GOVERNMENT OF RAJASTHAN
BOARD OF TECHNICAL EDUCATION RAJASTHAN
JODHPUR

SEMESTER SCHEME-2020-21

(SESSION 2021-2022 & ONWARDS)

TEACHING AND EXAMINATION SCHEME AND SYLLABUS

MECHANICAL (AUTOMOBILE) ENGINEERING

(MA)

.....

Curriculum Development Cell
Board of Technical Education, Rajasthan
W-6 Residency Road,
Jodhpur

GOVERNMENT OF RAJASTHAN
BOARD OF TECHNICAL EDUCATION RAJASTHAN, JODHPUR
TEACHING AND EXAMINATION SCHEME
(SEMESTER SCHEME-2020-21)
FOR DIPLOMA III MECHANICAL (AUTOMOBILE) ENGINEERING(MA)
SESSION 2021-2022& ONWARDS

Subject Category	Subject Code	Subjects	Distribution of Time				Distribution of Max. Marks/ Duration							Total Marks	Credits
			Hours per week				End Semester Exam				Internal Assessment				
			L	T	P	Tot	TH	Hrs	PR	Hrs.	CT	TU/Assign	PR(S)		
PC	$MA 3001	Basic Mechanical Engineering	2	1	0	3	60	3	-	-	20	20	-	100	3
PC	*MA 3002	Material Science & Engineering	3	0	0	3	60	3	-	-	20	20	-	100	3
PC	$MA 3003	Fluid Mechanics &Hydraulic Machinery	2	1	0	3	60	3	-	-	20	20	-	100	3
PC	*MA 3004	Manufacturing Engineering - I	3	0	0	3	60	3	-	-	20	20	-	100	3
PC	MA 3005	Auto Thermodynamics - I	3	0	0	3	60	3	-	-	20	20	-	100	3
PC	*MA 3006	Manufacturing Engineering -I Lab	0	0	2	2	-	-	40	3	-	-	60	100	1
PC	*MA 3007	Fluid Mechanics & Hydraulic Machinery Lab	0	0	2	2	-	-	40	3	-	-	60	100	1
PC	MA 3008	Auto Thermodynamics-I Lab	0	0	2	2	-	-	40	3	-	-	60	100	1
PC	**MA 3009	Computer Aided Machine Drawing Practice	0	0	4	4	-	-	40	3	-	-	60	100	2
SI	MA 3010	Summer Internship-I (4 weeks after II sem)	0	0	0	0	-	-	100	-	-	-	--	100	2
VS	+MA3333	Anandam(Joy of Giving)	--	--	1	1	--	--	--	--	--	--	100	100	2
		Students Centered Activities	0	0	3	3	--	--	--	--	--	--	--	--	--
		Total	**13**	**2**	**14**	**29**	**300**	**--**	**260**	**--**	**100**	**100**	**340**	**1100**	**24**
												Grand Total :		**1100**	**24**

1. L : Lecture
2. T : Tutorial
3. P : Practical
4. TH : Marks for End Semester Exam for Theory
5. PR : Marks for End Semester Exam for Practical
6. CT : Marks for class tests (Internal Assessment)
7. TU/Assi : Marks for tutorials/Assignment (Internal Assessment)
8. PR(S) : Marks for practical and viva (Internal Assessment)

1. +MA 3333 is same in all branches of Engineering
2. $MA 3001, $MA 3003 are same as ME/MP 3001 and ME/MP 3003 respectively
3. *MA 3002, *MA 3004, *MA 3006 and *MA 3007 are same as ME 3002, ME 3004, ME 3006 and ME 3007 respectively
4. **MA 3009 is same as ME/MT 3009
Student Centered Activities will be graded as A, B, C & D on the basis of attendance and interest of the student in learning.

GOVERNMENT OF RAJASTHAN
BOARD OF TECHNICAL EDUCATION RAJASTHAN, JODHPUR
TEACHING AND EXAMINATION SCHEME
(SEMESTER SCHEME-2020-21)
FOR DIPLOMA IV SEMESTER MECHANICAL (AUTOMOBILE) ENGINEERING(MA)
SESSION 2021-2022& ONWARDS

Subject Category	Subject Code	Subjects	Distribution of Time				Distribution of Max. Marks/ Duration							Total Marks	Credits
			Hours per week				End Semester Exam				Internal Assessment				
			L	T	P	Tot	TH	Hrs.	PR	Hrs.	CT	TU/Assi	PR(S)		
PC	*MA 4001	Measurements &Metrology	2	1	0	3	60	3	-	-	20	20	20	100	3
PC	***MA 4002	Strength of Materials	2	1	0	3	60	3	-	-	20	20	20	100	3
PC	MA 4003	Auto Thermodynamics -II	2	0	0	2	60	3	-	-	20	20	20	100	2
PE	MA 4004	**Programme Elective-I** **MA 40041-** Basic Vehicle Technology ****MA 40042-** Material Handling Systems	3	0	0	3	60	3	-	-	20	20	20	100	3
PE	MA 4005	**Programme Elective-II** ***MA 40051-** Refrigeration & Air-Conditioning **MA 40052-** Auto Electric Engineering	3	0	0	3	60	3	-	-	20	20	20	100	3
PC	$$MA 4006	Material Testing Lab	0	0	2	2	-	-	40	3		-	60	100	1
PC	*MA 4007	Measurements&MetrologyLab	0	0	2	2	-	-	40	3	-	-	60	100	1
PC	MA 4008	Auto Thermodynamics – II Lab	0	0	2	2	-	-	40	3	-	-	60	100	1
PC	MA 4009	Vehicle Technology Lab	0	0	2	2	-	-	40	3	-	-	60	100	1
PC	MA 4010	Auto Electrical Lab	0	0	2	2	-	-	40	3	-	-	60	100	1
PR	MA 4011	Minor Project	0	0	4	4	-	-	40	-	-	-	60	100	2
AU	+MA 4222	Essence of Indian Knowledge and Tradition	2	0	0	2	--	--	--	--	--	--	--	--	--
VS	+MA 4444	Anandam(Joy of Giving)	--	--	1	1	--	--	--	--	--	--	100	100	2
		Students Centered Activities	0	0	3	3	--	--	--	--	--	--	--	--	--
		Total	**14**	**2**	**18**	**34**	**300**	**--**	**240**	**--**	**100**	**100**	**460**	**1200**	**23**
														1200	**23**

Grand Total

1. L : Lecture
2. T : Tutorial
3. P : Practical
4. TH : Marks for End Semester Exam for Theory
5. PR : Marks for End Semester Exam for Practical
6. CT : Marks for class tests (Internal Assessment)
7. TU/Assi : Marks for tutorials/Assignment (Internal Assessment)
8. PR(S) : Marks for practical and viva (Internal Assessment)

1. +MA4222 and +MA 4444 are same in all branches of Engineering

2.*MA 4001, *MA40051and MA *4007are same as ME 4001, ME40051and ME 4007 respectively

3.***MA 4002 is same as ME/MP/MT 4002

4. .**MA 40042 is same as ME/MP 40042

5. $$MA 4006 is same as ME/MT40042

Student Centered Activities will be graded as A, B, C & D on the basis of attendance and interest of the student in learning.

Note:Students will go for 6 Weeks Summer Internship in the Summer Vacations after Fourth Semester. The assessment of the Summer Internship will be done in Fifth Semester

GOVERNMENT OF RAJASTHAN
BOARD OF TECHNICAL EDUCATION RAJASTHAN, JODHPUR
TEACHING AND EXAMINATION SCHEME
(SEMESTER SCHEME-2020-21)
FOR DIPLOMA V SEMESTERMECHANICAL (AUTOMOBILE) ENGINEERING(MA)
SESSION 2022-2023& ONWARDS

Subject Category	Subject Code	Subjects	Distribution of Time				Distribution of Max. Marks/Duration							Total Marks	Credits
			Hours per week				End Semester Exam				Internal Assessment				
			L	T	P	Tot	TH	Hrs.	PR	Hrs.	CT	TU/Assi	PR(S)		
PC	**MA 5001	Advanced Manufacturing Processes	3	0	0	3	60	3	-	-	20	20	-	100	3
PC	*MA5002	Theory of Machines & Mechanisms	2	1	0	3	60	3	-	-	20	20	-	100	3
OE	+MA 5100	**Open Elective-I** +MA 51001- Economic Policies in India +MA 51002- Engineering Economics & Accountancy	3	0	0	3	60	3	-	-	20	20	-	100	3
PC	MA 5003	Industrial Engineering & Transport Management	2	0	0	2	60	3	-	-	20	20	-	100	2
PE	MA 5004	**Programme Elective-III** ***MA 50041-** Power Plant Engineering **MA 50042-** Advance Vehicle Technology	3	0	0	3	60	3	-	-	20	20	-	100	3
PE	MA 5005	**Programme Elective-IV** **MA 50051-** Hybrid Vehicles ***MA 50052-** Industrial Robotics & Automation	3	0	0	3	60	3	-	-	20	20	-	100	3
PC	*MA 5006	CAD/CAM Lab	0	0	2	2	-	-	40	3	-	-	60	100	1
PC	*MA 5007	Manufacturing Engineering –II Lab	0	0	2	2	-	-	40	3	-	-	60	100	1
PC	MA 5008	AdvanceVehicle Technology Lab	0	0	2	2	-	-	40	3	-	-	60	100	1
SI	MA 5009	Summer Internship-II(6 weeks after IV Sem)	0	0	0	0	-	-	100	-	-	-	--	100	3
PR	MA 5010	Major Project	0	0	2	2	-	-	--		-	-	--	-	--
VS	+MA 5555	Anandam(Joy of Giving)	0	0	1	1	--	--	--	--	--	--	100	100	2
		Students Centered Activities	0	0	3	3	--	--	--	--	--	--	--	--	0
		Total	**16**	**1**	**12**	**29**	**360**	**18**	**220**	**--**	**120**	**120**	**280**	**1100**	**25**
													Grand Total :	**1100**	**25**

1. L : Lecture
2. T : Tutorial
3. P : Practical
4. TH : Marks for End Semester Exam for Theory
5. PR : Marks for End Semester Exam for Practical
6. CT : Marks for class tests (Internal Assessment)
7. TU/Assi : Marks for tutorials/Assignment (Internal Assessment)
8. PR(S) : Marks for practical and viva (Internal Assessment)

1. +MA 51001, +MA51002 and +MA 5555 are same in all branches of Engineering
2. **MA 5001 is same as ME/MT 5001
3. *MA 5002, MA50041, *MA 5006, *MA 5007, and MA50052 are same as ME 5002, ME50041, *ME 5006, *ME 5007, and ME50052 respectively
Student Centered Activities will be graded as A, B, C & D on the basis of attendance and interest of the student in learning.

Note:Major Project will be continued and Assesed in VI Semester

GOVERNMENT OF RAJASTHAN
BOARD OF TECHNICAL EDUCATION RAJASTHAN, JODHPUR
TEACHING AND EXAMINATION SCHEME
(SEMESTER SCHEME-2020-21)
FOR DIPLOMA VI SEMESTER MECHANICAL (AUTOMOBILE) ENGINEERING (MA)
SESSION 2022-2023 & ONWARDS

Subject Category	Subject Code	Subjects	Distribution of Time				Distribution of Max. Marks/ Duration							Total Marks	Credits
			Hours per week				End Semester Exam				Internal Assessment				
			L	T	P	Tot	TH	Hrs.	PR	Hrs.	CT	TU/Assi	PR(S)		
HS	+MA 6111	Entrepreneurship and Start-ups	3	1	0	4	60	3	-	-	20	20	-	100	4
OE	+MA 6200	**Open Elective-II** +**MA 62001**- Project Management +**MA 62002-** Renewable Energy Technologies	3	0	0	3	60	3	-	-	20	20	-	100	3
OE	+MA 6300	**Open Elective-III** +**MA 63001-** Product Design +**MA 63002-** Disaster Management	3	0	0	3	60	3	-	-	20	20	-	100	3
AU	+MA 6333	Indian Constitution	2	0	0	2	--	--	--	--	--	--	--	--	--
PC	*MA 6001	Design of Machine Elements	2	1	0	3	60	3	-	-	20	20	-	100	3
PC	MA 6002	Auto Workshop	0	0	4	4	-	-	40	3	-	-	60	100	2
PR	MA 6003	Major Project	0	0	6	6	-	-	40	-	-	-	60	100	4
SE	MA 6004	Seminar	1	0	0	1	-	-	--	-	-	-	100	100	1
VS	+MA 6666	Anandam(Joy of Giving)	0	0	1	1	--	--	--	--	--	--	100	100	2
		Students Centered Activities	0	0	3	3	--	--	--	--	--	--	--	-	-
		Total	**14**	**2**	**14**	**30**	**240**	**--**	**80**	**-**	**80**	**80**	**320**	**800**	**22**
													Grand Total	**800**	**22**

1. L : Lecture
2. T : Tutorial
3. P : Practical
4. TH : Marks for End Semester Exam for Theory
5. PR : Marks for End Semester Exam for Practical
6. CT : Marks for class tests (Internal Assessment)
7. TU/Assi : Marks for tutorials/Assignment (Internal Assessment)
8. PR(S) : Marks for practical and viva (Internal Assessment)

1 .+MA 6111, +MA 62001, +MA 62002, +MA 63001, +MA 63002, +MA 6333 and +MA 6666 are same in all branches of Engineering

2. *MA 6001 is same as ME 6001

Student Centered Activities will be graded as A, B, C & D on the basis of attendance and interest of the student in learning.

GOVERNMENT OF RAJASTHAN

BOARD OF TECHNICAL EDUCATION RAJASTHAN JODHPUR

SEMESTER SCHEME-2020-21

III SEMESTER

(SESSION 2021-2022 & ONWARDS)

BASIC MECHANICAL ENGINEERING

Course Code	:	MA 3001 (Same as ME/MP 3001)
Course Title	:	BASIC MECHANICAL ENGINEERING
Number of Credits	:	3 (L: 2, T: 1, P: 0)
Prerequisites (Course code)	:	NIL
Course Category	:	PC

COURSE OBJECTIVES

1. To understand General Principles of Mechanical Engineering.
2. To understand laws of thermodynamics, thermal and thermodynamic Processes.
3. To understand working principles of power developing and power absorbing devices.
4. To understand basic materials and manufacturing processes.

COURSE OUTCOMES:

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

CO1	Understand basics of thermodynamics and components of a thermal power plant
CO2	Understand basics of heat transfer, refrigeration and internal combustion engines
CO3	Understand mechanism of thermal power plant and boiler operation
CO4	Identify engineering materials, their properties, manufacturing methods encountered in engineering practice
CO5	Understand functions and operations of machine tools including milling, shaping, grinding and lathe machines

COURSE CONTENTS:

1. INTRODUCTION TO THERMODYNAMICS

- 1.1 Role of Thermodynamics in Engineering and Science.
- 1.2 Basic Concept of thermodynamic laws
  - 1.2.1 Types of system, Thermodynamic Equilibrium, properties (basic Concept only)
  - 1.2.2 Elementary introduction to Zeroth Law, First Law, Heat and work
  - 1.2.3 Second laws of thermodynamics Kelvin-Planck and Clausius Statements
  - 1.2.4 Concept of Heat Engine, Heat Pump & Refrigerator, Efficiency/COP
  - 1.2.5 Carnot Cycle, Carnot Efficiency, T-S and P-V Diagrams

2. HEAT TRANSFER & THERMAL POWER PLANT

- 2.1 Modes of Heat Transfer
- 2.2 Conduction:
  - 2.2.1 Composite Walls and Cylinders
- 2.3 Simple Numerical Problems
- 2.4 Thermal Power Plant Layout
- 2.5 Fire Tube and Water Tube boilers (only working principal and types)

3. STEAM TURBINES

- 3.1 Impulse and Reaction Turbines;
- 3.2 Condensers: Jet & Surface Condensers (only working principal of both type)
- 3.3 Cooling Towers(only working principal and types)

4. MATERIAL AND MANUFACTURING PROCESSES`

- 4.1 Engineering Materials
  - 4.1.1 Classification and their Properties
- 4.2 Metal Casting: Moulding, Patterns
- 4.3 Metal Working process: Hot and Cold working (Introduction only)
- 4.4 Metal Forming processes (Introduction Only)
- 4.5 Press Working process (Introduction and working)
  - 4.5.1 Press Working operations: - Cutting, bending, Drawing,
  - 4.5.2 Punch, blanking, piercing, notching, lancing

4.5.3 effect of clearance.

5. SUPER FINISHING AND METAL COATING PROCESSES

5.1 Finishing by grinding: (basic concept only and no mathematical formulation)
- 5.1.1 Honing,
- 5.1.2 Lapping,
- 5.1.3 Super finishing;

5.2 Electroplating: Basic principles and applications;

5.3 Hot dipping: Galvanizing, Tin coating

5.4 Metal spraying: (Basic Principle);

5.5 Finishing specifications.

REFERENCES:

1. Basic Mechanical Engineering – M.P. Poonia& S.C. Sharma, Khanna Publishing House, Delhi
2. Elements of Mechanical Engineering – M. L. Mathur, F. S. Mehta and R. P. Tiwari, Jain Brothers, New Delhi
3. Engineering Heat Transfer – Gupta & Prakash, Nem Chand & Brothers, New Delhi
4. Workshop Technology (Vol. 1 and 2) – B. S. Raghuvanshi, Dhanpath Rai and Sons, New Delhi.
5. Basic Mechanical Engineering – J Benjamin
6. Elements of Mechanical Engineering – Roy and Choudhary
7. Engineering Thermodynamics – Spalding and Cole

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MATERIAL SCIENCE & ENGINEERING

Course Code	:	MA 3002 (Same in ME 3002)
Course Title	:	MATERIAL SCIENCE & ENGINEERING
Number of Credits	:	3 (L: 3, T: 0, P: 0)
Prerequisites	:	NIL
Course Category	:	PC

COURSE OBJECTIVES:

- To understand crystal structures and atomic bonds.
- To understand the properties of different types of ferrous metals and alloys.
- To understand the properties of different types of non-ferrous metals and alloys.
- To understand various metallic failures and acquire the knowledge of testing of materials.
- To understand the concept of corrosion and its prevention.

COURSE OUTCOMES:

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

CO1	Explain about crystal structures and atomic bonds.
CO2	Describe about classification of ferrous metals and their properties.
CO3	Explain about non-ferrous metals, cutting tool materials and composites along with their properties.
CO4	Describe about the various metallic failures and knowledge in testing of materials.
CO5	Explain the principle of corrosion, their types and its prevention methods along with the various surface engineering processes.

