CURRICULUM

FOR

FIFTH SEMESTER

DIPLOMA IN

MECHANICAL

ENGINEERING

SUBJECT STUDY SCHEME (5TH Semester: Mechanical Engineering)

		Time in Hours				Credits		
Course Code	**Subjects**	**Theory**	**Tutorial**	**Practical**	**Total**	**Theory**	**Practical**	**Total**
MEPC501	Machine Design	3	1	0	4	4	0	4
MEPC502	Theory of Machines & Mechanism	3	0	0	3	3	0	3
Program Elective-B • Heat Transfer (MEPE501) • Automobile Engineering (MEPE502) • Power Plant Engineering (MEPE503)		3	0	0	3	3	0	3
Program Elective-C • Farm Equipment andFarm Machinery **(MEPE504)** • Material Handling Systems **(MEPE505)** • Hybrid Vehicles **(MEPE506)** • Mechatronics **(MEPE507)**		3	0	0	3	3	0	3
MEPR501	**Minor Project**	0	0	4	4	0	2	2
MEPC503	Internship	After the fourth semester during vacation				0	2	2
Open Elective-II • Operations Research **(MEOE501)** • Engineering Economics and Accounting (**MEOE502**) • Work Study & Ergonomics **(MEOE503)**		3	0	0	3	3	0	3
MEPC504	Theory of Machines & Mechanism lab	0	0	2	2	0	1	1
Program Elective-B Lab • Heat Transfer Lab **(MEPE508)** • Automobile Engineering Lab **(MEPE509**) • Power Plant Engineering Lab **(MEPE510)**		0	0	2	2	0	1	1
		15	**1**	**08**	**24***	**16**	**6**	**22**

** Note: 1. The remaining 6 hrs. in a week shall be utilized for sports and other activities like debates, seminars, etc*
2. The Lab in Program Elective-B shall have to be chosen corresponding to the subject opted as Program Elective-B

PROGRAM: THREE YEARS DIPLOMA PROGRAM IN MECHANICAL ENGINEERING	
Course Code: **MEPC 501**	Course Title: **MACHINE DESIGN**
Semester: **5th**	Credits: **4**
Hours Per Week: **4 (L: 3, T: 1, P: 0)**	

COURSE OBJECTIVE:

To enable the student to design and draw simple machine components used in small and Medium-scale industries. To understand the basic philosophy and fundamentals of Machine Design. To analyze and evaluate the loads, forces, and stresses involved in components and sub-assemblies and determine the dimensions. To develop analytical abilities to give solutions toengineering design problems.

COURSE CONTENT

1. Introduction to Design

1.1 Machine Design Philosophy and Procedures; General Considerations in Machine Design; Fundamentals: Types of loads, concepts of stress, Strain, Stress-Strain diagram for Ductile and Brittle Materials, Types of Stresses; Bearing pressure Intensity; Crushing

1.2 Bending and Torsion; Principal Stresses; Simple Numerical; Creep strain and Creep Curve; Fatigue, S-N curve; Endurance Limit; Factor of Safety and Factors governing the selection of factor of Safety; Stress Concentration: Causes & Remedies; Converting actual load or torque into design load or torque using design factors like velocity factor, factor of safety & service factor.

1.3 Properties of Engineering Materials; Designation of materials as per I.S. and introduction to international standards & advantages of standardization; Use of design data book; Use of standards in design and preferred numbers series; Theories of Elastic Failures; Principal normal stress theory; Maximum shear stress theory & Maximum distortion energy theory.

2. Design of Shaft and Keys

2.1 Design of Shafts: Types of Shafts; Shaft materials; Standard Sizes; Design of Shafts (Hollow and Solid) using strength and rigidity criteria.

2.2 Design of Sunk Keys; Effect of Keyways on Strength of Shaft.

3. Design of simple machine parts

3.1 Design of Cotter Joint and Knuckle Joint

3.2 Design of Antifriction Bearings: Classification of Bearings; sliding contact & rolling contact.

3.3 Terminology of Ball bearings: Life Load relationship, Basic static load rating, Basic dynamic load rating, limiting speed; Selection of ball bearings using manufacturer's catalog.

4. Design of Couplings and Gears

4.1 Design of Couplings – Muff Coupling, Protected type Flange Coupling, Bush-pin type flexible coupling. Spur gear design considerations; Lewis equation for static beam strength of spur gear teeth; Power transmission capacity of spur gears in bending.

5. Design of Fasteners

5.1 Stresses in Screwed fasteners; Bolts of Uniform Strength; Design of Bolted Joints subjected to simple loading; Design of Parallel and Transverse fillet welds; Axially loaded symmetrical section; Merits and demerits of screwed and welded joints.

6 Ergonomics & Aesthetic consideration in design

6.1 Ergonomics of Design: Man–Machine relationship; Design of Equipment for control, environment & safety; Aesthetic considerations regarding shape, size, color & surface finish.

COURSE OUTCOME

After the Completion of the course, the student will be able to:

- Analyze the various modes of failure of machine components under different loadpatterns.
- Design and prepare parts and assembly drawings.
- Design the various machine elements.
- Use design data books and different codes of design.
- Select standard components with their specifications from the manufacturer's catalog.

RECOMMENDED BOOKS:

1. Machine Design – Sadhu Singh, Khanna Book Publishing Co., Delhi (ISBN: 978-9382609-575)
2. Machine Design Data Book – Sadhu Singh, Revised Edition, Khanna Book Publishing Co., Delhi (ISBN: 978-9382609-513) Introduction to Machine Design – V.B.Bhandari, Tata Mc- Graw Hill, New Delhi.
3. Mechanical Engineering Design – Joseph Edward Shigley, Tata Mc- Graw Hill, New Delhi.
4. Machine design – Pandya & Shah, Dhanpat Rai & Son, New Delhi.
5. Machine design – R.K.Jain, Khanna Publication, New Delhi. Design Data Book – PSG Coimbtore, PSG Coimbtore.
6. Hand Book of Properties of Engineering Materials & Design Data for Machine Elements – Abdulla Shariff, Dhanpat Rai & Sons, New Delhi.

