VEER MADHO SINGH BHANDARI UTTARAKHAND TECHNICAL UNIVERSITY
(Formerly Uttarakhand Technical University, Dehradun Established by Uttarakhand State Govt. wide Act no. 415 of 2005)
Suddhowala, PO-Chandanwadi, Premnagar, Dehradun, Uttarakhand (Website- www.uktech.ac.in)

SYLLABUS

For

B.TECH.

(Robotics and Automation Engineering)

2ND Year

Effective From – Session 2023-24

B.Tech. (Robotics and Automation) Model Curriculum Structure

SEMESTER-III

Sl. No.	Subject Codes	Category	Subject	Periods			Evaluation Scheme					Subject Total	Credit
							Sessional Exam			ESE			
				L	T	P	CT	TA	Total	TE	PE		
1	AHT-006	BSC	Mathematics-III	3	1	0	30	20	50	100		150	4
2	AHT-007 / AHT-008	HSC	Technical Communication/Universal Human Values	2 / 3	1 / 0	0 / 0	30	20	50	100		150	3
3	RAT-001	DC	Sensors and Instrumentation	3	1	0	30	20	50	100		150	4
4	MET-003	DC	Materials Engineering	3	1	0	30	20	50	100		150	4
5	RAT-002	DC	Fundamentals of Mechatronics	3	1	0	30	20	50	100		150	4
6	MEP-004	DLC	Materials Engineering & Testing Lab	0	0	2		25	25		25	50	1
7	RAP-001	DLC	Mechatronics Lab	0	0	2		25	25		25	50	1
8	MEP-006	DLC	Machine Drawing & Solid Modelling Lab	0	1	2		25	25		25	50	1
9	RAP-002	DLC	Internship-I/Mini Project-I*	0	0	2			50			50	1
10	CST-006/ CST-005	NC	Cyber Security#/Python Programming#	2	0	0	15	10	25	50			
11	GP-03	NC	General Proficiency						50				
			Total									**950**	**23**
12			**Open Elective (Optional)**	3	1	0	30	20	50	50			**4**

*The Mini Project-I or Internship-I (3-4 weeks) conducted during summer break after II semester and will be assessed during III semester

* For Lateral entry admitted students will complete a mini project during the 3rd semester course and its evaluation will be against Internship-I/Mini Project-I (RAP-002)

 # The content of the course is based on the case studies.

SENSORS AND INSTRUMENTATION (RAT-001)

L T P: 3 1 0

Course Objectives:

- To understand the concepts of measurement technology.
- To learn the various sensors used to measure various physical parameters.
- To learn the fundamentals of signal conditioning, data acquisition and communication systems used in mechatronics system development.

Unit 1

Introduction

Basics of Measurement – Classification of errors – Error analysis – Static and dynamic, characteristics of transducers – Performance measures of sensors – Classification of sensors – Sensor calibration techniques – Sensor Output Signal Types.

Unit 2

Motion, Proximity and Ranging Sensors

Motion Sensors – Potentiometers, Resolver, Encoders – Optical, Magnetic, Inductive, Capacitive, LVDT – RVDT – Synchro – Microsyn, Accelerometer – GPS, Bluetooth, Range Sensors – RF beacons, Ultrasonic Ranging, Reflective beacons, Laser Range Sensor (LIDAR).

Unit 3

Force, Magnetic and Heading Sensors

Strain Gage, Load Cell, Magnetic Sensors –types, principle, requirement and advantages: Magneto resistive – Hall Effect – Current sensor Heading Sensors – Compass, Gyroscope, Inclinometers.

Unit 4

Optical, Pressure and Temperature Sensors

Photo conductive cell, photo voltaic, Photo resistive, LDR – Fiber optic sensors – Pressure – Diaphragm, Bellows, Piezoelectric – Tactile sensors, Temperature – IC, Thermistor, RTD, Thermocouple. Acoustic Sensors – flow and level measurement, Radiation Sensors – Smart Sensors - Film sensor, MEMS & Nano Sensors, LASER sensors.