COURSE CONTENTS:

1. CRYSTAL STRUCTURES AND BONDS

1.1 Unit cell and space lattice:
1.2 Crystal system:
- 1.2.1 The seven basic crystal systems
- 1.2.2 Atomic radius and atomic radius for Simple Cubic, BCC and FCC;
- 1.2.3 Atomic Packing Factor for Simple Cubic, BCC, FCC and HCP;

1.3 Simple problems on finding number of atoms for a unit cell.
- 1.3.1 Bonds in solids:Primary and secondary bond (Introduction)
- 1.3.2 Types of primary bonds: Ionic, Covalent and Metallic Bonds
- 1.3.3 Types of secondary bonds: Dispersion bond, Dipole bond and Hydrogen bond.

2. PHASE DIAGRAMS, FERROUS METALS AND ITS ALLOYS

2.1 Isomorphs, eutectic and eutectoid systems;
2.2 Iron-Carbon binary diagram;
2.3 Iron and Carbon Steels;
2.4 Flow sheet for production of iron and steel
2.5 Iron ores
2.6 Pig iron:
- 2.6.1 classification
- 2.6.2 composition and effects of impurities on iron;

2.7 Cast Iron:
- 2.7.1 Classification
- 2.7.2 Composition. properties and uses;

2.8 Wrought Iron
- 2.8.1 properties, uses/applications of wrought Iron;

2.9 Comparison of cast iron, wrought iron and mild steel and high carbon steel;
2.10 standard commercial grades of steel as per BIS and AISI;
2.11 Alloy Steels – Types and uses;
- 2.11.1 Stainless Steels – Types and uses

3. NON-FERROUS METALS AND ITS ALLOYS

3.1 Properties of Non-Ferrous metals
3.2 Copper alloys: Brasses, bronzes – composition, properties and uses;

3.3 Aluminium alloys: properties and uses;
3.4 Nickel alloys: properties and uses.
3.5 Types of Anti-friction/Bearing alloys:
3.5.1 Standard commercial grades as per BIS/ASME.

4. FAILURE ANALYSIS & TESTING OF MATERIALS

4.1 Introduction to failure analysis
4.2 Fatigue,
4.2.1 endurance limit
4.2.2 characteristics of fatigue fracture
4.2.3 variables affecting fatigue life
4.3 creep
4.3.1 creep curve;
4.3.2 creep fracture;
4.4 Destructive testing (Introduction only)
4.4.1 Tensile testing
4.4.2 compression testing
4.4.3 bend test;
4.4.4 torsion test;
4.4.5 fatigue test;
4.4.6 creep test.
4.4.7 Hardness testing
4.4.8 Brinell
4.4.9 Rockwell
4.5 Non-destructive testing:
4.5.1 Visual Inspection;
4.5.2 magnetic particle inspection;
4.5.3 liquid penetrant test;
4.5.4 ultrasonic inspection;
4.5.5 radiography.

5. SURFACE ENGINEERING

5.1 Surface engineering processes:
5.1.1 Coatings and surface treatments; Cleaning and mechanical finishing of surfaces;
5.1.2 Organic coatings;
5.1.3 Electroplating and
5.1.4 Special metallic plating;
5.1.5 Electro polishing and photo-etching ;

REFERENCES:

1. A Text Book of Material Science & Metallurgy – O.P. Khanna, Dhanpath Rai and Sons, New Delhi. 2003.
2. Material Science & Engineering – R.K. Rajput, S.K. Kataria& Sons, New Delhi, 2004.
3. Material Science – R.S. Khurmi, S. Chand & Co. Ltd., New Delhi, 2005.

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FLUID MECHANICS & HYDRAULIC MACHINERY

Course Code	:	MA 3003(Same as ME/MP 3003)
Course Title	:	FLUID MECHANICS & HYDRAULIC MACHINERY
Number of Credits	:	3 (L: 2, T: 1, P: 0)
Prerequisites	:	NIL
Course Category	:	PC

COURSE OBJECTIVES:

- To understand fluid flow & related machinery for power generation, water supply and irrigation.
- To Select and use appropriate flow measuring device.
- To Select and use appropriate pressure measuring device.
- To understand and analyze the performance of pumps and turbines.

COURSE OUTCOMES:

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

CO1	Measure various properties such as pressure, velocity, flow rate using various instruments.
CO2	Calculate different parameters such as co-efficient of friction, power, efficiency etc of various Systems.
CO3	Describe the construction and working of turbines and pumps.
CO4	Test the performance of turbines and pumps.
CO5	Plot characteristics curves of turbines and pumps.

COURSE CONTENT:

1. **Introduction of basic Properties of fluid**
   - 1.1 Surface tension, Capillarity,
   - 1.2 **Fluid Pressure & Pressure Measurement:**
     - 1.2.1 Fluid pressure, Pressure head, Pressure intensity
     - 1.2.2 Concept of vacuum and gauge pressures, atmospheric pressure, absolute pressure,
     - 1.2.3 Simple and differential manometers,
     - 1.2.4 Bourdan pressure gauge,
     - 1.2.5 Concept of Total pressure on immersed bodies, center of pressure,
     - 1.2.6 Simple problems on Manometers.
2. **FLUID FLOW:**
   - 2.1 Types of fluid flows,
   - 2.2 Continuity equation,
   - 2.3 Bernoulli's theorem,
   - 2.4 Principle of operation of Venturimeter,
   - 2.5 Orifice meter
   - 2.6 Pitot tube
   - 2.7 Numerical problems.
   - 2.8 Minor and major losses in pipes, Hydraulic gradient and total gradient line,
   - 2.9 Numerical problems to estimate major and minor losses
3. **IMPACT OF JETS**
   - 3.1 Impact of jet on fixed and vertical flat plates,
   - 3.2 Impact of jet on curved vanes,
   - 3.3 Simple Numericals on work done and efficiency.
4. **HYDRAULIC TURBINES**
   - 4.1 Layout of hydroelectric power plant (Basic Concept)
   - 4.2 Classification and selection of hydraulic turbines,
   - 4.3 Construction and working principle of Pelton wheel,
   - 4.4 Francis and Kaplan turbines (Derivation for work and efficiency)
   - 4.5 Draft tubes – types and construction,
   - 4.6 Concept of cavitation in turbines,
   - 4.7 Simple problem related to Calculation of Work done, Power, efficiency of turbines,
   - 4.8 Unit quantities
5. **CENTRIFUGAL PUMPS**

5.1 Principle working and applications of centrifugal pump (with Derivation for work done and efficiency),
5.2 Numericals on calculations of overall efficiency and power required to drive pumps
5.3 Reciprocating Pumps:
5.3.1 working principle and applications of reciprocating pumps,
5.4 Concept of Slip,
5.5 Cavitation and separation.

REFERENCES:

1. Fluid Mechanics & Hydraulic Machines, S.S. Rattan, Khanna Publishing House, New Delhi
2. Hydraulic, fluid mechanics & fluid machines – Ramamrutham S, Dhanpath Rai and Sons, New Delhi.
3. Hydraulics and fluid mechanics including Hydraulic machines – Modi P.N. and Seth S.M., Standard Book House. New Delhi
4. One Thousand Solved Problems in Fluid Mechanics – K. Subramanya, Tata McGraw Hill.
5. Hydraulic, fluid mechanics & fluid machines – S. Ramamrutham, Dhanpat Rai and Sons, New Delhi
6. Fluid Mechanics and Hydraulic Machines – R. K. Bansal, Laxmi Publications, New Delhi

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MANUFACTURING ENGINEERING-I

Course Code	:	MA 3004 (Same in ME 3004)
Course Title	:	MANUFACTURING ENGINEERING-I
Number of Credits	:	3 (L: 3, T: 0, P: 0)
Prerequisites	:	Basic Mechanical Engineering
Course Category	:	PC

COURSE OBJECTIVES:

- To understand the importance of cutting fluids & lubricants in machining.
- To study various types of basic production processes. To select, operate and control the appropriate processes for specific applications.
- To understand the concept of gear making and list various gear materials.
- To understand the importance of press tools and understand various die operations.
- To understand Grinding and finishing processes.

COURSE OUTCOMES:

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

CO1	Know and identify basic manufacturing processes for manufacturing different components.
CO2	Operate & control different machines and equipments.
CO3	Produce jobs as per specified dimensions and inspect the job for specified dimensions.
CO4	Select the specific manufacturing process for getting the desired type of output.
CO5	Adopt safety practices while working on various machines.

COURSE CONTENT:

1. **Cutting Fluids & Lubricants:**
   - 1.1 Introduction;
   - 1.2 Types of cutting fluids and coolants,
   - 1.3 Classification, properties and applications of lubricants

   Lathe Operations:
   - 1.4 Basic parts and their functions
   - 1.5 Types of lathes,
   - 1.6 Lathe Operations– Facing,Turning, step turning, taper turning, parting off, Knurling, Boring, drilling, threading,
2. **BROACHING MACHINES:**
   - 2.1 Introduction and Types of broaching machines;
   - 2.2 Elements of broach tool, Nomenclatureand Tool materials

   Drilling:
   - 2.3 Basic study of Drill machine with specification;
   - 2.4 Types of operations;
   - 2.5 Types of drills and reamers.
3. **WELDING:**
   - 3.1 Classification of Gas welding techniques and Types of welding flames;
   - 3.2 Introduction of different types of ARC welding
   - 3.3 Resistance welding -
     - 3.3.1 Spot welding,
     - 3.3.2 Seam welding,
     - 3.3.3 Projection welding;
   - 3.4 Welding defects;
   - 3.5 Brazing and soldering: Principles and Applications.
1. **MILLINGAND GEAR MAKING:**
   - 4.1 Introduction and Types of milling machines
     - 4.1.1 constructional details, specifications of milling machine
     - 4.1.2 Milling operations: simple, compound and differential indexing
     - 4.1.3 Milling cutters
     - 4.1.4 Tool & work holding devices
   - 4.2 Manufacture of gears by – (Basic concept of process Only)

4.2.1 Casting,
4.2.2 Moulding,
4.2.3 Stamping,
4.2.4 Coining
4.2.5 Extruding,
4.2.6 Rolling,
4.2.7 Machining;

4.3 Gear generating methods:
4.3.1 Gear Shaping with pinion cutter & rack cutter;
4.3.2 Gear hobbing;

5 GRINDING PROCESSES:

5.1 Principles of metal removal by Grinding;
5.2 Factors affecting the selection of grind wheels:
5.3 Standard marking systems
5.4 Grinding machines classification and Construction details;
5.5

REFERENCES:

1. Manufacturing technology – P N Rao, Tata McGraw-Hill Publications
2. Elements of workshop Technology (Volume I & II) – S. K. Hajra Chaudary, Bose & Roy, Media Promoters and Publishers Limited.
3. Production Technology (Volume I & II) – O. P. Khanna & Lal, Dhanpat Rai Publications.
4. Fundamental of metal cutting and machine tools– B. L. Juneja, New age international limited.
5. Manufacturing Technology, Metal Cutting & Machine tools– P. N. Rao, Tata McGraw-Hill Publications
6. Production Technology – R.B. Gupta, Satya Prakashan, New Delhi

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AUTO THERMODYNAMICS - I

Course Code	MA 3005
Course Title	AUTO THERMODYNAMICS - I
Number of Credits	3 (L: 3, T: 0, P: 0)
Prerequisites	Basic Mechanical Engineering (MA 3001)
Course Category	PC

COURSE OBJECTIVES:

- To understand the significance of different types of energy sources and its suitability for using in I.C. engines.
- To understand the basic working principle of the I.C. engines.
- To understand fuel supply, cooling, lubrication, governing and supercharging system of I.C. engines.
- To understand the performance of the I.C. engines.
- To understand the properties of the steam and performance of the boilers.

COURSE OUTCOMES:

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

CO1	know the significance of different types of energy sources and its suitability for I.C. engines
CO2	understand the basic working principle of the I.C. engines
CO3	explain fuel supply, cooling, lubrication, governing and supercharging system of I.C. engines
CO4	evaluate the performance of the I.C. engines
CO5	know the properties of the steam and evaluate performance of the boilers

COURSE CONTENT:

1. ENERGY SOURCES OF INTERNAL COMBUSTION ENGINES

1.1 Brief description of renewable and non-renewable energy sources
1.2 Petroleum based liquid fuels
1.3 Non petroleum based liquid fuels
1.4 Gaseous fuels including CNG, LPG
1.5 Biogas, biomass and biodiesel;
1.6 Chemical structure of Petroleum fuels
1.7 Heating value of fuels (concept only)
1.8 Flash point & fire point
1.9 Complete and partial combustion of the fules
1.10 Basic required properties of fuels for I.C. engines

2. BASICS OF I.C. ENGINES

2.1 Air standard cycle and its efficiency
2.2 Compression ratio and its effect on engine efficiency
2.3 Brief description of otto, diesel and dual cycle with PV and TS diagrams
2.4 Classification of internal combustion engines
2.5 Working of 2 stroke petrol and diesel engines
2.6 Working of 4 stroke petrol and diesel engines
2.7 PV & port timing diagrams of 2 stroke Petrol and diesel engines (theoretical & actual)
2.8 PV & valve timing diagrams of 4 stroke petrol and diesel engines (theoretical & actual)
2.9 Comparison between two stroke and four stroke engines
2.10 Comparison between petrol and diesel engines

3. I.C. ENGINE SYSTEMS

3.1 Fuel system of petrol engine
3.1.1 Mechanical and electrical feed pumps
3.1.2 Concept of carburetion and air fuel ratio

3.1.3 Simple carburettor and its limitations
3.1.4 M.P.F.I. systems
3.2 Fuel system of diesel engine
3.2.1 Working of fuel pumps
3.2.2 Air and airless fuel injection
3.2.3 Types of fuel injectors
3.3 Cooling system
3.3.1 Necessity of engine cooling
3.3.2 Methods of cooling
3.3.3 Properties of coolants
3.4 Lubrication system
3.4.1 Objectives of lubrication
3.4.2 Methods of lubrication with line diagrams
3.4.3 Properties of lubricant
3.5 Governing methods of I.C. engines
3.6 Objectives of supercharging

4. I.C. ENGINES PERFORMANCE

4.1 Engine powers
4.1.1 Brake power
4.1.2 Indicated power
4.1.3 Frictional power
4.2 Measurement of brake power by dynamometer
4.3 Measurement of indicated power by
4.3.1 Engine indicator
4.3.2 Morse test
4.4 Brake and indicated mean effective pressure
4.5 Engine efficiency-
4.5.1 Volumetric efficiency
4.5.2 Brake thermal efficiency
4.5.3 Indicated thermal efficiency
4.5.4 Mechanical efficiency
4.5.5 Relative efficiency
4.6 Heat balance sheet
4.7 Simple numerical problems

5. STEAM AND STEAM GENERATORS

5.1 Difference between evaporation and boiling
5.2 Showing phase and phase change of water from -30 degree Celsius to superheated steam on temperature- enthalpy (t-h) diagram
5.3 Define and show on steam property diagrams- Saturated liquid line, saturated vapour line, liquid region, two phase (liquid - vapour) region, superheat region, critical point, triple point, saturated liquid, saturation temperature, sensible heat, latent heat, wet steam, dryness fraction, wetness fraction, dry saturated steam, superheated steam, degree of superheat, enthalpy of evaporation and enthalpy of superheat
5.4 At constant pressure determine thermodynamic properties of steam
5.4.1 Specific volume
5.4.2 Specific enthalpy
5.4.3 Specific internal energy
5.4.4 Specific entropy
5.5 Heating and expansion of steam during-
5.5.1 Hyperbolic process
5.5.2 Isothermal process
5.5.3 Polytropic process
5.6 Classification of boilers
5.7 Define boiler mountings and accessories
5.8 Special characteristics of high pressure boilers
5.9 Boiler performance-
5.9.1 Actual evaporation
5.9.2 Equivalent evaporation

5.9.3 Factor of evaporation
5.9.4 Boiler efficiency
5.9.5 Boiler power
5.9.6 Energy balance sheet

5.10 Simple numerical problems with use of steam tables and mollier chart

REFERENCE BOOKS:

1. Thermal Engineering (Hindi) - Verma & Gulecha
2. Introduction to Renewable Energy – Vaughn Nelson, CRC Press
3. Internal Combustion Engine - Mathur & Sharma
4. Thermal Engineering – R.S. Khurmi and J.K. Gupta, 18th Edition, S. Chand & Co, NewDelhi.
5. Thermal Engineering – R. K. Rajput,8th Edition, Laxmi publications Pvt Ltd, New Delhi

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MANUFACTURING ENGINEERING-I LAB

Course Code	:	MA 3006 (Same in ME 3006)
Course Title	:	MANUFACTURING ENGINEERING-I LAB
Number of Credits	:	1 (L: 0, T: 0, P: 2)
Prerequisites	:	Nil
Course Category	:	PC

COURSE OBJECTIVES:

- To Practice the casting principles and operations in foundry.
- To Practice the operation of Lathe.
- To Practice the joining of metals using different Welding techniques.

COURSE CONTENT:

S.No.	Topics for Practice
1	Moulding& casting of (i) Connecting rod (ii) Solid bearing (iii) V-Pulley/Gear Pulley
2	Arc welding (i) Lap Joint (ii) Butt Joint (iii) T- Joint
3	Gas welding (i) Lap Joint (ii) Butt Joint
4	Spot welding (i) Lap Joint
5	Turning Exercise (i) Facing, Step Turning & Chamfering (ii) Step Turning & Taper Turning (iii) Step Turning & Groove Cutting (iv) Step Turning && Knurling (v) Step Turning & Thread Cutting (vi) Turning and Drilling
6	Grinding the Lathe Cutting tools to the required angles
7	Study of Lathe, Drilling machine, shaping machine and slotting machine
8	The dismantling some of the components of lathe and then assemble the same
9	List the faults associated with lathe and its remedies
10	The routine and preventive maintenance procedure for lathe

REFERENCE BOOKS:

1. Elements of Workshop Technology (Volume I & II) – HajraChowdry&Bhattacharaya, Media Promoters, 11th Edition, 2007
2. Introduction of Basic Manufacturing Processes and Workshop Technology – Rajendersingh, New age International (P) Ltd. NewDelhi, 2006
3. Workshop Technology – Raghuwanshi, Khanna Publishers. Jain &Gupta, New Delhi, 2002
4. Production Technology – Jain & Gupta, Khanna Publishers, New Delhi, 2006.
5. Production Technology –HMT, 18th edition, Tata McGraw Hill, New Delhi
6. Manufacturing process –Myro N Begman, 5th edition, Tata McGraw Hill, New Delhi

COURSE OUTCOMES:

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

CO1	Prepare a mould sand mix and molten metal and calculate the amount of metal to be poured in the mould
CO2	Centre the job and select the proper tool to perform the job on lathe machine.
CO3	Calculate the taper angle and practice different taper turning methods on lathe.
CO4	Prepare the edges for welding and select the suitable electrode, voltage and current.
CO5	Operate the welding transformer and generator to perform various weld joint operations.

