Connecting rod; Crank shaft; Cam shaft; Crankcase; Engine valves; Fly- wheel and Governer.	**10**
Unit-II	**Cooling and lubrication system**: 2.1 The necessity of cooling system; Types of cooling system-air cooling and water cooling; Air cooling system; Types of water cooling system Thermosyphon system and pump circulation system; Advantages and disadvantages of air cooling and water cooling systems; The components of water cooling System fan, radiator, pump and thermostat; 2.2 The necessity of lubrication system; S.A.E rating of lubrication system; Types of lubrication system; Petrol lubrication and high pressure lubrication system. 2.3 Fuel feed system: Conventional fuels and alternative fuels: Cetane and octane numbers; Types of carburettors; Working of simple carburettor; Multi point and single point fuel injection systems; Different fuel transfer pumps; Working of S.U electrical and A.C mechanical pump; Fuel filters; Fuel injection pump; Fuel injectors.	**10**
Unit-III	**Ignition system**: 3.1 Introduction to ignition system; Battery Ignition systems and magneto Ignition system; Electronic Ignition system; Construction and working of lead acid battery; Elements of charging system; Elements of starting system; Types of lights Used in the automobile: Transmission and steering system: 3.2 General arrangement of clutch; Principle of friction clutches; Constructional details of Single plate clutch; Constructional details of multi- plate clutch; Constructional details of centrifugal clutch; Necessity for gear ratios in transmission; Types of gear boxes; Working of sliding mesh gear box; Working of constant mesh gear box; Working of propeller shaft Working of propeller shaft; Working of Universal joint; Working of differential; Types of rear axle; Purpose of front axle; 3.3 Necessity of steering system; Caster, camber and king pin inclination; Rack and pinion steering system; Power steering.	**10**

Unit-IV	**Suspension system**: 4.1 Necessity of suspension system; Torsion bar suspension systems; Leaf spring and coil spring suspension system; Independent suspension for front wheel and rear wheel; Working of telescopic shock absorber; 4.2 Functions of brakes; Types of brakes; Working of internal expanding brake; Working of disc brake	**10**
Unit-V	**Special vehicles**: 5.1 Introduction to Special vehicles; Tractor; Motor grader; Scrappers; Excavators; Duper trucks.	**06**

References:

1. Automobile Engineering Vol I, II, Kirpal Singh, Standard Publishers Distributors, Delhi.2012.
2. Automobile Mechanics, A.K. Babu, S.C. Sharma, Khanna Publications, New Delhi
3. Automotive Mechanics: Principles and Practices, Joseph Heitner, East West Press
4. Automotive Mechanics, S. Srinivasan, 2nd Edition, Tata McGraw Hill
5. Automobile Engineering Vol I and Vol II, K. M. Gupta, Umesh Publications.
6. Automotive Engineering, Jain and Asthana, Tata McGraw Hill.
7. Automobile Engineering - K P Singh, FPH
8. Automobile Engineering - Sunil Rout, FPH

Course outcomes:

At the end of the course, the student will be able to:

CO1 Identify the components of an automobile with their working

CO2 Explain the concepts of cooling and lubricating systems.

CO3 Explain the concepts of Ignition and Transmission and steering systems.

CO4 Identify different suspension systems and their applications.

CO5 Differentiate the special vehicles according to the usage.

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ELECTIVE- I

REFRIGERATION AND AIR-CONDITIONING

Subject Code	Theory						Credits
2025504A	No. of Periods Per Week			Full Marks	:	100	03
	L	T	P/S	ESE	:	70	
	03	—	—	TA	:	10	
	—	—	—	CT	:	20	

Course objectives:

- To understand the basics of Refrigeration cycles.
- To understand basics of vapour compression and vapour absorbtion systems.
- To identify components and refrigerants and lubricants of a refrigeration system.
- To understand control strategies for refrigeration system.
- To understand the basics about air conditioning systems.

CONTENTS: THEORY

Unit	Name of Topics	Hrs
Unit-I	**Introduction to Refrigeration**: 1.1 Definition of Refrigeration; Refrigerating effect, unit of refrigeration, Coefficient of performance; Types of Refrigeration-Ice, dry ice, Steam jet, Throttling, Liquid nitrogen refrigeration; 1.2 Carnot refrigeration Cycle; Air refrigeration Bell Coleman cycle, PV& TS diagram; Advantage and disadvantages in air refrigeration; Simple problems.	10
Unit-II	**Refrigeration systems**: 2.1 Basic Components, Flow diagram of working of Vapour compression cycle; Representation of the vapour compression cycle on P-H, T-S & P-V Diagram; Expression for Refrigerating effect, work done and power required; Types of Vapour Compression cycle; Effects of super heating and under cooling, its advantages and disadvantages; 2.2 Simple Vapour absorptions cycle and its flow diagram; Simple Electrolux system for domestic units; Comparison of Vapour absorption and vapour compression system; Simple Problems on vapour compression cycle.	08
Unit-III	**Refrigeration Equipments**: 3.1 Compressor - types of compressors; Hermetically sealed and Semi hermetically sealed compressor; Condensers Air Cooled, water cooled, natural and force draught cooling system; Advantages and disadvantages of air cooled and water cooled condensers. 3.2 Evaporators – natural convection, forced convection types. Refrigerants and lubricants: Introduction to refrigerants; Properties of good refrigerants; Classification of refrigerants by group number and commonly used refrigerants in practice; Detection of refrigerants leakage; Charging the system with refrigerant; Lubricants used in refrigeration and their properties.	10
Unit-IV	**Refrigerant flow controls**: 4.1 Capillary tube; Automatic Expansion valve; Thermostatic expansion valve; High side and low side float valve; Solenoid valve; Evaporator pressure regulator. 4.2 Application of refrigeration: Slow and quick freezing; Cold storage and Frozen storage; Dairy refrigeration; Ice making industry; Water coolers.	10

Unit-V	**Air conditioning**: 5.1 Introduction to Air conditioning; Factors affecting Air conditioning; Psychometric chart and its use; Psychometric process-sensible heating and cooling, Humidifying and dehumidifying; Adiabatic saturation process; Equipment's used in air conditioning cycle; Air conditioning units and plants. 5.2 Refrigeration and Air-conditioning tools: Tools used in refrigeration And Air conditioner installation; Installation procedure; Faults in refrigeration and air conditioning system; Servicing procedure.	**10**

References:

1. Refrigeration and Air Conditioning – Sadhu Singh, Khanna Book Publishing Co., New Delhi
2. Refrigeration and Air Conditioning – S. Domakundawar, DhanpatRai publications.
3. Refrigeration and Air Conditioning – A.S.Sarao& G.S. Gabi, 6th edition, SatyaPrakashan publications, New Delhi, 2004.
4. Principles of Refrigeration – Roy J.Dossat, 5th edition, Pearson Publications, 2001.
5. Refrigeration and Air Conditioning – M.ZakriaBaig, Premier/ Radiant Publishing House.
6. Refrigration & Air-conditioning - Rohit Vashista , FPH
7. Refrigeration and Air Conditioning – C.P Arora, Tata McGraw Hill Education, 2000.

Course outcomes:

At the end of the course, the student will be able to:

CO1 Define refrigeration and types of Refrigeration cycles

CO2 Explain Vapour Compression and Vapour Absorption System working principles

CO3 Identify the components required for refrigeration system.

CO4 Identify the controlling components for a refrigeration system.

CO5 Explain the working principles of Air-conditioning.