Unit 5

Signal Conditioning and DAQ Systems

Amplification – Filtering – Sample and Hold circuits – Data Acquisition: Single channel and multichannel data acquisition – Data logging - applications - Automobile, Aerospace, Home appliances, Manufacturing, Environmental monitoring.

Text books

1. Ernest O Doebelin, "Measurement Systems – Applications and Design", Tata McGraw-Hill, 2009
2. Sawney A K and Puneet Sawney, "A Course in Mechanical Measurements and Instrumentation and Control", 12th edition, Dhanpat Rai & Co, New Delhi, 2013.

References

1. C. Sujatha ... Dyer, S.A., Survey of Instrumentation and Measurement, John Wiley & Sons, Canada, 2001
2. Hans Kurt Tönshoff (Editor), Ichiro , "Sensors in Manufacturing" Volume 1, Wiley-VCH April 2001.
3. John Turner and Martyn Hill, "Instrumentation for Engineers and Scientists", Oxford Science Publications, 1999.
4. Patranabis D, "Sensors and Transducers", 2nd Edition, PHI, New Delhi, 2011.
5. Richard Zurawski, "Industrial Communication Technology Handbook" 2nd edition, CRC Press, 2015

Course Outcomes

Upon Completion of the course the students will be able to

CO1: Familiar with various calibration techniques and signal types for sensors.

CO2: Apply the various sensors in the Automotive and Mechatronics applications

CO3: Describe the working principle and characteristics of force, magnetic and heading sensors.

CO4: Understand the basic principles of various pressure and temperature, smart sensors.

CO5: Ability to implement the DAQ systems with different sensors for real time applications.

Materials Engineering (MET-003)

L T P: 3 1 0

Course Objectives:

The course should enable the students to:

- Understand about the different types of materials and their properties.
- Understand the various ferrous material, their production process and properties.
- Study and examine the non-ferrous metals and testing of materials.
- Study the magnetic and electric properties of materials.
- Understand the various Non-Metallic Materials and their uses.

Particulars

Unit 1

Crystal Structure: Unit cells, Metallic crystal structures, Ceramics. Imperfection in solids: Point, line, interfacial and volume defects; dislocation strengthening mechanisms and slip systems, critically resolved shear stress. Mechanical Property measurement: Mechanical Properties measurement Tensile, compression and torsion tests, strength, ductility, resilience, toughness and elastic recovery; Hardness: Rockwell, Brinell and Vickers and their relation to strength.

Unit 2

Static Failure Theories: Ductile and brittle failure mechanisms, Tresca, Von-mises, Maximum normal stress, Mohr-Coulomb and Modified Mohr-Coulomb; Fracture mechanics: Introduction to Stress-intensity factor approach and Griffith criterion. Fatigue failure: High cycle fatigue, Stress-life approach, SN curve, endurance and fatigue limits, effects of mean stress using the Modified Goodman diagram; Fracture with fatigue, Introduction to non- destructive testing (NDT).

Unit 3

Alloys, Substitutional and Interstitial Solid Solutions- Phase Diagrams: Interpretation of binary phase diagrams and microstructure development; eutectic, peritectic, peritectoid and monotectic reactions. Iron Iron-carbide phase diagram and microstrctural aspects of ledeburite, austenite, ferrite and cementite, cast iron.

Unit 4

Heat Treatment of Steel: Annealing, tempering, normalising and spheroidising, isothermal transformation diagrams for Fe-C alloys and microstructure development.

Continuous cooling curves TTT diagram, and interpretation of final microstructures and properties- austempering, martempering, case hardening, carburizing, nitriding, cyaniding, carbo-nitriding, flame and induction hardening, vacuum and plasma hardening.

Unit 5

Alloying of steel, properties of stainless steel and tool steels, maraging steels- cast irons; grey, white, malleable and spheroidal cast irons- copper and copper alloys; brass, bronze and cupro-nickel; Aluminium and Al-Cu – Mg alloys- Nickel based superalloys and Titanium alloys .

References

1. Callister Jr, W. D., & Rethwisch, D. G. (2020). Materials science and engineering: an introduction. wiley.
2. Budinski, K. G., & Budinski, M. K. (1999). Engineering materials. Pearson Education India.
3. Raghavan, V. (2015). Materials Science and Engineering: A first course. PHI Learning Pvt. Ltd.
4. Jindal, U. C. (2012). Material Science and Metallurgy. Pearson Education India.