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FLUID MECHANICS & HYDRAULIC MACHINERY LAB

Course Code	:	MA 3007 (Same in ME 3007)
Course Title	:	FLUID MECHANICS & HYDRAULIC MACHINERY LAB
Number of Credits	:	1 (L: 0, T: 0, P: 2)
Prerequisites	:	Fluid Mechanics & Hydraulic Machinery
Course Category	:	PC

COURSE OBJECTIVES:

- To calibrate the given flow measuring device.
- To apply the knowledge acquired in theory subject.
- To analyse the performance of turbines and pumps.

COURSE CONTENT:

S.No.	Topics for practice
1	Verification of Bernoulli's theorem.
2	Determination of Coefficient of Discharge of Venturimeter.
3	Determination of Coefficient of Discharge, coefficient of contraction and coefficient of velocity of Orificemeter.
4	Determination of coefficient of friction of flow through pipes.
5	Determination of force exerted by the jet of water on the given vane.
6	Determination of minor losses of flow through pipes.
7	Calibration of pressure gauge using dead weight pressure gauge tester.
8	Trial on centrifugal pump to determine overall efficiency.
9	Trial on reciprocating pump to determine overall efficiency.
10	Trial on Pelton wheel to determine overall efficiency.
11	Trial on Francis/Kaplan turbine to determine overall efficiency.

REFERENCES:

N. Kumara Swamy, Fluid Mechanics and Machinery Laboratory Manual, Charotar Publishing House Pvt. Ltd., ANAND 388 001, Ed. 2008

COURSE OUTCOMES:

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

CO1	Measure various properties such as pressure, velocity, flow rate using various instruments.
CO2	Calculate different parameters such as co-efficient of friction, power, efficiency etc. of various systems.
CO3	Understand the need and importance of calibration of pressure gauges.
CO4	Describe the construction and working of turbines and pumps.
CO5	Test the performance of turbines and pumps and Plot characteristics curves.

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AUTO THERMODYNAMICS - I LAB

Course Code	MA 3008
Course Title	AUTO THERMODYNAMICS - I LAB
Number of Credits	1(L:0 , T: 0, P: 2)
Prerequisites	Auto Thermodynamics - I (MA 3005)
Course Category	PC

COURSE OBJECTIVES:

- To understand the various properties of I.C. engine fuels.
- To understand the working of two stroke and four stroke engines
- To understand the fuel supply, cooling, lubrication, supercharging and governing systems of engines
- To understand the working of the fuel pumps
- To understand the working of boilers.

COURSE OUTCOMES:

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

CO1	Know suitable properties of the fuels for particular type of engine
CO2	know the working of two stroke and four stroke I.C. engines
CO3	Know fuel supply, cooling, lubrication, supercharging and governing systems of engines
CO4	know the working of the fuel pumps
CO5	understand the working of boilers and identify the mountings & accessories of boilers

COURSE CONTENT:

1. Find Flash & Fire point tests using Able's/ Cleveland/ Pensky Martin Apparatus and Viscosity measurement using Saybolt viscometer
2. Study of two stroke petrol and diesel engine and port timing diagram
3. Study of four stroke petrol and diesel engine and valve timing diagram
4. Study of fuel supply, supercharging/ turbocharging, and exhaust system of the I.C. engines
5. Study of cooling and lubrication system of the I.C. engines
6. To find Brake Power and prepare heat balance sheet of the engine
7. Study of carburetors and MPFI system of petrol engine
8. Study of the mechanical/ electrical fuel feed pumps of a petrol engine and fuel pump/ Testing of injector of a diesel engine
9. Study of low & high pressure boilers with the help of models
10. Identification of boiler mountings and boiler accessories of a given boiler

REFERENCE BOOKS:

1. Thermal Engineering (Hindi) - Verma & Gulecha
2. Introduction to Renewable Energy – Vaughn Nelson, CRC Press
3. Internal Combustion Engine - Mathur & Sharma
4. Thermal Engineering – R.S. Khurmi and J.K. Gupta, 18th Edition, S. Chand & Co, NewDelhi.
5. Thermal Engineering – R. K. Rajput,8th Edition, Laxmi publications Pvt Ltd, New Delhi

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COMPUTER AIDED MACHINE DRAWING PRACTICE

Course Code	:	*MA 3009 (Same in ME/MT 3009)
Course Title	:	COMPUTER AIDED MACHINE DRAWING PRACTICE
Number of Credits	:	2 (L: 0, T: 0, P: 4)
Prerequisites (Course code)	:	Engineering Graphics
Course Category	:	PC

COURSE OBJECTIVES:

- To use computer aided drafting,
- To prepare geometrical model of various machine elements
- To draw the different views of machine elements
- To interpret the drawing in engineering field and illustrate three dimensional objects.

COURSE OUTCOMES:

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

CO1	Understand the representation of materials used in machine drawing
CO2	Draw the development of surfaces for sheet metal working applications.
CO3	Draw the machine elements including keys, couplings, cotters, riveted, bolted and welded joints.
CO4	Construct an assembly drawing using part drawings of machine components
CO5	Represent tolerances and the levels of surface finish of machine elements.

COURSE CONTENTS:

1. Introduction to CAD software.
2. Drawing aids and editing commands.
3. Basic dimensioning, hatching, blocks and views.
4. Isometric drawing, printing and plotting
5. Machine Drawing practice using Auto CAD:
   Detailed drawings of following machine parts are to be given to the students to assemble and draw the sectional or plain elevations, plans and side views with dimensioning and bill of materials using cad software (**12 exercises**).
   5.1 Sleeve & Cotter Joint
   5.2 Spigot & Cotter Joint
   5.3 Knuckle Joint
   5.4 Stuffing Box
   5.5 Screw Jack
   5.6 Foot Step Bearing
   5.7 Universal Coupling
   5.8 Plummer Block
   5.9 Simple Eccentric
   5.10 Machine Vice
   5.11 Connecting Rod
   5.12 Protected Type Flanged Coupling.

REFERENCES:

2. Bhatt, N.D., Machine Drawing, Charotar Publishing House, 2003.
3. Sidheswar, N., Kannaiah, P. and Sastry, V.V.S., Machine Drawing, Tata McGraw Hill Book Company, New Delhi, 2000.
4. Kannaih, P., Production Drawing, New Age International , 2009

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GOVERNMENT OF RAJASTHAN

BOARD OF TECHNICAL EDUCATION RAJASTHAN JODHPUR

SEMESTER SCHEME-2020-21

IV SEMESTER

(SESSION 2021-2022 & ONWARDS)

MEASUREMENTS & METROLOGY

Course Code	:	MA 4001(Same in ME 4001)
Course Title	:	MEASUREMENTS & METROLOGY
Number of Credits	:	3 (L: 2, T: 1, P: 0)
Prerequisites	:	NIL
Course Category	:	PC

COURSE OBJECTIVES:

- To study advances in technology, measurement techniques, types of instrumentation devices, innovations, refinements.
- To study the principles of instrumentation, transducers & measurement of non-electrical parameters like temperature, pressure, flow, speed, force and stress.

COURSE OUTCOMES

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

CO1	Define accuracy, precision, calibration, sensitivity, repeatability and such relevant terms in metrology.
CO2	Distinguish between various types of errors.
CO3	Understand the principle of operation of an instrument and select suitable measuring device for a particular application.
CO4	Appreciate the concept of calibration of an instrument.
CO5	Analyze and interpret the data obtained from the different measurements processes and present it in the graphical form, statistical form.

COURSE CONTENT:

1. INTRODUCTION TO MEASUREMENTS

1.1 measurement and its Significance.
1.2 Standards of measurements: Primary & Secondary.
1.6 Factors influencing selection of measuring instruments.
1.7 Terms applicable to measuring instruments: Precision and Accuracy, Sensitivity and Repeatability, Range, Threshold, Hysteresis, calibration.(Definition only)
1.8 Errors in Measurements.
1.9 Surface finish measurements

2. TRANSDUCERS AND STRAIN GAUGES

2.1 Introduction and Transducers
2.2 Strain gauge
2.3 Force measurement
2.4 Torque measurement
2.5 Pressure measurement: Mcloed gauge

3. APPLIED MECHANICAL MEASUREMENTS

3.1 Speed measurement
3.2 Displacement measurement
3.3 Flow measurement
3.4 Temperature measurement
3.5 Miscellaneous measurements
3.5.1 Humidity measurement: hair hygrometer
3.5.2 Density measurement: hydrometer
3.5.3 Liquid level measurement: sight glass, Float gauge
3.5.4 Biomedical measurement: Sphygmo monometer

4 LIMITS, FITS & TOLERANCES

4.1 Concept of Limits, Fits, and Tolerances
4.2 Selective Assembly

4.3 Interchangeability
4.4 Hole and Shaft Basis System
4.5 Taylor's Principle
4.6 Design of Plug
4.7 Ring Gauges
4.8 Concept of multi gauging and inspection
4.9 Angular Measurement
- 4.9.1 Working and Use of Universal Bevel Protractor, Sine Bar, Spirit Level
- 4.9.2 Principle of Working of Clinometers
- 4.9.3 Angle Gauges (With Numerical on Setting of Angle Gauges)

4.10 Screw thread Measurements
- 4.10.1 Two wire method
- 4.10.2 Thread gauge micrometer
- 4.10.3 Working principle of floating carriage dial micrometer

5. GEAR MEASUREMENTAND TESTING

5.1 Analytical and functional inspection
5.2 Rolling test
5.3 Measurement of tooth thickness (constant chord method)
5.4 Gear tooth vernier
5.5 Errors in gears such as backlash, runout, composite
5.6 Machine tool testing
- 5.6.1 Parallelism
- 5.6.2 Straightness
- 5.6.3 Squareness
- 5.6.4 Coaxiallity
- 5.6.5 Roundness
- 5.6.6 Run out
- 5.6.7 Alignment testing of machine tools as per IS standard procedure

REFERENCE BOOKS:

1. Mechanical measurements – Beckwith Marangoni and Lienhard, Pearson Education, 6th Ed., 2006.
2. Metrology & Measurement – Anand K Bewoor,Vinay kulakarni, Tata McGraw Hill, New Delhi, 2009
3. Principles of Industrial instrumentation and control systems – Channakesava. R. Alavala, DELMAR cenage learning, 2009.
4. Principles of Engineering Metrology – Rega Rajendra, Jaico publishers, 2008
5. Dimensional Metrology – Connie Dotson, DELMAR, Cenage learning, 2007
6. Instrumentation measurement and analysis – B.C. Nakara, K.K. Chaudary, second edition, Tata Mcgraw Hill, 2005.
7. Engineering Metrology – R.K. Jain, Khanna Publishers, New Delhi, 2005.
8. A text book of Engineering Metrology – I.C. Gupta, Dhanpat Rai and Sons, New Delhi, 2005
9. Metrology for Engineers – J.F.W. Galyer and C. R. Shotbolt, ELBS
10. Engineering Metrology – K. J. Hume, Kalyani publishers

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STRENGTH OF MATERIALS

Course Code	:	MA 4002 (Same in ME/MP/MT 4002)
Course Title	:	STRENGTH OF MATERIALS
Number of Credits	:	3 (L: 2, T: 1, P: 0)
Prerequisites	:	Engineering Mechanics (2005)
Course Category	:	PC

COURSE OBJECTIVES:

- To understand the concept of Simple Stresses and Strains.
- To understand the concept of Strain Energy.
- To understand the concept of Shear Force and Bending Moment Diagrams.
- To understand the concept of Theory of Simple Bending and Deflection of Beams.
- To understand the concept of Torsion in Shafts and springs.
- To understand the concept of Thin Cylindrical Shells.

COURSE OUTCOMES:

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

CO1	Compute stressand strain values and find the changes in axial, lateral and volumetric dimensions of bodies of uniform section and of composite section under the influence of normal forces.
CO2	Calculate thermal stresses, in bodies of uniform section and composite sections.
CO3	Define resilience, proof – resilience and modulus of resilience and obtain expressions for instantaneous stress developed in bodies subjected to different loads.
CO4	Compute shear force and bending moment at any section of beam and draw the S.F. & B.M diagrams of for UDL and Point loads.
CO5	Calculate the safe load, safe span and dimensions of cross section.
CO6	Compare strength and weight of solid and hollow shafts of the same length and material and compute the stress and deflection of the closed coil helical spring.

COURSE CONTENT:

1 SIMPLE STRESSES AND STRAINS

1.1 Types of forces; Stress, Strain and their nature
1.2 Mechanical properties of common engineering materials
1.3 Significance of various points on stress – strain diagram for M.S. and C.I. specimens
1.4 Significance of factor of safety
1.5 Relation between elastic constants
1.6 Stress and strain values in bodies of uniform section and of composite section under the influence of normal forces
1.7 Thermal stresses in bodies of uniform section and composite sections
1.8 Related numerical problems on the above topics
1.9 Strain Energy and its significance
1.10 Derivation of strain energy for the following cases: Gradually applied load, Suddenly applied load,
Impact/shock load

2. SHEAR FORCE & BENDING MOMENT DIAGRAMS

2.1 Types of beams
2.2 Types of Loads
2.3 SFD and BM Diagram for various types of beams
2.4 Analytical method for SF and BM of Simply supported beam
2.5 Over hanging beam with point loads,
2.6 Combination of point and UDL for the above; Related numerical problems

3. THEORY OF SIMPLE BENDING AND DEFLECTION OF BEAMS

3.1 Explanation of terms: Neutral layer, Neutral Axis, Modulus of Section, Moment of

Resistance,Bending stress, Radius of curvature(Definition only)

3.3 Problems involving calculations of bending stress, modulus of section and moment of resistance
3.4 Calculation of safe loads and safe span and dimensions of cross- section
3.5 Definition and explanation of deflection as applied to beams(Standard cases only)
3.6 Related numerical problems

4. TORSION IN SHAFTS AND SPRINGS

4.1 Definition and function of shaft
4.2 Calculation of polar M.I. for solid and hollow shafts
4.3 Assumptions in simple torsion
4.4 Problems on design of shaft based on strength and rigidity
4.5 Numerical Problems related to comparison of strength and weight of solid and hollow shafts
4.6 Classification of springs
4.7 Deflection formula for closed coil helical spring (without derivation)
4.8 Stiffness of spring
4.10 Numerical problems on closed coil helical spring to find safe load, deflection, size of coil and number of coils

5. THIN CYLINDRICAL SHELLS

5.1 Explanation of longitudinal and hoop stresses in the light of circumferential and longitudinal failure of shell
5.2 Derivation of expressions for the longitudinal and hoop stress for seamless and seam shells
5.3 Related numerical Problems for safe thickness and safe working pressure

REFERENCE BOOKS:

1. Strength of Materials – D.S. Bedi, Khanna Book Publishing Co. (P) Ltd., Delhi, 2017.
2. Strength of Materials – B.C.Punmia, Ashok Kumar Jain & Arun Kumar Jain, Laxmi Publications, New Delhi, 2013.
3. Strength of Materials – S. Ramamrutham, Dhanpat Rai & Publication New Delhi.
4. Strength of Materials – R.S. Khurmi, S.Chand Company Ltd. Delhi.
5. A Text Book strength of Material– R.K. Bansal, Laxmi Publication New Delhi.

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AUTO THERMODYNAMICS - II

Course Code	MA 4003
Course Title	AUTO THERMODYNAMICS - II
Number of Credits	2 (L: 2, T: 0, P: 0)
Prerequisites	Auto Thermodynamics – I (MA 3005)
Course Category	PC

COURSE OBJECTIVES:

- To understand combustion phenomenon and combustion chamber features of S.I. engines.
- To understand combustion phenomenon and combustion chamberfeatures of C.I. engines.
- To understand the causes of air pollution by I.C. engines.
- To understand the refrigeration and air conditioning systems.
- To understand working of gas turbines and compressors

COURSE OUTCOMES:

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

CO1	know combustion phenomenon and combustion chambers feature of S.I. engines
CO2	know combustion phenomenon and combustion chambers feature of C.I. engines
CO3	understand the causes of air pollution by I.C. engine
CO4	know the refrigeration and air conditioning systems.
CO5	know working of gas turbines and compressors

COURSE CONTENT:

1. COMBUSTION IN S.I. ENGINE AND COMBUSTION CHAMBERS

- 1.1 Required conditions of combustion
- 1.2 Air fuel ratio and ignition limit of I.C. engines
- 1.3 Normal combustion stages
- 1.4 Effect of engine variables on ignition lag
- 1.5 Effect of engine variables on flame propagation
- 1.6 Abnormal combustion
  - 1.6.1 Detonation
  - 1.6.2 Pre-ignition
- 1.7 Effect of engine variables on detonation
- 1.8 Rating of S.I. fuels
  - 1.8.1 Octane Number
  - 1.8.2 Sensitivity of the fuel
  - 1.8.3 Performance Number
  - 1.8.4 H.U.C.R.
- 1.9 Basic requirement of a good combustion chamber
- 1.10 Combustion chamber design principles
- 1.11 Comparison of various types of combustion chambers (only line sketches)

2. COMBUSTION IN C.I. ENGINE AND COMBUSTION CHAMBERS

- 2.1 Normal combustion stages
- 2.2 Comparison between combustion phenomenon of S.I. and C.I. engines
- 2.3 Delay period or ignition lag
  - 2.3.1 Physical delay

2.3.2 Chemical delay
2.3.3 Effect of engine variables on delay period
2.4 Rate of pressure rise
2.5 Diesel knock
2.6 Methods of controlling diesel knock
2.7 Cetane Number of the fuel
2.8 Methods of generating air swirl
2.9 Classification of C.I. engine combustion chambers

3. AIR POLLUTION BY AUTOMOBILE VEHICLES

3.1 Brief idea of air pollution
3.2 Gases exhausted by automobile vehicles
3.3 Smoke formation
3.4 Soot formation
3.5 Smog formation
3.6 Diesel odor
3.7 Pollutant control
3.7.1 Catalytic converter
3.7.2 Thermal converter
3.8 Exhaust Gas Recirculation (EGR)
3.9 Measurement of air pollution
3.9.1 Smoke meter
3.9.2 Exhaust gas analyzer

4. REFRIGERATION AND AIR CONDITIONING

4.1 Brief idea of cooling methods
4.2 Refrigerant
4.2.1 Classification
4.2.2 Nomenclature
4.2.3 Properties of a good refrigerant
4.3 Vapour compression refrigeration system
4.3.1 Layout diagram showing components, flow and state of refrigerant
4.3.2 P.V. & T.S. diagram with showing sub-cooling, wet, dry and superheat compression
4.3.3 Coefficient of performance (C.O.P.) and simple numerical problem using P-H chart
4.3.4 Effect of varying temperature and pressure of condensing and suction side
4.5 Layout diagram of simple vapor absorption system with showing components, flow and state of refrigerants
4.6 Define and show psychrometric properties & processes on psychrometric chart-
4.6.1 Dry Bulb, Wet Bulb and Dew Point Temperature (DBT, WBT & DPT)
4.6.2 Specific humidity/ humidity ratio (w), Relative humidity (RH) and degree of saturation
4.6.3 Sensible heating & cooling, humidification & dehumidification, heating & humidification heating & dehumidification, cooling & humidification, cooling & dehumidification
4.6.4 Specific enthalpy of moist air, specific volume of moist air and mixing of moist air streams
4.7 Human comfort, comfort chart and effective temperature
4.8 Summer and winter air conditioning system
4.9 Working of automobile air conditioningsystem.