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Elective-I

Heat Transfer

Subject Code	Theory						Credits
2025504B	No. of Periods Per Week			Full Marks	:	100	03
	L	T	P/S	ESE	:	70	
	03	—	—	TA	:	10	
	—	—	—	CT	:	20	

CONTENTS: THEORY

Unit	Topic	Hrs.
Unit-I	**Conduction**: 1.1 Fourier law of heat conduction for isotropic material; Thermal conductivity; Derivation of the energy equation in three dimensions including transient effect; 1.2 Non dimensional - thermal diffusivity and Fourier number; Types of boundary conditions (Dirchlet, Neumann, mixed type); One dimensional solution with and without heat generation; Analogy with electrical circuits.	10
Unit-II	**Fins**: 2.1 Rectangular and pin fins. Fin effectiveness and efficiency. Critical thickness of insulation. Lumped parameter approach and physical significance of time constant, Biot number, Validity of lumped parameter approach. Introduction to Heisler Chart.	08
Unit-III	**Convection**: 3.1 Introduction, Newton's law of cooling; Momentum and energy equations in two dimensions; non depersonalization, importance of non-dimensional quantities and their physical significance. 3.2 Velocity and thermal boundary layer thickness by integral method. Analogies between momentum, heat and mass transfer. Natural convection, effect of coupling on the conservation equations.	10
Unit-IV	**Radiation** : 4.1 Physical mechanism of thermal radiation, laws of radiation, definition of black body, emissive power, intensity of radiation, emissivity, reflectivity, transmissivity, irradiation, radiosity. 4.2 Radiation exchange between black bodies, concept of Gray Diffuse Isotropic (GDI) surface. Radiation exchange between GDI surfaces by radiation network and radiosity matrix method. Radiation shielding.	10

Unit-V	**Heat exchangers**: 5.1 Types of heat exchangers, parallel and counter flow types, Introduction to LMTD. Correction factors, fouling factor. NTU method for heat exchangers.	**10**

References:

1. Fundamentals of Heat and Mass Transfer by F.P. Incropera and D.P.Dewitt, 4th ed., John Wiley & Sons.
2. Heat Transfer - A Basic Approach by M.N.Ozisik, McGrawhill.
3. Heat Transfer by J.P.Holman, 8th ed., McGrawhill.
4. Elements of Heat & Mass Transfer by Vijay Gupta, 2nd ed., New Age International Publishers.

Course outcomes:

At the end of the course, the student will be able to:
CO1 Understand the concepts of conduction
CO2 understand the concepts of fins
CO3 Understand the concepts of radiation.
CO4 Understand the concepts of convection
CO5 Understand the basic concepts of heat exchangers.

ELECTIVE- I

POWER PLANT ENGINEERING

Subject Code	Theory						Credits
2025504C	No. of Periods Per Week			Full Marks	:	100	03
	L	T	P/S	ESE	:	70	
	03	—	—	TA	:	10	
	—	—	—	CT	:	20	

Course objectives:

- To understand the present scenario of power in India.
- To recognize various load terminologies used in power plants.
- To understand hydro working principles
- To understand working of Diesel, Gas and Nuclear power plants.
- To understand the issues and safety precautions in power plants.

CONTENTS: THEORY

Unit	Topic	Hrs/
Unit-I	**Introduction to Power plant**: 1.1 Introduction to power plant; Indian Energy scenario in India; Location of power plant; Choice of Power plant; Classification of power plants.	**10**
Unit-II	**Economics of power plant**: 2.1 Terminology used in power plant: Peak load, Base load, Load factor, Load curve; Various factor affecting the operation of power plant; Methods of meeting the fluctuating load in power plant; Load sharing- cost of power-tariff methods; Performance and operating characteristics of power plant. the fluctuating load in power plant; Load sharing- cost of power-tariff methods; Performance and operating characteristics of power plant.	**08**
Unit-III	**Hydro power plant**: 3.1 Introduction to Hydro electric power plant; Rainfall, Runoff and its measurement, Hydrograph, flow duration curve; Selection of sites for hydro electric power plant; General layout of Hydro electric power plant and its working; 3.2 Classification of the Plant-Run off river plant, storage river plant, pumped storage plant; Advantages and Disadvantages of hydro electric power plant.	**10**
Unit-IV	**Diesel and Gas turbine plant**: 4.1 The layout of diesel power plant; Components and the working of diesel power plant; Advantages and disadvantages of diesel power plant; 4.2 Gas turbine power Plant-Schematic diagram, components and its working; Combined cycle power generation- Combined gas and steam turbine Power plant operation (only flow diagram).	**10**

	4.3 Nuclear power plant: Introduction; Nuclear Power Radio activity- Radioactive charge-types of re- actions; Working of a nuclear power plant; Thermal fission Reactors- PWR, BWR and gas cooled reactors; Advantages and Disadvantages of Nuclear power plant.	
Unit-V	**Environmental impact of Power plant**: 5.1 Social and Economical issues of power plant; Green house effect; Acid precipitation-Acid rain, Acid snow, Dry deposition, Acid fog; Air, water, Thermal pollution from power plants; Radiations from nuclear power plant effluents. 5.2 Power plant safety: Plant safety concept; Safety policy to be observed in power plants; Safety practices to be observed in boiler operation; Safety in oil handling system; Safety in Chemical handling system; Statutory provision related to boiler operation.	**10**

References:

1. Power plant Engineering-P.K. Nag 4th edition, Tata McGraw Hill Education, 2014.
2. Power plant Engineering – Frederick T. Morse, Litton Educational Publishing Inc. 1953.
3. A Course in Power Plant Engineering – Subhash C. Arora, S. Domakundwar, DhanpatRai, 1984.
4. Power Plant Engineering – P.C. Sharma, S.K.Kataria& sons, 2009.
5. Power System Engineering – R.K. Rajput, Firewell Media,2006.

Course outcomes:

At the end of the course, the student will be able to:

CO1 Familiarised with the present and future power scenario

CO2 Enlist various load terminologies in power plants

CO3 Working and classifications in hydro power plant

CO4 Working principles of Diesel, Gas and Nuclear power plants.

CO5 Understand the issues and necessity of safety concepts of power plants.

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INDUSTRIAL ENGINEERING & MANAGEMENT

Subject Code	Theory						Credits
2025505A	No. of Periods Per Week			Full Marks	:	100	03
	L	T	P/S	ESE	:	70	
	04	—	—	TA	:	10	
	—	—	—	CT	:	20	

Course objectives:

- To take the right decisions to optimize resources utilization by improving productivity of the Lands, Buildings, People, Materials, Machines, Money, Methods and Management effectively.
- To eliminate unproductive activities under the control of the Management, Supervisor, worker and the Design of Products and Processes.
- To use the Charts to record the Activities of the people, materials and Equipment to find alternative methods which minimize waste and to implement the best method.

CONTENTS: THEORY

Unit	Name of Topics	Hrs
Unit-I	**Plant Engineering**: 1.1 Plant; Selection of site of industry; Plant layout; Principles of a good layout; Types; Process; Product and Fixed position; Techniques to improve Layout; Principles of Material handling equipment; 1.2 Plant maintenance; Importance; Break down maintenance; Preventive maintenance and Scheduled maintenance. Plant Safety: Importance; Accident: Causes and Cost of an Accident, Accident Proneness, Prevention of Accidents; 1.3 Industrial disputes; Settlement of Industrial disputes; Collective bargaining; Conciliation; Mediation; Arbitration; Indian Factories Act 1948 and its provisions related to health, welfare and safety.	10
Unit-II	**Work Study**: 2.1 Productivity; Standard of living; Method of improving Productivity; Objectives; Importance of good working conditions. Method Study: 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. 2.2 Work Measurement: 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; Numerical Problems; Basic concept of production study; Techniques of Work Measurement; Ratio delay study; Synthesis from standard data; Analytical estimating and Pre deter- mined Motion Time System (PMTS).	10
Unit-III	**Production Planning and Control**: 3.1 Introduction; Major functions of Production Planning and Control; Pre planning; Methods of forecasting; Routing and Scheduling; Dispatching and Controlling; Concept of Critical Path Method (CPM); Types of Production: Mass Production, Batch Production and Job Order Production; Characteristics; Economic Batch Quantity (EBQ); Principles of Product and Process Planning; Make or Buy decision; Numerical problems. 3.2 Quality Control: Definition; Objectives; Types of Inspection: First piece,Floor and Centralized	12