Course Outcomes

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

CO1: Identify crystal structures for various materials and understand the defects in such structures.

CO2: Understand how to tailor material properties of ferrous and non-ferrous alloys.

CO3: Explain detailed interpretation of equilibrium phase diagrams.

CO4: Understand how to quantify mechanical integrity and failure in materials.

CO5: Explain the different metals and alloys.

Fundamentals of Mechatronics (RAT-002)

L T P: 3 1 0

Course Objective

The course should enable the students to:

- To focused on the field of Control Systems and Automation.
- To understand the various aspects of control systems, signal conditioning, precision mechanical systems, and electromechanical drives.
- To provide the comprehensive understanding of Mechatronics concepts and their applications.

Unit 1

Introduction: Definition – Trends - Control Methods: Stand alone, PC Based (Real Time Operating Systems, Graphical User Interface, Simulation) - Applications: identification of Sensors and actuators in Washing machine, Automatic Camera, Engine Management, SPM, Robot, CNC, FMS, CIM.

Unit 2

Signal Conditioning: Introduction – Hardware - Digital I/O, Analog input – ADC, resolution, Filtering Noise using passive components – Registors, capacitors – Amplifying signals using OP amps –Software - Digital Signal Processing – Low pass, high pass, notch filtering

Unit 3

Precision Mechanical Systems: Modern CNC Machines – Design aspects in machine structures, guideways, feed drives, spindle and spindle bearings, measuring systems, control software and operator interface, gauging and tool monitoring.

Unit 4

Electromechanical Drives: Relays and Solenoids - Stepper Motors - DC brushed motors – DC brushless motors - DC servo motors - 4-quadrant servo drives, PWM's - Pulse Width Modulation – Variable Frequency Drives, Vector Drives - Drive System load calculation.

Text Books:

1. W.Bolton, “Mechatronics” , Pearson education, second edition, fifth Indian Reprint, 2003.
2. Smaili and F. Mrad, "Mechatronics- integrated technologies for intelligent machines", Oxford university press, 2008.

Reference Books:

1. R.K Rajput, A textbook of mechatronics, S. Chand & Co, 2007.
2. Michael B. Histand and David G. Alciatore, “Introduction to Mechatronics and Measurement Systems”, McGraw-Hill International Editions, 2000.
3. D. A. Bradley, Dawson D., Buru N.C. and. Loader A.J, “Mechatronics”, Chapman and Hall, 1993.
4. Dan Necsulesu, “Mechatronics”, Pearson Education Asia, 2002 (Indian Reprint).
5. Lawrence J. Kamm, “Understanding Electro – Mechanical Engineering”, An Introduction to Mechatronics, Prentice – Hall of India Pvt., Ltd., 2000.
6. Nitaigour Premchand Mahadik, “Mechatronics”, Tata McGraw-Hill publishing Company Ltd, 2003.

Course Outcomes

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

CO1: Understand the fundamental principles of control systems, signal conditioning, precision mechanical systems, and electromechanical drives.

CO2: Apply appropriate control methods and signal conditioning techniques to various applications, such as washing machines, cameras, robotics, and manufacturing systems.

CO3: Analyze and design precision mechanical systems, particularly in the context of modern CNC machines.

CO4: Evaluate and select suitable electromechanical drives for different industrial applications.

CO5: Demonstrate the ability to calculate and optimize drive system loads for efficient operation.

Materials Engineering and Testing Lab (MEP-004)

L T P: 0 0 2

Course Objective

The course should enable the students to:

- Acquire the basic knowledge of materials science, so that they would be able to understand and distinguish between varieties of materials based on their structure and properties.
- Gain the knowledge about the properties of materials at higher elevated temperatures.
- Refine properties and grain size of carbon steel and cast iron by heat treatment.
- Understand the Destructive and Non-Destructive methods of testing materials.
- Study and differentiate among microstructures of different engineering materials.

