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WESTBENGAL

EM 4, Sector V, Salt Lake, Kolkata-700091, West Bengal, India
Phone: +91 9836544416/17/18/19, Fax: +91 33 2357 1097

3-Year Diploma Engineering Curriculum and
Syllabus for Mechanical Engineering (ME)

SIXTH SEMESTER

Course Code	Course Title	Contact Hrs. / Week			Credit
		L	T	P	
Theory					
TIUSD-601	Career Advancement & Skill Development-VI	2	1	0	3
TIUDME-601	Design of Machine Elements	3	1	0	4
TIUDME-602	Industrial Management	2	1	0	3
TIUDME-603	Production Management	2	1	0	3
TIUDME-604	Machine Tool-II	2	1	0	3
TIUDME-605	Elective-II (any one) *	2	1	0	3
Practical					
TIUDME-691	Machine Tool Lab	0	0	3	2
TIUDME-692	General Viva Voce	0	0	3	2
TIUDME-693	Project	0	0	3	2
Sessional					
TIUCSL-681	Entrepreneurship & Skill Development-V	0	0	2	2
Total Credits					27

List of Papers for Elective II:

a) Refrigeration & Air-Conditioning
b) CAD-CAM & Automation
c) Alternate Energy Sources & Management
d) Material Handling Systems

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DESIGN OF MACHINE ELEMENTS

TIUDME

L-T-P: 3-1-0 **Credit: 4**

GROUP – A

Module 1 Introduction to Design

1.1 Machine Design philosophy and Procedures
1.2 General Considerations in Machine Design
1.3 Fundamentals:- Types of loads, concepts of stress, Strain, Stress – Strain Diagram for Ductile and Brittle Materials, Types of Stresses such as Tension, Compression, Shear, Bearing pressure Intensity, Crushing, bending and torsion, Principle Stresses (Simple Numerical)
1.4 Creep strain and Creep Curve
1.5 Fatigue, S-N curve, Endurance Limit.
1.6 Factor of Safety and Factors governing selection of factor of Safety.
1.7 Stress Concentration – Causes & Remedies
1.8 Converting actual load or torque into design load or torque using design factors like velocity factor, factor of safety & service factor.
1.9 Properties of Engineering materials, Designation of materials as per IS
1.10 Standardization, use of design data book, use of standards in design
1.11 Theories of Elastic Failures – Principal normal stress theory, Maximum shear stress theory & maximum distortion energy theory.

Module 2 Design of simple machine parts

2.1 Cotter Joint, Knuckle Joint,
2.2 Design of Levers: - Hand/Foot Lever & Bell Crank Lever.

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GROUP – B

Module 3 Design of Shafts, Keys and Couplings, Spur Gears and Pulley

3.1 Types of Shafts, Shaft materials, Standard Sizes, Design of Shafts (Hollow and Solid) using strength and rigidity criteria, ASME code of design for line shafts supported between bearings with one or two pulleys in between or one overhung pulley
3.2 Design of Sunk Keys, Effect of Keyways on strength of shaft.
3.3 Design of Couplings – Protected type Flange Coupling,
3.4 Spur gear design considerations. Lewis equation for static beam strength of spur gear teeth. Power transmission capacity of spur gears in bending
3.5 Design of C.I. Pulley.

GROUP – C

Module 4 Antifriction Bearings

5.1 Classification of Bearings – Sliding contact & rolling contact.
5.2 Terminology of Ball bearings – life load relationship, basic static load rating and basic dynamic load rating, limiting speed. Selection of ball bearings using manufacturer's catalogue

Module 5 Ergonomics & Aesthetic consideration in design

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

Module 6 Estimating & Costing

7.1 Definition of estimating and costing, elements of costing, overhead
7.2 Determination of weight of various parts such as simple bush, flanged pipe, Lathe centre, Rivets, Bolts & Nuts, Simple spanner, Simple crank & connecting Rod.
7.3 Estimation of selling price of cast part such as C.I. pulley, Coupling, and Wooden pattern of flange.
7.4 Estimation of fabricated job such as Simple chimney, Funnel, Cylindrical tank

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FLUID POWER
TIUDME

L-T-P: 3-1-0 **Credit: 4**

GROUP – A

Module 1 Introduction to Fluid Power Systems:

1.1 Introduction, components and General layout of Fluid Power Systems. Comparison of Hydraulic & Pneumatic System
1.2 Practical applications of Fluid Power Systems.
1.3 Advantages and Limitations of Fluid Power Systems.