	Inspection; Advantages and Disadvantages; Statistical Quality Control; 3.3 Types of Measurements; Method of Variables; Method of Attributes; Uses of X, R, p and c charts; Operating Characteristics curve (O.C curve); Sampling Inspection; Single and Double Sampling plan; Concept of ISO 9001:2008 Quality Management System Registration/ Certification procedure; Benefits of ISO to the organization.	
Unit-IV	**Principles of Management**: 4.1 Definition of Management; Administration; Organization; F.W. Taylor's and Henry Fayol's Principles of Management; Functions of Manager; Types of Organization: Line, Staff, Taylor's Pure functional types; Line and staff and committee type; Directing; Leadership, Styles of Leadership; Qualities of a good leader; Motivation; Positive and Negative Motivation; 4.2 Modern Management Techniques; Just In Time; Total Quality Management (TQM); Quality circle; Zero defect concept; 5S Concept; Management Information Systems. Personnel Management: 4.3 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; Component of Wages; Wage Fixation; Type of Wage Payment: Halsey's 50% Plan, Rowan's Plan and Emerson's efficiency plan; Numerical Problems.	**06**
Unit- V	**Financial Management**: 5.1 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; Numerical Problems; Depreciation; Causes; Methods: Straight line, sinking fund and percentage on Diminishing Value Method; Numerical Problems. 5.2 Material Management: Objectives of good stock control system; ABC analysis of Inventory; Procurement and Consumption	**10**

References:

1. Industrial Engineering & Management, S.C. Sharma, Khanna Book Publishing Co. (P) Ltd., Delhi
2. Industrial Engineering and Management, O.P. Khanna, Revised Edition, Dhanpat Rai Publications (P) Ltd., New Delhi – 110002.
3. Management, A global perspective, Heinz Weihrich, Harold Koontz, 10th Edition, McGraw Hill International Edition 1994.
4. Essentials of Management, 4th Edition, Joseph L.Massie, Prentice-Hall of India, New Delhi 2004.
5. Principles and Practices of Management, Premvir Kapoor, Khanna Publishing House, N.Delhi

Course outcomes:

- CO1 Explain the different types of layout and plant maintenance with safety
- CO2 List and explain the need of method study and work measurements
- CO3 Explain the production planning and quality control, and its functions
- CO4 Understand the basic principles, approaches and functions of management and identify concepts to specific situations
- CO5 List and explain the different financial sources and methods of inventory management.

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Open Elective / COE

FARM EQUIPMENT AND FARM MACHINERY

Subject Code	Theory						Credits
2025505B	No. of Periods Per Week			Full Marks	:	100	02
	L	T	P/S	ESE	:	70	
	03			TA	:	10	
				CA	:	20	

Course objectives:

- To find and characterize the machinery based on crop production.
- To find the field efficiency and capacities to calculate the economics ofmachinery.
- To find the machines usages for different tillage, and its power requirement calculations.
- To understand sowing, planting & transplanting equipment based oncrop.
- To understand machinery materials and heat effects for different farm machinery equipment.

CONTENTS: THEORY

Unit	Name of Topic	Hrs
Unit-I	**Introduction to farm mechanization**: 1.1 Classification of farm machines. Unit operations in crop production. Identification and selection of Machines for various operations on the farm. Hitching systems and controls of farm machinery.	08
Unit-II	**Calculation of field capacities and field efficiency**: 2.1 Calculations for economics of machinery usage, comparison of ownership with hiring of machines. Introduction to seed-bed preparation and its classification. Familiarization with land reclamation and earth moving equipment	10
Unit-III	**Introduction to machines** 3.1 used for primary tillage, secondary tillage, rotary tillage, deep tillage and minimum tillage. Measurement of draft of tillage tools and calculations for power requirement for the tillage machines. Introduction to tillage machines like mould-board plough, disc plough, chisel plough, sub-soiler, harrows, puddler, cultivators, identification of major functional components. Attachments with tillage machinery	10
Unit-IV	**Introduction to sowing, planting & transplanting equipment**. 4.1 Introduction to seed drills, no-till drills, and strip-till drills. Introduction to planters, bed planters and other planting equipment like sugarcane, potato. Study of types of furrow openers and metering systems in drills and planters. Calibration of seed-drills/ planters. Adjustments during operation	10
Unit-V	**Introduction to materials used in construction of farm machines**. 5.1 Heat treatment processes and their requirement in farm machines. Properties of materials used for critical and functional components of agricultural machines. 5.2 Introduction to steels and alloys for agricultural application. Identification of heat treatment processes specially for the agricultural machinery components.	10

References:

1. Farm Equipment & Farm Machinery - Sanjay Pandey , FPH
2. Farm Machinery and Equipment - H. P. Smith
3. Farm Machinery and equipment - C. P. Nakra
4. Engineering principles of Agril. Machines - Dr. Ajit K. Srivastav, Caroll E. Goering and Roger P. Rohrbach.
5. Farm Machinery – an Approach - S. C Jain & Grace Phillips
6. Agril. Engineering through worked out examples - Dr. R. Lal and Dr. A.C. Dutta
7. Farm Power and Machinery Engineering - Dr.R. Suresh and Sanjay Kumar

Course outcomes:

At the end of the course, the student will be able to:

CO1 Classify the Farm Machineries, equipment and materials

CO2 Describe the objectives of Farm mechanization.

CO3 Explain selection of the machineries

CO4 Discuss the forces acting on tillage tools and hitching systems

CO5 Understand the calibration, constructional features and working of various farm equipments.

ARTIFICIAL INTELLIGENCE (BASICS)

Subject Code 2000505B	Theory			No of Period in one session :			Credits
	No. of Periods Per Week			Full Marks	:	100	02
	L	T	P/S	ESE	:	70	
	03	—	—	TA	:	10	
				CT	:	20	

Rationale:

Artificial Intelligence , also known as data-driven science, is an interdisciplinary field of scientific methods, processes, and systems to extract knowledge or insights from data in various forms, structured or unstructured, similar to data mining.

What's the focus of this Curriculum?

Artificial Intelligence program is designed to impart an in-depth knowledge of the various libraries and packages required to perform data analysis, data visualization, web scraping, machine learning, Deep Learning using Python. The course is packed with real-life projects, assignments, demos, and case studies to give hands-on and experiments to the participants.