Particulars

List of Experiments

Minimum 10 experiments out of the following (or similar experiments).

1. Making a plastic mould for small metallic specimen.
2. Specimen preparation for micro structural examination-cutting, grinding, polishing, etching.
3. Grain size determination of a given specimen.
4. Comparative study of microstructures of different given specimens (mild steel, gray cast iron, brass, copper etc.)
5. Heat treatment experiments such as annealing, normalizing, quenching, case hardening and comparison of hardness before and after.
6. Study of corrosion and its effects.
7. Study of microstructure of welded component and HAZ, Macro and Micro Examination.
8. Suitable experiment on Magnetic/ Electrical/ Electronic materials.
9. To perform Tensile Test on Mild-steel specimen and draw stress strain curve.
10. To perform Izod, Charpy Impact test on standard specimen.
11. To perform Brinell, Rockwell, Vicker Hardness Test on standard specimen.
12. To calculate spring stiffness.
13. To calculate Torsional Rigidity.
14. To calculate Fatigue strength on Fatigue Testing Machine
15. To calculate Modulus of Elasticity by Non Destructive Testing.

16. Detection of cracks by Ultrasonic Testing Machine.
17. Detection of cracks by Dye Penetration Technique.
18. Detection of cracks by Eddy Current Tester.
19. To perform Wear Test

Reference Books:

1. Callister Jr, W. D., & Rethwisch, D. G. (2020). Materials science and engineering: an introduction. Wiley
2. Budinski, K. G., & Budinski, M. K. (1999). Engineering materials. Pearson Education India.
3. Raghavan, V. (2015). Materials Science and Engineering: A first course. PHI Learning Pvt. Ltd.
4. Jindal, U. C. (2012). Material Science and Metallurgy. Pearson Education India.
5. Khurmi, R. S., & Khurmi, N. (2019). A textbook of strength of materials. S. Chand Publishing.
6. Bansal, R. K. (2010). A textbook of strength of materials (in SI units). Laxmi Publications.

Course Outcomes

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

CO1: Correlate the microstructure with the mechanical & physical properties of given set of engineering materials.
CO2: Study the microstructure with the mechanical & physical properties of given set of engineering materials.
CO3: Perform destructive testing and find out the mechanical properties of given set of engineering materials.
CO4: Perform nondestructive testing and to find out any irregularities in the given set of engineering materials.
CO5: Conduct tribological experiments and to find out wear rate of given set of engineering materials.

Mechatronics lab (RAP-001)

L T P: 0 0 2

Course Objective:

The course should enable the students to:

- To provide students with hands-on experience and practical knowledge in the design, analysis, and implementation of fluid power circuits and control systems.
- Through a series of experiments and projects, students will develop a strong understanding of hydraulic and pneumatic systems, as well as their integration with electrical control systems.
- To equip students with the skills needed to design, simulate, and troubleshoot various fluid power and control circuits, preparing them for real-world applications in engineering and industrial settings.

Particulars

LIST OF EXPERIMENTS

1. Design and testing of fluid power circuits to control

(i) Velocity (ii) direction and (iii) force of single and double acting actuators

2. Design of circuits with logic sequence using Electro pneumatic trainer kits.

3. Simulation of basic Hydraulic, Pneumatic and Electric circuits using software

4. Circuits with multiple cylinder sequences in Electro pneumatic using PLC

5. Speed Control of AC & DC drives

6. Servo controller interfacing for DC motor

7. PID controller interfacing

8. Stepper motor interfacing with 8051 Micro controller

(i) Full step resolution (ii) half step resolution

9. Modeling and analysis of basic electrical, hydraulic and pneumatic systems using LAB VIEW

10. Computerized data logging system with control for process variables like pressure flow and temperature.

Course Outcomes

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

CO1: Through these experiments, students will develop practical skills in designing,

CO2: Through these experiments, students will analyzing, and troubleshooting fluid power and control systems.

CO3: Enhancing the ability to work with various tools, software, and hardware components commonly used in industrial automation and engineering fields.

CO4: Gaining experience in teamwork, documentation, and effective communication of findings and solutions.