Module 2 Components of Hydraulic Systems:

2.0 Types, Construction, Working Principle and Symbols of the following Components:
2.1 Pumps – Vane pump, Gear pump, and Piston pump.
2.2 Valves
2.2.1 Pressure control valves – Pressure relief valve, Pressure reducing valve, Pressure unloading valve.
2.2.2 Direction control valves – Poppet valve, Spool valve, 3/2, 4/2 &4/3 D.C. valves, Sequence valves, valve actuation.
2.2.3 Flow control valves – Pressure compensated, Non Pressure compensated flow control valve.
2.3Actuators
2.3.1 Rotary Actuators - Hydraulic motors
2.3.2 Linear Actuators – Cylinders - single acting, double acting & mountings.
2.4 Accessories –
2.4.1 Pipes, Hoses, fittings, Oil filters, Seals and gaskets, Intensifier, Accumulators.

Module 3 Hydraulic Circuits:

3.1 Meter in, Meter out circuits & pump unloading cut
3.2 Bleed off circuit
3.3 Sequencing circuit
3.4 Hydraulic circuits for Milling machine, Shaper machine, Motion synchronization circuit.

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GROUP – B

Module 4 Components of Pneumatic System:

4.0 Types, Construction, Working Principle and Symbols of the following Components:
4.1 Compressor – Reciprocating & Rotary compressors.
4.2 Control Valves – Pressure regulating valves, Flow Control valves and Direction Control Valves.
4.3 Actuators –
4.3.1 Rotary actuator - Air motors.
4.3.2 Linear actuator- Cylinders- single acting, double acting.
4.4 Accessories – Pipes, Hoses, Fittings, FRL unit.

Module 5 Pneumatic Circuits:

5.1 Speed control circuits.
5.2 Sequencing circuits.

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REFRIGERATION AND AIR CONDITIONING (Elective-II)

TIUDME

L-T-P: 3-1-0 **Credit: 4**

GROUP – A

Module 1 Basics of Refrigeration

1.1 Definition of refrigeration.
1.2 Necessity of refrigeration
1.3 Concept of heat engine, heat pump and refrigerator.
1.5 Unit of refrigeration, C.O.P. and refrigerating effect.
1.6 Major application areas of R.A.C. like domestic, commercial and industrial.

Module 2 Refrigeration Cycles

2.1 Reversed Carnot Cycle and its representation on PV and TS diagram & determination of COP.

2.2 Air Refrigeration Cycles: -
- Bell Coleman air refrigerator, it's representation on PV and TS diagram, types and applications like air craft refrigeration using simple air cooling system.
- (Simple numerical on Reversed Carnot cycle)

2.3 Vapour Compression Cycle (V.C.C): -
- Principle, Components, Representation on P-H and T-S diagram, COP, , Effect of superheating, under cooling, suction pressure and discharge pressure, (simple numerical), Actual V.C.C.
- Introduction to multistage V.C.C., its necessity, advantages.

2.4 Vapour Absorption system: -
- Flow diagram and working principle of aqua- ammonia system (simple & practical)
- Flow diagram and working principle of Electrolux Refrigeration System,
- Desirable properties of Refrigerant and absorbent used in Vapour Absorption System.
- Comparison of above Refrigeration Cycles.

Module 3 Refrigerants

3.1 Classification of refrigerants.
3.2 Desirable properties of refrigerants.

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3.3 Nomenclature of refrigerants.
3.4 Selection of refrigerant for specific applications.
3.5 Concept of Green House Effect, Ozone depletion, Global warming.
3.6 Eco-friendly refrigerants like R-134a, hydrocarbon refrigerants.