Course Objectives:

- This course gives an overview of the fundamentals of artificial intelligence.
- It contains a theory and practical component modern AI algorithms
- A practice component based on the real world problem to relate theoretical algorithms with experimental implementation.
- This course is divided into two parts viz.(Theory and Experiments)

Course Outcomes:

CO 1 : Understand the objectives and functions of modern Artificial Intelligence.
CO 2 : Develop AI based System Design & Development
CO 3 : Categorize an AI problem based on its characteristics and its constraints.
CO 4 : Develop AI Solutions & Applications
CO 5 : Knowledge of machine learning algorithms and extracting knowledge models from data.
CO 6 : Develop AI & Organizational Intelligence
CO 7 : Analyze the complexity of a given problem and come with suitable optimizations

	Contents: Theory	HRS
Unit -1	**Introduction to Data Science** **1)** Introduction to Data Science, ML, DL & AI - why is it so important? **2)** Applications of Data science across industries **3)** Business problems – Analytics scenarios **4)** Python for Data Science **5)** Data Scientist Toolbox, Tool of choice- Python: what & why? **6)** Data Scientist - Tasks and Capabilities **7)** Introduction to NumPy arrays, functions & properties 8) Introduction to pandas, Data frame functions and properties	

Unit -2	**Practice assignment – 2A Numerical Summary of Data** 1) Summarizing numeric data and categorical data in pandas 2) Group wise summary of mixed data 3) Visual summary of different data combinations **Practice assignment – 2B** **Data Visualization using Python** 1)Need for visual summary 2)Introduction to Seaborn	
Unit -3	**Basics of Statistics** **1)** Introduction to Univariate Statistics, Shape **2)** Central Tendency and variability 3) Outliers 4) Correlation **5)** Introduction to Linear Algebra **6)** Mathematics for Machine Learning **7)** Vectors and Matrices **8)** Matrices Operations **9)** Applications to Data Problems	

BIBLIOGRAPHY:

1. http://Pandas.pydata.org/Pandas-docs/version/0.23/tutorials.html

2. https://docs.python.org/3/tutorial/datastructures.html

3. https://docs.scipy.org/doc/numpy/user/quickstart.html

4. https://wiki.python.org/moin/TimeComplexity

5. Python Data Science Handbook: Essential Tools for Working with Data by Jake VanderPlas

6.Artificial Intelligence And Deep Learning For Decision Makers: A Growth Hacker's Guide To Cutting Edge Technologies by Dr. Jagreet Kaur

7. Machine Learning using Python by Manaranjan Pradhan

INTERNET OF THINGS (IOT) (BASICS)

Subject Code 2000505 C	Theor			No of Period in one session			Credit
	No. of Periods Per Week			Full Marks	:	100	02
	L	T	P/	ES	:	70	
	03	—	—	TA	:	10	
				CT	:	20	

Rationale:

Course Objectives:

- Get Internet of Things (IoT) Fundamentals
- A background in electronic engineering or a related subject
- An understanding of basic networking
- Some software (coding) experience
- This course is divided into three parts viz.(Theory , Experiments and mini project component)

Course Outcomes:

CO 1 : Explain the definition and usage of the term "Internet of Things" in different contexts

CO 2 : Understand the key components that make up an IoT system

CO 3 : Differentiate between the levels of the IoT stack and be familiar with the key technologies and protocols employed at each layer of the stack

CO 4 : Apply the knowledge and skills acquired during the course to build and test a complete, working IoT system involving prototyping, programming and data analysis

Contents: Theory		HRS
Unit -1	**Introduction to Internet of Things** **1)** Introduction to python and IOT Development Platforms **2)** IOT Software and Cloud Services **Practice Assignment**	
Unit -2	**Introduction to communication protocol and sensors** 1) IOT Communication Protocols 2) Identification and Localization for IoT 3) Introduction to node MCU 4) Device integration with node MCU 5) Sensors and Actuators **Practice assignment**	
Unit -3	**Introduction to APIs** **1)** APIs, and Client-Server Model for intranet and communication system **2)** Identification and Localization for IoT **3)** IOT based data-monitoring system **4)** Database creation on cloud	

Text Books/References:

1. Amini, P. (2014). Sulley: Pure Python fully automated and unattended fuzzing frame- work. https://github.com/OpenRCE/sulley

2.Internet of things (IoT) : technologies, applications, challenges and solutions by BK

3.. https://wiki.python.org/moin/TimeComplexity

4.. Internet-of-Things (IoT) Systems: Architectures, Algorithms, Methodologies by Dimitrios Serpanos & Marilyn Wolf

5.Custom Raspberry Pi Interfaces: Design and build hardware interfaces for the Raspberry Pi by Warren Gay

DRONE TECHNOLOGY (BASICS)

Subject Code 2000505 D	Theory			No of Period in one session :			Credits
	No. of Periods Per Week			Full Marks	:	100	02
	L	T	P/S	ESE	:	70	
	03	—	—	TA	:	10	
				CT	:	20	

Rationale:

In this Era of technology the demand for drones are increasing in the field of infrastructure, engineering, security, surveillance, environmental studies and monitoring. CoE-Drone initiative will address various aspects of the development and application of drone technology such as technological advancements, training, legal aspects, administrative management, and logistics. In this Center of Excellence we will collaborate with institutes and it is to provide a better environment for students and professionals. Drone Technology has applications across technological advancements, training, legal aspects, administrative management, and logistics. This tutorial for beginners covers all the basics of Drone Technology (UAV).

Course Objectives:

- Gain knowledge about the flying techniques of drones.
- Use of drones for the safe and secured methodology of data gathering.
- Understand the rules and compliance for drone operations,
- Understand the potential drone applications such as agriculture, survey, delivery system, safety, security and many other wider fields.

Course Outcomes:

CO 1 : Safely operate a drone using an understanding of drone components, equipment, and technology.

CO 2 : Integrate factors impacting drone flight such as environment, weather, and geography into planning and operations.

CO 3 : Plan drone flights using an understanding of FAA and National Airspace System regulations and drone operation ethics.

CO 4 : Use effective Crew Resource Management during field data collection.

CO 5 : Program and fly a drone equipped with GPS to capture video and/or still photography.

CO 6 : Use post-processing techniques to achieve project goals.

Contents: Theory		HRS
Unit -1	**Introduction to Drone Technology** **1)** Introduction to Drones and UAV **2)** drone flights using an understanding of FAA **3)** Introduction to Flight Dynamics **4)** Various types of Drones and their respective Applications **Practice Assignment**	
Unit -2	**Introduction to Drone component:** 1) Parts of Drones 2) Sensors 3) Motors 4) Application of DC motors in drones **Practice assignment**	

Unit -3	**Introduction to Drone controller and motion** **1)** Propulsion and Vertical Motion **2)** Controller and Flying Instructions	

Text Books/References:

1. DIY Drone and Quadcopter Projects: A Collection of Drone-Based Essays, Tutorials, and Projects by Make Magazine

2. Make: Getting Started with Drones: Build and Customize Your Own Quadcopter by Terry Kilby & Belinda Kilby

3. Agricultural Drones: A Peaceful Pursuit by K R Krishna

4. Building Multicopter Video Drones: Build and fly multicopter drones to gather breathtaking video footage by **Ty Audronis**

3D PRINTING & DESIGN (BASICS)

Subject Code 2000505 E	Theory			No of Period in one session :			Credits
	No. of Periods Per Week			Full Marks	:	100	02
	L	T	P/S	ESE	:	70	
	03	—	—	TA	:	10	
				CT	:	20	

Rationale:

COURSE OBJECTIVES

The student will be able to

- To gain knowledge and skills related to 3D printing technologies.
- To learn the selection of material, equipment, and development of a product for the Industry 4.0 environment.
- To understand the various software tools, processes and techniques for digital manufacturing.
- To apply these techniques to various applications.

COURSE OUTCOMES

After completion of this course, the students will be able to:

CO 1 : Develop CAD models for 3D printing.

CO 2 : Import and Export CAD data in STL file format and able to generate GCODE of file.

CO 3 : Select a specific material for the given application.

CO 4 : Select a 3D printing process for an application.

CO 5 : Produce a product using 3D Printing or Additive Manufacturing (AM).