5. GAS TURBINES AND AIR COMPRESSORS

5.1 Classification of gas turbines
5.2 Application of gas turbines
5.3 Description of constant pressure and constant volume gas turbines
5.4 Methods of increasing thermal efficiency of gas turbines
5.4.1 Regeneration
5.4.2 Inter cooling
5.4.3 Re-heating
5.5 Classification of compressors

5.6 Uses of compressed air
5.7 Working of single stage reciprocating compressors with line diagram and P.V. diagram
5.8 P.V. diagram and line diagram of multi-stage reciprocating compressors with inter-cooling
5.9 Rotary compressors
  5.9.1 Centrifugal compressor
  5.9.2 Axial flow type compressor
  5.9.3 Vane type compressors
5.10 Comparison between reciprocating and rotary air compressors

Reference Books:

1. Internal Combustion Engines- M.L. Mathur & R. P. Sharma
2. Automobile Engineering (Hindi & English) - Kirpal Singh
3. Automobile Engineering - R.B. Gupta
4. Thermal Engineering (Hindi) - Verma & Gulecha
5. Refrigeration & Air Conditioning - C.P.Arora
6. Thermal Engineering – R.S. Khurmi and J.K. Gupta, 18th Edition, S. Chand & Co, NewDelhi.

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BASIC VEHICLE TECHNOLOGY

Course Code	MA 40041
Course Title	Basic Vehicle Technology
Number of Credits	3 (L: 3, T: 0, P: 0)
Prerequisites	Basic Mechanical Engineering (MA 3001)
Course Category	PE

COURSE OBJECTIVES:

- To know about the basic structure of conventional vehicle
- To understand the conventional suspension system
- To know about the major components of engine
- To understand the flow of power from engine to wheels in conventional vehicle
- To understand the mechanical and hydraulic braking system
- To understand the steering system of conventional vehicle.

COURSE OUTCOMES:

At the end of the semester students will learn about

CO1	Basic structure of conventional vehicle
CO2	Conventional leaf spring suspension system
CO3	Major components of engine
CO4	Power transmission system of conventional vehicle
CO5	Braking and steering system of conventional vehicle.

COURSE CONTENT:

1. BASIC STRUCTURE OF VEHICLE:

1.1 Classification of Automobiles
1.2 Chassis and body
1.3 Layout of conventional type vehicle (front engine rear wheel drive)
1.4 Vehicle specifications – Vehicle dimensions, Vehicle weights and spaces
1.5 Frame
- 1.5.1 Function of frame, loads or frame
- 1.5.2 Frame construction, sub-frame
- 1.5.3 Defects in frame chassis repair and alignment
- 1.5.4 Frame less construction

1.6 Wheels and Tyres
- 1.6.1 Requirements of wheel
- 1.6.2 Types of wheels - pressed steel disc, wire, light alloy cast wheels
- 1.6.3 Tyre Types (Tubed, Tubeless, Cross ply, Radial ply, Belted biasd)
- 1.6.4 Cross section of a pneumatic tyre
- 1.6.5. Construction and Comparison of cross ply and radial ply tyres
- 1.6.6 Specification of tyres, Factor affecting tyre life.

2. SUSPENSION SYSTEM:

2.1 Basic functions of suspension system
2.2 Types - Independent and rigid, coil, leaf, torsion bar, air, rubber suspension (Elementary idea)
2.3 Conventional leaf spring rigid beam suspension for light vehicle and with helper spring for heavy vehicles.
2.4 Function, construction and working of Telescopic type shock absorber. Gas filled shock absorber
2.5 Sprung and unsprung weight.

3. ENGINE COMPONENTS:

Types, functions, constructional details, materials and defects in following engine components-

- 3.1 Cylinder, cylinder liner, block and head
- 3.2 Piston, piston rings, gudgeon pin
- 3.3 Connecting rod, lubrication of big end and small end
- 3.4 Crank shaft, Flywheel, Ring gear, Vibration damper
- 3.5 Cam shaft, Valves, valve operating mechanisms, Tappet clearance and it's adjustment
- 3.7 Gaskets and oil seals
- 3.8 Bearings
  - 3.8.1 Main bearing, Big end bearing
  - 3.8.2 Bearing failures and causes

4. TRANSMISSION SYSTEM:

- 4.1 Clutch:
  - 4.1.1 Purpose and requirements of clutch
  - 4.1.2 Construction of working detail of single plate coil spring and diaphragm spring clutch, multi plate clutch, centrifugal clutch.
  - 4.1.3 Dry and wet clutch
  - 4.1.4 Construction of clutch plate
- 4.2 Gear Box:
  - 4.2.1 Functions and types of gear boxes
  - 4.2.2 Constructional and working of sliding mesh, constant mesh and synchronousmesh gear boxes
  - 4.2.3 Construction and working of selector and inter locking mechanism
- 4.3 Final Drive:
  - 4.3.1 Function and constructional details of - Propeller shafts, Universal joints, Sliding joint
  - 4.3.2 Differential - Principles, function, construction and working of conventional differential
  - 4.3.3 Different types of rear axles according to methods of supporting.

5. CONTROL SYSTEMS:

- 5.1 Purpose, principle and classification of brakes.
- 5.2 Layout and description of mechanical brakes.
- 5.3 Hydraulic brakes
  - 5.3.1 Principle, layout
  - 5.3.2 Construction & working of single and tandem master cylinder, wheel cylinder
  - 5.3.3 Bleeding of hydraulic brakes
  - 5.3.4 Brake fluids and characteristics
- 5.4 Hand brakes
- 5.5 Front axle and Steering
  - 5.5.1 Front axle - types and construction, front wheel stub axle assembly
  - 5.5.2 Purpose and requirements of steering system
  - 5.5.3 General arrangement of steering systems steering gear ratio
  - 5.5.4 Steering system components – steering wheel, steering column, conventional steering linkage, steering and ignition lock, Adjustable and Collapsible steering column
  - 5.5.5 Construction and working details of different types of steering gear boxes

REFERENCE BOOKS :

1. Automotive Chassis & Body. P.L.Kohli.
2. Vehicle & Engine Technology (Vol. I & II) Heinz Heisler.
3. Basic Automobile Engineering C.P.Nakra.
4. Automobile Engineering. R.B.Gupta
5. Automobile Engineering H.S. Reyat
6. Automobile Engineering (Hindi & English) Kirpal Singh
7. ऑटोमोबाइल अभियांत्रिकी एस.एम.पाण्डेय (दीपक प्रकाशन म.प्र.)

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MATERIAL HANDLING SYSTEMS

Subject Code	:	MA 40042 (Sane as ME/MP 40042)
Course Title	:	MATERIAL HANDLING SYSTEMS
Number of Credits	:	3 (L: 3, T: 0, P: 0)
Prerequisites (Course code)	:	NIL
Course Category	:	PE

Course Learning Objectives:

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

COURSE OUTCOMES:

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

CO1	Understand constructional & operational features of various materials handling systems.
CO2	Identify, compare & select proper material handling equipment for specified applications.
CO3	Know the controls & safety measures incorporated on material handling equipment.
CO4.	Appreciate the role of material handling devices in mechanization & automation of industrial process.
CO5	Understand & appreciate safety instrumentation for equipment

COURSE CONTENT:

1. **Introduction to Material Handling System**:
   - 1.1. Main types of Material handling equipments & their applications
   - 1.2. Types of load to be handled
   - 1.3. Types of Movements, Methods of stacking, loading & unloading systems
   - 1.4. Principles of Material Handling Systems; Modern trends in Materials handling.

2. **Hoisting Machinery & Equipments**:
   - 2.1. Construction and Working of different types of hoists such as Lever operated hoist, Portable hand chain hoist, Electric & Pneumatic hoists;
   - 2.2. Construction and Working of different types of cranes such as Mobile cranes, Bridge cranes, Cable cranes, & Cranes traveling on guide rails;
   - 2.3. Construction and Working of Elevating equipments such as Stackers, Industrial lifts, Freight elevators, Passenger lifts.

3. **Conveying Machinery**:
   - 3.1. Construction and Working of Traction type conveyors such as Belt conveyors, Chain conveyors, Bucket elevators, Escalators;
   - 3.2. Construction and Working of Traction less type conveyors such as Gravity type conveyors, Vibrating & Oscillating conveyors, Screw conveyors, Pneumatic & Hydraulic conveyors, Hoppers gates & Feeders.
   - 3.3. Surface Transportation Equipment: Construction, Function, Working of Trackless equipment such as Hand operated trucks, Powered trucks, Tractors, Automatic Guided vehicle

4. **Components of Material Handling Systems:**
   - 4.1. Flexible hoisting appliances such as Welded load chains, Roller chains, Hemp ropes, Steel wire ropes, Fastening methods of wire & chains, Eye bolts, Lifting tackles, Lifting & Rigging practices;
   - 4.2. Load handling attachments: a) Various types of hooks-Forged, Triangular eye hooks, Appliances for suspending hooks b) Crane grab for unit & piece loads c) Electric lifting magnet, vacuum lifter. d) Grabbing attachment for loose materials e) Crane attachment for handling liquids/molten metals;

5. **Mechanism used in Material Handling Equipment**:
   - 5.1. Steady state motion; Starting & stopping of motion in following mechanisms: Hoisting mechanism, Lifting Mechanism, Traveling Mechanism.

5.2. Selection of Material Handling Equipment: Factors affecting choice of material handling equipment such as Type of loads, Hourly capacity of the unit, Direction & length of travel,

Reference Books:

1. Material Handling (Principles & Practice) – Allegri T. H., CBS Publisher, New Delhi.
2. Plant Layout & Materials Handling – Apple J. M., John Wiley Publishers.
3. Material Handling Equipment – N. Rundenko, Peace Publisher, Moscow.
4. Material Handling Equipment – M. P. Alexandrov, MIR Publisher, Moscow.
5. Material Handling Equipment – Y. I. Oberman, MIR Publisher, Moscow.

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REFRIGERATION AND AIR-CONDITIONING

Course Code	:	*MA 40051(Same in ME 40051)
Course Title	:	REFRIGERATION AND AIR-CONDITIONING
Number of Credits	:	3 (L: 3, T: 0, P: 0)
Prerequisites	:	Thermal Engineering - I (ME 305)
Course Category	:	PE

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.

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.

COURSE CONTENT:

UNIT-I: INTRODUCTION TO REFRIGERATION

Definition of Refrigeration; Refrigerating effect-unit of refrigeration- Coefficient of performance; Types of Refrigeration-Ice, dry ice, Steam jet, Throttling, Liquid nitrogen refrigeration; Carnot refrigeration Cycle(Introduction only); Air refrigeration- Bell - Coleman cycle, Advantage and disadvantages in air refrigeration; Simple problems

UNIT-II: REFRIGERATION SYSTEMS

Working of Vapour compression refrigeration cycle with expression; Representation of the vapour compression cycle on P-H, T-S & P-V Diagram; Types of Vapour Compression cycle and its advantages and disadvantages; Simple Vapour absorptions cycle(Basic Introduction only); Simple Electrolux system for domestic units; Comparison of Vapour absorption and vapour compression system; Simple problems on vapour compression cycle.

UNIT-III: REFRIGERATION EQUIPMENTS

Types of compressors used in refrigeration

Types of Condensers used in refrigeration

natural and forced draught cooling system(Only Basic Introduction); Advantages and disadvantages of air cooled and water-cooled condensers;Types of Evaporators.

Refrigerants and lubricants: Introduction and Properties of good refrigerants; Classification of refrigerants Detection of refrigerants leakage; Charging the system with refrigerant; Lubricants used in refrigeration

UNIT-IV: REFRIGERANT FLOW CONTROLS

Types of Expansion devices used in refrigeration; High side and low side float valve; Solenoid valve; Evaporator pressure regulator.

Application of refrigeration: Slow and quick freezing; Cold storage and Frozen storage; Dairy refrigeration; Ice making industry; Water coolers.

UNIT-V: AIR CONDITIONING

Introduction to Air conditioning; Psychometric chart and its usefor various processes; Equipments used in air

conditioning units and plants.

Refrigeration and Air-conditioning tools: Tools used in refrigeration and Air conditioner installation; Installation procedure; Faults in refrigeration and air conditioning system; Servicing procedure.

REFERENCE BOOKS:

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

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AUTO ELECTRICAL ENGINEERING

Course Code	MA 40052
Course Title	AUTO ELECTRICAL ENGINEERING
Number of Credits	3 (L:3, T:0,P:0)
Prerequisites	NIL
Course Category	PE

COURSE OBJECTIVES:

- To understand about Lead acid battery used in automobiles, its types ,charging processes, various tests, battery failure and rectification.
- Tounderstandthe principles of Alternatorof automotive vehicles.
- To understand the principles of Self Starterof automotive vehicles.
- To understand the principles of Ignition Systemof automotive vehicles.
- Tounderstandthe principles of Lighting Systems of automotive vehicles.

COURSE OUTCOMES:

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

CO1	Know about lead acid battery used in automobiles.
CO2	Understand the working of alternator.
CO3	Understand the principle and operation of starting motor.
CO4	Know about ignition system, ECM , Sensors and spark plug.
CO5	Understand the working of lighting system, wiring and Horn.

COURSE CONTENT:

1. BATTERY :

1.1 Function and types of battery
1.2 Lead acid battery- principle, chemical reaction and Construction detail
1.3 Battery rating.
1.4 Battery Charging:
- 1.4.1 Charging system - constant current and constant voltage
- 1.4.2 Normal, booster and trickle charging

1.5 Battery test
- 1.5.1 Specific gravity test
- 1.5.2 Open and short circuit voltage test
- 1.5.3 High discharge test
- 1.5.4 Cadmium tip test

1.6 Battery failure and rectification
- 1.6.1 Overcharging
- 1.6.2 Cycling
- 1.6.3 Sulfation
- 1.6.4 Internal short circuit
- 1.6.5 Buckling and cracking

1.7 Battery maintenance and storage (dry and wet type)

2. ALTERNATOR AND REGULATOR

2.1 Alternator
- 2.1.1 Construction and working principle
- 2.1.2 Advantage of alternator over dynamo
- 2.1.3 Rectifier

2.1.3.1 Y- connected stator alternator with 6 diode rectifier
2.1.3.2 Delta-connected stator alternator with 6 diode rectifier

2.2 Regulator
2.2.1 Single unit regulator
2.2.2 Two-unit regulator
2.2.3 Three-unit regulator
2.2.4 Fully transistorized regulator
2.2 Alternator fault and rectification

3. STARTING SYSTEM

3.1 Starting Motor
3.1.1 Motor types and specifications
3.1.2 Construction of starting motor and working principle
3.2 Starter motor drive mechanism
3.2.1 Need of drive mechanism
3.2.2 Bendix drive
3.2.3 Over running clutch drive
3.4 Starter motor control
3.4.1 Manual switch
3.4.2 Solenoid switch
3.5 Starting cable and specification

4. IGNITION SYSTEM :

4.1 Principle
4.2 Spark Advance Mechanism
4.3 Centrifugal spark advance mechanism
4.4 Vacuum spark advance mechanism
4.5 Magneto ignition system
4.6 Coil ignition system :
4.6.1 Working principle
4.6.2 Constructional detail of Ignition coil
4.6.3 Constructional detail of Distributor
4.6.4 Limitations of coil ignition system
4.7 Ignition timing
4.8 Comparison of coil and magneto ignition system
4.9 Electronic magneto ignition system
4.10 Electronic fuel injection
4.10.1 E.C.M.
4.10.2 Sensors and their supporting circuits
4.10.3 M.P.F.I.
4.10.4 C.R.D.I.
4.11 Spark Plug :
4.11.1 Constructional details and classification
4.11.2 Effect of leaded fuels
4.11.3 Plug polarity

5. LIGHTING SYSTEM :

5.1 Introduction
5.2 Head lamps- Sealed beam type
5.3 Focusing and alignment of head lamp
5.4 Fog lamp, brake warning light, side light, direction indicator, hazard warning light (functions only)
5.5 Switches : (function only)- Door switch, Head light, Parking light, Combination switch, Horn switch
5.6 Wiring
5.6.1 Wiring circuit for two wheeler and four wheeler vehicle.
5.6.2 H.T.L.T. cable and specification

5.6.3 Fuse and fuse rating
5.6.4 Cable colour code
5.7 Horn :Electric ,Windtone type ,Diaphragm type

REFERENCE BOOKS:

1. Automotive Electrical Equipment William H Crouse (TMH)
2. Basic Automobile Engineering C.P.Nakra (DhanpatRai publishing)
3. Automobile Engineering Kirpal Singh(Standard Publishers Distributors)
4. Automobile Engineering R.B. Gupta(SatyaPrakashan)
5. Automotive Electrical Equipment P.L. Kohli (TMH)
6. Automotive Electrical Systems & Equipments N.R.Khatawate(S.Chand& Company Ltd.)

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MATERIAL TESTING LAB

Course Code	*MA 4006 (Same in ME/MT 4006)
Course Title	MATERIAL TESTING LAB
Number of Credits	1 (L: 0, T: 0, P: 2)
Prerequisites	Material Science & Engineering (ME 3002) Strength of Materials (ME 4002)
Course Category	PC

COURSE OBJECTIVES:

- To identify the type of material based on its grain structure
- To learn the procedure for identifying the cracks in the material
- To understand various material testing methods to determine mechanical properties such as yield stress, Ultimate stress, percentage elongation, Young's Modulus etc.