UNIT-WISE TIME AND MARKS DISTRIBUTION

Unit No	Time Allotted (Hrs)	Marks Allotted (%)
1	10	20
2	10	20
3	12	24
4	8	16
5	4	10
6	4	10
Total	**48**	**100**

PROGRAM: THREE YEARS DIPLOMA PROGRAM IN ENGINEERING	**MECHANICAL**
Course Code: **MEPC502**	Course Title: **THEORY OF MACHINES & MECHANISM**
Semester: **5TH**	Credits: **3**
Hours Per Week: **3 (L: 2, T: 1, P: 0)**	

COURSE OBJECTIVE:

To understand the basics of the Theory of Machines, the student must be made conversant with the principles related to simple mechanisms, the design of various components like Cams, Power transmission drives, flywheels, governors, Brake and Clutches, and the application of these principles for designing.

COURSE CONTENT

1. Simple Mechanisms

1.1 Introduction to link, kinematic pair, lower and higher pair, Kinematic chain

1.2 Mechanism, Inversions, Different types of mechanisms (with examples).

2. Cams and Followers

2.1 Concept; Definition and application of Cams and Followers; Classification of Camsand Followers.

2.2 Different follower motions and their displacement diagrams like uniform velocity,SHM, uniform acceleration, and Retardation.

2.3 Drawing of the profile of radial cam with knife-edge and roller follower with and withoutoffset with reciprocating motion.

3. Power Transmission

3.1 Types of Drives – Belt, Chain, Rope, Gear drives & their comparison; Belt Drives - flat belt, V– belt & its applications; Material for flat and V-belt; Angle of the lap, Belt length.

3.2 Slip and Creep; Determination of Velocity Ratio, Ratio of tight side and slack side tension; Centrifugal tension and Initial tension; Condition for maximum power transmission (Simple numerical).

3.3 Gear Drives – Spur gear terminology; Types of gears and gear trains, their selection for different applications; Train value & Velocity ratio for simple, compound, reverted, and epicyclic gear train; Law of gearing.

4. Flywheel and Governors

4.1 Flywheel - Concept, function, and application of flywheel with the help of turning moment diagram for single cylinder 4-Stroke I.C. Engine, Coefficient of fluctuation of energy, Coefficient of fluctuation of speed, and its significance.

4.2 Governors - Types and explanation with neat sketches (Centrifugal, Watt, andPorter); Concept, function and applications & Terminology of Governors; Comparison between Flywheel and Governor.

5. Brakes, Dynamometers, Clutches & Bearings

5.1 Function of brakes and dynamometers; Types of brakes and Dynamometers; Comparison between brakes and dynamometers.

5.2 Clutches- Uniform pressure and Uniform Wear theories; Function of Clutch and its application.

5.3 Construction and working of i) Single plate clutch (Simple numerical on single plateclutch).

5.4 Bearings – i) Simple Pivot, ii) Collar Bearing, iii) Conical pivot. Torque & power lostin friction (no derivation). Simple numerical.

6. Balancing & Vibrations

6.1 Concept of balancing: Balancing of single rotating mass; Graphical method forbalancing several masses revolving in the same plane.

6.2 Concept and terminology used in vibrations, Causes of vibrations in machines, theirharmful effects, and remedies.

COURSE OUTCOME

After the Completion of the course, the student will be able to:

- Know different machine elements and mechanisms.
- Understand the different types of cams and their motions and draw cam profiles for various motions.
- Select suitable drives and Mechanisms for a particular application.
- Understand the function of flywheels and governors and their applications.
- Understand the construction and working of Brakes, Dynamometers, Clutches & Bearings.

RECOMMENDED BOOKS:

1. Theory of machines – S.S. Rattan, Tata McGraw-Hill publications.
2. Theory of machines – R.K. Bansal, Laxmi publications
3. Theory of machines – R.S. Khurmi & J.K.Gupta, S.Chand publications.
4. Dynamics of Machines – J B K Das, Sapna Publications.
5. Theory of machines – Jagdishlal, Bombay Metro – Politan Book Ltd.

UNIT-WISE TIME AND MARKS DISTRIBUTION

Unit No	Time Allotted (Hrs)	Marks Allotted (%)
1	6	10
2	8	12
3	10	24
4	10	24
5	8	20
6	6	10
Total	**48**	**100**

PROGRAM: THREE YEARS DIPLOMA PROGRAM IN MECHANICAL ENGINEERING	
Course Code: ME**PE 501**	Course Title: **HEAT TRANSFER**
Semester: 5TH	Credits: **3**
Hours Per Week: **3 (L: 3, T: 0, P: 0)**	

COURSE OBJECTIVE:

The main objective of this course is to understand the concepts of conduction, convection, radiation and concepts of Fins heat transfer, and the basics of heat exchangers.

COURSE CONTENT

1. Conduction

1.1 Introduction to Conduction; Fourier law of heat conduction for isotropic material;Thermal conductivity.
1.2 Heat Transfer by Conduction through Plane Wall, Composite Wall and thick cylinder.
1.3 Derivation of the energy equation in three dimensions: Non-dimensional - thermaldiffusivity and Fourier number.
1.4 One dimensional solution with and without heat generation; Analogy with electricalcircuits.

2. Fins

2.1 Rectangular and pin fins. Fin effectiveness and efficiency.
2.2 Critical radius of insulation.
2.3 Lumped parameter approach and physical significance of time constant, Biotnumber, Validity of lumped parameter approach.

3. Convection

3.1 Introduction, Newton's law of cooling; Concept of Free and Forced Convection
3.2 Momentum and energy equations in two dimensions: importance of non-dimensional quantities and their physical significance.
3.3 Velocity and thermal boundary layer thickness by integral method.
3.4 Analogies between momentum, heat, and mass transfer. Natural convection, the effectof coupling on the conservation equations.

4. Radiation

4.1 The physical mechanism of thermal radiation, laws of radiation,
4.2 Definition of the black body, emissive power, radiation intensity, emissivity, reflectivity, transmissivity, irradiation, radiosity, Stefan Boltzmann Law, and Kirchoff's Law.
4.3 Radiation exchange between black bodies, the Gray-Diffuse Isotropic (GDI) surface concept.

5. Heat exchangers

5.1 Types of heat exchangers, parallel and counterflow types
5.2 Introduction to LMTD.
5.3 Fouling factor.
5.4 NTU method for heat exchangers.

