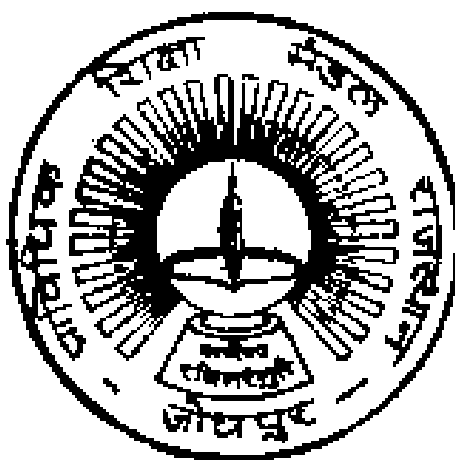# GOVERNMENT OF RAJASTHAN
BOARD OF TECHNICAL EDUCATION RAJASTHAN JODHPUR

SEMESTER SCHEME-2020-21

(SESSION 2021-2022 & ONWARDS)

TEACHING AND EXAMINATION SCHEME AND SYLLABUS

MECHATRONICS

(MA)

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

1GOVERNMENT OF RAJASTHAN
BOARD OF TECHNICAL EDUCATION RAJASTHAN, JODHPUR
TEACHING AND EXAMINATION SCHEME
(SEMESTER SCHEME-2020-21)
FOR DIPLOMA **III SEMESTER (MECHATRONICS) (MT)**
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	MT 3001	Fluid Mechanics & Hydraulic Machinery	2	1	0	3	60	3	--	--	20	20	--	100	3
PC	MT 3002	Manufacturing Engineering	3	0	0	3	60	3	--	--	20	20	--	100	3
PC	**MT 3003	Digital Electronics	3	0	0	3	60	3	--	--	20	20	--	100	3
PC	MT 3004	Analog Electronics & Devices	3	0	0	3	60	3	-	-	20	20	--	100	3
PC	MT 3005	Basic Concepts of Mechatronics	3	0	0	3	60	3	--	--	20	20	--	100	3
PC	MT 3006	Fluid Mechanics & Hydraulic Machinery Lab	0	0	2	2	--	--	40	3	--	--	60	100	1
PC	MT 3007	Manufacturing Engineering Lab	0	0	2	2	--	--	40	3	--	--	60	100	1
PC	MT 3008	Electronics & Mechatronics Lab	0	0	4	4	--	--	40	3	--	--	60	100	2
PC	*MT 3009	Computer Aided Machine Drawing Practice	0	0	4	4	--	--	40	3	--	--	60	100	2
SI	MT 3010	Summer Internship-I (4 weeks after II sem)	0	0	0	0	--	--	100	--	--	--	--	100	2
VS	+MT 3333	Anandam (Joy of Giving)	--	--	1	1	--	--	--	--	--	--	100	100	2
		Students Centered Activities	0	0	3	3	--	--	--	--	--	--	--	--	--
		Total	14	1	16	31	300	--	260	--	100	100	340	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. +MT3333 is same in all branches of Engineering

2. *MT 3009 is same as MA/ME 3009,

3. **MT 3003 is same as **EF/EL/ER/RA 3003

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 (MECHATRONICS) (MT)**
SESSION 2022-23 & OONWARDS

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	MT 4001	Electronics Instrumentation & Sensors	3	0	0	3	60	3	--	--	40	--	--	100	3
PC	***MT 4002	Strength of Materials	2	1	0	3	60	3	--	--	20	20	--	100	3
PC	MT 4003	Microcontroller & Applications	3	0	0	3	60	3	--	--	40	--	--	100	3
PE	MT 4004	**Programme Elective-I** **MT 40041-** Material Science & Engineering **MT 40042-** Thermal Engineering	3	0	0	3	60	3	--	--	40	--	--	100	3
PE	MT 4005	**Programme Elective-II** **MT 40051-** Industrial Automation **MT 40052-** Control System & PLC	3	0	0	3	60	3	--	--	40	--	--	100	3
PC	MT 4006	Material Testing Lab	0	0	2	2	--	--	40	3	--	--	60	100	1
PC	MT 4007	Electronics Instrumentation & Sensors Lab	0	0	2	2	--	--	40	3	--	--	60	100	1
PC	MT 4008	Microcontroller & Applications Lab	0	0	2	2	--	--	40	3	--	--	60	100	1
PR	MT 4009	Minor Project	0	0	4	4	-	-	40	--	-	-	60	100	2
AU	+MT 4222	Essence of Indian Knowledge and Tradition	2	0	0	2	--	--	--	--	--	--	--	--	--
VS	+MT 4444	Anandam (Joy of Giving)	--	--	1	1	--	--	--	--	--	--	100	100	2
		Students Centered Activities	0	0	3	3	--	--	--	--	--	--	--	--	--
		Total	**16**	**1**	**14**	**31**	**300**	**--**	**160**	**--**	**180**	**20**	**340**	**1000**	**22**
		Grand Total												**1000**	**22**

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

1. +MT 4222 and +MT 4444 are same in all branches of Engineering

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

3. $$MT 4006 is   same as MA/ME40042

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 SEMESTER (MECHATRONICS) (MT)**
SESSION 2023-2024 & 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	**MT 5001	Advance Manufacturing Process	3	0	0	3	60	3	--	--	40	--	--	100	3
PC	MT 5002	Design of Machine Elements	2	1	0	3	60	3	--	--	20	20	--	100	3
OE	+MT 5100	**Open Elective-I** +**MT 51001**- Economic Policies in India +**MT 51002**- Engineering Economics & Accountancy	3	0	0	3	60	3	--	--	40	--	--	100	3
PC	$$MT 5003	Industrial Engineering & Management	3	0	0	3	60	3	--	--	40	--	--	100	3
PE	MT 5004	**Programme Elective-III** **MT 50041**- Computer Integrated Manufacturing **MT 50042**-Theory of Mechanics & Mechanisms	3	0	0	3	60	3	--	--	40	--	--	100	3
PE	MT 5005	**Programme Elective-IV** **MT 50051**- Robotics **MT 50052**- Electrical Machines	3	0	0	3	60	3	--	--	40	--	--	100	3
PC	MT 5006	Advance Manufacturing Process Lab	0	0	2	2	--	--	40	3	--	--	60	100	1
PE	MT 5007	**Programme Elective-IV Lab** **MT 50071**- Robotics Lab **MT50072** - Electrical Machines Lab	0	0	2	2	--	--	40	3	--	--	60	100	1
SI	MT 5008	Summer Internship-II (6 weeks after IV Semester)	0	0	0	0	-	-	100	-	-	-	--	100	3
PR	MT 5009	Major Project	0	0	2	2	-	-	--	-	-	-	--	-	--
VS	+MT 5555	Anandam (Joy of Giving)	0	0	1	1	--	--	--	--	--	--	100	100	2
		Students Centered Activities	0	0	3	3	--	--	--	--	--	--	--	--	0
		Total	17	1	10	28	360	--	180	--	220	20	220	1000	25

Grand Total : 1000 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. +MT 51001, +MT 51002   and +MT 5555 are same in all branches of Engineering

2. *MT5001 is same as MA/ME 5001

3. $$MT 5003 is same as ME/MP 5003
 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 (MECHATRONICS) (MT)**
SESSION 2023-2024 & 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	+MT 6111	Entrepreneurship and Start-ups	3	1	0	4	60	3	--	--	20	20	--	100	4
OE	+MT 6200	**Open Elective-II** +**MT 62001**- Project Management +**MT 62002**- Renewable Energy Technologies	3	0	0	3	60	3	--	--	40	--	--	100	3
OE	+MT 6300	**Open Elective-III** +**MT 63001**- Product Design +**MT 63002**- Disaster Management	3	0	0	3	60	3	--	--	40	--	--	100	3
AU	+MT 6333	Indian Constitution	2	0	0	2	--	--	--	--	--	--	--	--	--
PC	MT 6001	Embedded System	4	0	0	4	60	3	--	--	40	--	--	100	4
PC	MT 6002	Embedded System Lab	0	0	2	2	--	--	40	3	--	--	60	100	1
PR	MT 6003	Major Project	0	0	6	6	-	-	40	-	-	-	60	100	4
SE	MT 6004	Seminar	1	0	0	1	-	-	--	-	-	-	100	100	1
VS	+MT 6666	Anandam (Joy of Giving)	0	0	1	1	--	--	--	--	--	--	100	100	2
		Students Centered Activities	0	0	3	3	--	--	--	--	--	--	--	-	-
		Total	**16**	**1**	**12**	**29**	**240**	**--**	**80**	**-**	**140**	**20**	**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. +MT 6111, +MT62001, +MT62002, +MT 63001, +MT 63002, +MT 6333 and +MT 6666 are same in all branches of Engineering

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)

FLUID MECHANICS & HYDRAULIC MACHINERY

Course Code	MT 3001
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.   **UNIT 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.   **UNIT 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.   **UNIT 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.   **UNIT 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.   UNIT 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

Course Code	MT 3002
Course Title	Manufacturing Engineering
Number of Credits	3 (L: 3, T: 0, P: 0)
Prerequisites	NIL
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. **UNIT 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. **UNIT 2 - BROACHING MACHINES:**
   2,1 Introduction and Types of broaching machines;
   2.2 Elements of broach tool, Nomenclature and 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   **UNIT 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.