Module 4 Equipment selection

4.1 Components of Vapour Compression Refrigeration System
4.1.1 Compressors:
- Classification, Construction and working of open type, hermetic, centrifugal, rotary, screw and scroll compressor and their applications.
4.1.2 Condensers:
- Classification, description of air cooled and water cooled condensers, 10 comparison and applications
- Evaporative condensers.
4.1.3 Expansion devices:
- Types: - Capillary tube, automatic, thermostatic and their applications
4.1.4 Evaporators and chillers: -
- Classification of evaporators Construction and working of Bare tube, Plate surface, finned, shell and tube, flooded and dry expansion evaporator
- Capacity of evaporator and their applications
4.2 Draw the flow diagram of the following Vapour compression refrigeration system and label the type of components & refrigerant used: Water coolers, ice plants, cold storage, domestic refrigerator

GROUP – B

Module 5 Psychrometry

5.1 Definition and necessity of air conditioning.
5.2 Properties of Air, Dalton's law of partial pressure
5.3 Psychrometric chart
5.4 Discussion on Psychrometric processes using Psychrometric chart & flow diagram, Concept of Bypass Factor, ADP, SHF, RSHF, ERSHF, and GSHF.
5.5 Adiabatic mixing of Air streams
5.6 Simple numerical using Psychrometric chart
5.7 Equipments used for Air- conditioning like humidifier, dehumidifier, filter, heating and cooling coils

Module 6 Air- conditioning systems

6.1 Classification of A.C. systems
6.2 Industrial and commercial A.C. systems

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6.3 Summer, winter and year round A.C. systems
6.4 Central and unitary A.C. systems
6.5 Application areas of A.C. systems

CAD-CAM & AUTOMATION
TIUDME

L-T-P: 3-1-0 **Credit: 4**

GROUP – A

Module 1 Introduction to CAD/CAM

Computers in industrial manufacturing, Product Cycle, CAD/CAM CAD/CAM hardware: basic structure, CPU, Memory, I/O devices, Storage devices and system configuration.

Module 2 Geometric Modelling

Requirement of geometric modelling, Types of geometric models. Geometric construction method-sweep, solid modelling- Primitives & Boolean operations, free formed surfaces (Classification of surface only) (No numerical treatment)

GROUP – B

Module 3 Introduction to computer numerical Control

Introduction - NC, CNC, DNC, Advantages of CNC, The coordinate system in CNC, Motion control system - point to point, straight line, Continuous path (Contouring). Application of CNC

Module 4 Part programming

Fundamentals, manual part programming, NC –Words, Programming format, part programming, use of subroutines and do loops, computer aided part programming (APT).

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GROUP – C

Module 5 Industrial Robotics

Introduction, physical configuration, basic robot motions, technical features such as - work volume, precision and speed of movement, weight carrying capacity, drive system, End effectors, robot sensors.
Application – Material transfer, machine loading, welding, spray coating, processing operation, assembly, inspection.

Module 6 Automation

Basic elements of automated system, advanced automation functions, levels of automation, Flexible manufacturing system

PRODUCTION MANAGEMENT
TIUDME

L-T-P: 3-1-0 **Credit: 4**

GROUP – A

Module 1 Production System

Production - Definition, Types of production systems
Productivity - Importance, Measurement of Productivity, Techniques of improving productivity
Elements of cost- Fixed cost, Variable Cost. Break even analysis, Calculation of Break even point.

Module 2 Plant location, Plant layout and Material Handling

Plant Location - Importance of Site Selection, Factors affecting Site Selection, Government Policies, and relaxation for Backward Areas
Plant Layout - Objectives, types, design principles, characteristics of Plant Layout, Symptoms of Bad Plant Layout. Group technology, Cellular layout,
Material handling – Need, Principles and Types of material handling devices – conveyors, Hoist & cranes, forklift truck, trolleys, Pipes, Automated Guided Vehicles (AGV's) Selection of Material Handling systems and Devices.