COURSE OUTCOME

After the Completion of the course, the student will be able to:

- Explain the concepts of conduction
- Highlight the effectiveness of fins
- Explain the concepts of convection
- Determine the design parameters of the heat exchangers.

RECOMMENDED BOOKS

1. Heat Transfer by R.K. Rajput, S. Chand & Sons.
2. Fundamentals of Heat and Mass Transfer by F.P.Incropera and D.P. Dewitt, JohnWiley & Sons.
3. Heat Transfer - A Basic Approach by M.N.Ozisik, McGraw-Hill.
4. Heat Transfer by J.P. Holman, McGraw-Hill.
5. Elements of Heat & Mass Transfer by Vijay Gupta, New Age International Publishers.

UNIT-WISE TIME AND MARKS DISTRIBUTION

Unit No.	Time Allotted (Hrs)	Marks Allotted (%)
1	8	15
2	10	20
3	12	25
4	10	20
5	8	20
Total	**48**	**100**

PROGRAM: THREE YEARS DIPLOMA PROGRAM IN MECHANICALENGINEERING	
Course Code: ME**PE 502**	Course Title: **AUTOMOBILE ENGINEERING**
Semester: **5TH**	Credits: **3**
Hours Per Week: **3 (L: 3, T: 0, P: 0)**	

COURSE OBJECTIVE:

The objective of this course is to acquire knowledge of the basic structure and components of an automobile, understand the concepts and necessity of cooling and lubricating systems, and understand the concepts of Ignition and transmission, steering systems, and necessity ofsuspension systems and alternate fuels that can be used to propel the vehicles.

COURSE CONTENT

1. **Vehicle Structure and Engines**
   - **1.1** Types of Automobiles
   - **1.2** Vehicle Construction – Chassis, Frame and Body, Aerodynamics,
   - **1.3** Components of Engine – Their forms, Functions, and Materials,
   - **1.4** Review of Cooling and Lubrication systems in Engine
   - **1.5** Turbo Chargers,
   - **1.6** Engine Emission Control by 3–Way Catalytic Controller, Electronic EngineManagement System.

2. **Engine Auxiliary Systems**
   - **2.1** Carburetor–working principle
   - **2.2** Electronic fuel injection system – Mono-point and Multi-Point Injection Systems
   - **2.3** Electrical systems, Battery generator,
   - **2.4** Starting Motor and Drives – Lighting and Ignition (Battery, Magneto Coil and Electronic Type)
   - **2.5** Regulators-cut outs

3. **Transmission Systems-Clutch**
   - **3.1** Types and Construction
   - **3.2** Gear Boxes-Manual and Automatic, Simple Floor Mounted Shift Mechanism
   - **3.3** Over Dsrives, Transfer Box Fluid flywheel
   - **3.4** Torque converters, Propeller shaft – Slip Joint – Universal Joints, Differential, Rear Axle, Hotchkiss Drive, and Torque Tube Drive.

4. **Steering, Brakes, and Suspension**
   - **4.1** Wheels and Tires – Wheel Alignment Parameters
   - **4.2** Steering Geometry and Types of Steering Gearbox, Power Steering
   - **4.3** Types of Front Axle Suspension Systems.
   - **4.4** Braking Systems – Types and Construction, Diagonal Braking System, Antilock Braking System.

5. **Alternative Energy Sources**
   - **5.1** Use of Natural Gas, LPG, Biodiesel, Gasohol and Hydrogen in Automobiles,
   - **5.2** Electric and Hybrid Vehicles
   - **5.3** Fuel Cells.

RECOMMENDED BOOKS:

1. Crolla, D. Automotive Engineering: Powertrain, Chassis System and Vehicle Body: Butterworth-Heinemann.
2. Heisler, H. Advanced vehicle technology: Butterworth-Heinemann.
3. Happian-Smith, J. An introduction to modern vehicle design: Butterworth-Heinemann.
4. Newton, Steeds and Garet, Motor vehicles, Butterworth Publishers.
5. Crouse, W. H., & Anglin, D. L. Automotive Mechanics, Study Guide: McGraw-Hill.

COURSE OUTCOME

After the Completion of the course, the student will be able to:

- Identify the components of an automobile with their working
- Explain the concepts of cooling and lubricating systems.
- Explain the concepts of Ignition, Transmission, and steering systems.
- Identify different suspension systems and their applications.
- Differentiate the special vehicles according to the different types of fuels used.

UNIT-WISE TIME AND MARKS DISTRIBUTION

Unit No.	Time Allotted (Hrs)	Marks Allotted (%)
1	10	20
2	10	20
3	10	20
4	10	20
5	08	20
Total	**48**	**100**

PROGRAM: THREE YEARS DIPLOMA PROGRAM IN MECHANICAL ENGINEERING	
Course Code: ME**PE 503**	Course Title: **POWER PLANT ENGINEERING**
Semester: 5TH	Credits: **3**
Hours Per Week: **3 (L: 3, T: 0, P: 0)**	

COURSE OBJECTIVE:

To introduce students to different aspects of power plant engineering. To familiarize the students with the working of power plants based on different fuels. To expose the students to the principles of safety and environmental issues.

COURSE CONTENT

1. Introduction to Power Plant

- **1.1** Introduction, classifications of power plant, terminology used in power plant
- **1.2** Various factors affect power plant operation: Load sharing, cost of power, and tariff methods.

2. Thermal Power Plant

- **2.1** Role of thermal power plant in current power generation scenario, selection of site and plant layout.
- **2.2** Fuels, handling layout and its methods, stages in coal handling storage.

3. Hydro Power Plant

- **3.1** Introduction, working, advantages, and disadvantages.
- **3.2** Diesel and Gas turbine plant layouts, components, working, advantages and disadvantages of diesel power plant.
- **3.3** Combined cycle power generation, combined gas and steam turbine power plant operation (only flow diagram).

4. Nuclear Power Plant

- **4.1** Introduction, working principle; Thermal fission Reactors: PWR, BWR and gas-cooled reactors, advantages and Disadvantages.
- **4.2** Environmental impact of power plant: Social and Economic issues of the power plant, Greenhouse effect, Acid rain, Acid snow, Dry deposition, Acid fog. Air, water; Thermal pollution from power plants: Radiations.

5. Power Plant Safety

- **5.1** Power plant safety concept, safety practices to be observed in boiler operation, and statutory provision related to boiler operation.
- **5.2** Safety in oil handling system, chemical handling system.