Machine Drawing and Solid Modelling Lab (MEP-006)

L T P: 0 1 2

Course Objective

The course should enable the students to:

- Apply knowledge of Modeling, Science & Engineering.
- Use engineering graphic skills as a means of communicating technical ideas, information and instructions
- Use of Sectional views, Part sectioning, Assembly drawings and Layouts forms a part of this learning
- Modeled this drawing even in CAD/CAM software by applying the basic knowledge of machine drawing.
- Demonstrate an ability to design and conduct experiments, analyze and interpret data and assembly and disassembly drawings knowledge will be provided.

Particulars

Unit 1

Introduction to Engineering Drawing, Classification of Engineering Drawings, Machine Drawing and representation of materials, Representation of different types of lines, Representation of geometrical and dimensional tolerance and surface roughness symbols.

Unit 2

Conversion of Isometric Views into Orthographic Projection, Symbols for weldments, process flow, electrical and instrumentation Units, IS/ISO codes.

Projections, Sectional views and sectioning of parts and assemblies.

Unit 3

Introduction of shapes of rivet heads. Caulking and Fullering pitch, Diagonal pitch, Margin, Back pitch, etc. Types of riveting lap and butt joint, zigzag and chain structure, Boiler joint.

Drawing of Machine Elements and simple parts: Views of any three sets of the following machine elements and parts; Popular forms of Screw threads, bolts, nuts, stud bolts.

Keys, cotter joints and knuckle joint.

Shaft coupling, Hook’s joint, knuckle joint Journal, pivot and collar and foot step bearings.

Unit 4

Assembly Drawings: Drawings of assembled views for the part drawings of the following using conventions and easy drawing proportions; (any one)

a) Engine parts – Connecting rod, Piston assembly.

b) Other machine parts - Screws jacks, Machine Vices, Plummer block, Tailstock.

c) Valves: Steam stop valve, spring loaded safety valve, feed check valve and air cock

Unit 5

Engineering Graphics Software, Co-ordinate Systems, Drafting and Modelling, Evolution of geometric modeling, Advantages of solid modeling, Definition, Advantages and disadvantages of wireframe models, Solid Representation, Boundary Representation (B-rep), Constructive Solid Geometry (CSG).Solid modeling: Use of modeling software, Part model, Assembly.

Reference Books:

1. Bhatt, N. D., & Panchal, V. M. (1991). Machine drawing. Charotar.
2. Dhawan, R. K. (2006). A Textbook of Machine Drawing. S. Chand Publishing.
3. Narayana, K. L. (2009). Machine drawing. New Age International.
4. Kannaiah, P., & Reddy, K. V. (2006). Machine drawing. New Age International.
5. Pohit, G. (2004). Machine Drawing with AutoCAD. Pearson Education India.
6. John, K. C. (2009). Textbook of Machine Drawing. PHI Learning Pvt. Ltd.
7. Gill, P. S. (2013). A Textbook of Machine Drawing. S. K. Kataria & Sons Publishers.

Course Outcomes

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

CO1: Draft their technical ideas.

CO2: Develop their knowledge about the various practices as dimensioning, sectioning and development of views.

CO3: Understand the importance of the linking functional and visualization aspects in preparation of the part drawings.

CO4: Prepare the part or assembly drawings as per the conventions.

CO5: Interpret various machine drawings that will in turn help them to prepare the production drawings.