Contents: Theory		HRS
Unit -1	INTRODUCTION CAD-CAM and its integration, Process chain for 3D Printing, Classification of 3D Printing Processes, Product design and prototyping, Advantages, Additive v/s Conventional Manufacturing processes, Applications, Reverse Engineering for 3D Printing.	
Unit -2	DATA PREPARATION FOR 3D Printing STL interface Specification, STL data generation, STL data Manipulation, Advantages and limitations of STL file format, Open files, Repair of STL files, Alternative 3D Printing interfaces, Part orientation and support generation, Factors affecting part orientation, Various models for part orientation determination, The function of part supports, Support structure design, Automatic support structure generation. Model Slicing and Contour Data organization, Direct and adaptive slicing: Identification of peak features, Adaptive layer thickness determination, Tool path generation	

Unit -3	Additive Manufacturing Techniques Stereo- Lithography, LOM, FDM, SLS, SLM, Binder Jet technology, Direct Energy Deposition. Process, Process parameter, Process Selection for various applications, typical materials and applications. Additive Manufacturing Application Domains: Aerospace, Electronics, Health Care, Defense, Automotive, Construction, Food Processing, Machine Tools	

LIST OF SUGGESTED BOOKS

1. Lan Gibson, David W. Rosen and Brent Stucker, "Additive Manufacturing Technologies:Rapid Prototyping to Direct Digital Manufacturing", Springer, 2010.

2. Andreas Gebhardt, "Understanding Additive Manufacturing: Rapid Prototyping, Rapid Tooling, Rapid Manufacturing", Hanser Publisher, 2011.

3. Khanna Editorial, "3D Printing and Design", Khanna Publishing House, Delhi.

4. CK Chua, Kah Fai Leong, "3D Printing and Rapid Prototyping- Principles and Applications", World Scientific, 2017.

5. D. Majumdar and I. Manna, "Laser-Assisted Fabrication of Materials", Springer Series in Material Science, 2013.

6. L. Lu, J. Fuh and Y.S. Wong, "Laser-Induced Materials and Processes for Rapid Prototyping", Kulwer Academic Press, 2001.

7. Zhiqiang Fan And Frank Liou, "Numerical Modelling of the Additive Manufacturing (AM) Processes of Titanium Alloy", InTech, 2012.

INDUSTRIAL AUTOMATION (BASICS)

Subject Code 2000505 F	Theory			No of Period in one session :			Credits
	No. of Periods Per Week			Full Marks	:	100	02
	L	T	P/S	ESE	:	70	
	03	—	—	TA	:	10	
				CT	:	20	

Rationale:

Course Objectives:

- Understanding the fundamental terminologies used in the manufacturing industry, viz. lead time, cycle time, production rate, communication.
- Understanding of the discussions, subjects, and programming.
- This course is divided into two parts viz.(Theory & Experiments)

Course Outcomes:

CO 1 : Understand the various Automation Strategies.

CO 2 : Co-relate Industrial Manufacturing Processes and Applications

CO 3 : Understanding to Reduces production time while maintaining excellent accuracy

CO 4 : Understanding the basic operation of electrical and electronic devices.

CO 5 : Learn software (coding)

	Contents: Theory	HRS
Unit -1	**What is Industrial Automation** **1)** **Introduction to Industrial Automation and component** **2)** Applied Mathematics **3)** Temperature Measurement **4)** AC VS DC **5)** Motors **6)** Power Supply **7)** Fuses **8)** Circuit Breakers Relays	
Unit -2	1) Three Phase Systems 2) Automation Principles and Strategies 3) Introduction to Computer Integrated Manufacturing 4) Overloads and Overcurrents 5) MCCB 6) Motor Driving overview **Practice assignment**	

Unit -3	**1)** FW-BW Motor Driving Design **2)** Simulating FW-BW **3)** Star-Delta Motor Driving **4)** Limit Switches **5)** Role of Sensors in an Automation System **6)** Level Sensors **7)** Temperature Sensors **8)** Flow Sensors Pressure Sensors	

ELECTRIC VEHICLES (BASICS)

Subject Code 2000505 G	Theory			No of Period in one session :			Credits
	No. of Periods Per Week			Full Marks	:	100	02
	L	T	P/S	ESE	:	70	
	03	—	—	TA	:	10	
				CT	:	20	

Rationale:

Based on above lab details and equipment specifications, students will be trained to meet the demand of EV industry. Theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry-oriented competency.

Course outcomes:

CO 1 : Explain the fundamental concept of an Electric Vehicle.
CO 2 :.Explain the application and functions of various Electronic Hardware in an EV.
CO 3 : Explain the role of a Motor & Transmission Control in an EV.
CO 4 : Interpret the salient features of Hybrid Electric Vehicles.
CO 5 : Interpret the Dynamics of hybrid and Electric Vehicles.
CO 6 : Maintain the DC-DC and DC-AC converters in EV applications.
CO 7 : Select the batteries for EV applications.

Contents: Theory		HRS
Unit -1	**Electrical Fundamentals** Fundamentals of Electrical engineering, Wiring, Power generation, distribution and transmission, Earthing and Insulation, RLC circuits, Transformers, AC/DC systems, DC/DC systems, Introduction to EV Powertrain, AC-DC Converters, DC-DC Converters, Auxiliary Battery Systems, Regenerative systems	
Unit -2	**Introduction to Electric Vehicles** Introduction to Electric Vehicles, Electric Drives, Energy Storage, Energy management system, mobility and connectors	
Unit -3	**Electric Motors** Introduction to electrical machines, DC Motor Dynamics and control, AC Motor Dynamics and Control, PWM and Inverter	
Unit -4	**Battery and Energy Storage** Battery Fundamentals- characteristics, configuration and parameters, Battery pack and Battery management system, Battery testing, disposal and recycling	
Unit -5	**Charging Stations** Introduction to Charging stations, On-board and off-board chargers, CHAdeMO charging system, CCS charging system, GB/T charging system, Indian Charging system, CAN communication and interaction with VCU	

ROBOTICS (BASICS)

Subject Code 2000505 H	Theory			No of Period in one session :			Credits
	No. of Periods Per Week			Full Marks	:	100	
	L	T	P/S	ESE	:	70	
	03	—	—	TA	:	10	02
				CT	:	20	

Rationale:

Course Objectives:

- Understanding of the basic concepts of design, Function and applications of Robots
- Application of sensors and drives in the Robots
- Learn the robot programming and robot kinematics
- Learn software (coding)
- This course is divided into two parts viz.(Theory and Experiments)

Course Outcomes:

CO 1 : The students will be able to apply the basic engineering after this course
CO 2 : Gain knowledge for the robotics design .
CO 3 : Understand robot Functionality and key robot part.
CO 4 : Will understand application of Robots

	Contents: Theory	HRS
Unit -1	**What is Robotics** **1) Introduction to Robotics and history of Robot types and component** **2)** Robot Control :Basics of control: open loop- closed loop, Transfer functions, Control laws: P, PD, PID **3)** Sensors in Robotics: Contact and Proximity, Position, Velocity, Force, Tactile Robot Simulation software	
Unit -2	1) Control Hardware and Interfacing **2)** Classification of robots 3) Forward and inverse kinematics, Jacobian, Singularity, and Statics 4) Axis and Angle Representations 5) Actuators in Robotics: Electric, Hydraulic and Pneumatic; Transmission: Gears Timing Belts and Bearings, Parameters for selection of actuators **Practice assignment**	
Unit -3	**1)** Position and Orientation in Robot **2)** The Pose of a Rigid Body Kinematic Modeling: Translation and Rotation Representation, Coordinate transformation, DH parameters	

Text Book/References:

1. Introduction to Robotics : J. Craig , Pearson
2. Robotics Engineering : R. Klafter, PHI
3. Industrial Robotics : M. P. Groover, Ashish Dutta , McGraw Hill

CAD/CAM LAB

Subject Code 2025506	Practical			No of Period in one session :			Credits
	No. of Periods Per Week			Full Marks	:	50	02
	L	T	P/S	Internal (PA)	:	15	
	—	—	04	External (ESE)	:	35	

Course Objectives:

- To understand the fundamentals and use CAD.
- To conceptualize drafting and modeling in CAD.
- To interpret the various features in the menu of solid modeling package.
- To synthesize various parts or components in an assembly.
- To prepare CNC programmes for various jobs.