4   UNIT 4 – MILLIMG AND 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.   UNIT 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.

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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DIGITAL ELECTRONICS

Course Code	MT 3003 Same as EF/EL/ER/RA 3003
Course Title	Digital Electronics
Number of Credits	3 (L-3,T-0, P-0)
Prerequisites	NIL
Course Category	PC

COURSE CONTENTS:

UNIT 1 – NUMBER SYSTEMS & BOOLEAN ALGEBRA
- 1.1   Introduction to different number systems – Binary, Octal, Decimal, Hexadecimal;
- 1.2   Conversion from one number system to another;
- 1.3   Boolean variables – Rules and laws of Boolean algebra;
- 1.4   De-Morgan's Theorem;
- 1.5   Karnaugh Maps and their use for simplification of Boolean expressions.

UNIT 2 – LOGIC GATES
- 2.1   Logic Gates – AND, OR, NOT, NAND, NOR, XOR, XNOR: Symbolic representation and truth table;
- 2.2   Implementation of Boolean expressions and Logic Functions using gates;
- 2.3   Simplification of expressions.

UNIT 3 – COMBINATIONAL LOGIC CIRCUITS
- 3.1   Arithmetic Circuits – Addition, Subtraction, 1's 2's Complement, Half Adder, Full Adder, Half Subtractor, Full Subtractor, Parallel and Series Adders;
- 3.2   Encoder, Decoder;
- 3.3   Multiplexer – 2 to 1 MUX, 4 to 1 MUX, 8 to 1 MUX. Applications;
- 3.4   Demultiplexer – 1 to 2 DEMUX, 1- 4 DEMUX, 1- 8 DEMUX.

UNIT 4 – SEQUENTIAL LOGIC CIRCUITS
- 4.1   Flip Flops – SR, JK, T, D, FF, JK-MS, Triggering;
- 4.2   Counters – 4 bit Up – Down Counters, Asynchronous/ Ripple Counter, Decade Counter- Mod 3, Mod 7 Counter, Johnson Counter, Ring Counter;
- 4.3   Registers – 4bit Shift Register: Serial in Serial Out, Serial in Parallel Out, Parallel in Serial Out, and Parallel in Parallel Out.

UNIT 5 – MEMORY DEVICES
- 5.1   Classification of Memories – RAM Organization, Address Lines and Memory Sixe;
- 5.2   Static RAM, Bipolar RAM, cell Dynamic RAM, D RAM, DDR RAM;
- 5.3   Read only memory – ROM organization, Expanding memory, PROM, EPROM, EEPROM, Flash memory;
- 5.4   Data Converters – Digital to Analog converters, Analog to Digital Converters.

REFERENCES /SUGGESTED LEARNING RESOURCES:

1. Digital principles & Applications Albert Paul Malvino & Donald P. Leach McGraw Hill Education; Eighth edition, ISBN: 978-9339203405.
2. Digital Electronics Roger L. Tokheim Macmillian McGraw-Hill Education (ISE Editions); International 2 Revised edition, ISBN: 978-0071167963.
3. Digital Electronics – an introduction to theory and practice William H. Gothmann Prentice Hall India Learning Private Limited; 2 edition, ISBN: 978-8120303485.
4. Fundamentals of Logic Design Charles H. Roth Jr. Jaico Publishing House; First edition, ISBN: 978-8172247744.
5. Digital Electronics R. Anand Khanna Publications, New Delhi (Edition 2018), ISBN: 978-93-82609445.

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ANALOG ELECTRONICS & DEVICES

Course Code	MT 3004
Course Title	Analog Electronics & Devices
Number of Credits	3 (L-3, T-0, P-0)
Prerequisites	NIL
Course Category	PC

COURSE CONTENTS:

UNIT 1 – DIODES AND BIPOLAR JUNCTION TRANSISTOR (BJT)
    1.1   Definition, Extrinsic/Intrinsic, N-type & p-type;
    1.2   PN Junction Diode – Forward and Reverse Bias Characteristics;
    1.3   Diode Rectifiers – Half Wave and Full Wave;
    1.4   NPN and PNP Transistor – Operation and characteristics;
    1.5   CB, CE & CC, Configuration.

UNIT 2 – FIELD EFFECT TRANSISTORS

    2.1   FET – Working Principle, Classification;
    2.2   N-Channel / P-Channel MOSFETs – characteristics;
    2.3   Enhancement and depletion mode;
    2.4   MOS- FET as a Switch;
    2.5   Common Source Amplifiers;
    2.6   Uni-Junction Transistor – equivalent circuit and operation.

UNIT 3 – SCR DIAC & TRIAC

    3.1   SCR – Construction, operation, working, characteristics;
    3.2   DIAC - Construction, operation, working, characteristics;
    3.3   TRIAC - Construction, operation, working;
    3.4   Characteristics SCR and MOSFET as a Switch;
    3.5   DIAC as bidirectional switch;
    3.6   Comparison of SCR, DIAC, TRIAC, MOSFET.

UNIT 4 – AMPLIFIERS AND OSCILLATORS

    4.1   Classification of amplifiers Feedback Amplifiers – Properties of negative Feedback, impact of feedback on different parameters;
    4.2   Basic Feedback Amplifier Topologies: Voltage Series, Voltage Shunt Current Series, Current Shunt;
    4.3   Oscillator – Basic Principles, Crystal Oscillator, Non-linear/ Pulse Oscillator.

UNIT 5 – OPERATIONAL AMPLIFIERS AND TIMERS

    5.1   Operational amplifier; Ideal Op. Amp; Block diagram and characteristics;
    5.2   Op-amp parameters – CMRR, Slew rate, Virtual ground , Applications of op-amp;
    5.3   Inverting amplifier, Summing amplifier , Non inverting amplifier;
    5.4   Instrumentation amplifier, Voltage follower, Comparator, Zero crossing detector Integrator, Differentiator;
    5.5   Logarithmic amplifier - Antilogarithmic amplifier Op- Amp Specifications;
    5.6   555 Timer – Functional Block diagram, Astable, Monostable and Schmitt Trigger, Sequence timer, 555 timer can be used as PWM.

REFERENCES /SUGGESTED LEARNING RESOURCES:

1. Electronic Devices and Circuits S. Salivahanan and N. Suresh Kumar McGraw Hill Education; Fourth edition (1July 2017), ISBN: 978-9339219505.
2. Electronics Devices and circuit theory Boyestad & Nashelsky Pearson Education India; 11 edition (2015), ISBN: 978-9332542600.
3. Electronic Principles Albert Malvino & David Bates Tata McGraw Hill Publication 2010, ISBN: 978-0070634244.
4. Electronics Devices & Circuits Jacob Millman McGraw Hill Education; 4 edition (2015), ISBN: 978-9339219543.
5. Design with operational amplifiers and analog integrated circuits, 3rd Edition Sergio Franco Tata McGraw-Hill, 2007.
6. OP-AMP and Linear Ics Ramakant A.Gayakwad Prentice Hall / Pearson Education, 4th Edition, 2001.
7. Analog Circuits , A K Maini, Khanna Publishing House, Ed. 2018, ISBN: 978-93-86173-584.

SUGGESTED SOFTWARE/LEARNING WEBSITES:

1.   https://www.electronics-tutorials.ws/

2.   https://www.youtube.com/watch?v=Rx43l-QpeWQ

3.   https://electronicsforu.com/resources/electronic-devices-and-circuit-theory

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BASIC CONCEPTS OF MECHATRONICS

Course Code	MT 3005
Course Title	Basic Concepts of Mechatronics
Number of Credits	3 (L-3,T-0, P-0)
Prerequisites	NIL
Course Category	PC

COURSE OBJECTIVE:
- This course aims at providing fundamental understanding about the basic elements of a mechatronics system, interfacing, and its practical applications.

COURSE CONTENTS:

UNIT 1 - INTRODUCTION
1.1   Definition of Mechanical Systems;
1.2   Systems and Design: Mechatronic approach;
1.3   Integrated Product Design, Modeling, Analysis and Simulation;
1.4   Man-Machine Interface.

UNIT 2 - SENSORS
2.1   Opto - Electronics-Shaft encoders; CD Sensors, Vision System, etc.
2.2   Ultrasonic Sensors: for Level Measurement and Distance Measurement.
2.3   Hall effect Sensors: Hall effect, Hall effect sensors for Displacement measurement, Fluid level measurement;
2.4   Pyro electric Sensors: Pyro electric Sensors as Thermal Detector;

UNIT 3 - DRIVES AND ACTUATORS
3.1   Hydraulic and Pneumatic drives;
3.2   Electrical Actuators such as servo motor and Stepper motor;
3.3   Drive circuits, open and closed loop control;
3.4   Embedded systems: hardware structure;
3.5   Software design and communication;
3.6   Programmable logic devices;
3.7   Automatic control and real time control systems.