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GROUP – B

Module 3 Process Planning

Planning of Processes from raw material to finished product, Factors affecting Process Planning, Deciding sequence of operations, Operation Sheet, Combined operations, Determination of Inspection Stages, Selection of Machine Techniques of assembly planning, Types of assembly. Plant Capacity, Machine Capacity, Plant Efficiency. Numerical not to be asked,

Module 4 Production Planning and Control

Routing, Sequencing [n job 2 machines], Scheduling, Dispatching, Meaning of Control, Progressive Control, Gantt chart. Concept of Line balancing,

GROUP – C

Module 5 Work Study

Method Study- Objectives, Procedure, Selection of work. Recording Techniques - Process Charts – Outline process chart, Flow process chart, Two Hand process chart, Multiple activity chart, Flow diagram, String diagram, Travel chart.
Micro motion study-Critical Examination, Principles of Motion Economy, Concept of ergonomics and workplace layout
Work Measurement -
Objectives, procedure, Time Study, Time Study Equipments, Stop Watch Time Study, Standard Time, Work Sampling, Analytical Estimating, Predetermined Motion Time Study, Allowances, Calculation of Standard Time, Concept of Merit Rating.

Module 6 Maintenance of machine Tools

Types of maintenance, repair cycle analysis, repair complexity, maintenance manual, maintenance records, housekeeping, Introduction to total production maintenance (TPM).

Module 7 Quality Control:

A) Quality: Definitions, meaning of quality of product and services, quality characteristics, quality of design, quality of conformance, quality of performance, concept of reliability, cost, quantity assurance, cost of rework and repair, quality and inspection, inspection stage.

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B) Total Quality Management (TQM):

1. Principles of total quantity management.

i) customer focus.

ii) Commitment by top management.

iii) Continuous improvement-PDCA, Quality Circles.

iv) Employee empowerment (JIDOKA).

-Quality Audit: Concept of audit practices, lead assessor certification.

-Six sigma: Statistical meaning, methodology of system improvement, DMAIC cycle, yellow belt, green belt, black belt certification

C) ISO 9000 Series & other standards:

Concept, ISO 9000 series quality standards, Qs 14000, Standards certification, other Quality systems

Module 8 Modern Trends

Just In Time manufacturing – Pull and push types of manufacturing systems, Waste reduction, 5'S', inventory reduction, single piece production systems. Concept of continuous improvement (Kaizen) – DMIAC cycle, Brain storming. Poka Yoke. Concept of Rapid Prototyping Concept of Flexible manufacturing system

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MATERIAL HANDLING SYSTEM (ELECTIVE II)

TIUDME

L-T-P: 3-1-0 **Credit: 4**

GROUP – A

Module 1 Introduction to Material Handling System

1.1 Over view of basic principles, equipments and operations, importance of material handling equipments in relation to productivity and cost of production.

1.2 Principle groups of equipment. Unit load, bulk load and their designation by code, various load handling attachments

Module 2 Hoisting Machinery & Equipments

2.1 Construction, working principle and application of Hand Operated Hoists, Electric Hoists and Winch.

2.2 Essential parts, operating principle of EOT Cranes. Long travel & cross travel mechanisms, break arrangement and safety arrangement of EOT Cranes.

2.3 Essential parts, operating principle of Jib Crane, portal, semi-portal and mobile Crane. Basic principle of level lifting mechanism, luffing gear hoisting mechanism and slewing gear mechanism of Crane, Constructional details and applications of Bucket Elevator.

GROUP – B

Module 3 Conveying Machinery

3.1 Essential components, operating principle and applications of Belt Conveyors, Roller Conveyors, Screw Conveyors, Pneumatic Conveyors and Hydraulic Conveyors.

Module 4 Surface Transportation Equipment

4.1 Construction, working principle and application of trackless equipment such as Hand Operated Trucks, Powered Trucks, Tractors, AGV- Automatic Guided Vehicle and Industrial Trailers.

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Module 5 Selection of Material Handling Equipment

5.1 Factors affecting choice of material handling equipment such as type of loads, hourly capacity of the unit, direction & length of travel, methods of stocking at initial, final & intermediate points, nature of production process involved, specific load conditions & economics of material handling system.