COURSE OUTCOME

After the Completion of the course, the student will be able to:

- Understand power plant engineering and its classification.
- Understand the working and the importance of thermal power plants.
- Understand the components of hydroelectric, diesel, and gas turbine power plants and their importance.
- Understand the workings of nuclear power plants and various environmental aspectsrelated to power plants.
- Understand and appreciate the safety aspects related to power plants.

RECOMMENDED BOOKS:

1. Power plant Engineering-P.K.Nag Tata McGraw Hill.
2. Power plant Engineering-Morse.
3. Power plant Engineering-Domkundawar, Dhanpat Rai Publications.

UNIT-WISE TIME AND MARK DISTRIBUTION

Unit No	Time Allotted (Hrs)	Marks Allotted (%)
1	8	18
2	10	20
3	10	20
4	12	24
5	8	18
Total	**48**	**100**

PROGRAM: THREE YEARS DIPLOMA PROGRAM IN MECHANICAL ENGINEERING	
Course Code: M E **PE 504**	Course Title **FARM EQUIPMENT AND FARM MACHINERY**
Semester: **5th**	Credits: **3**
Hours Per Week : **3 (L:3, T: 0, P: 0)**	

COURSE OBJECTIVE:

This course aims to find and characterize the machinery based on crop production, field efficiency, and capacities to calculate the machinery's economics, find the machine's usages for different tillage, and calculate its power requirement.

COURSE CONTENT

1. **Introduction**
   - **1.1** Introduction to farm mechanization.
   - **1.2** Classification of farm machines. Unit operations in crop production.
   - **1.3** Identification and selection of machines for various operations on the farm.
   - **1.4** Hitching Systems and controls of farm machinery.
2. **Economics of Machinery**
   - **2.1** Calculation of field capacities and field efficiency.
   - **2.2** Calculations for the economics of machinery usage, comparison of ownership with the hiring of machines.
   - **2.3** Introduction to seed-bed Preparation and its Classification.
   - **2.4** Familiarization with land reclamation and earth-moving equipment
3. **Tillage**
   - **3.1** Introduction to machines used for primary, secondary, rotary, deep, and minimum tillage.
   - **3.2** Measurement of draft of tillage tools and calculations for power requirement for the tillage machines. Introduction to tillage machines like a mold-board plough, disc plough, chisel plough, sub-soiler, harrows, puddler, cultivators, identification of major functional components. Attachments with tillage machinery
4. **Sowing & Transplanting Equipment**
   - **4.1** Introduction to sowing, planting & transplanting equipment.
   - **4.2** Introduction to seed drills, no-till drills, and strip-till drills.
   - **4.3** Introduction to planters, bed planters, and other planting equipment like sugarcane potato.
   - **4.4** Study of types of furrow openers and metering systems in drills and planters.
   - **4.5** Calibration of seed drills/ planters. Adjustments during operation.
5. **Farm Machines**
   - **5.1** Introduction to materials used in the construction of farm machines.
   - **5.2** Heat treatment processes and their requirement in farm machines.
   - **5.3** Properties of materials used for critical and functional components of agricultural machines.
   - **5.4** Introduction to steels and alloys for agricultural application. Identification of heat treatment processes, especially for the agricultural machinery components.

COURSE OUTCOME

After the Completion of the course, the student will be able to:

- Classify the Farm Machinery, equipment, and materials
- Describe the objectives of Farm mechanization.
- Explain the selection of the machinery.
- Discuss the forces acting on tillage tools and hitching systems CO5 Understand the calibration, constructional features, and working of various farm equipment.

RECOMMENDED BOOKS:

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. Mechanical Engineering Curriculum Structure 266
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

UNIT-WISE TIME AND MARKS DISTRIBUTION

Unit No.	Time Allotted (Hrs)	Marks Allotted (%)
1	8	18
2	8	18
3	10	20
4	10	20
5	12	24
Total	**48**	**100**

PROGRAM: THREE YEARS DIPLOMA PROGRAM IN MECHANICAL ENGINEERING	
Course Code: M E **PE 505**	Course Title **MATERIAL HANDLING SYSTEMS**
Semester: **5th**	Credits: **3**
Hours Per Week : **3 (L:3, T: 0, P: 0)**	

COURSE OBJECTIVE:

This course aims to know the operational features of material handling equipment & its practical applications, understand, select, operate, and maintain the material handling equipment, understand different material handling processes used in industries, and understand & appreciate safety instrumentation for equipment.

COURSE CONTENT:

1. Introduction

- **1.1** Elements of Material Handling System-Importance
- **1.2** Terminology, Objectives, and Benefits of Better Material Handling;
- **1.3** Principles and features of Material Handling System;
- **1.4** Interrelationships between material handling and plant layout, physical facilities,and other organizational functions;

2. Material Handling Equipment

- **2.1** Selection of Material Handling Equipment-Factors affecting for selection
- **2.2** Material Handling Equation; Choices of Material Handling Equipment
- **2.3** General analysis Procedures; Basic Analytical techniques
- **2.4** The unit load concept: Selection of suitable types of systems for applications
- **2.5** Activity cost data and economic analysis for the design of components ofMaterial Handling Systems;
- **2.6** Functions and parameters affecting service, packing, and storage of materials.

3. Design of Handling Equipment

- **3.1** Introduction Design of Mechanical Handling Equipment- Design of Hoists, Drives for hoisting, components, and hoisting mechanisms; rail traveling components and mechanisms;
- **3.2** Hoisting gear operation during transient motion; selecting the motor rating anddetermining breaking torque for hoisting mechanisms.
- **3.3** Design of Cranes, Hand-propelled and electrically driven EOT overheat Travelling cranes; Traveling mechanisms of cantilever and monorail cranes;
- **3.4** Design considerations for structures of rotary cranes with a fixed radius, fixed post, and overhead traveling cranes; Stability of stationary rotary and 'travelingrotary cranes.

4. Design of Load Lifting Attachments

4.1 Design of load lifting attachments- Load chains and types of ropes used inMaterial Handling System;
4.2 Forged, Standard, and Ramshorn Hooks; Crane Grabs and Clamps; Grab Buckets; Electromagnet;
4.3 Design consideration for conveyor belts; Application of attachments.