COURSE OUTCOMES

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

CO1	Identify the given specimen by viewing the micro structure using metallurgical microscope
CO2	Identify the cracks in the specimen using different techniques
CO3	Determine the various types of stress and plot the stress strain diagram for mild steel.
CO4	Determine the torsion, bending, impact and shear values of given materials
CO5	Determine the modulus of rigidity, strain energy, shear stress and stiffness of coil spring

PRACTICALS:

1. Prepare a specimen and examine the microstructure of the Ferrous and Non- ferrous metals using the Metallurgical Microscope.
2. Detect the cracks in the specimen using
   (i) Visual inspection and ring test (ii) Die penetration test (iii) Magnetic particle test.
3. Determination of Rockwell's Hardness Number for various materials like mild steel, high carbon steel, brass, copper and aluminium.
4. Finding the resistance of materials to impact loads by Izod test and Charpy test.
5. Torsion test on mild steel – relation between torque and angle of twist determination of shear modulus and shear stress.
6. Finding Young's Modulus of Elasticity, yield points, percentage elongation and percentage reduction in area, stress strain diagram plotting, tests on mild steel.
7. Determination of modulus of rigidity, strain energy, shear stress and stiffness by load deflection method (Open & Closed coil spring)
8. Single or double Shear test on M.S. bar to finding the resistance of material to shear load.

REFERENCE BOOKS:

1. Measurement system (Application and Design) – Ernest O Doebelin.
2. Strength of Materials – R.S. Khurmi, S.Chand Company Ltd. Delhi
3. A Text Book strength of Material– R.K. Bansal, Laxmi Publication New Delhi

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MEASUREMENTS & METEOROLOGY LAB

Course Code	:	*MA 4007 (Same in ME 4007)
Course Title	:	MEASUREMENTS & METROLOGY LAB
Number of Credits	:	1 (L:0, T:0 , P:2)
Prerequisites	:	Measurements & Meteorology (ME 4001)
Course Catergory	:	PC

COURSE OBJECTIVES:

- To understand techniques for precise measurement of the dimensions of various objects and shapes.

COURSE OUTCOMES:

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

CO1	Measure various component of linear measurement using Vernier calipers and Micrometre.
CO2	Measure various component of angle measurement using sine bar and bevel Protractor
CO3	Measure the geometrical dimensions of V-thread and spur gear

PRACTICALS:

1. Measure the diameter of a wire using micrometre and compare the result with digital Micrometer.
2. Measure the angle of the machined surface using sine bar with slip gauges.
3. Measure the angle of a V-block / Taper Shank of Drill / Dovetail using universal bevel protractor.
4. Measure the dimensions of ground MS flat/cylindrical bush using Vernier Calliper compare with Digital/Dial Vernier Calliper.
5. Measure the geometrical dimensions of V-Thread using thread Vernier gauge.
6. Measure the thickness of ground MS plates using slip gauges.

REFERENCE BOOKS:

1. Engineering Metrology – R. K. Jain
2. Engineering precision metrology – R. C. Gupta
3. A Hand book of Industrial Metrology – ASME

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AUTO THERMODYNAMICS – II LAB

Course Code	MA 4008
Course Title	AUTO THERMODYNAMICS – II LAB
Number of Credits	1 (L:0, T:0, P:2)
Prerequisites	Auto Thermodynamics – I (MA 3005)
Course Category	PC

COURSE OBJECTIVES:

* To understand features of I.C.engine combustion chambers
* To understand the exhaust gas analysis ofI.C.engine
* To understand the refrigeration and air-conditioning processes and tools.
* To understand the automobile air-conditioning system components and their working.
* To understand the air compressor construction and working

COURSE OUTCOMES:

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

CO1	Explain the features of I.C.engine combustion chambers
CO2	Explain the exhaust gas analysis of I.C.engine
CO3	Explain the refrigeration and air-conditioning processes and tools.
CO4	Explain the working of automobile air conditioning system
CO5	Explain the construction and working of air compressor.

PRACTICALS

1. Study of different type of S. I. combustion chambers.
2. Study of different type of C. I. combustion chambers
3. Emission measurement by exhaust gas analyzer.
4. To aquaint with the use of refrigeration tools, charging board, special refrigeration tube fittings.
5. Copper tube jointing practice, flaring and brazing.
6. Study of following components:-
   6.1 Auto air-conditioning Compressor
   6.2 Expansion valves
   6.3 Starting and over load relay
   6.4 Thermostats
   6.5 Strainer and receiver drier
   6.6 Magnetic clutch
7. Charging practice including making vacuum, pressure testing, charging and final testing for performance
8. Determination of psychometric properties of air at different places with the help of sling-psychrometerandhygrometer.
9. Using refrigeration trainer test rig / Air-conditioning test rig to find out its refrigerating capacity, power input and C.O.P.
10. Study of Air compressor components and working.

REFERENCE BOOKS:

1. Internal Combustion Engines ML.Mathur&R.P.Sharma
2. Automobile Engines Dr. Kirpal Singh
3. Automobile Engg. R.B. Gupta
4. Refrigeration & Air Conditioning Manohar Prasad
5. Refrigeration & Air Conditioning C.P.Arora
6. Refrigeration & Air Conditioning R.K. Rajput
7. Refrigeration & Air Conditioning R.S. Khurmi

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VEHICLE TECHNOLOGY LAB

Course Code	MA 4009
Course Title	VEHICLE TECHNOLOGY LAB
Number of Credits	1 (L: 0, T: 0, P: 2)
Prerequisites	Basic Vehicle Technology (MA 40041)
Course Category	PC

COURSE OBJECTIVES:

* To impart practical knowledge of various tools used in auto workshop.
* To impart practical knowledge of the basic structure of conventional vehicle.
* To understand the constructional and working features of different systems of vehicle such as suspension, brakes, steering, transmission.

COURSE OUTCOMES:

At the end of the semester, student will acquire practical knowledge of

CO1	Various tools used in auto workshop
CO2	Basic structure of a conventional vehicle
CO3	Constructional and working features of different systems of vehicle such as suspension, brakes, steering, transmission.

PRACTICALS:

1. Study of various tools used in Auto workshop.
2. Study of conventional layout of 4×2 vehicle.
3. Study and inspection of suspension system of light and heavy vehicles(with helper spring)
4. Study of mechanical and hydraulic braking system (Drum and Disc) and bleeding of hydraulic braking system.
5. Study of Steering system of conventional vehicle.
6. Study of clutch - Single plate & multi plate, Coil and Diaphragm spring type
7. Study of sliding mesh, constant mesh and synchronous mesh gear boxes.
8. Study of Propeller shafts, Universal joints, Sliding joint, differential and rear axle.
9. Study of wheel and tyre construction, Tyre repair, Wheel balancing, Tyre retreading study
10. Visit to nearby auto workshop and service station.

REFERENCE BOOKS:

1. Automobile Engineering(Hindi and English) Dr.Kirpal Singh
2. Basic Automobile Engineering C.P.Nakra
3. Automobile Engineering R.B.Gupta
4. AutomobileEngineering H.S. Reyat
5.AutomobileEngineering T.R.Banga, Nathu Singh
6. ऑटोमोबाइलअभियांत्रिकीएस. एम.पाण्डेय(दीपकप्रकाशन, म.प्र.)
7. Vehicle and Engine Technology Vol 1&2 Heinz Heisler

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AUTO ELECTRICAL LAB

Course Code	MA 4010
Course Title	AUTO ELECTRICAL Lab
Number of Credits	1 (L:0, T: 0,P :2)
Prerequisites	NIL
Course Category	PC

COURSE OBJECTIVES:

- To study about Lead acid battery used in automobiles, its constructional details, various tests, battery failure and rectification.
- To understand the working of Alternatorof automotive vehicles.
- Tounderstand the working of Self Starterof automotive vehicles and their testing procedures.
- To understand the working of Ignition Systemof automotive vehicles .
- To understand the working of Lighting Systems of automotive vehicles and their testing procedures.

COURSE OUTCOMES:

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

CO1	Know about construction, testing and failure of lead acid battery used in automobiles.
CO2	Explain the construction and working of alternator.
CO3	Explain the working principle of operation of starting motor.
CO4	Know about ignition system, spark plug cleaning ,setting and testing ,MPFI system, Sensors and their locations.
CO5	Explain the working of lighting system , wiring and Horn.

PRACTICALS

1. To study the constructional details of lead acid battery
2. To study various causes of failures and
   various tests to determine the condition of lead acid battery.
3. To study and testing the various components of charging system.
4. To study and testing the regulator system.
5. Study of starting system.
6. Study of Ignition system.
7. Study of Light and sound system
8. Spark plug cleaning, setting and testing.
9. Practice to read, the wiring diagram of different vehicles and
   to trace fault in electrical circuit and
   different electrical components.
10. Study of MPFI system and sensors

REFERENCE BOOKS:

1. Automotive Electrical Equipment William H Crouse (TMH)
2. Automobile Engineering Kirpal Singh (Standard Publishers Distributors)
3. Automotive Electrical Equipment P.L. Kohli (TMH)
4. Automotive Electrical Systems & Equipments N.R.Khatawate (S.Chand& Company Ltd.)

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ESSENCE OF INDIAN KNOWLEDGE AND TRADITION

Course Code	MA 4222 (Same in All Branches of Engg.)
Course Title	Essence of Indian Knowledge and Tradition
Number of Credits	0(L-2,T-0, P-0)
Prerequisites	None
Course Category	AU

COURSE CONTENTS:

Basic Structure of Indian Knowledge System:

(i)वेद,

(ii)उन्नवेद (आयुवेद,धनुवेद,गन्धवेद,स्थान्नत्यआदद)

(iii)वेदथाथांग (शिक्था, कलन्न, ननरुत, व्थाकरण, ज्योनतषछथांद),

(iv)उन्नथाइग (धर्मशथास्न, र्ीर्थाथांसथा, नुरथाण, तकशरथास्न)

- •Modern Science and Indian Knowledge System
- •Yoga and Holistic Health care
- •Case Studies.

REFERENCES /SUGGESTED LEARNING RESOURCES:

1. V. Sivarama Krishna, " Cultural Heritage of India- Course Material", Bhartiya Vidya Bhavan, Mumbai, fifth Edition, 2014.
2. Swami Jitatmanand, " Modern Physics and Vedant", Bhartiya Vidya Bhavan.
3. Fritz of Capra, " The wave of Life".
4. Fritz of Capra, " Tao of Physics".
5. V N Jha, " Tarka sangraha of Annam Bhatta, International" Cinmay Foundation, Velliarnad, Amakuam.
6. R N Jha, " Science of Consciousness Psychotheraphy and Yoga Practices" Vidya nidhi Prakasham, Delhi, 2016.

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GOVERNMENT OF RAJASTHAN

BOARD OF TECHNICAL EDUCATION RAJASTHAN JODHPUR

SEMESTER SCHEME-2020-21

V SEMESTER

(SESSION 2021-2022 & ONWARDS)

ADVANCED MANUFACTURING PROCESSES

Course Code	:	MA 5001 (Same in ME/MT 5001)
Course Title	:	ADVANCED MANUFACTURING PROCESSES
Number of Credits	:	3 (L: 3, T: 0, P: 0)
Prerequisites	:	Basic Mechanical Engineering (ME 3001) Manufacturing Engineering (ME 3004)
Course Category	:	PC

COURSE OBJECTIVES:

- To know the functions of Jigs and Fixtures.
- To know the applications of jig-boring machines.
- To identify different fabrication methods of plastic processing viz., sheet forming, blow moulding, laminating and reinforcing of plastics.
- To distinguish between non-conventional machining and traditional machining processes.
- To know about the advancements in the area of manufacturing and production processes.
- To impart knowledge & skills necessary for working in modern manufacturing environment.
- To get familiarized with working principles and operations performed on non-traditional machines, machining center, SPM, automated machines and maintenance of machine tools.

COURSE OUTCOMES:

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

CO1	Know the Operation and control of different advanced machine tools and equipments.
CO2	Produce jobs as per specified requirements by selecting the specific machining process.
CO3	Develop the mind set for modern trends in manufacturing and automation.
CO4	Identify the different fabrication methods viz., sheet forming, blow moulding, laminating and reinforcing of plastics.
CO5	Know different non-traditional machining processes, CNC milling machines, special purpose machines.
CO6	Work as maintenance engineer.

COURSE CONTENT:

1. JIGS & FIXTURES

1.1 Definition of jig
1.2 General consideration in the design of drill jigs and bush
1.3 Types of fixtures
1.4 Basic principles of clamping
1.10 Types of clamps

2. JIG BORING

2.1 Introduction of Jig boring on vertical milling machine
2.2 Types and construction details of jig boring machines
2.3 Plastic Processing:
- 2.3.1 Processing of plastics
- 2.3.2 Introduction of Moulding,Extruding; Casting, Calendering
- 2.3.3 Fabrication methods
- 2.3.4 Sheet forming
- 2.3.5 Blow moulding

3. MODERN MACHINING PROCESSES

3.1 Introduction and Comparison of MMP with traditional machining

3.3 Ultrasonic Machining:
- 3.3.1 Principle
- 3.3.2 Description of equipment
- 3.3.3 Applications

3.4 Electric Discharge Machining:
- 3.4.1 Principle
- 3.4.2 Description and its applications

3.5 Wire cut EDM:
- 3.5.1 Principle
- 3.5.2 Description of equipment
- 3.5.3 Applications

3.6 Abrasive Jet Machining:
- 3.6.1 Principle
- 3.6.2 Description of equipment
- 3.6.3 Application

3.7 Laser Beam Machining:
- 3.7.1 Principle
- 3.7.2 Description of equipment
- 3.7.3 Application

3.8 Electro Chemical Machining
- 3.8.1 Description of equipment
- 3.8.2 Application

4. CNC MILLING MACHINES

4.1 Vertical and horizontal machining center (Constructional features, Axis identification)
4.2 Introduction to Electronic control system, Automatic tool changer and tool magazine
4.3 CNC programming
4.3 Preparatory functions (G code)
4.4 Miscellaneous functions (M code)
4.5 Part programming including subroutines and canned cycles
4.6 Principles of computer aided part programming

5. MACHINE TOOL AUTOMATION:

5.1 Introduction and Need
5.2 Single spindle automates, transfer lines
5.3 Elements of control system in machines for automation
5.4 Introduction to PLC
5.4.1 Block diagram of PLC

REFERENCE BOOKS:

1. Production Technology – HMT, Banglore, Tata Mc-Graw Hill.
2. CNC machines – Pabla B. S. & M. Adithan, New Age international limited.
3. Non Conventional Machining – P. K. Mistra, NarvasaPublishining House.
4. Manufacturing Processes – Begman& Amsted, John Willey and Sons.
5. Advanced manufacturing technology – David L. Goetsch.
6. Exploring Advanced Manufacturing Technologies – Stephen F. Krar& Arthur Gil, Industrial Press.

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THEORY OF MACHINES & MECHANISMS

Course Code	:	MA 5002 (Same in ME 5002)
Course Title	:	THEORY OF MACHINES & MECHANISMS
Number of Credits	:	3 (L: 2, T: 1, P: 0)
Prerequisites	:	Engineering Mechanics Engineering (2005)
Course Category	:	PC

COURSE OBJECTIVES:

- To understand different types of cams and their motions and also to draw cam profiles for various motions.
- To understand the mechanism of various types of drives available for transmission of power.
- To understand the design of Brakes, Dynamometers, Bearings and Clutches and their function and working.
- To understand the need for balancing of masses in the same plane
- To know different types of governors.

COURSE OUTCOMES:

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

CO1	Know different machine elements and mechanisms.
CO2	Understand Kinematics and Dynamics of different machines and mechanisms.
CO3	Select Suitable Drives and Mechanisms for a particular application.
CO4	Appreciate concept of balancing and Vibration.
CO5	Develop ability to come up with innovative ideas.
CO6	Understand different types of cams and their motions and also draw cam profiles for various motions

COURSE CONTENT:

1. CAMS AND FOLLOWERS

1.1 Concept Definition and application of Cams and Followers

1.3 Different follower motions and their displacement diagrams, SHM, uniform acceleration and Retardation

2. POWER TRANSMISSION

2.1 Types of Drives – Belt, Chain, Rope, Gear drives & their comparison

2.2 Types of Belt Drives and Material for flat and V-belt

2.3 Angle of lap, Belt length, Slip and Creep, Determination of Velocity Ratio, Ratio of tight side and slack side tension(Basic Definition and Formulae)

2.4 Derivation for open belt drive

2.5 Condition for maximum power transmission (Simple numericals)

2.6 Chain Drives

2.7 Gear Drives and Gear trains

2.8 Rope Drives – Types, Applications and Advantages & limitations of Steel ropes

3. FLYWHEEL AND GOVERNORS

3.1 Flywheel -Concept, function and application of flywheel with the help of turning moment diagram forsingle cylinder 4-Stroke I.C. Engine (Simple Numerical Problems Except Punching Machine Problems)

3.2 Coefficient of fluctuation of energy,

3.3 Coefficient of fluctuation of speed and its significance;

3.4 Governors Types

3.5 Explanation with neat sketches (Centrifugal, Watt and Porter); Concept, function and applications (No Numericals)

3.6 Terminology of Governors

3.7 Comparison between Flywheel and Governor

4. BRAKES, DYNAMOMETERS, CLUTCHES & BEARINGS

4.1 Function of brakes and dynamometers
4.2 Construction and working ofBrakes
4.3 Construction and working of Dynamometers
4.4 Clutches- (Basic Concept)
4.5 Function of Clutch and its application
4.6 Simple numericals on single and Multiplate clutch(No Derivation)
4.7 Types of Bearings (no derivation)
4.8 Simple numericals

5. BALANCING & VIBRATIONS:

5.1 Concept of balancing
5.2 Balancing of single rotating mass
5.3 Graphical method for balancing of several masses revolving in same plane
5.3.1 Simple Numerical Problems
5.4 Causes of vibrations in machines
5.5 Their harmful effects and remedies

REFERENCE 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.

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ECONOMIC POLICIES IN INDIA

Course Code	MA 51001(Same in All Branches of Engg.)
Course Title	Economic Policies in India
Number of Credits	3 (L:3,T:0,P:0)
Prerequisites	NIL
CourseCategory	OE

COURSE LEARNING OBJECTIVES:

The objective of this course is to familiarize the students of different streams with the basic concepts, structure, problems and issues concerning Indian economy.