B.Tech. (Robotics and Automation) SEMESTER-IV													
Sl. No.	**Subject Codes**	**Category**	**Subject**	**Periods**			**Evaluation Scheme**					**Subject Total**	**Credit**
							Sessional Exam			**ESE**			
				L	**T**	**P**	**CT**	**TA**	**Total**	**TE**	**PE**		
1	AHT-008	HSC	Universal Human Values /Technical Communication	3	0	0	30	20	50	100		150	3
	AHT-007			2	1	0							
2	RAT-003	DC	Automatic control system	3	1	0	30	20	50	100		150	4
3	RAT-004		Microprocessors and Microcontrollers	3	1	0	30	20	50	100		150	4
4	MET-007	DC	Strength of Materials	3	1	0	30	20	50	100		150	4
5	MET-008	DC	Manufacturing Science and Technology -I	3	1	0	30	20	50	100		150	4
6	RAP-003	DLC	Microprocessors and Microcontrollers Lab	0	0	2		25	25		25	50	1
7	MEP-009	DLC	Manufacturing Science and Technology -I Lab	0	0	2		25	25		25	50	1
8	MEP-010	DLC	Mechanics of Machine Lab	0	0	2		25	25		25	50	1
9	CST-006/ CST-005	NC	Python Programming/Cyber Security	2	0	0	15	10	25	50		75	
10	GP-04	NC	General Proficiency						50			50	
			Total									**900**	**22**
11			**Open Elective (Optional)**	3	1	0	30	20	50	100		150	**4**
Internship-II/Mini Project-II* To be completed at the end of fourth semester (during Summer Break) & its evaluation/credit to be added in Fifth semester.													

AUTOMATIC CONTROL SYSTEMS (RAT-003)

L T P: 3 1 0

Course Objectives

- To study the basics of control system and its response. stability of mechanical and electrical systems. Use of MATLAB to design a stable control system.
- To introduce the elements of control system and their modeling using various Techniques.
- To introduce methods for analyzing the time response.
- To impart knowledge about the frequency response and the stability of systems
- To introduce the state variable analysis method

Particulars

Unit 1 Introduction

Open loop and closed loop systems - Examples - Elements of closed loop systems - Transfer function - Modeling of physical systems – Mechanical, Thermal, Hydraulic systems and Electric Networks - Transfer function of DC generator, DC servomotor, AC servomotor, Potentiometer, Synchros, Tacho- generator, Stepper motor - Block diagram - reduction techniques, Signal flow graph – Mason‟ gain formula. (Related Tutorials Using MATLAB/ Simulink – Toolboxes & Functions)

Unit 2 Time domain analysis

Standard Test signals – Time response of second order system - Time domain specifications – Types of systems - Steady state error constants - Introduction to P, PI and PID modes of feedback control. (Related Tutorials Using MATLAB/ Simulink – Toolboxes & Functions)

Unit 3 Frequency domain analysis

Frequency domain specifications - Time and frequency response correlation – Polar plot – Bode plot – All pass minimum phase and non-minimum phase systems. (Related Tutorials Using MATLAB/Simulink – Toolboxes & Functions)

Unit 4 System stability

Characteristic equation - Routh Hurwitz criterion of stability - Absolute and Relative stability – Nyquist stability - Nyquist stability criterion - Assessment of relative stability – Gain and Phase Margin. (Related Tutorials Using MATLAB/ Simulink – Toolboxes & Functions)

Unit 5 Root Locus Method

Root locus concepts - Construction of root loci – Root contours. (Related Tutorials Using MATLAB/ Simulink – Toolboxes & Functions) STATE SPACE ANALYSIS: Limitations of conventional control theory - Concepts of state, state variables and state model – state model for linear time invariant systems - Introduction to state space representation using physical - Phase and canonical variables. (Related Tutorials Using MATLAB/ Simulink – Toolboxes & Functions)

Text books:

1. Nagrath I J, and Gopal, M, 'Control Systems Engineering" Prentice Hall of India, New Delhi, 2008.

2. Richard C Dorf and Robert H Bishop, "Modern Control Systems.", Addison-Wesley -2007

References:

1. Ogata K, "Modern Control Engineering", Pearson Education, New Delhi, 2006.

2. Kuo B C, "Automatic Control Systems", Prentice-Hall of India Pvt. Ltd, New Delhi, 2004.

3. Norman C. Nise S, “Control system Engineering“, John Wiley & Sons, Singapore, 2004.

Course Outcomes

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

CO1: To understand the basic of the control system

CO2: Ability to know about the time and frequency domain analysis

CO3: To know about the different stability of the systems

CO4: To expose students to the state space representation and its analysis.

CO5: To introduce non-linear systems and their control and to impart knowledge on advanced control techniques

Microprocessors and Microcontrollers (RAT-004)

L T P : 3 1 0

Course Objectives

- Study the Architecture of 8085 microprocessor.
- Study the Architecture of 8086 microprocessor.
- Learn the design aspects of I/O and Memory Interfacing circuits.
- Study about communication and bus interfacing.
- Study the Architecture of 8051 microcontroller.