UNIT 4 - SMART MATERIALS:
4.1   Shape Memory Alloy;
4.2   Piezoelectric and Magnetostrictive Actuators;
4.3   Materials, Static and dynamic characteristics;
4.4   Examples for positioning, vibration isolation, etc.

UNIT 5 - MICROMECHATRONIC SYSTEMS
5.1   Microsensors, Microactuators;
5.2   Micro-fabrication techniques LIGA Process;
5.3   Lithography, etching, Micro-joining etc.;
5.4   Application and examples of Mechatronic Systems.

REFERENCE BOOKS:

1.   Mechatronics System Design, Devdas Shetty & Richard A. Kolk, PWS Publishing Company (Thomson Learning Inc.).
2.   Mechatronics: A Multidisciplinary Approach, William Bolton, Pearson Education
3.   A Textbook of Mechatronics, R.K. Rajput, S. Chand & Company Private Limited
4.   Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, Willia Bolton, Prentice Hall.

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FLUID MECHANICS & HYDRAULIC MACHINERY LAB

Course Code	MT 3006
Course Title	Fluid Mechanics & Hydraulic Machinery Lab
Number of Credits	1 (L: 0, T: 0, P: 2)
Prerequisites	NIL
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 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.

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

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MANUFACTURING ENGINEERING

Course Code	MT 3007
Course Title	Manufacturing Engineering 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 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.

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) – Hajra Chowdry & 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.

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ELECTRONICS & MECHATRONICS LAB

Course Code	MT 3008
Course Title	Electronics & Mechatronics Lab
Number of Credits	2 (L-0, T-0, P-4)
Prerequisites	NIL
Course Category	PC

PRACTICAL OUTCOMES (PROs)

The practical in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for theattainment of the competency.

PRACTICALS:

1. To verify the truth tables for all logic fates – NOT OR AND NAND NOR XOR XNOR using CMOSLogic gates and TTL Logic Gates
2. Implement and realize Boolean Expressions with Logic Gates
3. Implement Half Adder, Full Adder, Half Subtractor, Full subtractor using ICs
4. Implement parallel and serial full-adder using ICs
5. Design and development of Multiplexer and De-multiplexer using multiplexer ICs
6. Verification of the function of SR,D, JK and T Flip Flops
7. Design controlled shift registers
8. Construct a Single digit Decade Counter (0-9) with 7 segment display
9. To design a programmable Up-Down Counter with a 7 segment display
10. Study of different memory ICs
11. Study Digital to Analog and Analog to Digital Converters Construct the circuit and plot the VI
12. Characteristics of the PN Junction Diode ,find the cut in voltage
13. Construct a Half Wave Rectifier and obtain regulation characteristics –Without Filters and with Filters Compare the results
14. Construct a Full Wave Rectifier and obtain regulation characteristics –Without Filters and with Filters Compare the results
15. Construct a Bridge Rectifier and obtain regulation characteristics – Without Filters and with Filters
16. Obtain the characteristics of DIAC and TRIAC
17. Develop circuits for Voltage Series and Voltage Shunt Feedback Amplifiers and Obtain output plots.
18. Develop circuits for Current Series and Current Shunt Feedback Amplifiers and Obtain output plots.
19. Operational Amplifiers (IC741)-Characteristics and Application.
20. Waveform Generation using Op-Amp (IC741).
21. Applications of Timer IC555

REFERENCES /SUGGESTED LEARNING RESOURCES:

1. Digital principles & Applications Albert Paul Malvino & Donald P. Leach McGraw Hill Education; Eighthedition, ISBN: 978-9339203405.
2. Digital Electronics Roger L. Tokheim Macmillian McGraw-Hill Education (ISE Editions); International 2Revised edition, ISBN: 978-0071167963.
3. Digital Electronics – an introduction to theory and practice William H. Gothmann Prentice Hall India LearningPrivate Limited; 2 edition, ISBN: 978-8120303485.
4. Fundamentals of Logic Design Charles H. Roth Jr. Jaico Publishing House; First edition, ISBN: 978-8172247744.
5. Digital Electronics R. Anand Khanna Publications, New Delhi (Edition 2018), ISBN: 978-93-82609445.

6. Analog Circuits By AK Maini Khanna Publishing House Ed. 2018, ISBN: 978-93-86173-584.

7. Electronic Devices and Circuits S. Salivahanan and N. Suresh Kumar McGraw Hill Education; Fourth edition , 2017, ISBN: 978-9339219505.

8. Electronics Devices and circuit theory Boyestad & Nashelsky Pearson Education India; 11 edition, 2015, ISBN: 978-9332542600.

9. Electronic Principles Albert Malvino & David Bates Tata McGraw Hill Publication 2010 ,ISBN: 978-0070634244.

10. Electronics Devices & Circuits Jacob Millman McGraw Hill Education; 4 edition , 2015, ISBN: 978-9339219543.

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COMPUTER AIDED MACHINE DRAWING PRACTICE

Course Code	MT 3009 Same as MA/ME 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:

1. Bhatt, N.D., Machine Drawing, Charotar Publishing House, 2003.
2. Sidheswar, N., Kannaiah, P. and Sastry, V.V.S., Machine Drawing, Tata McGraw Hill Book Company, New Delhi, 2000.
3. 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)

ELECTRONIC INSTRUMENTATION & SENSORS

Course Code	MT 4001
Course Title	Electronic Instrumentation & Sensors
Number of Credits	3 (L-3, T-0, P-0)
Prerequisites	NIL
Course Category	PC

COURSE CONTENTS:

UNIT – 1 ANALOG INSTRUMENTS:

1.1 Characteristics of Instruments – True value, Accuracy, Precision, Sensitivity, Reproducibility, Range, Drift, Static Error and Correction, Resolution; (Definitions only)

1.2 Classification of Instruments – Primary and Secondary Instruments – Indicating, Recording & Integrating instruments;

1.3 Operating forces – Deflecting, Controlling and Damping force;

1.4 Instruments - Permanent Magnet Moving Coil instrument, Moving Iron Instrument – attraction and repulsion type;

1.5 Analog multimeter, Dynamometer Watt meter, Single phase induction type Energy meter.

UNIT – 2   CRO & BRIDGES:

2.1   CRO **-** Block diagram of oscilloscope construction, operation, screens, graticules Vertical deflection system, Horizontal deflection system, Delay line, Measurement of frequency, time delay, phase angle and modulation index (trapezoidal method);

2.2   Oscilloscope probe: Structure of 1:1 and 10:1 probe Multiple Trace CRO Digital Storage Oscilloscope;

2.3   Bridges – Construction, working, balance equation (derivation not required) & applications of measurement of resistance by wheat stone bridge, measurement of capacitance by Schering Bridge, measurement of inductance by Maxwell's bridge.

UNIT – 3 DIGITAL INSTRUMENTS, DISPLAYS AND RECORDERS:

3.1   Digital Instruments – Digital Vs Analog Instruments – Auto ranging – Auto zeroing – Auto Polarity – Block diagram of Digital Multimeter, Digital frequency counter, Digital Tachometer;

3.2   Displays –Seven Segment Display, Alpha Numeric display, Liquid Vapour display (LVD);

3.3   Recorders – Strip-chart recorder, X-Y recorder, CD recording and reproduction.

UNIT - 4 TRANSDUCERS AND STRAIN GAUGES

4.1   Classification, Selection Criteria, Characteristics, Construction;

4.2   Working Principles and Application of following, Transducers: RTD, Thermocouple;

4.3   Thermistor, POT, LVDT, Strain Gauge, Load Cell, Piezoelectric Transducers.

4.4   Force, Torque, Pressure measurement.

UNIT—5 ADVANCE AND SMART SENSOR TECHNOLOGY:

5.1   Fiber optic Sensors: Temperature sensors, Liquid level sensing, Fluid flow sensing, Micro bend sensors, Advantages of fiber optic sensors;

5.2   Smart Sensors: Primary sensors, Excitation, Amplification, filter, converters, information coding/processing, data communication, the automation;

5.3   Automotive Sensors (On-Board automobile sensors):- Flow-rate sensors, pressure sensors, oxygen sensors, torque and position sensors;

5.4   Recent trends in Sensor Technologies:- Film sensors- Thick film and Thin film sensors. - MEMS – Advantages and Applications of MEMS, micro machining, MEMS Accelerometer. - Nano sensors.

REFERENCES /SUGGESTED LEARNING RESOURCES:

1. Electrical & Electronic Measurement & Instruments A.K. Sawhney Dhanpat Rai & Sons, India
2. Electronic Instrument and Measurement Technique W.D. Cooper Prentice Hall International, India.
3. Electronic Measurement & Instrumentation J.G. Joshi Khanna Publishing House, Delhi
4. Measurement systems application and design E.O. Doebelin and D. N. Manik the Mcgraw-Hill
5. Electronic Measurements and Instrumentation Oliver and Cage the Mcgraw-Hill
6. Basic Electrical Measurement M.B. Stout Prentice hall of India, India
7. Electronic Instrumentation H. S. Kalsi the Mcgraw-Hill
8. Electrical and Electronics Measurement and Instrumentation Prithwiraj Pukrait, Budhaditya Biswas, Santanu Das,Chiranjib Koley The Mcgraw-Hill

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STRENGTH OF MATERIALS

Course Code	MT 4002 (Same as MA/MP/ME 4002)
Course Title	Strength of Materials
Number of Credits	3 (L: 2, T: 1, P: 0)
Prerequisites	Engineering Mechanics
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 stress and 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   UNIT 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.   UNIT 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.   UNIT 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);
   3.2   Problems involving calculations of bending stress, modulus of section and moment of resistance;
   3.3   Calculation of safe loads and safe span and dimensions of cross- section;
   3.4   Definition and explanation of deflection as applied to beams (Standard cases only);
   3.5   Related numerical problems.