CO1	Understand Indian economics policy, planning strategies
CO2	It will enable to students to comprehend theoretical and empirical development across countries and region for policy purposes
CO3	Development Economics as a discipline encompasses different approach estotheproblemsofunemployment,poverty,incomegeneration,industrializationfromdifferentperspec-tives
CO4	Abletoidentifytheproblemsandcapabletodecidetheapplicationforfuturedevelopment
CO5	Analyzeeconomicissuesandfindsolutionstocomplexeconomicproblemsandtakecor-recteconomicjudgment

COURSE CONTENTS:

1. BASIC FEATURES AND PROBLEMS OF INDIAN ECONOMY:

- 1.1. Economic History of India;
- 1.2. Nature of Indian Economy
- 1.3. Demographic features and Human Development Index,
- 1.4. Problems of Poverty, Unemploy-ment, Inflation, income inequality, Blackmoney in India.

2. SECTORAL COMPOSITION OF INDIAN ECONOMY:

- 2.1. Issues in Agriculture sector in India,
- 2.2. land reforms
- 2.3. Green Revolution
- 2.4. agriculture policies of India,

3. INDUSTRIAL DEVELOPMENT,

- 3.1. Small scale and cottage industries,
- 3.2. Industrial Policy,
- 3.3. Public sector in India,
- 3.4. Service sector in India.

4. ECONOMIC POLICIES:

- 4.1. Economic Planning in India,
- 4.2. Planning commission v/s NITI Aayog,
- 4.3. Five Year Plans,
- 4.4. Monetary policy in India,
- 4.5. Fiscal Policy in India,
- 4.6. Centre state Finance Relations,
- 4.7. Finance commission in India
- 4.8. LPG policy in India

5. EXTERNAL SECTOR IN INDIA

- 5.1. India's foreign trade value composition and direction,

5.2. India Balance of payment since 1991,
5.3. FDI in India,
5.4. Impact of Globalization on Indian Economy,
5.5. WTO and India.

REFERENCE BOOKS:

1. Dutt Rudder and K.P.M Sunderam (2017). Indian Economy .S Chand & Co.Ltd. New Delhi.
2. Mishra S. K & V. K Puri (2017). Indian Economy and Its Development Experience. Himalaya Publishing House.
3. Singh, Ramesh, (2016): Indian Economy, Tata-McGraw Hill Publications, New Delhi.
4. Dhingra, I.C., (2017): March of the Indian Economy, Heed Publications Pvt. Ltd.
5. Karam Singh Gill, (1978): Evolution of the Indian Economy, NCERT, NewDelhi
6. Kaushik Basu (2007): The Oxford Companion to Economics of India ,Oxford University Press.

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ENGINEERING ECONOMICS & ACCOUNTANCY

Course Code	MA 51002 (Same in All Branches of Engg.)
Course Title	Engineering Economics & Accountancy
Number of Credits	3 (L:3,T:0,P:0)
Prerequisites	NIL
Course Category	OE

COURSE OBJECTIVES

•To acquire knowledge of basic economicst of a cilitate the process of economic decision making.
•To acquire knowledge on basic financial management aspects.
•To develop the basic skills to analyze financial statements.

COURSE OUTCOMES:

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

CO1	Understand the macro-economic environment of the business and its impact on enterprise
CO2	Understand cost elements of the product and its effect on decision making
CO3	Prepare accounting records and summarize and interpret the accounting datafor managerial decisions
CO4	Understand accounting systems and analyze financial statements using ratio analysis
CO5	Understand the concepts of financial management and investment

COURSE CONTENTS

1. INTRODUCTION:

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

2. DEMAND & SUPPLY ANALYSIS:

2.1. Demand;
2.1.1. Types of demand;
2.1.2. Determinants of demand;
2.1.3. Demand function;
2.1.4. Demand elasticity;
2.1.5. Demand forecasting;
2.2. Supply;
2.2.1. Determinants of supply;
2.2.2. Supply function;
2.2.3. Supply elasticity.

3. PRODUCTION AND COST ANALYSIS:

3.1. Production function;
3.2. Returns to scale;
3.3. Production optimization;
3.4. Least cost input; Iso quants;
3.5. Managerial uses of production function;
3.6. Cost Concepts;
3.6.1. Cost function;
3.6.2. Types of Cost;

3.6.3. Determinants of cost;
3.6.4. Short run and Long run cost curves;
3.6.5. Cost Output Decision;
3.6.6. Estimation of Cost.

4. PRICING:

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

5. FINANCIAL ACCOUNTING (ELEMENTARY TREATMENT):

5.1. Balance sheet and related concepts;
5.2. Profit & Loss Statement and related concepts;
5.3. Financial Ratio Analysis;
5.4. Cash flow analysis;
5.5. Funds flow analysis;
5.6. Comparative financial statements;
5.7. Analysis & Interpretation of financial statements;
5.8. Investments;
5.9. Risks and return evaluation of investment decision;
5.10. Average rate of return;
5.11. Payback Period;
5.12. Net Present Value;
5.13. Internal rate of return,

REFERENCE BOOKS:

1.Mc Guigan, Moyer and Harris,' Managerial Economics; Applications, Strategy and Tactics', Thomson South Western, 10th Edition, 2005.
2.Prasanna Chandra. 'Fundamentals of Financial Management', Tata Mcgraw Hill Publishing Ltd., 4th edition,2005.
3.Samuelson. Paul A and Nordhaus W. D., 'Economics', Tata Mcgraw Hill Publishing Company Limited, New Delhi, 2004.
4.Paresh Shah, 'Basic Financial Accounting for Management', Oxford University Press, NewDelhi, 2007.
5.Salvatore Dominick, 'Managerial Economics in a global economy'. Thomson SouthWestern, 4th Edition, 2001.

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INDUSTRIAL ENGINEERING AND TRANSPORT MANAGEMENT

Course Code	MA 5003
Course Title	INDUSTRIAL ENGINEERING AND TRANSPORT MANAGEMENT
Number of Credits	2 (L: 2, T: 0, P: 0)
Prerequisites	NIL
Course Category	PC

COURSE OBJECTIVES:.

- To understand the Plant site selection and Plant Layouts
- To understand the concept of Work Study
- To understand the functions of Production , Planning and Control Department
- To understand the basic Principles of Management
- To understand the basics of Transport Management and Motor Vehicle Laws

COURSE OUTCOMES:

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

CO1	Understand the Plant site selection and Plant Layouts
CO2	Understand the concept of Work Study
CO3	Understand the functions of Production , Planning and Control department
CO4	Understand the basic Principles of Management
CO5	Understand the basics of Transport Management and Motor Vehicle Laws

COURSE CONTENT:

1. PLANT ENGINEERING

1.1 Introduction of plant and plant location
1.2 Factors affecting plant location
1.3 Plant layout
1.3.1 Principles of a good layout
1.3.2 Factors affecting plant layout
1.3.3 Types of layouts

2. WORK STUDY

2.1 Work study - Definition and objectives
2.2 Productivity - Definition and methods of improving
2.3 Method study -
2.3.1 Definition, objectives and procedure
2.3.2 Principles of motion economy
2.4 Work measurement
2.4.1 Definition and objectives
2.4.2 Techniques of work measurement -Time study, PMTS, Sampling
2.4.3 Basic procedure of Time Study
2.4.4 Employee Rating factor, Time allowances
2.4.5 Calculation of Standard Time

3. PRODUCTION, PLANNING AND CONTROL

3.1 Introduction - Definition and importance
3.2 Types of production - Job, batch, mass and their characteristics
3.3 Major function of Production Planning and Control :
Planning (pre and active), Routing, Scheduling, Dispatching and Follow up / Control
3.4 Concept of Critical Path Method (CPM) and PERT
3.5 Inventory control : Objectives, Economic Order Quantity, Procurement and Carrying cost, Lead time, reorder point and ABC analysis

3.6 Inspection and Quality Control : Definition, Types and Objectives
3.7 Statistical Quality control and Sampling : Introduction and importance.

4. PRINCIPLES OF MANAGEMENT

4.1 Management, Administration and Organisation – Definition and difference between these
4.2 Scientific Management :
- 4.2.1 Meaning, Characteristics, Objectives and Advantages
- 4.2.2 Functions of management
- 4.2.3 Taylor's and Fayol's Principles of management

4.3 Organisation : Types, advantages and disadvantages
4.4 Leadership, Qualities of a good leader
4.5 Modern Management Techniques ; Introduction of JIT,TQM, Quality Circles, Zero Defect and 5S concept.
4.6 Personnel Management:
- 4.6.1 Objectives and Functions of Personnel Department
- 4.6.2 Wage payment methods and Wage Incentive Plans

4.7 Material Management : Brief concept of Sales, Purchase, Store management
4.8 Factory Costing :
- 4.8.1 Estimating and Costing
- 4.8.2 Components of Cost
- 4.8.3 Allocation of Oncost

4.9 Depriciation : Definition, Causes and Methods of calculating.

5. TRANSPORT MANAGEMENT

5.1 Structure of Fleet Organisation
- 5.1.1 Route Planning – Necessity, Urban Root Planning
- 5.1.2 Vehicle and Crew Scheduling
- 5.1.3 Road Worthiness of a vehicle

5.2 Road Accidents : Definition, Causes and Prevention of Road Accidents
5.3 Motor Vehicle Laws
- 5.3.1 Main provisions of Motor Vehicle Act related to Licencing, Registration of Motor Vehicles, Control of Vehicles, Control of Traffic, Insurance, Claim, Offences, Penalties
- 5.3.2 Traffic Rules ; Road Signs, Hand Signals, Traffic Lights, Road Markings.

REFERENCE BOOKS :

1.Industrial Engg. And Management S.C.Sharma Khanna Book Publishing Co.
1. Industrial Management (Hindi) V.K. Sharma & O.P. Harkut
2. Industrial Engg. & Management O.P. Khanna Dhanpat Rai Publications
3. Industrial Engineering (Hindi) Vinod Kumar Sharma CBC (College Book Center , Jaipur)

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POWER PLANT ENGINEERING

Course Code	:	MA 50041 (Same in ME 50041)
Course Title	:	POWER PLANT ENGINEERING
Number of Credits	:	3 (L: 3, T: 0, P: 0)
Prerequisites	:	Thermal Engineering - I Engineering (ME 3004)
Course Category	:	PE

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.

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.

COURSE CONTENT:

UNIT-I: INTRODUCTION TO POWER PLANT

Introduction to power plant; Indian Energy scenario in India; Location of power plant; Choice of Power plant; Classification of power plants. Basic layout of thermal power plant ; Construction and Working.

UNIT-II: ECONOMICS OF POWER PLANT

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; Performance and operating characteristics of power plant. Simple numerical problems

UNIT-III: HYDRO POWER PLANT

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; Classification of the hydro electric power Plant. Advantages and disadvantages of hydro electric power plant.

UNIT-IV: DIESEL AND GAS TURBINE PLANT

The layout of diesel power plant; Components and the working of diesel power plant; Advantages and disadvantages of diesel power plant; 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).

Nuclear power plant: Introduction; Nuclear Power-Radio activity-Radioactive charge-types of reactions; Thermal fission Reactors- PWR, BWR and gas cooled reactors; Advantages and Disadvantages of Nuclear power plant.

UNIT-V: ENVIRONMENTAL IMPACT OF POWER PLANT

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.

Power plant safety: Plant safety concept; Safety policy to be observed in power plants; Safety practices to be

observed in boiler operation.

REFERENCE BOOKS:

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, Dhanpat Rai, 1984.
4. Power Plant Engineering – P.C. Sharma, S.K.Kataria& sons, 2009.
5. Power System Engineering – R.K. Rajput, Firewell Media,2006.

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ADVANCE VEHICLE TECHNOLOGY

Course Code	MA 50042
Course Title	ADVANCE VEHICLE TECHNOLOGY
Number of Credits	3 (L: 3, T: 0, P: 0)
Prerequisites	Basic Vehicle Technology (MA-40041)
Course Category	PE

COURSE OBJECTIVES:

- To know about alternative layouts of Light and Commercial vehicles.
- To understand different independent Suspension systems.
- To understand Transmission system, Vehicle resistances, Automatic transmission.
- To understand Power brakes , ABS, EBD.
- To understand Steering mechanism, Front end geometry and Power steering.
- To understand different features of vehicle body and upholstery.

COURSE OUTCOMES:

At the end of the semester, student will acquireknowledge of

CO1	Different alternative layouts of light and commercial vehicles.
CO2	Independent suspension system - construction and working.
CO3	Transmission, Vehicle resistances, Automatic transmission.
CO4	Power brakes, ABS, Power steering, Steering geometry.
CO5	Different Body features of vehicle and upholstery.

COURSE CONTENTS:

1. LAYOUTS AND SUSPENSION SYSTEM

1.1 Different layouts for light vehicles.
- 1.1.1 Front engine front wheel drive.
- 1.1.2 Front engine four-wheel drive.
- 1.1.3 Rear engine rear wheel drive.

1.2. Layouts for commercial vehicles
- 1.2.1 Rigid Trucks-4x2, 6x2, 6x4, 8x4 and Dual steer axle truck.
- 1.2.2 Articulated vehicles - Rigid 4x2 Tractor and single axle trailer. Rigid 6x4 Tractor and Tandem axle Trailer, 6x2 Dual steer axle Tractor and Tri axle Trailer.

1.3 Forces acting on suspension system.

1.4 Variables rate springs.

1.5 Independent Suspension System (Front and Rear)
- 1.5.1 Construction and operation of different types - Vertical slide. Divided axle. Swinging Arm. Parallel link double wishbone, McPherson Strut
- 1.5.2 Stabilizer Rod.

1.6 Air Suspension System - Layouts and Working, Advantages.

2. TRANSMISSION SYSTEM

2.1 Clutch
- 2.1.1 Factors affecting the power transmitted by clutch.
- 2.1.2 Clutch Operation -
  Mechanical - Rod and Cable.
  Hydraulic operation - Clutch master cylinder and slave cylinder.
  Electromagnetic operation.
- 2.1.3. Fluid Flywheel - Construction, characteristics, Advantages and disadvantages.

2.2 Transmission
- 2.2.1 Transmission requirements, Tractive effort.
- 2.2.2 Vehicle Resistances - Rolling, Air and Gradient resistance and their effect on vehicle motion.

2.2.3 Power and Torque, Power weight ratio, draw bar pull.
2.2.4 Transfer case- Construction and Operation.
2.2.5 Principle and operation of CVT.
2.2.6 Transaxle Unit - Types construction and operation.
2.2.7 Principle and operation of Overdrive
2.2.8 Torque converter, Automatic transmission, Freewheeling device.

2.3 Final Drive
2.3.1 Hotchkiss and Torque tube drive, Torque reaction.
2.3.2 Differential – Types, construction and working of Limited slip differential and Double reduction differential

3. BRAKING SYSTEM

3.1. Power Brakes - Layout, constructional details and working of following
3.1.1 Air Brakes
3.1.2 Air Hydraulic Brakes
3.1.3 Vacuum Brakes.

3.2 Disc Brakes
3.2.1 Constructional details and working of floating piston and floating caliper type.
3.2.2 Advantages and disadvantages of disc brakes.

3.3. Introduction to Anti-Lock Braking System, Electronic Brakeforce Distribution, ElectronicStability Control

4. STEERING SYSTEM

4.1 Steering Mechanisms:
4.1.1 Davis and Ackerman steering mechanism.
4.1.2 Fundamental equation for correct steering.
4.1.3 Cornering force end slip angle, under steer and over steer.

4.2 Front End Geometry: - Camber, Caster, Kingpin or Steering axis inclination, Included angle, Toe-in and Toe-out on turns (Definition and their effects).

4.3 Power steering:
4.3.1 Types – Integral, linkages types, Electronic power steering, Hydraulic power steering
4.3.2 Construction and working of power steering.

5. BODY AND UPHOLSTERY:

5..1 Types and construction (parts of body)

5.2. Main features – strength, stiffness, space, air drag, stream lining,thermal considerations, weight, vibration, profectionagainst weather, corrosion, safety and economy considerations.

5.3 Dashboard features, Bumpers – types and functions

5.4 Seats - location, mounting and adjustment

5.5 Seat belts - location fitting points and operation

5.6 Ceiling, side panels, door channels, beading and furnishing materials

REFERENCE BOOKS:

1. Vehicle and Engine Technology (vol.1&2) Heinz Heisler
2. Basic Automobile Engineering C.P.Nakra
3. Automobile Engineering R.B.Gupta
4. AutomobileEngineering (Hindi and English)Dr.Kirpal Singh
5. AutomobileEngineering G.B.S.Narang
6. Auto Chassis and Body P.L.Kohli
7. AutoChassisandBody Crouse, Anglin

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HYBRID VEHICLES

Course Code :	MA 50051
Course Title :	HYBRID VEHICLES
Number of Credits :	3 (L: 3, T: 0, P: 0)
Prerequisites :	NIL
Course Category :	PE

COURSE OBJECTIVES:

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

COURSE OUTCOMES:

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

CO1	Understand the basics of electrical vehicle history and components.
CO2	Understand the properties of batteries.
CO3	Understand the electrical machine properties and classifications.
CO4	Understand the properties of electrical vehicle drive systems.
CO5	Understand the concepts of hybrid electric vehicles.

COURSE CONTENT:

UNIT-I: Electric Vehicles:

Introduction, History of Hybrid and Electric Vehicles, Social and Environmental importance of Hybrid and Electric Vehicles, Components, Vehicle mechanics: Roadway fundamentals, Vehicle kinetics, Dynamics of vehicle motion, Propulsion System Design.

Unit-II: Battery:

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

Unit-III:DC & AC Electrical Machines:

Motor and Engine rating, Requirements, DC machines, Three phase A/c machines, Induction machines, Permanent magnet machines, Switched reluctance machines.

Unit-IV: Electric Vehicle Drive Train:

Transmission configuration, Components: Gears, Differential, Clutch, Brakes, Regenerative braking, Motor sizing, Fuel efficiency analysis.

Unit-V: Hybrid Electric Vehicles:

Types: Parallel, Series, Parallel and Series configurations, Drive train, Sizing of components, Basics of Micro, Mild, Mini, Plug-in and Fully hybrid.