5. Material Storage

5.1 Study of systems and Equipment used for Material Storage
5.2 Objectives of storage: Bulk material handling
5.3 Gravity flow of solids through slides and chutes
5.4 Storage in bins and hoppers; Belt conveyors; Bucket-elevators; Screw conveyors; Vibratory Conveyors; Cabin conveyors; Mobile racks etc.

6. Material Handling

6.1 Material Handling / Warehouse Automation and Safety Considerations
6.2 Storage and warehouse planning and design;
6.3 Computerized warehouse planning; Need, Factors, and Indicators for consideration in warehouse automation; Which function, when, and How to automate;
6.4 Levels and Means of Mechanizations. Safety and design; Safety regulations anddiscipline.

COURSE OUTCOME:

After the course, the student will be able to:

- Explain the construction & operational features of various materials handling systems.
- Identify, compare & select proper material handling equipment for specified applications.
- Explain the controls & safety measures incorporated into material handling equipment.
- Appreciate the role of material handling devices in mechanization & automation of industrial processes.
- Explain the safety instrumentation for equipment.

RECOMMENDED BOOKS:

1. N. Rudenko, "Material Handling Equipments," Peace Publishers, Moscow.
2. James M. Apple, "Material Handling System Design," John-Willlwy and Sons Publication, New York.
3. John R. Immer, "Material Handling" McGraw Hill Co. Ltd., New York.
4. Colin Hardi, "Material Handling in Machine Shops". Machinery Publication Co. Ltd., London.
5. M .P. Nexandrn, "Material Handling Equipment," MIR Publication, Moscow.
6. C. R. Cock and J. Mason, "Bulk Solid Handling," Leonard Hill Publication Co. Ltd., USA.
7. Spivakovsy, A.O. and Dyachkov, V.K., "Conveying Machines," Volumes I and II, MIR Publishers
8. Kulwiac R. A., "Material Handling Handbook," JohnWilly Publication, New York.

UNIT-WISE TIME AND MARKS DISTRIBUTION

Unit No.	Time Allotted (Hrs)	Marks Allotted (%)
1	6	16
2	10	20
3	8	16
4	8	16
5	8	16
6	8	16
Total	**48**	**100**

PROGRAM: THREE YEARS DIPLOMA PROGRAM IN MECHANICAL ENGINEERING	
Course Code: M E **PE 506**	Course Title: **HYBRID VEHICLES**
Semester: **5th**	Credits: **3**
Hours Per Week : **3 (L:3, T: 0, P: 0)**	

COURSE OBJECTIVE:

This course's main objective is to familiarize candidates with the properties of electric vehicle drive systems, the concepts of hybrid electric vehicles, and the properties of batteries.

COURSE CONTENT

1. Electric Vehicles:

- **1.1** Introduction; History of Hybrid and Electric Vehicles;
- **1.2** Social and Environmental Importance of Hybrid and Electric Vehicles;
- **1.3** Components, Vehicle mechanics: Roadway fundamentals, Vehicle kinetics, Dynamicsof vehicle motion, Propulsion System Design.

2. Battery

- **2.1** Basics; Types; Parameters:
- **2.2** Capacity, Discharge rate, State of charge, State of Discharge, Depth of Discharge;
- **2.3** Technical characteristics, Battery pack Design, Properties of Batteries.

3. D.C. & A.C. Electrical Machines:

- **3.1** Motor and Engine rating; Requirements;
- **3.2** DC machines; Three phase A/c machines; Induction machines;
- **3.3** Permanent magnet machines; Switched reluctance machines.

4. Electric Vehicle Drive Train:

- **4.1** Transmission configuration;
- **4.2** Components: Gears, Differential, Clutch, Brakes;
- **4.3** Regenerative braking, Motor sizing;
- **4.4** Fuel efficiency analysis.

5. Hybrid Electric Vehicles:

- **5.1** Types: Parallel, Series, Parallel, and Series configurations;
- **5.2** Drive train; Sizing of components;
- **5.3** Basics of Micro, Mild, Mini, Plug-in, and Fully Hybrid.

COURSE OUTCOME:

After Completion of the course, the student will be able to:

- Identify the basics of electrical vehicle history and components.
- Explain the properties of batteries.
- Explain the electrical machine properties and classifications.
- Identify the properties of electric vehicle drive systems.
- Explain the concepts of hybrid electric vehicles.

RECOMMENDED BOOKS

1. Electric & Hybrid Vehicles – A.K. Babu, Khanna Publishing House, New Delhi
2. Electric & Hybrid Vehicles – Design Fundamentals - Iqbal Hussain, Second Edition.
3. Electric Vehicle Technology Explained - James Larminie, John Wiley & Sons.
4. Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals - Mehrdad Ehsani, Yimin Gao, Ali Emadi.
5. Electric Vehicle Battery Systems - Sandeep Dhameja, Newnes

UNIT-WISE TIME AND MARKS DISTRIBUTION

Unit No.	Time Allotted (Hrs)	Marks Allotted (%)
1	10	20
2	08	20
3	10	20
4	10	20
5	10	20
Total	**48**	**100**

PROGRAM: THREE YEARS DIPLOMA PROGRAM IN MECHANICAL ENGINEERING	
Course Code: M E **PE 507**	Course Title **MECHATRONICS**
Semester: **5th**	Credits: **3**
Hours Per Week : **3 (L:3, T: 0, P: 0)**	

COURSE OBJECTIVE:

This course aims to understand the basic concepts and characteristics of measurement systems, various types of sensors and transducers, and various mechanical, electrical, and pneumatic actuation systems and to evaluate the performance of mechatronic systems.