4.   UNIT 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;
   4.9   Numerical problems on closed coil helical spring to find safe load, deflection, size of coil and number of coils.

5.   UNIT 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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MICROCONTROLLER & APPLICATIONS

Course Code	MT 4003
Course Title	Microcontroller & Applications
Number of Credits	3 (L-3,T-0, P-0)
Prerequisites	NIL
Course Category	PC

COURSE CONTENTS:

UNIT 1 - INTRODUCTION
    1.1   Introduction to Microprocessors and Microcontrollers;
    1.2   Architectures [8085, 8086];
    1.3   Intel MCS- 51 family features;
    1.4   8051 -organization and architecture.

UNIT 2 - PROGRAMMING WITH 8051
    2.1   8051 instruction set;
    2.2   Addressing modes;
    2.3   Conditional instructions;
    2.4   I/O Programming;
    2.5   Arithmetic logic instructions;
    2.6   Single bit instructions;
    2.7   Interrupt handling;
    2.8   Programming counters, timers and Stack.

UNIT 3 - INTERFACES
    3.1   MCS51 and external Interfaces;
    3.2   User interface – keyboard, LCD, LED;
    3.3   Real world interface -ADC, DAC;
    3.4   Sensors Communication interface.

UNIT 4 - C PROGRAMMING WITH 8051
    4.1   I/O Programming;
    4.2   Timers/counters;
    4.3   Serial Communication;
    4.4   Interrupt;
    4.5   User Interfaces- LCD, Keypad, LED and communication interfaces [RS232].

UNIT 5 - ARM PROCESSOR CORE BASED MICROCONTROLLERS
    5.1   Need for RISC Processor-ARM processor fundamentals;
    5.2   ARM core based controller [LPC214X];
    5.3   IO ports, ADC/DAC, Timers.

REFERENCES /SUGGESTED LEARNING RESOURCES:

1.   The 8051 Micro Controller and Embedded Systems Muhammad Ali Mazidi& Janice Gilli Mazidi, R.D.Kinely PHI Pearson Education, 5th Indian reprint.
2.   Microprocessor and Microcontrollers Krishna Kant Eastern Company Edition, Prentice Hall of India, New Delhi.
3.   Microprocessor & Microcontroller Architecture: Programming & Interfacing using 8085, 8086, 8051 Soumitra Kumar Mandal McGraw Hill Edu.
4.   Microcontrollers: Architecture implementation and Programming Tabak Daniel, Hintz Kenneth j Tata McGraw Hill, 2007.
5.   ARM Developer's Guide.UM10139 LPC214X User manual – Rev.4 Andrew N.Sloss,Dominic Symes, Chris Wright User manual – Rev.4.
6.   Microprocessors and interfacing: programming and hardware Douglas V. Hall Tata McGraw Hill, 2editon, 2000.
7.   Microcontroller – Fundamentals and Applications with Pic Valder – Perez Yeesdee Publishers, Tayler &Francis.

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MATERIAL SCIENCE & ENGINEERING

Course Code	MT 40041
Course Title	Material Science & Engineering
Number of Credits	3 (L: 3, T: 0, P: 0)
Prerequisites	NIL
Course Category	PE

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. **UNIT 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. **UNIT 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 steel - Types and uses.

3. UNIT 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. UNIT 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 Penetrate Test;
        4.5.4 Ultrasonic Inspection;
        4.5.5 Radiography.

5. UNIT 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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THERMAL ENGINEERING

Course Code	MS 40042
Course Title	Thermal Engineering
Number of Credits	3 (L: 3, T: 0, P: 0)
Prerequisites (Course code)	NIL
Course Category	PE

COURSE OBJECTIVES

- To understand General Principles of Mechanical Engineering.
- To understand laws of thermodynamics, thermal and thermodynamic Processes.
- To understand working principles of power developing I. C. engine devices.
- To understand the working and applications of Gas turbines
- To understand the refrigeration and air-conditioning systems

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	Classify I.C. engines and understand their working and constructional features.
CO3	Understand different systems of I.C. engines
CO4	Know the working and applications of gas turbines
CO5	Know the applications of refrigeration and classify air-conditioning systems.

COURSE CONTENTS:

1. UNIT 1 - INTRODUCTION TO THERMODYNAMICS
   1.1 Role of Thermodynamics in Engineering and Science;
   1.2 Types of Systems;
   1.3 Thermodynamic Equilibrium;
   1.4 Properties, State, Process and Cycle;
   1.5 Elementary introduction to Zeroth Law;
   1.6 First Law, Heat & Work Interactions for various non-flow and flow processes (No numericals);
   1.7 Second laws of thermodynamics Kelvin-Planck and Clausius Statements (No numericals).

2 UNIT 2 - INTERNAL COMBUSTION ENGINES:
   2.1 Brief description of Carnot, Otto and Diesel cycles with P-V and T-S diagrams;
   2.2 Internal and external combustion engines;
   2.3 Advantages of I.C. engines over external combustion engines;
   2.4 Classification of I.C. engines;
   2.5 Working of four-stroke and two-stroke petrol and diesel engines;
   2.6 Comparison of two stroke and four stroke engines;
   2.7 Comparison of C.I. and S.I. engines.

3 UNIT 3 - I.C. ENGINE SYSTEMS:
   3.1 Fuel system of Petrol engines;
   3.2 Fuel system of Diesel engines;
   3.3 Cooling system - Air cooling and Water cooling system;
   3.4 Types of lubricating systems used in I.C. engines with line diagram.

4.   UNIT 4 - GAS TURBINES
   4.1 Air-standard Brayton cycle, description with p-v and T-S diagrams;
   4.2 Gas turbines Classification, open cycle gas turbines and closed cycle gas turbines;
   4.3 Applications and limitations of gas turbines;
   4.4 General layout of open cycle constant pressure gas turbine; P-V and T-S diagrams and working;
   4.5 General layout of closed cycle gas turbine; P-V and T-S diagrams and working.

5   **UNIT 5 - REFRIGERATION & AIR-CONDITIONING:**
    5.1 Refrigeration; COP of refrigeration systems;
    5.2 Vapour Compression system: components, working & applications;
    5.3 Air conditioning; Classification of Air-conditioning systems;
    5.4 Summer Air-Conditioning system, Winter Air-Conditioning system, Year-round Air-Conditioning system.

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.   A Course in Thermal Engineering – S. Domkundwar & C.P. Kothandaraman, Dhanpat Rai.
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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INDUSTRIAL AUTOMATION

Course Code	MT 40051
Course Title	Industrial Automation
Number of Credits	3 (L-3, T-0, P-0)
Prerequisites	NIL
Course Category	PE

COURSE CONTENTS:

UNIT 1 -
- 1.1 Industrial automation overview and data acquisition;
- 1.2 Architecture of Industrial Automation Systems;
- 1.3 Measurement Systems Characteristics;
- 1.4 Data Acquisition Systems.

UNIT 2 -
- 2.1 Control Generation;
- 2.2 Introduction to Automatic Control;
- 2.3 P-I-D Control;
- 2.4 Feed-forward Control Ratio Control;
- 2.5 The branching operations based on conditions expression.

UNIT 3
- 3.1 Sequential control and PLC;
- 3.2 Introduction to Sequence Control, PLC, RLL;
- 3.3 PLC Hardware Environment.

UNIT 4
- 4.1 Industrial control application;
- 4.2 Hydraulic Control Systems;
- 4.3 Pneumatic Control Systems;
- 4.4 Energy Savings with Variable Speed Drives;
- 4.5 Introduction to CNC Machines.

REFERENCES /SUGGESTED LEARNING RESOURCES:

1. Industrial Instrumentation, Control and Automation S.Mukhopadhyay, S. Sen and A. K. Deb Jaico Publishing House, 2013, ISBN: 978-8184954098.
2. Electric Motor Drives, Modelling, Analysis and Control R. Krishnan Prentice Hall India, 2002, ISBN: 978-0130910141.

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CONTROL SYSTEM & PLC

Course Code	MT 40052
Course Title	Control System & PLC
Number of Credits	3 (L-3, T-0, P-0)
Prerequisites	NIL
Course Category	PE

COURSE CONTENTS:

UNIT 1 - BASICS OF CONTROL SYSTEM
- 1.1   Basics of control system diagram and practical examples;
- 1.2   Classification of control systems;
- 1.3   Open loop and closed loop systems;
- 1.4   Linear and non-linear systems;
- 1.5   Transfer function.