REFERENCE BOOKS:

1. Electric & Hybrid Vehicles – A.K. Babu, Khanna Publishing House, New Delhi, 2018
2. Electric & Hybrid Vehicles – Design Fundamentals - Iqbal Hussain, Second Edition, CRC Press, 2011.
3. Electric Vehicle Technology Explained - James Larminie, John Wiley & Sons, 2003.
4. Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals - Mehrdad Ehsani, Yimin Gao, Ali Emadi, CRC Press, 2010.
5. Electric Vehicle Battery Systems - Sandeep Dhameja

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INDUSTRIAL ROBOTICS & AUTOMATION

Course Code	:	MA 50052 (Same as in ME 50052)
Course Title	:	INDUSTRIAL ROBOTICS & AUTOMATION
Number of Credits	:	3 (L: 3, T: 0, P: 0)
Prerequisites (Course code)	:	NIL
Course Category	:	PE

COURSE OBJECTIVES:

- To introduce the basic concepts, parts of robots and types of robots.
- To make the student familiar with the various drive systems for robot, sensors and their applications in robots and programming of robots.
- To select the robots according to its usage.
- To discuss about the various applications of robots, justification and implementation of robot.
- To Conceptualize automation and understand applications of robots in various industries.

COURSE OUTCOMES:

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

CO1	Explain the robot anatomy, classification, characteristics of robot, advantages and disadvantages.
CO2	Explain the various robotic actuators on hydraulic, pneumatic and electrical drives.
CO3	Explain about various types of sensors and concepts on robot vision system.
CO4	Explain the concepts of robot programming languages and various methods of robot programming.
CO5	Explain the various applications of robots.

COURSE CONTENT:

UNIT-I: FUNDAMENTALS OF ROBOTICS

Introduction; Definition; Robot anatomy (parts) and its working; Robot Components: Manipulator, End effectors; Construction of links, Types of joints; Classification of robots; Structural Characteristics of robots; Mechanical rigidity; Effects of structure on control work envelope and work Volume; Robot work Volumes, comparison; Advantages and disadvantages of robots.

UNIT-II: ROBOTIC DRIVE SYSTEM AND CONTROLLER

Actuators; Hydraulic, Pneumatic and Electrical drives; Linear actuator; Rotary drives; AC servo motor; DC servo motors and Stepper motors; Conversion between linear and rotary motion; Feedback devices; Potentiometers; Optical encoders; DC tachometers; Robot controller; Controller programming.

UNIT-III: SENSORS

Requirements of a senso used in Robotics; Proximity sensing; Force and torque sensing.

Introduction to Machine Vision: Robot vision system (scanning and digitizing image data); Image processing and analysis; Cameras (Acquisition of images); Videocon camera (Working principle & construction); Applications of Robot vision system: Inspection, Identification, Navigation & serving.

UNIT-IV: ROBOT KINEMATICS AND ROBOT PROGRAMMING

Forward Kinematics; Inverse Kinematics and Differences; Forward Kinematics and Reverse Kinematics of Manipulators with Two Degrees of Freedom (In 2 Dimensional); Deviations and Problems. Teach Pendant Programming; Lead through programming; Robot programming Languages; VAL Programming; Motion Commands; Sensor Commands; End effecter commands; and Simple programs

UNIT-V: AUTOMATION

Basic elements of automated system, advanced automation functions, levels of automation.

Industrial Applications: Application of robots in machining; welding; assembly and material handling.

REFERENCE BOOKS:

1. Introduction to Robotics: Analysis, Systems, Applications – Saeed B. Niku, Pearson Education Inc. New Delhi 2006.
2. Industrial Robotics: Technology, Programming and Applications – M.P. Groover, Tata McGraw Hill Co, 2001.
3. Robotics Control, Sensing, Vision and Intelligence – Fu.K.S. Gonzalz.R.C and Lee C.S.G, McGraw Hill Book Co, 1987.
4. Robotics for Engineers – Yoram Koren, McGraw Hill Book Co, 1992.
5. A Text book on Industrial Robotics – Ganesh S. Hedge, Laxmi Publications Pvt. Ltd., New Delhi, 2008.
6. Robotics Technology and Flexible Automation – S.R. Deb & Sankha Deb, Tata McGraw-Hill, 2010.
7. Elements of Robotics Process Automation, Mukherjee, Khanna Publishing House, Delhi, 2018

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CAD/CAM LAB

Course Code	:	MA 5006 (Same in ME 5006)
Course Title	:	CAD/CAM LAB
Number of Credits	:	1 (L: 0, T: 0, P: 2)
Prerequisites	:	Computer Aided Machine Drawing Engineering (ME 3009)
Course Category	:	PC

COURSE OBJECTIVES:

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

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 simples solids
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

COURSE CONTENT:

S.No.	Topics for practice
PART-A	**Introduction:** 1.Part modelling; Datum Plane; constraint; sketch; dimensioning; extrude; revolve; sweep; blend; protrusion; extrusion; rib; shell; hole; round; chamfer; copy; mirror; assembly; align; orient.
	2.Exercises: 3D Drawings of 2.1). Geneva Wheel; 2.2). Bearing Block; 2.3). Bushed bearing; 2.4). Gib and Cotter joint; 2. 5). Screw Jack; 2.6). Connecting Rod: Note: Print the orthographic view and sectional view from the above assembled 3D drawing.
PART-B	**CNC Programming and Machining:** 3.Introduction; 3.1). Study of CNC lathe, milling; 3.2). Study of international standard codes: G-Codes and M-Codes; 3.3). Format – Dimensioning methods; 3.4). Program writing – Turning simulator – Milling simulator, IS practice – commands menus; 3.5). Editing the program in the CNC machines; 3.6). Execute the program in the CNC machines; 3.7). Exercises Note: Print the Program from the Simulation Software and make the Component in the CNC Machine.
	CNC Turning Machine: **4** (Material: Aluminium/Acrylic/Plastic rod) 4.1) Using Linear and Circular interpolation - Create a part program and produce component in the Machine. 4.2) Using Stock removal cycle – Create a part program for multiple turning operations and

	produce component in the Machine. 4.3) Using canned cycle - Create a part program for thread cutting, grooving and produce component in the Machine.
	CNC Milling Machine **5**(Material: Aluminium/ Acrylic/ Plastic) 5.1 Using Linear interpolation and Circular interpolation – Create a part program for grooving and produce component in the Machine. **5.2** Using canned cycle - Create a part program for drilling, tapping, counter sinking and produce component in the Machine. **5.3**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. TamtaDhanpat Rai & 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

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MANUFACTURING ENGINEERING -II LAB

Course Code	:	MA 5007(Same in ME 5007)
Course Title	:	MANUFACTURING ENGINEERING -II LAB
Number of Credits	:	1 (L: 0, T: 0, P: 2)
Prerequisites	:	Manufacturing Engineering Engineering (ME 303)
Course Category	:	PC

COURSE OBJECTIVES:

- To know the working of Drilling machine, shaper, slotter, planer, milling and grinding machines and be in a position to operate the same.
- To make use of various measuring instruments for taking dimensions.
- To Practice different operations on drilling shaper, slotter, planer, milling and grinding machines.

COURSE OUTCOMES:

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

CO1	Dismantle and assemble the components on drilling, shaping, milling and grinding machines.
CO2	Perform operations on drilling, shaping, milling and grinding machines.
CO3	Produce articles of industrial application such as Spur gear, square headed bolt, V- block
CO4	Make use of various measuring instruments for taking dimensions

PRACTICALS:

1. Drilling Exercise (Three different sized holes for different materials maintaining uniform distance between them).
2. Milling-square-hexagon from round bars with indexing and without indexing.
3. Generation of spur gear teeth on a round bar.
4. Simple planning exercise cutting 'T' slots (one model).
5. Shaping a Hexagon on a round bar, key ways, groovessplines.
6. Shaping step block cut dovetail to angles 60, 90, 120 degrees.
7. Cylindrical grinding of external surface and internal surface using universal grinding machines.
8. Grinding Cutting tools to the required angles.
9. Grinding of milling cutters etc, on a tool and cutter grinder.
10. Grinding flat surface on a surface grinder using magnetic chuck and clamping devices.
11. Dismantling some of the components of drilling machine and service, assemble the same.
12. Dismantling some of the components of shaper head and then assemble the same.
13. Dismantling some of the components of Milling machines and service, assemble the same.
14. Servicing of universal grinding machine.

REFERENCE BOOKS:

1. Elements of Workshop Technology (Volume I & II) – HajraChowdry&Bhattacharaya, Media Promoters, 11th Edition, 2007.
2. Introduction of Basic Manufacturing Processes and Workshop Technology – Rajendersingh, New ageInternational (P) Ltd. NewDelhi, 2006.
3. Production Technology –HMT, 18th edition, Tata McGraw Hill, New Delhi.
4. Manufacturing process –Myro N Begman, 5th edition, Tata McGraw Hill, New Delhi.

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ADVANCE VEHICLE TECHNOLOGY LAB

Course Code	MA 5008
Course Title	ADVANCE VEHICLE TECHNOLOGY LAB
Number of Credits	1 (L:0, T:0, P:2)
Pre-requisites	BASIC VEHICLE TECHNOLOGY (MA 40041), VEHICLE TECHNOLOGY LAB (MA 4009)
Course Category	PC

COURSE OBJECTIVES:

* To know different layouts and body features of vehicle.
* To understand the constructional features of different engine components.
* To understand the construction and working of Transfer Case, Transaxle unit and CVT.
* To understand the Construction and working of Air Power Brakes.
* To understand the Front End Geometry (Wheel Alignment) and Power Steering.

COURSE OUTCOMES:

At the end of semester, student will acquire practical knowledge of

CO1	Different layouts and body features.
CO2	Different components of Engine
CO3	Construction and working of Transfer Case, Transaxle unit and CVT.
CO4	Construction and working of Air Power Brakes.
CO5	Front End Geometry (Wheel Alignment) and Power Steering.

PRACTICALS:

Sr.No.	Name of Practical
1	Study of different layouts of Light and Commercial vehicles.
2	Study of different Body features of Car.
3	Study the construction of Engine head, Block, Liner, Oil pan.
4	Study the construction of Piston, Piston Rings, Gudgeon Pin, Connecting Rod and Crank Shaft
5	Study of different Valve operating mechanisms.
6	Study the construction and working of Transfer Case and Transaxle unit.
7	Study the construction and working of Air Power Brakes.
8	Study and ckecking of Front End Geometry (Wheel Alignment)
9	Study the construction and working of Power Steering.
10	Study construction and working of Continuously Variable Transmission.

Note: The department may arrange visit to nearby auto workshop for the practicals not feasible in institute.

REFERENCE BOOKS:

1. Vehicle and Engine Technology (vol.1&2) Heinz Heisler
2. Basic Automobile Engineering C.P.Nakra
3. Automobile Engineering R.B.Gupta
4. AutomobileEngineering (Hindi and English)Dr.Kirpal Singh
6. Auto Chassis and Body P.L.Kohli
7. AutoChassisandBody Crouse, Anglin

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GOVERNMENT OF RAJASTHAN

BOARD OF TECHNICAL EDUCATION RAJASTHAN JODHPUR

SEMESTER SCHEME-2020-21

VI SEMESTER

(SESSION 2021-2022 & ONWARDS)

ENTREPRENEURSHIP AND START-UPS

Course Code	MA 6111 (Same in All Branches of Engg.)
Course Title	Entrepreneurship and Start-ups
Number of Credits	4 (L-3 ,T-1, P-0)
Prerequisites (Course code)	None
Course Category	HS

COURSE LEARNING OBJECTIVES:

1. Acquiring Entrepreneurial spirit and resourcefulness.
2. Familiarization with varioususes ofhuman resource for earning dignified means of living.
3. Understanding the concept and process of entrepreneurship-its contribution and role in the growth and development of individual and the nation.
4. Acquiring entrepreneurial quality, competency, and motivation.
5. Learning the process and skills of creation and management of entrepreneurial venture.

LEARNING OUTCOME:

Upon completion of the course, these student will be able to demonstrate knowledge of the following topics:

1. Understanding the dynamic role of entrepreneurship and small businesses
2. Organizing and Managing a Small Business
3. Financial Planning and Control
4. Forms of Ownership for Small Business
5. StrategicMarketing Planning
6. New Productor Service Development
7. Business Plan Creation

COURSE CONTENTS:

1. INTRODUCTION TO ENTREPRENEURSHIP AND START–UPS

- 1.1. Definitions, Traits of an entrepreneur, Intrapreneurship, Motivation
- 1.2. Types of Business Structures,
- 1.3. Similarities / differences between entrepreneurs and managers.

2. BUSINESS IDEAS AND THEIR IMPLEMENTATION

- 2.1. Discovering ideas and visualizing the business
- 2.2. Activity map
- 2.3. Business Plan

3. IDEA TO START-UP

- 3.1. Market Analysis– Identifying the target market,
- 3.2. Competition evaluation and Strategy Development,
- 3.3. Marketing and accounting,
- 3.4. Risk analysis

4. MANAGEMENT

- 4.1. Company's Organization Structure,
- 4.2. Recruitment and management of talent.
- 4.3. Financial organization and management

5. FINANCING AND PROTECTION OF IDEAS

- 5.1. Financing methods available for start-ups in India
- 5.2. Communication of Ideas to potential investors– Investor Pitch
- 5.3. Patenting and Licenses

6. EXIT STRATEGIES FOR ENTREPRENEURS ,BANKRUPTCY, AND SUCCESSION AND HARVESTING STRATEGY

SUGGESTED LEARNING RESOURCES:

S.No.	Title of Book	Author	Publication

1.	The Startup Owner's Manual: The Step by-Step Guide for Building a Great Company	Steve Blank and Bob Dorf	K & S Ranch ISBN–978-0984999392
2.	The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses	Eric Ries	Penguin UK ISBN–978-0670921607
3.	Demand: Creating What People Love Before They Know They Want It	Adrian J. Slywotzky with Karl Weber	Headline Book Publishing ISBN–978-0755388974
4.	The Innovator's Dilemma: The Revolutionary Book That Will Change the Way You Do Business	Clayton M. Chris Tensen	Harvard business ISBN:978-142219602

SUGGESTEDSOFTWARE/LEARNINGWEBSITES:

a. https://www.fundable.com/learn/resources/guides/startup
b. https://corporatefinanceinstitute.com/resources/knowledge/finance/corporatehstructure/
c .https://www.finder.com/small-business-finance-tips
d. https://www.profitbooks.net/funding-options-to-raise-startup-capital-for-your-business/

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PROJECT MANAGEMENT

CourseCode	MA 62001(Same in All Branches of Engg.)
CourseTitle	Project Management
NumberofCredits	3(L:3,T:0,P:0)
Prerequisites	NIL
CourseCategory	OE

COURSE LEARNING OBJECTIVES

•To develop the idea of project plan, from defining and confirming the project goals and objectives, identifying tasks and how goals will be achieved.

•To develop an understanding of key project management skills and strategies.

COURSE OUTCOMES

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

CO1	Understand the importance of projects and its phases.
CO2	Analyze projects from marketing, operational and financial perspectives.
CO3	Evaluate projects based on discount and non-discount methods.
CO4	Develop network diagrams for planning and execution of a given project.
CO5	Apply crashing procedures for time and cost optimization.

COURSE CONTENTS

1. CONCEPT OF A PROJECT:

1.1. Classification of projects
1.2. Importance of project management
1.3. The project Life cycle
1.4. Establishing project priorities (scope-cost-time)
1.5. Project priority matrix
1.6. Work break down structure.

2. CAPITAL BUDGETING PROCESS:

2.1. Planning -Analysis-Selection-Financing-Implementation-Review.
2.2. Generation and screening of project ideas
2.3. Market and demand analysis
2.4. Demand forecasting techniques.
2.5. Market planning and marketing research process
2.6. Technical analysis

3. FINANCIAL ESTIMATES AND PROJECTIONS:

3.1. Cost of projects
3.2. Means of financing
3.3. Estimates of sales and production-cost of production
3.4. Working capital requirement and its financing
3.5. Profitability project , cash flow statement and balance sheet.
3.6. Breakeven analysis.

4. BASIC TECHNIQUES IN CAPITAL BUDGETING:

4.1. Non discounting and discounting methods
4.2. pay-back period
4.3. Accounting rate of return
4.4. Net present value
4.5. Benefit cost ratio
4.6. Internal rate of return.
4.7. Project risk.
4.8. Social cost benefit analysis andeconomic rate of return.
4.9. Non-financial justification of projects**.**

5. PROJECT ADMINISTRATION:

5.1. Progress payments,
5.2. Expenditure planning,

5.3. Project scheduling and network planning,
5.4. Use of Critical Path Method(CPM),
5.5. Schedule of payments and physical progress,
5.6. time-cost trade off.
5.7. Concepts and uses of PERT
5.8. Cost as a function of time,
5.9. Project Evaluation and Review Techniques
5.10. Cost mechanisms.
5.11. Determination of least cost duration.
5.12. Post project evaluation.
5.13. Introduction to various Project management softwares.

REFERENCE BOOKS

1.Project planning, analysis, selection, implementation and review –Prasannachandra–Tata McGraw Hill
2.Project Management – the Managerial Process– Clifford F. Gray & Erik W. Larson-McGrawHill
3.Project management- David I Cleland- Mcgraw Hill International Edition, 1999
4.Project Management– Gopala krishnan– Mcmillan India Ltd.
5.Project Management- Harry – Maylor – Peason Publication

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RENEWABLE ENERGY TECHNOLOGIES

CourseCode	MA 62002(Same in All Branches of Engg.)
CourseTitle	Renewable Energy Technologies
NumberofCredits	3 (L:3,T:0,P:0)
Prerequisites	NIL
CourseCategory	OE

COURSE LEARNING OBJECTIVES

•To understand present and future scenario of world energy use.
•To understand fundamentals of solar energy systems.
•To understand basics of wind energy.
•To understand bio energy and its usage in different ways.
•To identify different available non-conventional energy sources.

COURSE OUTCOMES

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

CO1	Understand present and future energy scenario of the world.
CO2	Understand various methods of solar energy harvesting.
CO3	Identify various wind energy systems.
CO4	Evaluate appropriate methods for Bio energy generations from various Bio wastes.
CO5	Identify suitable energy sources for a location.

COURSE CONTENTS

1. INTRODUCTION:

1.1. World Energy Use;
1.2. Reserves of Energy Resources;
1.3. Environmental Aspects OF Energy Utilisation;
1.4. Renewable Energy Scenario in India and around the World;
1.5. Potentials; Achievements/ Applications;
1.6. Economics of renewable energy systems.

2. SOLAR ENERGY:

2.1. Solar Radiation;
2.2. Measurements of Solar Radiation;
2.3. Flat Plate and Concentrating Collectors;
2.4. Solar direct Thermal Applications;
2.5. Solar thermal Power Generation
2.6. Fundamentals of Solar Photo Voltaic Conversion;
2.7. Solar Cells;
2.8. Solar PV Power Generation;
2.9. Solar PV Applications.

3. WIND ENERGY:

3.1. Wind Data and Energy Estimation;
3.2. Types of Wind Energy Systems;
3.3. Performance; Site Selection;
3.4. Details of Wind Turbine Generator;
3.5. Safety and Environmental Aspects.