COURSE CONTENT

1. **Introduction**
   - **1.1** Introduction to Mechatronics
   - **1.2** Mechatronic system
   - **1.3** Measurement systems
   - **1.4** Control system Loop, Close loop, and sequential
   - **1.5** Microprocessor-based controllers
   - **1.6** The Mechatronics approach
2. **Sensors and Transducers**
   - **2.1** Sensors and transducers Performance terminology
   - **2.2** Displacement, position, and motion sensors
   - **2.3** Electromechanical sensors and transducers
   - **2.4** Force sensors
   - **2.5** Liquid flow sensors
   - **2.6** Liquid level sensors
   - **2.7** Temperature sensors
   - **2.8** Light sensors
   - **2.9** Selection of sensors
   - **2.10** Simple problems
3. **Data Presentation Systems**.
   - **3.1** Displays
   - **3.2** Data presentation elements
   - **3.3** Magnetic recording
   - **3.4** Data acquisition systems
   - **3.5** Measurement systems
   - **3.6** Testing and calibration
   - **3.7** Simple problems
4. **Pneumatic and Hydraulic Systems**
   - **4.1** Actuation systems
   - **4.2** Pneumatic and hydraulic systems
   - **4.3** Directional control valves

- **4.4** Pressure control valves
- **4.5** Cylinders
- **4.6** Process control valves
- **4.7** Rotary actuators
- **4.8** Simple problems

5. Mechanical Actuation Systems

- **5.1** Mechanical systems
- **5.2** Types of motion
- **5.3** Kinematic chains
- **5.4** Cams
- **5.5** Gear trains
- **5.6** Ratchet and pawl
- **5.7** Belt and chain drives
- **5.8** Bearing
- **5.9** Mechanical aspects of motor selection
- **5.10** Simple problems

6. Electrical Actuation System

- **6.1** Electrical systems
- **6.2** Mechanical switches
- **6.3** Solid-state switches
- **6.4** Solenoids
- **6.5** DC motors
- **6.6** A.C. motors
- **6.7** Stepper motors
- **6.8** Problems

7. Basic System Models

- **7.1** Mathematical models
- **7.2** Mechanical systems building blocks
- **7.3** Electrical system building blocks
- **7.4** Fluid system building blocks
- **7.5** Thermal system building blocks
- **7.6** Simple Problems

8. Digital Logic

- **8.1** Digital logic
- **8.2** Number systems
- **8.3** Logic gates
- **8.4** Boolean algebra
- **8.5** Karnaugh maps
- **8.6** Applications of logic gates
- **8.7** Sequential logic
- **8.8** Simple Problems

9. Microprocessors

- **9.1** Control
- **9.2** Microcomputer structure
- **9.3** Microcontrollers
- **9.4** Applications
- **9.5** Programming problems

10. Input/output Systems

- **10.1** Interfacing
- **10.2** Input/output ports
- **10.3** Interface requirements
- **10.4** Peripheral interface adapters
- **10.5** Serial communications interface
- **10.6** Examples of interfacing
- **10.7** Simple problems

11. Programmable Logic Controllers

- **11.1** Programmable Logic Controllers- Applications
- **11.2** Basic structure
- **11.3** Input/output processing
- **11.4** Programming-ladder diagrams
- **11.5** Mnemonics
- **11.6** Timers, internet relays, and counter
- **11.7** Shift registers
- **11.8** Master and jump controls
- **11.9** Data handling
- **11.10** Analog input/output
- **11.11** Selection of a PLC
- **11.12** Simple problems

COURSE OUTCOME

After the Completion of the course, the student will be able to:

- Describe various types of sensors and transducers.
- Explain the various mechanical, electrical, and pneumatic actuation systems.
- Explain the basic mathematical building blocks for mechanical, electrical, thermal, andfluid actuation systems and their interfacing of input/output requirements.
- Explain the basic PLC architecture and PLC programming concepts.
- Describe the design examples of mechatronics systems. Explain the conditionmonitoring of production systems using sensors.

RECOMMENDED BOOKS

1. Mechatronics – W. Bolton, Pearson Education India.
2. A Text Book on Mechatronics – R.K. Rajput, S.Chand& Co, New Delhi.
3. Mechatronics – M.D.Singh & Joshi, Prentice Hall of India.
4. Mechatronics – HMT, Tata McGraw Hill, New Delhi.
5. Mechatronics System – Devadas Shetty, PWS Publishing
6. Exploring Programmable Logic Controllers with Applications – Pradeep Kumar Srivatsava, BPB Publications.

UNIT-WISE TIME AND MARKS DISTRIBUTION

Unit No.	Time Allotted (Hrs)	Marks Allotted (%)
1	4	8
2	5	10
3	5	10
4	4	8
5	4	10
6	4	8
7	4	8
8	4	10
9	4	8
10	4	8
11	6	12
Total	**48**	**100**

PROGRAM: THREE YEARS DIPLOMA PROGRAM IN MECHANICAL ENGINEERING	
Course Code: **MEPC 503**	Course Title: **INTERNSHIP/MINOR PROJECT**
Semester: **5th**	Credits: **4**
Hours Per Week: **During Summer Break After Vacations**	

COURSE OBJECTIVE:

Industrial training allows students to experience the environment and culture of industrial production units and commercial activities undertaken in field organizations. It prepares students for their future role as diploma engineers in the world of work and enables them to integrate theory with practice.

DESCRIPTION:

For this purpose, students at the end of the fourth semester must be sent for industrial training for at least **four weeks** to be organized during the semester break after the IV Semester examinations. The concerned HODs and other teachers will guide and help students in arranging appropriate training places relevant to their specific branch. It is suggested that a training schedule be drawn up for each student before starting the training in consultation with the training providers. Students should also be briefed about the organizational setup, product range, manufacturing process, important machines, and materials used in the training organization. Equally important with the guidance is the supervision of students training in the industry/organization by the teachers. A teacher may guide a group of 4-5 students. A minimum of one visit per week by the teacher is recommended. Students should be encouraged to write a daily report in their diary to enable them to write a final report and its presentation later. Four credits have been provided in the study and evaluation scheme of the V Semester. Evaluation of professional industrial training report through viva-voce/presentation aims at assessing students understanding of materials, industrial processes, practices in industry/field organization and their ability to engage in activities related to problem-solving in industrial setup as well as an understanding of the application of knowledge and skills learned in real life situations.

PROGRAM: THREE YEARS DIPLOMA IN MECHANICAL ENGINEERING PROGRAM	
Course Code: **MEOE501**	Course Title: **OPERATIONS RESEARCH**
Semester: **5th**	Credits: **3**
Hours Per Week : **3 (L:3, T: 0, P: 0)**	

COURSE OBJECTIVE:

To provide a broad and in depth knowledge of a range of operation research models and techniques, which can be applied to various industrial applications.