UNIT 2 - TIME DOMAIN STABILITY ANALYSIS
- 2.1   Transient and steady state response;
- 2.2   Standard test inputs: Step, Ramp, Parabolic, Impulse and their corresponding Laplace transform;
- 2.3   Analysis of second order control system: analysis for unit step input, concept, definition, effect of damping;
- 2.4   Steady state analysis: type 0, 1, 2 systems, steady state error and error constants, numerical problems.

UNIT 3 - PROCESS CONTROLLERS
- 3.1   Process control system: block diagram, functions of each block;
- 3.2   Control actions: discontinuous mode, continuous mode;
- 3.3   Composite controllers: PI, PD, PID controllers- output equation, response.

UNIT 4 - FUNDAMENTALS OF PLC
- 4.1   PLC: block diagram, classification, needs and benefits of PLCs in automation;
- 4.2   Descriptions of different parts of PLC: CPU function, scanning cycle, speed of execution, memory, i/o modules;
- 4.3   PLC installation.

UNIT 5 - PLC HARDWARE AND PROGRAMMING
- 5.1   Discrete input modules: block diagram, specifications of AC input modules and DC input module. Sinking and Sourcing concept in DC input modules;
- 5.2   Discrete output modules: block diagram, description, specifications of AC output module and DC output modules;
- 5.3   Analog input and output modules: block diagram and specifications;
- 5.4   I/O addressing of PLC: addressing data files, format of logical address, different addressing types;
- 5.5   PLC programs using Ladder programming language.

REFERENCES / SUGGESTED LEARNING RESOURCES:

1. Modern control engineering Ogata K. PHI 5th edition New Delhi
2. Programmable Logic Controllers Petruzella F.D. TMH 3rd edition New Delhi

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MATERIAL TESTING LAB

Course Code	MT 4006
Course Title	Material Testing Lab
Number of Credits	1 (L: 0, T: 0, P: 2)
Prerequisites	NIL
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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ELECTRONIC INSTRUMENTATION & SENSORS LAB

Course Code	MT 4007
Course Title	Electronics instrumentation & sensors Lab
Number of Credits	1 (L-0, T-0, P-2)
Prerequisites	NIL
Course Category	PC

PRACTICAL OUTCOMES

- The practical in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for theattainment of the competency.

PRACTICALS:

1. Measure unknown inductance using following bridges Maxwell Bridge
2. Measure resistance by wheat stone bridge
3. Study working and applications of (i) C.R.O. (ii) Digital Storage C.R.O. & (ii) C.R.O. Probes
4. Measurement of displacement with the help of LVDT
5. Draw the characteristics of the following temperature transducers
   (i) RTD (Pt-100), (ii) Thermistor
6. Measurement of strain/force with the help of strain gauge load cell
7. Study of the characteristics of Capacitor Level Sensor for Level Measurement of a Liquid in a Tank.
8. Study of the characteristics of a Piezo Resistive Sensor for Pressure Measurement of a Liquid in a Tank.
9. Study of the characteristics of a Thermocouple
10. Study of the characteristics and operation of Magnetic Sensor.
11. Measure the dimensions of ground MS flat/cylindrical bush using Vernier Calliper compare with Digital/Dial Vernier Calliper.
12. Measure the diameter of a wire using micrometre and compare the result with digital Micrometer.
13. Measure the thickness of ground MS plates using slip gauges.

REFERENCES / SUGGESTED LEARNING RESOURCES:

1. Electrical & Electronic Measurement & Instruments A.K. Sawhney Dhanpat Rai & Sons, India
2. Electronic Instrument and Measurement Technique W.D. Cooper Prentice Hall International, India.
3. Electronic Measurement & Instrumentation J.G. Joshi Khanna Publishing House, Delhi
4. Measurement systems application and design E.O. Doebelin and D. N. Manik the Mcgraw-Hill
5. Electronic Measurements and Instrumentation Oliver and Cage the Mcgraw-Hill
6. Basic Electrical Measurement M.B. Stout Prentice hall of India, India
7. Electronic Instrumentation H. S. Kalsi the Mcgraw-Hill
8. Electrical and Electronics Measurement and Instrumentation Prithwiraj Pukrait, Budhaditya Biswas, Santanu Das,Chiranjib Koley The Mcgraw-Hill

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MICROCONTROLLER & APPLICATIONS LAB

Course Code	MT 4008
Course Title	Microcontroller & Applications Lab
Number of Credits	1 (L-0,T-0, P-2)
Prerequisites	NIL
Course Category	PC

PRACTICALS:

1. Programming 8051 Micro controller using ASM and C, and implementation in flash 8051microcontroller.
2. Programming with Arithmetic logic instructions [Assembly]
3. Program using constructs (Sorting an array) [Assembly]
4. Programming using Ports [Assembly and C]
5. Delay generation using Timer [Assembly and C]
6. Programming Interrupts [Assembly and C]
7. Implementation of standard UART communication (using hyper terminal) [Assembly and C].
8. Interfacing LCD Display. [Assembly and C]
9. Interfacing with Keypad [Assembly and C]
10. Programming ADC/DAC [Assembly and C]
11. Interfacing with stepper motor. [Assembly and C]
12. Pulse Width Modulation. [Assembly and C] Programming ARM Micro controller using ASM and C using simulator.
13. Programming with Arithmetic logic instructions [Assembly]
14. GPIO programming in ARM microcontroller. [C Programming].
15. Timers programming in ARM Microcontroller. [C Programming].

REFERENCES /SUGGESTED LEARNING RESOURCES:

1. The 8051 Micro Controller and Embedded Systems Muhammad Ali Mazidi& Janice Gilli Mazidi, R.D.Kinely PHI Pearson Education, 5th Indian reprint.
2. Microprocessor and Microcontrollers Krishna Kant Eastern Company Edition, Prentice Hall of India, New Delhi.
3. Microprocessor & Microcontroller Architecture: Programming & Interfacing using 8085,8086,8051 Soumitra Kumar Mandal McGraw Hill Edu.
4. Microcontrollers: Architecture implementation and Programming Tabak Daniel, Hintz Kenneth j Tata McGraw Hill, 2007.
5. ARM Developer's Guide.UM10139 LPC214X User manual – Rev.4 Andrew   N.Sloss,Dominic Symes, Chris Wright User manual – Rev.4.
6. Microprocessors and interfacing: programming and hardware Douglas V. Hall Tata McGraw Hill, 2editon, 2000.
7. "Microcontroller – Fundamentals and Applications with Pic Valder – Perez Yeesdee Publishers, Tayler & Francis.

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ESSENCE OF INDIAN KNOWLEDGE AND TRADITION

Course Code	MS 4222 (Same in all Branches of Engineering)
Course Title	Essence of Indian Knowledge and Tradition
Number of Credits	0 (L-2,T-0, P-0)
Prerequisites	NIL
Course Category	AU

COURSE CONTENTS:

Basic Structure of Indian Knowledge System:

(i)   वेद,

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

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

(iv)   उनथाइग (धर्मिथास्त, र ी थामथांसथा, नुरथाण, तकिरथास्त)

- 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	MT 5001 Same as MA/ME 5001
Course Title	Advanced Manufacturing Processes
Number of Credits	3 (L: 3, T: 0, P: 0)
Prerequisites	Manufacturing Engineering
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 centres, 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.   **UNIT 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;
      1.5   Types of clamps.

2.   **UNIT 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.   UNIT 3 - MODERN MACHINING PROCESSES
   3.1   Introduction and Comparison of MMP with traditional machining;
   3.2   Ultrasonic Machining:
            3.2.1   Principle;
            3.2.2   Description of equipment;
            3.2.3   Applications;
   3.3   Electric Discharge Machining:
            3.3.1   Principle;
            3.3.2   Description and its applications;
   3.4   Wire cut EDM:
            3.4.1   Principle;
            3.4.2   Description of equipment;
            3.4.3   Applications;
   3.5   Abrasive Jet Machining:
            3.5.1   Principle;
            3.5.2   Description of equipment;
            3.5.3   Application;
   3.6   Laser Beam Machining:
            3.6.1   Principle;
            3.6.2   Description of equipment;
            3.6.3   Application;
   3.7   Electro Chemical Machining:
            3.7.1   Description of equipment;
            3.7.2   Application.