Course Content:

S.No. Topics for practice

PART-A Introduction: Part modelling; Datum Plane; constraint; sketch; dimensioning; ex- trude; revolve; sweep; blend; protrusion; extrusion; rib; shell; hole; round; chamfer; copy; mirror; assembly; align; orient.

Exercises: 3D Drawings of

1). Geneva Wheel; 2). Bearing Block; 3). Bushed bearing: 4). Gib and Cotter joint; 5). Screw Jack; 6). Connecting Rod:

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). Execute the program in the CNC machines; Exercises:

Note: Print the Program from the Simulation Software and make the Component in the CNC Machine.

CNC Turning Machine: (Material: Aluminium/Acrylic/Plastic rod)

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

CNC Milling Machine (Material: Aluminium/ Acrylic/ Plastic)

1. Using Linear interpolation and Circular interpolation – Create a part program for grooving and produce component in the Machine.
2. Using canned cycle - Create a part program for drilling, tapping, counter sinking and produce component in the Machine.
3. Using subprogram - Create a part program for mirroring and produce component in the Machine.

Reference Books:

1. Machine Drawing – P.S. Gill S. K. Kataria& Sons, Delhi., 17th Revised edition, 2001
2. Mechanical Draughtsmanship - G.L. TamtaDhanpatRai& Sons, Delhi, 1992
3. Inside AutoCAD – D. Raker and H. Rice, BPB Publications, New Delhi, 1985
4. CAD/CAM/CIM – P. Radhakrishnan, S. Subramaniyan& V. Raju, New Age International Pvt. Ltd., New Delhi, 3rd Edition,
5. Engineering AutoCAD, A.P. Gautam& Pradeep Jain, Khanna Book Publishing Co., Delhi

Course outcomes:

At the end of the course, the student will be able to:

CO1	Explain the 3D commands and features of a CAD software
CO2	Create 3D solid model and find the mass properties of simplessolids
CO3	Demonstrate the working of CNC turning and milling machine
CO4	Develop the part program using simulation software for Lathe and Milling
CO5	Assess the part program, edit and execute in CNC turning and machining centre

Elective Lab I
REFRIGERATION AND AIR-CONDITIONING LAB

Subject Code 2025507A	Practical			No of Period in one session :			Credits
	No. of Periods Per Week			Full Marks	:	25	01
	L	T	P/S	Internal (PA)	:	07	
	—	—	02	External (ESE)	:	18	

Course objectives:

- To understand the basics of Refrigeration cycles.
- To understand basics of vapour compression and vapourabsorbtion systems.
- To identify components and refrigerants and lubricants of a refrigeration system.
- To understand control strategies for refrigeration system.
- To understand the basics about air conditioning systems.

CONTENTS: PRACTICAL

(i) To Find COP of vapour compression refrigeration system.
(ii) Study of different types of condenser in refrigeration system.
(iii) Study of evaporators used in refrigeration system.
(iv) To find out DBT and WBT of given thermometer.
(v) Study of sling Psychrometer.
(vi) Study of factors affecting air conditioning.
(vii) To detect refrigerant leakage.

References:

1. Refrigeration and Air Conditioning – Sadhu Singh, Khanna Book Publishing Co., New Delhi
2. Refrigeration and Air Conditioning – S. Domakundawar, DhanpatRai publications.
3. Refrigeration and Air Conditioning – A.S.Sarao& G.S. Gabi, 6th edition, SatyaPrakashan pub- lications, New Delhi, 2004.
4. Principles of Refrigeration – Roy J.Dossat, 5th edition, Pearson Publications, 2001.
5. Refrigeration and Air Conditioning – M.ZakriaBaig, Premier/ Radiant Publishing House.
6. Refrigeration and Air Conditioning – C.P Arora, Tata McGraw Hill Education, 2000.

Course outcomes:

At the end of the course, the student will be able to:
CO1 Define refrigeration and types of Refrigeration cycles
CO2 Explain Vapour Compression and Vapour Absorbtion System working principles
CO3 Identify the components required for refrigeration system.
CO4 Identify the controlling components for a refrigeration system. CO5 Explain the working principles of Air-conditioning.

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ELECTIVE LAB I
HEAT TRANSFER LAB

Subject Code 2025507B	Practical			No of Period in one session :			Credits
	No. of Periods Per Week			Full Marks	:	25	01
	L	T	P/S	Internal (PA)	:	07	
	—	—	02	External (ESE)	:	18	

CONTENTS: PRACTICAL

(i) To study of different types Fins on models in laboratory.
(ii) To study of parallel flow heat exchange and find itsefficiency experimentally.
(iii) To study of counter flow heat exchanger and its efficiencyexperimentally.
(iv) Study of Heissier chart.
(v) Study of Grey- Diffuse Isotropic surface.
(vi) Study of LMTD of heat exchanger available in lab.

References:

1. Fundamentals of Heat and Mass Transfer by F.P.Incropera and D.P.Dewitt, 4th ed., John Wiley & Sons.
2. Heat Transfer - A Basic Approach by M.N.Ozisik, McGrawhill.
3. Heat Transfer by J.P.Holman, 8th ed., McGrawhill.
4. Elements of Heat & Mass Transfer by Vijay Gupta, 2nd ed., New Age International Publishers. Course outcomes:

Course outcomes:

At the end of the course, the student will be able to:
CO1 Understand the concepts of conduction

CO2 understand the concepts of fins

CO3 Understand the concepts of radiation.

CO4 Understand the concepts of convection

CO5 Understand the basic concepts of heat exchangers.

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ELECTIVE LAB I
POWER PLANT ENGINEERING LAB

Subject Code 2025507C	Practical			No of Period in one session :			Credits
	No. of Periods Per Week			Full Marks	:	25	01
	L	T	P/S	Internal (PA)	:	07	
	—	—	02	External (ESE)	:	18	

Course objectives:

- To understand the present scenario of power in India.
- To recognize various load terminologies used in power plants.
- To understand hydro working principles
- To understand working of Diesel, Gas and Nuclear power plants.
- To understand the issues and safety precautions in power plants.

CONTENTS: PRACTICAL

i To study of performance and operating characteristic of power plant.

ii To study of diesel power plant and its layout.

iii To study of advantages of hydral power plant and show its schematic diagram

iv To study of thermal fission reactors. PWR, BWR and gas cooled reactors.

v To study the environmental impact of Power plant mainly. Greenhouse effect, acid rain.

References:

1. Power plant Engineering-P.K. Nag 4th edition, Tata McGraw Hill Education, 2014.
2. Power plant Engineering – Frederick T. Morse, Litton Educational Publishing Inc. 1953.
3. A Course in Power Plant Engineering – Subhash C. Arora, S. Domakundwar, DhanpatRai, 1984.
4. Power Plant Engineering – P.C. Sharma, S.K.Kataria& sons, 2009.
5. Power System Engineering – R.K. Rajput, Firewell Media,2006.

Course outcomes:

At the end of the course, the student will be able to:

CO1 Familiarised with the present and future power scenario of India.

CO2 Enlist various load terminologies in power plants

CO3 Working and classifications in hydro power plant

CO4 Working principles of Diesel, Gas and Nuclear power plants.

CO5 Understand the issues and necessity of safety concepts of power plants.

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ELECTIVE LAB /COE LAB
AUTOMOBILE ENGINEERING LAB

Subject Code 2025508A	Practical			No of Period in one session :			Credits
	No. of Periods Per Week			Full Marks	:	50	03
	L	T	P/S	Internal (PA)	:	15	
	—	—	06	External (ESE)	:	35	

Course objectives:

- To understand the basic structure and components of an automobile.
- To understand the concepts of cooling and lubricating systems.
- To understand the concepts of Ignition and transmission and steering systems.
- To understand the classification and necessity of suspension system.
- To identify different special vehicles.