Particulars

Unit 1 8086 Microprocessor

Architecture – Pin description – Operating modes – Registers – Interrupts – Bus cycle – Addressing modes – Typical configuration of 8086 system – Overview of Instruction set.

Unit 2 80286 Microprocessor

Functional block diagram - Modes of operation – Real and protected mode – Memory management and protection features.

Unit 3 80386, 80486 Processors

80386: Functional block diagram - Programming model - Addressing modes and instruction set overview – Address translation - Modes of operation - 80486 processor - Functional block diagram- Comparison of 80386 and 80486 processors.

Unit 4 Pentium Microprocessor

Introduction – Architecture – Special Pentium registers – Memory management.

Unit 5 Pic Microcontroller

Architecture – Memory structure – Register File – Addressing modes – Interrupts – Timers: Modes of operation PIC PERIPHERAL FUNCTIONS AND SPECIAL FEATURES: PWM output – Analog to Digital converter – UART – Watchdog timer – RESET Alternatives – Power Down mode – I2C Bus operation.

Text books:

1. Barry B Brey, "The Intel Microprocessor 8086/8088, 80186/80188, 80286, 80386, 80486 Pentium and Pentium processor, Pentium II, III, 4, Prentice Hall of India, New Delhi, 2005.

2. Douglas V Hall, "Microprocessors and Interfacing: Programming and Hardware", McGraw Hill,

New Delhi, 2005.

3. John B Peatman, “Design with PIC Microcontroller, McGraw Hill, Singapore, 1st Reprint, 2001

References:

1. Mohammed Rafiquzzaman, "Microprocessors and microcomputer-based system design", CRCPress, 2005.

2. Walter A Triebel, Avtar Singh.” The 8088 and 8086 microprocessors Programming Interfacing

software, Hardware and Applications”,Pearson Education ,2009

3. Myke Pred ko, “Programming and Customising the PIC Microcontroller, “McGraw Hill, USA, 1998

Course Outcomes

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

CO1: Design and implement programs on 8085 microprocessor.

CO2: Design and implement programs on 8086 microprocessor.

CO3: Design I/O circuits.

CO4: Design Memory Interfacing circuits.

CO5: Design and implement 8051 microcontroller-based systems.

Strength of Material (MET-007)

L T P: 3 1 0

Course Objectives

The course should enable the students to:

- Confidently tackle equilibrium equations, moments and inertia problems.
- To solve real field problems through evaluating the relationship between stress and strain.
- To understand the shear force and bending moment diagrams of symmetrical beams.
- To determine deflection, bending and shear stresses developed in beams of various sections
- To understand and apply the concept of stress and strain to analyze and design structural members and machine parts under axial load, shear load, bending moment and torsion

Particulars

Unit 1

Simple Stress and Strain: Introduction, Normal and shear stresses, Hooke's law, Stress strain diagrams for ductile and brittle materials, Elastic constants- Relationship between elastic constant one dimensional loading of members of varying cross-section, Strain energy, Thermal stresses.

Compound stress and strain: Introduction, State of plane stress, Principal stress and strain, Mohr's circle for stress, Moment of Inertia.

Unit 2

Beams: Definition and types of beams (cantilever, simply supported, overhanging, fixed, continuous), Types of end supports (simply support, hinged, roller, fixed), Classification of loads (point load, inclined point load, uniformly distributed load, uniformly varying load) Reactions of a simply supported and overhanging beam by analytical method.

Pure Bending of Beams: Introduction, Simple bending theory, bending stress distribution and neutral axis, shear stress distribution, point and distributed loads.

Unit 3

Stresses in Beams: Bending moment (BM) and shear force (SF) diagrams. BM and SF diagrams for cantilevers simply supported and fixed beams with or without overhangs. Calculation of maximum BM and SF and the point of contra-

flexure under concentrated loads, uniformly distributed loads over the whole span or part of the span. Deflection of beams: Equation of elastic curve, cantilever and simply supported beams. Double integration method, Moment area method, Macaulay's method, Maxwell's reciprocal theorems.