4.   UNIT 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.   UNIT 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, Narvasa Publishining 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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DESIGN OF MACHINE ELEMENTS

Course Code	MT 5002
Course Title	Design of Machine Elements
Number of Credits	3 (L: 2, T: 1, P: 0)
Prerequisites	Engineering Mechanics ,Strength of Materials
Course Category	PC

COURSE OBJECTIVES:

- To enable the student to design and draw simple machine components used in small and medium scale industries.
- To understand the basic philosophy and fundamentals of Machine Design.
- To 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.   **UNIT 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.   **UNIT 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.   UNIT 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.   UNIT 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.   UNIT 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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ECONOMIC POLICIES IN INDIA

Course Code	MS 51001 (Common in all branches of Engineering)
Course Title	Economic Policies in India
Number of Credits	3 (L:3,T:0,P:0)
Prerequisites	NIL
Course Category	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 approaches to the problems of unemployment, poverty, income generation, industrialization from different perspec-tives
CO4	Able to identify the problems and capable to decide the application for future development
CO5	Analyze economic issues and find solutions to complex economic problems and take correct economic judgment

COURSE CONTENTS:

1. **UNIT 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. **UNIT 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. **UNIT 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. **UNIT 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. **UNIT 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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(SEMESTER SCHEME-2020-21)

ENGINEERING ECONOMICS & ACCOUNTANCY

Course Code	MS 51002 (Common in all branches of Engineering)
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 economics to facilitate 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 data for 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. UNIT 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. UNIT 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. UNIT 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.   UNIT 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.   UNIT 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 & MANAGEMENT

Course Code	MT 5003 (Same as ME/MP 5003)
Course Title	Industrial Engineering & Management
Number of Credits	3 (L: 3, T: 0, P: 0)
Prerequisites	NIL
Course Category	PC

COURSE OBJECTIVES:

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

COURSE OUTCOMES:

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

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

COURSE CONTENT:

1.   UNIT 1 - PLANT ENGINEERING
     1.1   Plant;
     1.2   Selection of site of industry;
     1.3   Plant layout;
     1.4   Principles of a good layout;
     1.5   Types; Process; Product and Fixed position;
     1.6   Techniques to improve Layout.

2.   UNIT 2 - WORK STUDY
     2.1   Productivity;
     2.2   Standard of living;
     2.3   Method of improving Productivity;
        2.3.1   Objectives;
     2.4   Importance of good working conditions;
     2.5   Method Study
        2.5.1   Definition;
           2.5.1.1 Objectives;
        2.5.2   Selection of a job for method study;
        2.5.3   Basic procedure for conduct of Method study;
        2.5.4   Tools used
           2.5.4.1 Operation process chart;
           2.5.4.2 Flow process chart;
           2.5.4.3 Two handed process chart;
           2.5.4.4 Man Machine chart;
           2.5.4.5 String diagram;
           2.5.4.6 Flow diagram;
     2.6   Work Measurement

2.6.1 Definition;
2.6.2 Basic procedure in making a time study;
2.6.3 Employees rating factor;
2.6.4 Application of time allowances;
2.6.4.1 Rest;
2.6.4.2 Personal;
2.6.4.3 Process;
2.6.4.4 Special and Policy allowances;
2.7 Calculation of standard time;
2.8 Numerical Problems;
2.9 Basic concept of production study;
2.10 Techniques of Work Measurement;
2.11 Pre determined Motion Time System (PMTS).

3. **UNIT 3 - PRODUCTION PLANNING AND CONTROL**
3.1 Introduction;
3.2 Major functions of Production Planning and Control;
3.3 Pre planning;
3.4 Methods of forecasting;
3.5 Routing and Scheduling;
3.6 Dispatching and Controlling;
3.7 Concept of Critical Path Method (CPM);
3.8 Types of Production;
3.8.1 Mass Production;
3.8.2 Batch Production;
3.8.3 Job Order Production; Characteristics;
3.9 Economic Batch Quantity (EBQ);
3.10 Principles of Product and Process Planning;
3.11 Make or Buy decision;
3.12 Numerical problems;
3.13 Quality Control
3.13.1 Definition;
3.13.2 Objectives;
3.13.3 Types of Inspection;
3.13.3.1 First piece;
3.13.3.2 Floor;
3.13.3.3 Centralized Inspection;
3.13.4 Advantages and Disadvantages;
3.13.5 Sampling Inspection; Single and Double Sampling plan
3.13.6 Concept of ISO 9001:2008;
3.13.7 Quality Management System Registration/Certification procedure;
3.13.8 Benefits of ISO to the organization.

4. **UNIT 4 - PRINCIPLES OF MANAGEMENT**
4.1 Definition of Management;
4.2 Administration; Organization;
4.3 F.W. Taylor's and Henry Fayol's Principles of Management;
4.4 Functions of Manager;
4.5 Types of Organization
4.5.1 Line;
4.5.2 Staff;
4.5.3 Taylor's Pure functional types;
4.5.4 Line and staff and committee type;
4.6 Directing;
4.7 Leadership;
4.8 Styles of Leadership;
4.9 Qualities of a good leader;
4.10 Motivation; Positive and Negative Motivation;
4.11 Management Information Systems;
4.12 Personnel Management

    4.12.1   Responsibility of Human Resource Management;
    4.12.2   Selection Procedure;
    4.12.3   Training of Workers;
        4.12.3.1 Apprentice Training;
        4.12.3.2 On the Job training;
        4.12.3.3 Vestibule School Training;
    4.12.4   Job Evaluation.

5.   UNIT 5 - FINANCIAL MANAGEMENT
    5.1   Fixed and Working Capital;
    5.2   Resources of Capital;
    5.3   Shares Preference and Equity Shares;
    5.4   Debentures;
      5.4.1   Type of debentures;
    5.5   Public Deposits;
    5.6   Factory Costing;
      5.6.1   Direct Cost;
      5.6.2   Indirect Cost;
      5.6.3   Factory Overhead;
      5.6.4   Selling Price of a product;
      5.6.5   Profit;
    5.7   Numerical Problems;
    5.8   Depreciation; Causes;
    5.9   Methods
      5.9.1   Straight line;
      5.9.2   Sinking fund;
      5.9.3   Percentage on Diminishing Value Method;
    5.10   Numerical Problems;
    5.11   Material Management
      5.11.1 Objectives of good stock control system;
      5.11.2 ABC analysis of Inventory;
      5.11.3 Procurement and Consumption cycle;
      5.11.4 Minimum Stock, Lead Time, Reorder Level;
      5.11.5 Economic Order Quantity problems;
      5.11.6 Supply Chain.

REFERENCE BOOKS:

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

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COMPUTER INTEGRATED MANUFACTURING

Course Code	Mt 50041
Course Title	Computer Integrated Manufacturing
Number of Credits	3 (L: 3, T: 0, P: 0)
Prerequisites	NIL
Course Category	PE

COURSE OBJECTIVES:
To understand general principles of Mechanical Engineering.

- To understand the manufacturing principles and Computer Aided Design
- To understand Computer Aided Manufacturing process
- To understand basic materials and manufacturing processes

COURSE OUTCOMES

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

CO1	Understand the Concept of Computer Integrated Manufacturing
CO2	Understand the principle of Computer Aided Design
CO3	To know about Computer Aided Manufacturing
CO4	To learn about Computer aided production scheduling; computer aided inspection planning
CO5	Understand the Integrating NC machines, robots, AGVs, and other NC equipments.

COURSE CONTENT:

1. **UNIT 1 - INTRODUCTION TO COMPUTER INTIGRATED MANUFACTURING**
   1.1   Concept of Computer Integrated Manufacturing (CIM);
   1.2   Basic components of CIM; Distributed database system; distributed communication system;
   1.3   Computer networks for manufacturing;
   1.4   Future automated factory; social and economic factors.

2. **UNIT 2 - COMPUTER AIDED DESIGN**
   2.1   Computer Aided Design (CAD): CAD hardware and software;
   2.2   Product modelling, automatic drafting; engineering analysis;
   2.3   FEM design review and evaluation;
   2.4   Group Technology Centre.

3. **UNIT 3 - COMPUTER AIDED MANUFACTURING**
   3.1   Computer Aided Manufacturing (CAM);
   3.2   Computer assisted NC part programming;
   3.3   Computer assisted robot programming; computer aided process planning (CAPP);
   3.4   Computer aided material requirements planning (MRP).

4   **UNIT 4 - COMPUTER AIDED PRODUCTION PLANNING**
   4.1   Computer aided production scheduling;
   4.2   Computer aided inspection planning;
   4.3   Computer aided inventory planning;
   4.4   Concept of Flexible Manufacturing System (FMS).

5. **UNIT 5 - NC MACHINES AND EQUIPMENTS**
   5.1   Integrating NC machines, robots, AGVs, and other NC equipment;
   5.2   Computer aided quality control;
   5.3   Business functions,
   5.4   Computer aided forecasting and office automation

REFERENCE BOOKS:

1.   CAD, CAM, CIM - P. Radhakrishnan and S. Subramanyan, New Age International Publishers.
2.   Computer Integrated Manufacturing - Paul G. Rankey, Prentice Hall.
3.   Robotics Technology and Flexible Automation – S. R. Deb, Tata McGraw Hill.

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(SEMESTER SCHEME-2020-21)

THEORY OF MACHINES & MECHANISMS

Course Code	MT 50042
Course Title	Theory of Machines & Mechanisms
Number of Credits	3 (L: 3, T: 0, P: 0)
Prerequisites	Engineering Mechanics
Course Category	PE

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. **UNIT 1 - CAMS AND FOLLOWERS**
   1.1 Concept Definition and application of Cams and Followers;
   1.2 Different follower motions and their displacement diagrams like uniform velocity, SHM, uniform acceleration and Retardation.

2. **UNIT 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. **UNIT 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.   UNIT 4 - BRAKES, DYNAMOMETERS, CLUTCHES & BEARINGS
   4.1   Function of brakes and dynamometers;
   4.2   Construction and working of Brakes;
   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 numerical.