4. BIO-ENERGY:

4.1. Bio mass direct combustion;
4.2. Bio mass gasifiers;
4.3. Bio gas plants;
4.4. Digesters;
4.5. Ethanol production;
4.6. Bio diesel;
4.7. Cogeneration;

4.8. Bio mass Applications.

5. OTHER RENEWABLE ENERGY SOURCES:

5.1. Tidal energy;
5.2. Wave Energy;
5.3. Open and Closed OTEC Cycles;
5.4. Small Hydro Geothermal Energy;
5.5. Hydrogen and Storage;
5.6. Fuel Cell Systems;
5.7. Hybrid Systems.

REFERENCE BOOKS

1. Non-Conventional Energy Sources, Rai. G. D., Khanna Publishers, New Delhi, 2011.
2. Renewable Energy Sources, Twidell, J.W. & Weir, A., EFN SponLtd.,UK,2 006.
3. Solar Energy, Sukhatme. S. P., Tata Mc Graw Hill Publishing CompanyLtd. ,New Delhi, 1997.
4. Renewable Energy, Power for a Sustainable Future, Godfrey Boyle, Oxford University Press, U.K., 1996.
5. Fundamental of Renewable Energy Sources, G N Tiwari and M K Ghoshal, Narosa, New Delhi, 2007.
6. Renewable Energy and Environment A Policy Analysis for India ,NH Ravindranath, U K Rao, B Natarajan, P Monga, Tata McGraw Hill.
7. Energy and The Environment, R A Ristinen and J J Kraushaar, second edition, John Willey & Sons, New York, 2006.
8. Renewable Energy Resources, J W T widell and A D Weir, ELBS, 2006.

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PRODUCT DESIGN

CourseCode	MA 63001(Same in All Branches of Engg.)
CourseTitle	Product Design
NumberofCredits	3 (L:3,T:0,P:0)
Prerequisites	NIL
CourseCategory	OE

COURSE LEARNING OBJECTIVES

•To acquire the basic concepts of product design and development process
•To understand the engineering and scientific process in executing a design from concept to finished product
•To study the key reasons for design or redesign.

COURSE OUTCOMES

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

CO1	Understand the basic concepts of product design and development process.
CO2	Illustrate the methods to define thecustomer needs.
CO3	Describe an engineering design and development process.
CO4	Understand the intuitive and advanced methods used to develop and evaluate a concept.
CO5	Apply modelling and embodiment principles in product design and development process.

COURSE CONTENTS

1. DEFINITION OF A PRODUCT

1.1. Types of product;
1.2. Levels of product;
1.3. Product-market mix;
1.4. New prod-uct development (NPD) process;
1.5. Idea generation methods;
1.6. Creativity;
1.6.1. Creative attitude;
1.6.2. Creative design process;
1.7. Morpho logical analysis;
1.8. Analysis of inter-connected decision areas;
1.9. Brain storming.

2. PRODUCT LIFECYCLE;

2.1. The challenges of Product development;
2.2. Product analysis;
2.3. Product characteristics;
2.4. Economic considerations;
2.5. Production and Marketing aspects;
2.6. Characteristics of successful Product development;
2.7. Phases of a generic product development process;
2.8. Customer need identification;
2.9. Product development practices and industry-product strategies.

3. PRODUCT DESIGN

3.1. Design by evolution;
3.2. Design by innovation;
3.3. Design by imitation;
3.4. Factors affecting product design;
3.5. Standards of performance and environmental factors;
3.6. Decision making and iteration;
3.7. Morphology of design (different phases);
3.8. Role of aesthetics in design.

4. INTRODUCTION TO OPTIMIZATION IN DESIGN

4.1. Economic factors in design;
4.2. Design for safety and reliability;

4.3. Role of computers in design;
4.4. Modeling and Simulation;
4.5. The role of models in engineering design;
4.6. Mathematical modeling;
4.7. Similitude and scale models;
4.8. Concurrent design;
4.9. Six sigma and design for six sigma;
4.10. Introduction to optimization in design;
4.11. Economic factors and financial feasibility in design;
4.12. Design for manufacturing;
4.13. Rapid Proto typing (RP);
4.14. Application of RP in product design;
4.15. Product Development versus Design.

5. DESIGN OF SIMPLE PRODUCTS DEALING WITH VARIOUS ASPECTS OF PRODUCT DEVELOPMENT;

5.1. Design Starting from need till the manufacture of the product

REFERENCE BOOKS

1.Product Design and Development, Karl T.Ulrichand Steven D.Eppinger, TataMc Graw–Hill edition.
2.Engineering Design– George E. Dieter.
3.An Introduction to Engineering Design methods Vijay Gupta.
4.Merie Crawford: New Product management, McGraw-Hill Irwin.
5.Chitale A K and Gupta R C," Product Design and Manufacturing", Prentice Hall of India, 2005.
6.Kevin Otto and Kristin Wood, Product Design, Techniques in Reverse Engineering and New Product Development, Pears on education.

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DISASTER MANAGEMENT

Course Code	MA 63002(Same in All Branches of Engg.)
Course Title	Disaster Management
Number of Credits	3 (L: 3, T: 0 ,P :0)
Prerequisites	NIL
Course Category	OE

COURSE LEARNING OBJECTIVES

Following are the objectives of this course:

•To learn about various types of natural and man-made disasters.
•To know pre and post-disaster management for some of the disasters.
•To know about various information and organizations in disaster management in India.
•To get exposed to technological tools and their role in disaster management.

COURSE OUTCOMES:

1.1. After competing this course, student will be:
1.2. Acquainted with basic information on various types of disasters
1.3. Knowing the precautions and awareness regarding various disasters
1.4. Decide first action to be taken under various disasters
1.5. Familiarised with organization in India which are dealing with disasters
1.6. Able to select IT tools to help in disaster management

COURSE CONTENTS

1. UNDERSTANDING DISASTER

1.1. Understanding the Concepts and definitions of Disaster,
1.2. Hazard,
1.3. Vulnerability,
1.4. Risk,
1.5. Capacity–Disaster and Development,
1.6. Disaster management.

2. TYPES, TRENDS, CAUSES, CONSEQUENCES AND CONTROL OF DISASTERS

2.1. Geological Disasters (earth quakes, land slides,tsunami, mining);
2.2. Hydro-Meteorological Di-sasters (floods, cyclones, lightning, thunder-storms, hailstorms, avalanches, droughts, cold and heat waves)
2.3. Biological Disasters (epidemics, pestattacks, forestfire);
2.4. Technological Disasters (chemical, industrial, radiological, nuclear)
2.5. Manmade Disasters (building collapse, rural and urban fire, road and rail accidents, nuclear, radiological, chemicals and biological disasters)
2.6. Global Disaster Trends
2.7. Emerging Risks of Disasters
2.8. Climate Change and Urban Disasters.

3. DISASTER MANAGEMENT CYCLE AND FRAME WORK

3.1. Disaster Management Cycle
3.2. Paradigm Shift in Disaster Management.
3.3. Pre-Disaster
3.4. Risk Assessment and Analysis,
3.5. Risk Mapping,
3.6. Zonation and Microzonation,
3.7. Prevention and Mitigation of Disasters,
3.8. Early Warning System
  3.8.1. Preparedness,
  3.8.2. Capacity Development;
  3.8.3. Awareness.
3.9. During Disaster
  3.9.1. Evacuation
  3.9.2. Disaster Communication
  3.9.3. Search and Rescue
  3.9.4. Emergency Operation Centre

3.9.5. Incident Comm and System
3.9.6. Relief and Rehabilitation
3.10. Post-disaster
3.10.1. Damage and Needs Assessment,
3.10.2. Restoration of Critical Infra structure
3.10.3. Early Recovery Reconstruction and Redevelopment;
3.10.4. IDNDR, Yokohama Stretegy, Hyogo Frame-work of Action.

4. DISASTER MANAGEMENT IN INDIA

4.1. Disaster Profile of India
4.2. Mega Disasters of India and Lessons Learnt.
4.3. Disaster Management Act 2005
4.4. Institutional and Financial Mechanism,
4.5. National Policy on Disaster Management,
4.6. National Guidelines and Plans on Disaster Management;
4.7. Role of Government (local, state and national),
4.8. Non-Government and Inter Governmental Agencies

5. APPLICATIONS OF SCIENCE AND TECHNOLOGY FOR DISASTER MANAGEMENT

5.1. Geo informatics in Disaster Management (RS, GIS, GPS and RS).
5.2. Disaster Communication System (Early Warning and Its Dissemination).
5.3. Land Use Planning and Development Regulations,
5.4. Disaster Safe Designs and Constructions,
5.5. Structural and Non Structural Mitigation of Disasters
5.6. S & T Institutions for Disaster Management in India

REFERENCES

1.Publications of National Disaster Management Authority (NDMA) on Various Templates and Guide lines for Disaster Management
2.Bhandani, R. K., An over view on natural & man-made disasters and their reduction, CSIR, New Delhi
3.Srivastava, H. N., and Gupta G. D. , Management of Natural Disasters in developing countries, Daya Publishers, Delhi
4.Alexander, David, Natural Disasters, Kluwer Academic London
5.Ghosh, G .K. ,Disaster Management, APH Publishing Corporation
6.Murthy, D. B. N., Disaster Management: Text & Case Studies, Deep & Deep Pvt. Ltd.

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INDIAN CONSTITUTION

CourseCode	MA 6333(Same in All Branches of Engg.)
CourseTitle	Indian Constitution
NumberofCredits	0 (L:2,T:0;P:0)
Prerequisites(Coursecode)	None
CourseCategory	AU

COURSE CONTENT

1. THE CONSTITUTION –

1.1. Introduction
1.2. The History of the Making of the Indian Constitution
1.3. Preamble and the Basic Structure, and its interpretation
1.4. Fundamental Rights and Duties and their interpretation
1.5. State Policy Principles

2. UNION GOVERNMENT

2.1. Structure of the Indian Union
2.2. President– Role and Power
2.3. Prime Minister and Council of Ministers
2.4. Lok Sabha and Rajya Sabha

3. STATE GOVERNMENT

3.1. Governor– Role and Power
3.2. Chief Minister and Council of Ministers
3.3. State Secretariat

4. LOCAL ADMINISTRATION

4.1. District Administration
4.2. Municipal Corporation
4.3. Zila Panchayat

5. ELECTION COMMISSION

5.1. Role and Functioning
5.2. Chief Election Commissioner
5.3. State Election Commission

SUGGESTED LEARNING RESOURCES:

S.No.	Title of Book	Author	Publication
1.	Ethics and Politics of the Indian Constitution	Rajeev Bhargava	Oxford University Press, New Delhi, 2008
2.	The Constitution of India	B.L.Fadia	Sahitya Bhawan; New edition(2017)
3.	Introduction to the Constitution of India	D D Basu	Lexis Nexis; Twenty-Third 2018 edition

SUGGESTED SOFTWARE / LEARNING WEBSITES:

1. https://www.constitution.org/cons/india/const.html
2. http://www.legislative.gov.in/constitution-of-india
3. https://www.sci.gov.in/constitution
4. https://www.toppr.com/guides/civics/the-indian-constitution/the-constitution-of-india/

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DESIGN OF MACHINE ELEMENTS

Course Code	:	MA 6001(Same in ME 6001)
Course Title	:	Design of Machine Elements
Number of Credits	:	3 (L: 2, T: 1, P: 0)
Prerequisites	:	Engineering Mechanics (2005) Strength of Materials Engineering (ME 402) Theory of Machines & Mechanisms Engineering (ME 502)
Course Category	:	PC

COURSE OBJECTIVES:

- To enable the student to design and draw simple machine components used in small and medium scale industries.
- Tounderstand the basic philosophy and fundamentals of Machine Design.
- To understand the modes of failures of m/c components and decide the design criteria and equations.
- To analyze and evaluate the loads, forces, stresses involved in components and subassemblies and decide the dimensions.
- To develop analytical abilities to give solutions to engineering design problems.

COURSE OUTCOMES:

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

CO1	Analyze the various modes of failure of machine components under different load patterns.
CO2	Design and prepare part and assembly drawings.
CO3	Use design data books and different codes of design.
CO4	Select standard components with their specifications from manufacturer's catalogue.
CO5	Develop drawings on CAD software.

COURSE CONTENT:

1. INTRODUCTION TO DESIGN

1.1 Machine Design philosophy and Procedures
1.2 General Considerations in Machine Design
1.3 Types of loads
1.4 Concepts of stress, Strain
1.5 Stress – Strain Diagram for Ductile and Brittle Materials
1.6 Types of Stresses
  1.6.1 Bearing pressure Intensity
  1.6.2 Crushing
  1.6.3 Bending
  1.6.4 Torsion
1.7 Principal Stresses
1.8 Simple Numericals
1.9 Fatigue
1.10 Endurance Limit
1.11 Factor of Safety and Factors governing selection of factor of Safety
1.12 Stress Concentration
  1.12.1 Causes & Remedies
1.13 Converting actual load or torque into design load or torque using design factors like
  1.13.1 Factor of safety
1.14 Properties of Engineering materials
1.15 Theories of Elastic Failures

1.15.1 Principal normal stress theory
1.15.2 Maximum shear stress theory
1.16 Use of design data book

2. DESIGN OF SIMPLE MACHINE PARTS:

2.1 Cotter Joint
2.2 Knuckle Joint
2.3 Turnbuckle
2.4 Design of Levers
2.4.1 Hand/Foot Lever
2.4.2 Bell Crank Lever
2.5 Arm of Pulley
2.6 Antifriction Bearings
2.6.1 Classification of Bearings
2.6.1.1 Sliding contact
2.6.1.2 Rolling contact
2.6.2 Terminology of Ball bearings
2.6.2.1 Life Load relationship
2.6.2.2 Basic static load rating
2.6.2.3 Basic dynamic load rating
2.6.2.4 Limiting speed
2.6.3 Selection of ball bearings using manufacturer's catalogue

3. DESIGN OF SHAFTS, KEYS, COUPLINGS AND SPUR GEARS

3.1 Types of Shafts
3.2 Shaft materials
3.3 Standard Sizes
3.4 Design of Shafts (Hollow and Solid) using strength and rigidity criteria
3.5 ASME code of design for line shafts supported between bearings with one or two pulleys in between or one overhung pulley
3.6 Design of Sunk Keys
3.7 Design of Couplings
3.7.1 Muff Coupling
3.7.2 Protected type Flange Coupling

4. DESIGN OF POWER SCREWS

4.1 Thread Profiles used for power Screws
4.1.1 Relative merits and demerits of each
4.2 Torque required to overcome thread friction
4.3 Self-locking and overhauling property
4.4 Efficiency of power screws
4.5 Types of stresses induced
4.6 Design of Screw Jack
4.7 Design of springs
4.7.1 Classification and Applications of springs
4.7.2 Spring terminology
4.7.3 Materials and Specifications
4.7.4 Stresses in springs
4.7.5 Wahl's correction factor
4.7.6 Deflection of springs
4.7.7 Energy stored in springs
4.7.8 Design of Helical, Tension and Compression springs subjected to uniform applied loads like I.C. engine valves, Weighing balance, Railway buffers and Governor springs
4.7.9 Leaf springs: Construction and Application

5. DESIGN OF FASTENERS

5.1 Stresses in Screwed fasteners
5.2 Bolts of Uniform Strength
5.3 Design of Parallel and Transverse fillet welds

5.3.1 Design of eccentrically loading welded joints

5.4 Axially loaded symmetrical section
5.5 Merits and demerits of screwed and welded joints

REFERENCE 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).
3. Introduction to Machine Design – V.B.Bhandari, Tata Mc- Graw Hill, New Delhi.
4. Mechanical Engineering Design – Joseph Edward Shigley, Tata Mc- Graw Hill, New Delhi.
5. Machine design – Pandya & Shah, Dhanpat Rai & Son, New Delhi.
6. Machine design – R.K.Jain, Khanna Publication, New Delhi.
7. Design Data Book – PSG Coimbtore, PSG Coimbtore.
8. Hand Book of Properties of Engineering Materials & Design Data for Machine Elements – Abdulla Shariff, Dhanpat Rai & Sons, New Delhi.

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AUTO WORKSHOP

Course Code	MA 6002
Course Title	AUTO WORKSHOP
Number of Credits	2 (L: 0, T: 0, P: 4)
Prerequisites	NIL
Course Category	PC

COURSE OBJECTIVES:

- To understand the layout of an auto workshop, working and uses of the auto workshop equipments.
- To understand about inspection, testing and fault rectification procedure of engine components.
- To understand the procedure of calibrating and testing fuel injection pump.
- To understand the procedure of dismantling and assembling of the clutch, gear box, differential, steering & suspension system of an automotive vehicle.
- To understand overhauling of the braking system of an automotive vehicle.

COURSE OUTCOMES:

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

CO1	know the layout of an auto workshop and working & uses of the auto workshop equipments
CO2	know about inspection, testing and fault rectification procedure of cooling system, connecting rod, crankshaft, and cylinder liner
CO3	know the procedure of calibrating and testing of fuel injection pump
CO4	dismantle and assemble the clutch, gear box, differential, steering & suspension system
CO5	overhaul the braking system of automotive vehicle

COURSE CONTENT:

1. Study about the layout of an auto workshop and working & uses of the auto workshop equipments
2. Inspection and testing of cooling systems.
3. Inspection of connecting rod and crankshaft.
4. Inspection and prepare measurement sheet for taper and ovality of cylinder liner.
5. Boring cylinder liner by boring machine.
6. Study the working, calibration and testing of fuel injection pump.
7. Dismantling, assembling and testing of diesel injector.
8. Dismantling and assembling of single and multi- plate clutches.
9. Dismantling and assembling of gear boxes.
10. Dismantling and assembling of differential.
11. Dismantling and assembling of steering system.
12. Dismantling and assembling of suspension system.
13. Overhauling of the braking system.

Note - Visit to nearby Auto Workshop may be arranged for the practicals which are not feasible in institute.

REFERENCE BOOKS :

1. Car Maintenance & Repair by W. Judge
2 Automobile Engineering by Kirpal Singh, Standard Publishers, Delhi
3. Automobile Engineering by R.B. Gupta, Satya Parkashan, New Delhi
4. Maintenance and Repair of Motor Vehicle by H.O. Geneva; , R-686, New Rajinder Nagar, New Delhi.
5. Automotive mechanics by C. P Nakra, Dhanpat rai and Publishing, Delhi
6. Automobile Practicals (in hindi) by K. B. LaL, Arihant prakashan, Merrut

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