CONTENTS: PRACTICAL

(i) To Study of cooling system of four stroke petrol/diesel engine available in lab.

(ii) To study of ignition system of petrol engine.

(iii) To study of ignition system of diesel engine

(iv) To study of steering system available in lab.

(v) To study transmission system available in lab.

(vi) To study of suspension system available in lab.

References:

1. Automobile Engineering Vol I, II, Kirpal Singh, Standard Publishers Distributors, Delhi.2012.
2. Automobile Mechanics, A.K. Babu, S.C. Sharma, Khanna Publications, New Delhi
3. Automotive Mechanics: Principles and Practices, Joseph Heitner, East West Press
4. Automotive Mechanics, S. Srinivasan, 2nd Edition, Tata McGraw Hill
5. Automobile Engineering Vol I and Vol II, K. M. Gupta, Umesh Publications.
6. Automotive Engineering, Jain and Asthana, Tata McGraw Hill.

Course outcomes:

At the end of the course, the student will be able to:

CO1 Identify the components of an automobile with their working

CO2 Explain the concepts of cooling and lubricating systems.

CO3 Explain the concepts of Ignition and Transmission and steering systems.

CO4 Identify different suspension systems and their applications.

CO5 Differentiate the special vehicles according to the usage.

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Elective Lab / COE LAB

FARM EQUIPMENT AND FARM MACHINERY LAB

Subject Code 2025508B	Practical			No of Period in one session :			Credits
	No. of Periods Per Week			Full Marks	:	50	03
	L	T	P/S	Internal (PA)	:	15	
	—	—	06	External (ESE)	:	35	

Course objectives:

- To find and characterize the machinery based on crop production.
- To find the field efficiency and capacities to calculate the economics ofmachinery.
- To find the machines usages for different tillage, and its power requirement calculations.
- To understand sowing, planting & transplanting equipment based on crop.
- To understand machinery materials and heat effects for different farmmachinery equipment.

CONTENTS: PRACTICAL

(i) Study of Primary tillage machines.

(ii) Study of rotary tillage and deep tillage machines.

(iii) Study of disc plough and chisel Plough.

(iv) Study of planting and transplanting equipment.

(v) To Study of Heat treatment process for agricultural machinery.

(vi) Calibration of seed- drills/planters.

References:

1. Principles of Farm Machinery - R.A. Kepner, Roy Bainer, and E. L. Berger
2. Farm Machinery and Equipment - H. P. Smith
3. Farm Machinery and equipment - C. P. Nakra
4. Engineering principles of Agril. Machines - Dr. Ajit K. Srivastav, Caroll E. Goering and Roger P. Rohrbach.
5. Farm Machinery – an Approach - S. C Jain & Grace Phillips
6. Agril. Engineering through worked out examples - Dr. R. Lal and Dr. A.C. Dutta
7. Farm Power and Machinery Engineering - Dr.R. Suresh and Sanjay Kumar

Course outcomes:

At the end of the course, the student will be able to:

CO1 Classify the Farm Machineries, equipment and materials

CO2 Describe the objectives of Farm mechanization.

CO3 Explain selection of the machineries

CO4 Discuss the forces acting on tillage tools and hitching systems

CO5 Understand the calibration, constructional features and working of various farm equipments.

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ARTIFICIAL INTELLIGENCE LAB (BASICS)

Subject Code 2000508 B	Practical			No of Period in one session:			Credits
	No. of Periods Per Week			Full Marks	:	50	03
	L	T	P/S	Internal (PA)	:	15	
	—	—	06	External (ESE)	:	35	

Rationale:
Objective:

	Contents: Practical	Hrs
Unit -1	**Introduction to Python** **1)** Installation of Python framework and packages: Anaconda and pip **2)** Writing/Running python programs using Spyder, Command Prompt **3)** Working with Jupyter Notebooks **4)** Creating Python variables: Numeric, string and logical operations 5) Basic Data containers: Lists, Dictionaries, Tuples & sets **Practice Assignment-2 Operations & Functions in Python** 1)Writing for loops in Python 2) List & Dictionary Comprehension 3) While loops and conditional blocks 4) List/Dictionary comprehensions with loops 5) Writing your own functions in Python 6)Writing your own classes and functions as class objects 7) Introduction to NumPy arrays, functions & properties in python	
Unit -2	1)Reading and writing external data 2)Manipulating Data Columns	
Unit -3	1) Introduction to Univariate Statistics, Shape 2) Central Tendency and variability 3) Outliers 4) Correlation 5) Z-score 6) Normalization	
	Total	

INTERNET OF THINGS (IOT) LAB (BASICS)

Subject Code 2000508 C	Practical			No of Period in one session:			Credits
	No. of Periods Per Week			Full Marks	:	50	03
	L	T	P/S	Internal (PA)	:	15	
	—	—	06	External (ESE)	:	35	

Contents: Practical		Hrs
Unit -1	**Introduction to Python for IoT** **1)** Python programing refreshers for IoT **2)** Integration of python program with cloud services **3)** Microsoft Azure, AWS and GCP **Practice Assignment**	
Unit -2	1)Python and Cloud for sensor integration 2) IoT Kit development with sensors and camera integration 3)Home Automation System **Practice assignment**	
Unit -3	1) Face Recognition Bot 2) Working with Raspberry pi development with sensor 3) Smart Garage Door **Practice assignment**	
	Total	

DRONE TECHNOLOGY (BASICS) LAB

Subject Code 2000508 D	Practical			No of Period in one session:			Credits
	No. of Periods Per Week			Full Marks	:	50	03
	L	T	P/S	Internal (PA)	:	15	
	—	—	06	External (ESE)	:	35	

Contents: Practical		Hrs
Unit -1	**Introduction to Python for Drone** **1)** Python programing refreshers for IoT, AI and Drone **2)** Integration of devices with cloud services **3)** Microsoft Azure, AWS **Practice Assignment**	
Unit -2	1)Understanding Electronic Components like IC, Resistors, Capacitors, Inductors 2) Fly with a Smartphone as a Controller 3) Design & Development of basic drone **Practice assignment**	
Unit -3	1. Understanding of various Drone Components such as Fan, Propeller, Electric-Motor, Camera System, GPS, etc. 2. Kits development for basics drone applications 3. Training on Drone simulator software viz. Air Sim **Practice assignment**	
	Total	

3D PRINTING & DESIGN LAB (BASICS)

Subject Code 2000508 E	Practical			No of Period in one session:			Credits
	No. of Periods Per Week			Full Marks	:	50	03
	L	T	P/S	Internal (PA)	:	15	
	—	—	06	External (ESE)	:	35	

List of Experiment

	Contents: Practical	Hrs
	1. To study the anatomy of FDM based 3D Printer Machine. 2. To model the single 3-D component using CAD software. 3. To model 3D multiple components joined together to form assembly. 4. To Practice on CAD Data Exchange in different file formats. 5. To study the various Pre-processing requirements on 3D printing. 6. To calibrate the 3D printer and making it ready for 3d print. 7. To Analyze and apply different process of algorithm for slicing/supports/layers/orientation etc. 8. To study the relationship between different process parameter of slicing tool and printing time. 9. To Scan the any 3D object using 3D scanner and prepare it for 3d printing. 10. To design and develop any machine components prototype into 3D printer Machine.	
	Total	

INDUSTRIAL AUTOMATION LAB (BASICS)

Subject Code 2000508F	Practical			No of Period in one session:			Credits
	No. of Periods Per Week			Full Marks	:	50	03
	L	T	P/S	Internal (PA)	:	15	
	—	—	06	External (ESE)	:	35	