5.   UNIT 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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ROBOTICS

Course Code	MT 50051
Course Title	Robotics
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- 1: FUNDAMENTALS OF ROBOTICS
1.1   Introduction; Definition; Robot anatomy (parts) and its working;
1.2   Robot Components: Manipulator, End effectors; Construction of links, Types of joints;
1.3   Classification of robots; Cartesian, Cylindrical, Spherical, Scara, Vertical articulated;
1.4   Structural Characteristics of robots; Mechanical rigidity; Effects of structure on control work envelope and work Volume;
1.5   Robot work Volumes, comparison; Advantages and disadvantages of robots.

UNIT- 2 : ROBOTIC DRIVE SYSTEM AND CONTROLLER
2.1   Conversion between linear and rotary motion;
2.2   Feedback devices; Potentiometers; Optical encoders; DC tachometers; Robot controller;
2.3   Microprocessor based control system;
2.4   Robot path control: Point to point, Continuous path control and Sensor based path control;
2.5   Controller programming.

UNIT- 3 : MACHINE VISION
3.1   Principles and Applications of the following types of sensors related to robots: Position sensors (Encoders, Resolvers, Piezo Electric);
3.2   Range sensors (Triangulation Principle, Structured lighting approach); Proximity sensing;
3.3   Introduction to Machine Vision: Robot vision system (scanning and digitizing image data);
3.4   Image processing and analysis; Cameras (Acquisition of images); Videocon camera (Working principle & construction);
3.5   Applications of Robot vision system: Inspection, Identification, Navigation & serving.

UNIT- 4 : ROBOT KINEMATICS AND ROBOT PROGRAMMING
4.1   Forward Kinematics; Inverse Kinematics and Differences;
4.2   Forward Kinematics and Reverse Kinematics of Manipulators with Two Degrees of Freedom (In 2 Dimensional); Deviations and Problems.
4.3   Teach Pendant Programming; Lead through programming; Robot programming Languages; VAL Programming; Motion Commands;
4.4   Sensor Commands; End effecter commands; and Simple programs

UNIT- 5 : INDUSTRIAL APPLICATION OF ROBOTS
5.1   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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ELECTRICAL MACHINES

Course Code	MT 50052
Course Title	Electrical Machines
Number of Credits	3 (L: 3, T: 0, P: 0)
Prerequisites (Course code)	NIL
Course Category	PE

COURSE OBJECTIVES

The aim of the course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Maintain electric motors .
- Maintain Induction, Synchronous and Special purpose Machines used in different application.

COURSE OUTCOMES

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

- Maintain different types of DC generators.
- Maintain different types of DC motors.
- Maintain three phase induction motor used in different applications.
- Maintain single phase induction motor used in different applications.
- Maintain three phase alternators used in different applications.
- Maintain synchronous motors used in different applications.
- Maintain Special purpose motors used in different applications

COURSE CONTENTS

1.   UNIT 1 - DC GENERATORS

1.1   Construction, parts, materials and their functions;
1.2   Principle of operation of DC generator: Fleming's right hand rule;
1.3   E.m.f. equation of generators;
1.4   Armature reaction.

2.   UNIT 2 - D.C. MOTORS
2.1   Types of DC motors;
2.2   Fleming's left hand rule;
2.3   Principle of operation;
2.4   Back e.m.f. and its significance;
2.5   Voltage equation of DC motor;
2.6   Torque:
     2.6.1 Armature torque;
     2.6.2 Shaft torque;
2.7   Losses;
2.8   Efficiency;
2.9   Speed control of DC shunt and series motor;
     2.9.1 Flux;
     2.9.2 Armature control.

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3.   UNIT 3 - THREE PHASE INDUCTION MOTOR

3.1   Working principle;
3.2   Production of rotating magnetic field;
3.3   Synchronous speed;
3.4   Rotor;
3.5   Slip;
3.6   Construction of 3-phase induction motors:
   3.6.1   Squirrel cage induction motor;
   3.6.2   Slip ring induction motor;
3.7   Rotor qualities :
   3.7.1   Frequency;
   3.7.2   Induction emf;
   3.7.3   Power factor at starting and running condition;
3.8   Characteristics of torque versus slip (speed);
3.9   Starters:
   3.9.1   Need and types;
   3.9.2   Stator resistance;
   3.9.3   Auto transformer;
   3.9.4   Star delta;
   3.9.5   Rotor Resistance.

4.   UNIT 4 - SINGLE PHASE INDUCTION AND SPESIAL PURPOSE MOTORS

4.1   Double field revolving theory;
4.2   Principle of making these motors self-start;
4.3   Construction, working and Torque-speed characteristics of following motors:
   4.3.1 Resistance start induction run;
   4.3.2 Capacitor start induction run;
   4.3.3 Capacitor start capacitor run;
4.4   Construction, working and application of following special purpose motors;
   4.4.1   BLDC motor;
   4.4.2   Permanent Magnet Synchronous Motor;
   4.4.3   Stepper motors;
   4.4.4   AC and DC servomotors;
   4.4.5   Repulsion type motor;
   4.4.6   Universal motor.

5.   THREE PHASE ALTERNATORS AND SYNCHRONOUS MOTOR
5.1   Construction of three phase alternator;
5.2   Working principle of three phase alternator;
5.3   Alternator loading;
   5.3.1   Factor affecting the terminal voltage of alternator;
   5.3.2   Armature resistance and leakage reactance drops;
5.4   Armature reaction at various power factors;
5.5   Principle of working /operation of synchronous;
5.6   Methods of starting of Synchronous Motor.

REFERENCES /SUGGESTED LEARNING RESOURCES:

1. P.S. Bimbhra, Electric Machines, Khanna Book Publishing Co., New Delhi.
2. Mittle, V. N. and Mittle, Arvind, Basic Electrical Engineering, McGraw Hill Education New Delhi.
3. Kothari, D. P. and Nagrath, I. J., Electrical Machines, McGraw Hill Education. New Delhi.
4. Bhattacharya, S. K., Electrical Machines, McGraw Hill Education, New Delhi.
5. Theraja, B. L., Electrical Technology Vol-II (AC and DC machines), S. Chand and Co. Ltd., New Delhi.
6. Sen, S. K., Special Purpose Electrical Machines, Khanna Publishers, New Delhi.
7. Janardanan E. G, Special Electrical Machines, Prentice Hall India, New Delhi.
8. Hughes E., Electrical Technology, ELBS
9. Cotton H., Electrical Technology, ELBS

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ADVANCE MANUFACTURING PROCESS LAB

Course Code	MT 5006
Course Title	Advance Manufacturing Process Lab
Number of Credits	1 (L: 0, T: 0, P: 2)
Prerequisites	Manufacturing Engineering
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, grooves splines.
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) – Hajra Chowdry & 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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ROBOTICS LAB

Course Code	MT 50071
Course Title	Robotics Lab
Number of Credits	1 (L: 0, T: 0, P: 2)
Prerequisites (Course code)	NIL
Course Category	PE

COURSE OBJECTIVE:

- To introduce different types of robotics and demonstrate them to identify different parts and components.
- To write programming for simple operations.

COURSE OUTCOMES:

Upon Completion of the course, the students will be able;
- To assess kinematics & dynamic analysis of robot manipulators.
- To understand the functionality and limitations of robot actuators.
- To program a robot to perform a specified task in a target environment and solve problems in areas such as robot control and navigation.
- To Understand how simulations of robots, where they can be useful and where they can break down.

LIST OF EXPERIMENTS AND EXERCISE ON ANY ROBOTIC SIMULATION SOFTWARE:

1. Study the major equipment/Software/Components in Robotics Lab, e.g. Robotic Arm components, Arena etc.

2. Study components of a real robot.

3. Integration of assorted sensors (IR, Potentiometer, strain gages etc.), micro controllers and ROS (Robot Operating System) in a robotic system
4. Determination of maximum and minimum position of links.
5. Study Forward kinematics and validation.
6. Study Inverse kinematics and validation.
7. Measure the knowledge of Robotic arm, material handling, Scorbase Software and Homing and Moving Robot
8. Recoding Robot positions (Absolute positions, Delete Positions, Save and load positions and Move the Robot to recorded positions.)
9. Verification of transformation (Position and orientation) with respect to gripper and world coordinate system.
10. Robot Programming and Simulation using linear and nonlinear paths.
11. Writing and running Robot programs.

TEXT BOOKS/REFERENCES:

1. Saha, S.K., "Introduction to Robotics, 2nd Edition, McGraw-Hill Higher Education, New Delhi, 2014.

2. Richard D, Klafter, Thomason A ChmielOwski, Michel Nagin "Robotics Engg-an Integrated Approach" PHI 2005.

3. R.K. Mittal & I.J. Nagrath, "Robotics & Control" TMH-2007.
4. http://vlabs.iitkgp.ernet.in/mr/exp2/index.html

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ELECTRICAL MACHINES LAB

Course Code	MT 50072
Course Title	Electrical Machines Lab
Number of Credits	1 (L: 0, T: 0, P: 2)
Prerequisites (Course code)	NIL
Course Category	PE

COURSE OBJECTIVES

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences.