COURSE CONTENT

1. **Introduction**
   - 1.1 Development, Definition, Characteristics and phase of Scientific Method, Types of models;
   - 1.2 General methods for solving operations research models.
2. **Linear Programming Problem**
   - 2.1 Allocation Introduction to linear programming formulation, graphical solution, Simplex Method, artificial variable technique, Duality principle. Sensitivity analysis.
3. **Transportation**

   Transportation Problem Formulation optimal solution. Unbalanced transportation problems, Degeneracy. Assignment problem, Formulation optimal solution.
4. **Sequencing**
   - 4.1 Introduction, terminology, notations and assumptions, problems with n-jobs and two machines, optimal sequence algorithm, problems with n-jobs and three machines.
5. **Theory of games**
   - 5.1 Introduction, Two-person zero-sum games, The Maximum – Minimax principle, Games without saddle points – Mixed Strategies, 2 x n and m x 2 Games – Graphical solutions, Dominance property, Use of L.P. to games.

COURSE OUTCOME

After the Completion of the course, the student will be able to:

- Understand the formulation of Linear Programming.
- Analyze and Convert the problem into a mathematical model.
- Understand and implement the transportation problems at the workplace.
- Understand sequencing to optimize the processing time for n-job and m-machine.
- Identify and select suitable methods for various games and apply the L.P.

RECOMMENDED BOOKS

1. Operations Research: an introduction, Hamdy A. Taha, Pearson Education.
2. Operations. Research: theory and application, J.K. Sharma, Macmillan Publishers.
3. Introduction to Operations Research: concept and cases, Frederick S. Hillier and Gerald J. Lieberman, Tata McGraw-Hill

UNIT-WISE TIME AND MARKS DISTRIBUTION

Unit No.	Time Allotted (Hrs)	Marks Allotted (%)
1	6	12
2	10	22
3	10	20
4	10	22
5	12	24
Total	**48**	**100**

PROGRAM: THREE YEARS DIPLOMA PROGRAM IN MECHANICAL ENGINEERING	
Course Code: **MEOE502**	Course Title: **ENGINEERING ECONOMICS AND ACCOUNTANCY**
Semester: **5th**	Credits: **3**
Hours Per Week : **3 (L:3, T: 0, P: 0)**	

COURSE OBJECTIVE:

The objective of this course is to acquire knowledge of basic economics and financial management aspects to facilitate the process of economic decision-making and to develop the basic skills to analyze financial statements.

COURSE CONTENT

1. Introduction:

- **1.1** Managerial Economics
- **1.2** Relationship with other disciplines
- **1.3** Firms: Types, objectives, and goals
- **1.4** Managerial decisions; Decision analysis.

2. Demand & Supply Analysis:

- **2.1** Demand, Types of Demand, Determinants of Demand, Demand function, Demandelasticity, Demand forecasting.
- **2.2** Supply: Determinants of supply, Supply function, Supply elasticity.

3. Production and Cost Analysis:

- 3.1 Production function; Returns to scale; Production optimization; Least cost input;Isoquants; Managerial uses of production function;
- 3.2 Cost Concepts; Cost function; Types of Cost; Determinants of Cost; Short run and Long run cost curves; Cost Output Decision; Estimation of Cost.

4. Pricing:

- 4.1 Determinants of Price; Pricing under different objectives and different market structures; Price discrimination;
- 4.2 Pricing methods in practice; Role of Government in pricing control.

5. Financial Accounting (Elementary Treatment):

- 5.1 Balance sheet and related concepts, Profit & Loss Statement and related concepts
- 5.2 Financial Ratio Analysis, Cash flow analysis, Funds flow analysis, Comparative financial statements Analysis, & Interpretation of financial statements.
- 5.3 Investments, Risks and return evaluation of investment decision, Average rate ofreturn, Payback Period, Net Present Value, Internal rate of return

COURSE OUTCOME

After the Completion of the course, the student will be able to:

- Describe the macro-economic environment of the business and its impact on enterprise
- Explain the cost elements of the product and their effect on decision-making
- Prepare accounting records and summarize and interpret the accounting data for managerial decisions
- Describe accounting systems and analyze financial statements using ratio analysis
- Explain the concepts of financial management and investment

RECOMMENDED BOOKS

1. Premvir Kapoor, Sociology & Economics for Engineers, Khanna Publishing House, New Delhi, 2018
2. McGuigan, Moyer and Harris, 'Managerial Economics; Applications, Strategy and Tactics', Thomson South Western, 10th Edition, 2005.
3. Prasanna Chandra. 'Fundamentals of Financial Management,' Tata Mcgraw Hill Publishing Ltd., 4th Edition, 2005.
4. Samuelson. Paul A and Nordhaus W.D., 'Economics,' Tata Mcgraw Hill Publishing Company Limited, New Delhi, 2004.
5. Paresh Shah, 'Basic Financial Accounting for Management', Oxford University Press, New Delhi, 2007. 3. Salvatore Dominick, 'Managerial Economics in a Global Economy.' Thomson South Western, 4th Edition, 2001. COURSE OUTCOME:

UNIT-WISE TIME AND MARKS DISTRIBUTION

Unit No.	Time Allotted (Hrs)	Marks Allotted (%)
1	7	15
2	7	15
3	12	25
4	7	15
5	15	30
Total	**48**	**100**

PROGRAM: THREE YEARS DIPLOMA PROGRAM IN MECHANICAL ENGINEERING	
Course Code: M E **0E 503**	Course Title: **WORK STUDY & ERGONOMICS**
Semester: **5th**	Credits: **3**
Hours Per Week : **3 (L:3, T: 0, P: 0)**	

COURSE OBJECTIVE:

To provide a basic understanding to the students about the concept and significance of work-study and ergonomics. To impart thorough knowledge to the students about various work-study techniques for improving an organization's productivity. To impart knowledge and skills to students concerning allowances, rating, and calculation of basic and standard time for manual operations in an organization. To provide knowledge to the students about various wages and incentive schemes. To inculcate analyzing skills among the students concerning workplace design, working postures, and lifting tasks.

COURSE CONTENT

1. Work Study

1.1 Historical background; Work study definition; Role of work-study in improving productivity; Work Content, Human Factors consideration in Work study. Work study procedure: selection of jobs.

1.2 Information collection and recording; Recording techniques; critical analysis; developing better method; installation and follow up of standard method.