Rationale:
Objective:

Contents: Practical		Hrs	
Unit -1	**1)** Circuit Simulation Software Installation **2)** Simulating a Relay **3)** Contactors, Simulating a Contactor **Practice Assignment**		
Unit -2	1. Direct Driving Design 2. Simulating Direct Drive 3. Pressure and Temperature Transmitters 4. Flow Measurement Practice assignment		
Unit -3	1. Simulation FW-BW 2. Simulation Star-Delta **Practice assignment**		
	Total		

ELECTRIC VEHICLES LAB (BASICS)

Subject Code 2000508 G	Practical			No of Period in one session:			Credits
	No. of Periods Per Week			Full Marks	:	50	03
	L	T	P/S	Internal (PA)	:	15	
	—	—	06	External (ESE)	:	35	

Lab: Electric Vehicle (21 Hrs Duration)

1. Evaluation of charging characteristics of battery using CC, CV and CP mode.
2. Evaluation of discharging characteristics of battery.
3. Evaluation of charging/discharging of battery while charging/discharging with different C-rate.
4. Evaluation of Battery Charging/Discharging characteristics at different ambient temperatures. (Using thermal chamber)
5. Fuel economy comparison with new set of batteries and aged batteries.
6. Demonstrate the effect on state of health after a no. Of charge/discharge cycle.
7. Evaluate the temperature cut-off point for BMS.
8. Testing batteries and comparing performance using different testing standards:

   a) GB/T-31484 or 31485

   b) IEC 62660-1: 2018 or IEC 62660-2 : 2018

9.Comparing performance of battery and finding gas gauge after charging battery

   a) 0%-100%

   b) 30%-100%

   c) 50%-100%

10.A) Evaluate specific power, specific energy, life span, performance and cost parameter of EV battery.

   B) Evaluate SoH of EV battery after a no. of charge/discharge cycles.

   C) Selecting suitable battery for EV based on the above findings

ROBOTICS LAB (BASICS)

Subject Code 2000508 H	Practical			No of Period in one session:			Credits
	No. of Periods Per Week			Full Marks	:	50	03
	L	T	P/S	Internal (PA)	:	15	
	—	—	06	External (ESE)	:	35	

Contents: Practical		Hrs
Unit -1	**1)** Study components of an industrial robot **2)** Robot simulator for Robotics **3)** Integration of assorted sensors (IR, Potentiometer, strain gages etc.) **Practice Assignment**	
Unit -2	**1.** Forward kinematics and validation using a software (Free software tool). **2.** War Field Spying Robot using Night Vision Wireless Camera 3. Obstacle Avoiding Robot Practice assignment	
Unit -3	1. Inverse kinematics of an industrial robot and validation using any open source software. 2. Smart Cleaning Robot 3. Microcontroller lab (open source) **Practice assignment**	
	Total	

TERM WORK

Summer Internship-II (4 weeks)

Subject Code	Term Work			No of Period in one session :			Credits
	No. of Periods Per Week			Full Marks	:	50	
	L	T	P/S	Internal (PA)	:	15	02
2025509	—	—	4 weeks	External (ESE)	:	35	

- How important is it really to do an internship before applying for a job?
- Do you need to get the hands-on experience that is talked about when discussing the importanceof internships or is it a matter of just landing the right job?

During the Course duration year, students may feel overwhelmed with coursework, sports, or co-curricular activities that may keep them extremely busy while leaving no time to think of doing an internship or a job. Many students may also feel that they are caught in a bind since they need to make money to pay for their expenses but they can only find unpaid internships in their field.

Getting Your Feet Wet

Internships are a proven way to gain relevant knowledge, skills, and experience while establishing important connections in the field. Internships are also a way to get your feet wet and find out if a specific field is something you could see yourself doing full-time.

Internships may be completed during fall or spring semester or full time over the course of the summer. Unpaid internships may be easier to get but may also pose problems if making money is necessary, especially during the summer. There are many who cannot afford to work for no pay, so they are forced into doing menial jobs such as wait staff or bartending to work their way through college. It may preclude some from doing an internship which may be a detriment when hoping to get a full-timejob.

Financial Considerations

Financial considerations when looking for an internship can make a big difference in the decision-making process. Sometimes, students will take a part-time or full-time job to supplement the time that they are spending at their internship. Whether an internship is paid or unpaid, there are many things that need to be taken into consideration to decide if an internship is worthwhile. It's important to decide if an internship will ultimately be in the best interest of the student to help meet the requirements needed when applying for a full-time job.

How to Get Funding for an Internship

Some colleges also offer funded internships for students. Check with your college to see if they offer a funded internship program that may help to meet the requirements of your college curriculum while offering experiences that employers seek when hiring new college graduates for entry-level jobs. Many foundations and organizations offer financing to college students so they may try writing to a number of them to see if they provide funding for college students seeking to do internships in their field.

Having an Internship and a Job

Students may elect to do a summer internship a couple of days per week while working a part-time job for the remainder of the time. For those who need to maximize the amount of money they make over the course of the summer, they may look into doing an internship during the academic year whenthey are less likely to expect to make money to help defray their college expenses.

In addition to internships, volunteer opportunities can also be an excellent way to gain experience and exposure to the workforce. Employers love to see volunteer experiences on a student's resume. Volunteering shows commitment to causes and certain values that are intrinsic to the individuals who have participated in these types of experiences. Employers look for employees who are publicly engaged and who take an interest in community service and in doing good work.

TERM WORK

MAJOR PROJECT

Subject Code 2025510	Term Work			No of Period in one session :			Credits
	No. of Periods Per Week			Full Marks	:	25	01
	L	T	P/S	Internal (PA)	:	07	
	—	—	02	External (ESE)	:	18	

Course objectives:

The projects if done right can help enthusiastic Mechanical engineering students to develop the skills/profile needed for an exciting career in core technologies. Since practical skills are very important to work on core industries, experts tend to analyse candidate's performance based on their project experience during the interviews.

These projects provide an excellent opportunity to learn and showcase your practical skills to your future interviewers easily. If spent qualitatively you can build a very innovative electrical project and get a great learning experience. By doing so, you will not only develop an innovative project but also develop valuable skills needed for a successful career in core technologies related to electrical engineering. The best way to master a subject is by doing projects. Through a project you not only get a deeper understanding of the subject but also gain hands-on practical experience. If you are looking to do internships in college, the best way to catch the companies attention is through projects.

Projects are generally done as a combined team effort. Two or more students work under a guide or a staff to get a certain results. By doing a project, you will

- Understand your subject better
- Get practical experience
- Chance to showcase your skills
- Learn about team work, communication skills and responsibilities

When companies look for interns, they prefer students who have good understanding of the subject with atleast some hands on experience. The best to achieve both is by doing projects.

There is no fixed time to do a project. You can do it right from your first year in college. If you are looking to do a technical project, then the best time to start would be mid second year. It’s not mandatory that you do many projects but make sure that you at least do one project. A lot of students tend to do few small projects from their second year and do a big project in their final year. By showcasing your projects, you can even look for internships while in college.

You can do any kind of projects based on your interests or subjects. The best way to go about this is to figure out what you are interested in. So the first step is to find your interest and then do projects in your area of interest.

Find your area of interest and then do a project in that field.

You can start by exploring different areas and then pick the field in which you are interested in. You can learn more about it and start working on small problems.

TERM WORK

Course Under MOOCs/ SWYAM / Others.

Subject Code 2025511	Term Work			No of Period in one session :			Credits
	No. of Periods Per Week			Full Marks	:	50	01
	L	T	P/S	Internal (PA)	:	15	
	—	—	02	External (ESE)	:	35	

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