- Use electric motors.
- Maintain Induction, Synchronous and FHP Machines used in different applications

COURSE OUTCOMES

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

- Maintain different types of DC generators.
- Maintain different types of DC motors.
- Maintain three phase induction motor used in different applications.
- Maintain single phase induction motor used in different applications.
- Maintain three phase alternators used in different applications.
- Maintain synchronous motors used in different applications.
- Maintain FHP motors used in different applications.

PRACTICALS:

1. Dismantle a DC machine.
2. Reverse the direction of rotation of the DC shunt motor.
3. Control the speed of DC shunt motor by different methods.
4. Control the speed of DC series motor by different methods.
5. Identify the different parts (along with function and materials) for the given single phase and three phase induction motor.
6. Connect and run the three phase squirrel cage induction motors (in both directions) using the DOL, star-delta, auto-transformer starters (any two).
7. Perform the direct loading test on the given three phase alternator and determine the regulation and Efficiency.
8. Dismantling and reassembling of single phase motors used for ceiling fans, universal motor for mixer.
9. Control the speed and reverse the direction of stepper motor.
10. Control the speed and reverse the direction of the AC servo motor.
11. Control the speed and reverse the direction of the DC servo motor.

REFERENCES /SUGGESTED LEARNING RESOURCES:

1. P.S. Bimbhra, Electric Machines, Khanna Book Publishing Co., New Delhi.

2. Mittle, V. N. and Mittle, Arvind, Basic Electrical Engineering, McGraw Hill Education New Delhi.

3. Kothari, D. P. and Nagrath, I. J., Electrical Machines, McGraw Hill Education. New Delhi.

4. Bhattacharya, S. K., Electrical Machines, McGraw Hill Education, New Delhi.

5. Theraja, B. L., Electrical Technology Vol-II (AC and DC machines), S. Chand and Co. Ltd., New Delhi.

6. Sen, S. K., Special Purpose Electrical Machines, Khanna Publishers, New Delhi.

7. Janardanan E. G, Special Electrical Machines, Prentice Hall India, New Delhi.

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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	MT 6111 (Common in all branches of Engineering)
Course Title	Entrepreneurship and Start-ups
Number of Credits	4 (L-3, T-1, P-0)
Prerequisites (Course code)	NIL
Course Category	HS

COURSE LEARNING OBJECTIVES:

1. Acquiring Entrepreneurial spirit and resourcefulness.
2. Familiarization with various uses of human 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, the students 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. Strategic Marketing Planning
6. New Product or Service Development
7. Business Plan Creation

COURSE CONTENTS:

1. **UNIT 1 - INTRODUCTION TO ENTREPRENEURSHIP AND START–UPS**
   1.1. Definitions, Traits of an entrepreneur, Entrepreneurship, Motivation;
   1.2. Types of Business Structures;
   1.3. Similarities / differences between entrepreneurs and managers.

2. **UNIT 2 - BUSINESS IDEAS AND THEIR IMPLEMENTATION**
   2.1. Discovering ideas and visualizing the business;
   2.2. Activity map;
   2.3. Business Plan.

3. **UNIT 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. **UNIT 4 - MANAGEMENT**
   4.1. Company's Organization Structure;
   4.2. Recruitment and management of talent;
   4.3. Financial organization and management.

5. **UNIT 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	MT 62001 (Common in all branches of Engineering)
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. **UNIT 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. **UNIT 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. **UNIT 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.   UNIT 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 benefits analysis and economic rate of return;
     4.9.   Non-financial justification of projects**.**

5.   UNIT 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	MT 62002 (Common in all branches of Engineering)
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. **UNIT 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. **UNIT 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.   UNIT 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.   UNIT 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.   UNIT 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.

PRODUCT DESIGN

CourseCode	MT 63001 (Common in all branches of Engineering)
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 the customer 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. **UNIT 1- DEFINITION OF A PRODUCT**
    1.1.   Types of products;
    1.2.   Levels of product;
    1.3.   Product-market mix;
    1.4.   New product 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. **UNIT 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. **UNIT 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. **UNIT 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.   Modelling and Simulation;
4.5.   The role of models in engineering design;
4.6.   Mathematical modelling;
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 Prototyping (RP);
4.14.   Application of RP in product design;
4.15.   Product Development versus Design.

5. **UNIT 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, Tata McGraw–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	MT 63002 (Common in all branches of Engineering)
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:

After completion of this course, student will be:

- Acquainted with basic information on various types of disasters
- Knowing the precautions and awareness regarding various disasters
- Decide first action to be taken under various disasters
- Familiarised with organization in India which are dealing with disasters
- Able to select IT tools to help in disaster management

COURSE CONTENTS

1. **UNIT 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. **UNIT 2 - TYPES, TRENDS, CAUSES, CONSEQUENCES AND CONTROL OF DISASTERS**
    2.1. Geological Disasters (earth quakes, landslides, tsunami, mining);
    2.2. Hydro-Meteorological Disasters (floods, cyclones, lightning, thunder-storms, hailstorms, avalanches, droughts, cold and heat waves);
    2.3. Biological Disasters (epidemics, pest attacks, forest fire);
    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. **UNIT 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 Micro zonation;

    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 Strategy, Hyogo Frame-work of Action.

4. UNIT 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. UNIT 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	MT 6333 (Common in all branches of Engineering)
CourseTitle	Indian Constitution
NumberofCredits	0 (L:2,T:0;P:0)
Prerequisites(Coursecode)	NIL
CourseCategory	AU

COURSE CONTENT

1. **UNIT 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. **UNIT 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. **UNIT 3 - STATE GOVERNMENT:**
   3.1. Governor– Role and Power
   3.2. Chief Minister and Council of Ministers
   3.3. State Secretariat

4. **UNIT 4 - LOCAL ADMINISTRATION:**
   4.1. District Administration
   4.2. Municipal Corporation
   4.3. Zila Panchayat

5. **UNIT 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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EMBEDDED SYSTEMS

Course Code	MT 6001
Course Title	Embedded Systems
Number of Credits	4 (L-4, T-0, P-0)
Prerequisites	NIL
Course Category	PC

COURSE CONTENTS:

UNIT 1 –
    1.1   Embedded C basics operators for Arduino;
    1.2   Familiarizing with the Arduino IDE;
    1.3   Sketch designing for Arduino Communication interfaces using serial port;
    1.4   Basic understanding of the code with Boolean operations, pointer access operations, bitwise operations, compounded operations.

UNIT 2 –
    2.1   Embedded C control structure blocks;
    2.2   looping mechanism – for, do and while;
    2.3   The branching operations based on conditions expression.

UNIT 3 -
    3.1   Introduction to Arduino Mega;
    3.2   Arduino Mega specifications including power ratings, digital and analog peripherals;
    3.3   Difference between the C language and Embedded C language;
    3.4   Arduino Mega Ports, Pins, Digital and Analog Peripherals.

UNIT 4 -
    4.1   Communication with Arduino;
    4.2   Different communication modules available with their real-life application Communication interface.

REFERENCES /SUGGESTED LEARNING RESOURCES:

1.   Arduino Projects For Dummies (For Dummies Series) Kennedy George; Davis Bernard; Prasanna SRM Wiley (5 July 2013), ISBN: 978-1118551479.

2.   Make: Getting Started With Arduino - The Open Source Electronics Prototyping Platform Massimo Banzi and Michael Shiloh Shroff/Maker Media; Third edition (27 December 2014), ISBN : 978-9351109075.

SUGGESTED SOFTWARE/LEARNING WEBSITES:

- https://www.arduino.cc/reference/en/
- https://learn.adafruit.com/category/learn-arduino

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EMBEDDED SYSTEMS LAB

Course Code	MS 6002
Course Title	Embedded Systems Lab
Number of Credits	1 (L-0, T-0, P-2)
Prerequisites	NIL
Course Category	PC

PRACTICALS:-

1. Built-in LED state control by push button sketch implementation
2. Built-in LED blinking sketch implementation
3. Built-in LED blinking by toggling states based on binary operation
4. Built-in LED state control by user interface through serial port
5. User interface for Boolean operation and bit wise operation through serial port
6. User interface for compounded operation through serial port
7. Looping mechanism to check the state of pin and if change print its status on serial port
8. Controlling multiple LEDs with a loop and an array
9. Use a potentiometer to control the blinking of an LED
10. Uses an analog output (PWM pin) to fade an LED.
11. Servo Motor Control using PWM
12. Temperature sensor interfacing and sending its reading over serial port
13. I2C light sensor interfacing and sending its reading over serial port

REFERENCES /SUGGESTED LEARNING RESOURCES:

1. Arduino Projects for Dummies (For Dummies Series) Kennedy George; Davis Bernard; Prasanna SRM Wiley (5 July 2013), ISBN: 978-1118551479.

2. Make: Getting Started With Arduino - The Open Source Electronics Prototyping Platform Massimo Banzi and Michael Shiloh Shroff/Maker Media; Third edition (27 December 2014), ISBN : 978-9351109075.

SUGGESTED SOFTWARE/LEARNING WEBSITES:

- https://www.arduino.cc/reference/en/
- https://learn.adafruit.com/category/learn-arduino

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