1.3 Motion Study/Method Study: Definition, objectives, step-by-step procedure, Recording techniques for method study, charts and diagrams Memo motion and micro motion study; therbligs; cyclograph and chrono cyclegraph; simo chart;Principles of motion economy; Design of workplace layout.

2. Work measurement

2.1 Definition: Components of Work measurement, Procedure, tools, Performance rating, Concept of normal time, allowances. Work sampling technique of work measurement. Introduction to pre-determined motion time system.

2.2 Definition, objectives of an incentive plan, and various types of incentive plans.

3. Ergonomics

3.1 Introduction, definition, objectives and scope, man-machine system and its components. Introduction to the musculoskeletal system, respiratory and circulatory system, metabolism, measure of physiological functions- workload and energyconsumption.

3.2 Introduction to biomechanics, types of movements of body members, design of lifting tasks using NIOSH lifting equation, Distal upper extremities risk factors, and risk assessment tools.

3.3 Strain Index, RULA, REBA. Introduction to anthropometry; work table and seat designing.

COURSE OUTCOME

After the Completion of the course, the student will be able to:

- Students will be able to calculate the basic work content of a specific job for employees of an organization. Thereby, they can calculate an organization's production capacity of manpower.
- Students will be able to analyze and calculate the level of risk in a job causing stress, fatigue, and musculoskeletal disorders and design appropriate work systems.
- Students will be able to rate a worker engaged in a live job and calculate basic, allowed and standard time.
- Students can analyze the existing working methods for a particular joband develop an improved method through questioning techniques.
- Students will be able to provide appropriate allowances for the jobs under analysis.

RECOMMENDED BOOKS

1. Barnes Ralph M., "Motion & Time study: Design and Measurement of Work," Wiley Text Books, 2001.
2. Marvin E, Mundel & David L, "Motion & Time Study: Improving Productivity," Pearson Education, 2000.
3. Benjamin E Niebel and Freivalds Andris, "Methods Standards & Work Design," Mc Graw Hill, 1997.
4. Lakhwinder P S," Work Study and Ergonomics," Cambridge University Press, 2016
5. International Labour Organization, "Work-study," Oxford and IBH publishing company Pvt. Ltd., N.Delhi, 2001.
6. Sanders Mark S and McCormick Ernert J, "Human Factors in Engineering and Design", McGraw-Hill Inc., 1993.
7. KjellZandin, Maynard's Industrial Engineering Handbook, Fifth Edition, McGraw Hill, 2001.

UNIT-WISE TIME AND MARKS DISTRIBUTION

Unit No.	Time Allotted (Hrs)	Marks Allotted (%)
1	20	40
2	10	20
3	18	40
Total	**48**	**100**

PROGRAM: THREE YEARS DIPLOMA PROGRAM IN MECHANICAL ENGINEERING	
Course Code: **MEPC 504**	Course Title: **THEORY OF MACHINES & MECHANISM LAB**
Semester: **5TH**	Credits: **1**
Hours Per Week: **1 (L: 0, T: 0, P: 2)**	

LIST OF PRACTICALS:

1. To study various types of kinematics links, pairs, chains & Mechanisms.
2. To plot slider displacement, velocity & acceleration against crank rotation for single slider crank mechanisms.
3. To study various types of gears.
4. To study various types of gear trains – Simple, Compound, reverted, Epicyclic, and Differential.
5. To experiment with static balancing on a static balancing machine.
6. To study various types of dynamometers.
7. To find the Coefficient of friction between the belt and pulley.

PROGRAM: THREE YEARS DIPLOMA PROGRAM IN MECHANICAL ENGINEERING	
Course Code: **MEPE508**	Course Title: **HEAT TRANSFER LAB**
Semester: **5TH**	Credits: **1**
Hours Per Week: **1 (L: 0, T: 0, P: 2)**	

COURSE OBJECTIVE:

The objective is to enable the students to identify the various forms of heat transfer and their applications in real-life problems and analyze different methods to calculate the heat transfer coefficient in various heat transfer problems. Moreover, apply the theoretical knowledge for conducting experiments in the forms of heat transfer.

LIST OF PRACTICALS:

1. To find out the Thermal Conductivity of a given Metallic Rod
2. To find out the Thermal Conductivity of a given insulating Powder
3. To study the counterflow and parallel-flow heat exchangers
4. To find out the emissivity of a given grey body.
5. To find out the value of Stephen Boltzmann constant and compare the same with the theoretical values.
6. To find heat transfer coefficients under different flow conditions and compare those with theoretical values.
7. To find out the efficiency of pin fin in natural convection conditions

PROGRAM: THREE YEARS DIPLOMA PROGRAM IN MECHANICAL ENGINEERING	
Course Code: **MEPE509**	Course Title: **AUTOMOBILE ENGINEERING LAB**
Semester: **5TH**	Credits: **1**
Hours Per Week: **1 (L: 0, T: 0, P: 2)**	

COURSE OBJECTIVE:

The objective of this course is to improve understanding of automobile engines and their operation and to make students familiar with concepts of different mechanisms, clutches, and Braking system

LIST OF PRACTICALS

1. Study of an Automobile Chassis
2. Study of Differential Mechanism of an Automobile
3. Study of Multiple Clutch of an Automobile
4. Study of Braking System (Hydraulic / Air Brake)
5. Checking the spark plug setting the port and check the Ignition in the spark plug
6. Study the assembly of the Car Engine.

PROGRAM: THREE YEARS DIPLOMA PROGRAM IN MECHANICAL ENGINEERING	
Course Code: **MEPE510**	Course Title: **POWER PLANT ENGINEERING LAB**
Semester: **5TH**	Credits: **1**
Hours Per Week: **1 (L: 0, T: 0, P: 2)**	

COURSE OBJECTIVE:

The objective of the course is to introduce students to different aspects of power plant engineering and to familiarize the students with the working of power plants based on different fuels. To expose the students to the principles of safety and environmental issues.

LIST OF PRACTICAL

1. To study modern steam power plants.
2. To study the Various Types of Fuel & Ash Handling Systems.
3. To study nuclear power plants.
4. To study different types of steam turbines.
5. To study about economics of power generation systems.
6. To study gas power plants.
7. To study combined steam & gas turbine power plants.
8. Testing of diesel-fired water tube boiler-based steam power plant.