Torsion: Introduction, Derivation of torsion equation and its assumptions. Torsional rigidity. Torsion stresses and deformation in circular and hollow shafts, stepped shafts, combined torsion and bending of circular shafts, Torsion of non- circular shaft.

Unit 4

Axial and hoop stresses in cylinders subjected to internal pressure, deformation of thick and thin cylinders, deformation in spherical shells subjected to internal pressure.

Columns and Struts: Combined bending and direct stress, middle third and middle quarter rules. Struts with different end conditions. Euler's theory and experimental results, Rankine Jordan Formulae, Examples of columns in mechanical equipment's and machines. Columns and Struts: Combined bending and direct stress, middle third and middle quarter rules. Struts with different end conditions. Euler's theory and experimental results, Rankine Jordan Formulae, Examples of columns in mechanical equipment's and machines.

Unit 5

Introduction to Stress and Strain in 3D

Introduction to stress in 3D, Stress components on an arbitrary plane, Differential equations of equilibrium, Boundary conditions, Strains: Concept of strain.

Relationship between elastic constants for different materials

Stress-strain relations for linearly elastic solid, Generalized Hooke's law, Stress-strain relations for isotropic, orthotropic and anisotropic materials.

Reference Books:

1. Strength of Materials by R. Subramaniam, Oxford University Press, New Delhi, 2007.
2. Strength of Materials by B.C. Punamia, Laxmi Publications, 2015
3. Gere J. M., Timoshenko S.P., Mechanics of materials, CBS Publication, 2nd edition, ISBN- 8123908946.
4. Popov Eger P.,"Engg. Mechanics of solids", Prentice Hall, New Delhi, 2nd edition, ISBN- 0135713560.
5. Hibbeler R.C.,"Mechanics of Materials", Prentice Hall, New Delhi, 9th edition, ISBN- 0133254429.
6. Fenner, Roger.T, "Mechanics of Solids", U.K. B.C. Publication, New Delhi.
7. Ferdinand P. Been, Russel Johnson Jr and John J. Dewole, Mechanics of Materials, Tata McGraw-Hill Publishing Co. Ltd., New Delhi 2005

Course Outcomes

At the end of this course students will be able to:

CO1: Recognize various types of loads applied on machine components of simple geometry and understand the nature of internal stresses that will develop within the components.

CO2: Analyze determinate beams and trusses to determine shear forces, bending moments and axial forces.

CO3: Gain sufficient knowledge in designing shafts to transmit required power and also spring for its maximum energy storage capacities.

CO4: Identify modes of failure in components.

CO5: Identify, formulate and solve engineering problems.

Manufacturing Science and Technology – I (MEP-009)

L T P: 3 1 0

Course Objective

The course should enable the students to:

- Understand the different metal casting processes, different metal forming and sheet metal operations along with the force calculations.
- Study the basic manufacturing processes and tools.
- Understand different conventional machining processes.
- Understand different nonconventional process.
- Emphasize the importance of manufacturing.

Particulars

Unit 1

Introduction: Importance of manufacturing, Economic & technological considerations in manufacturing. Classification of manufacturing processes, Materials & manufacturing processes for common items.

Casting: Basic principle & survey of casting processes. Types of patterns and allowances. Types and properties of moulding sand. Elements of mould and design considerations, Gating, Riser, Runners, Core. Solidification of casting,. Sand casting, defects & remedies and inspection. Die Casting, Centrifugal casting. Investment casting, CO_2 casting and Stir casting etc.

Unit 2

Metal Forming Processes: Elastic & plastic deformation, yield criteria, Hot working vs. cold working. Analysis (equilibrium equation method) of forging process for load estimation with sliding friction sticking friction and mixed condition for slab and disc. Work required for forging, Hand, Power, Drop Forging. Analysis of Wire/strip drawing and maximum- education, Tube drawing, Extrusion and its application.

Unit 3

Rolling: Condition for Rolling force and power in rolling, Rolling mills & rolled-sections. Design, lubrication and defects in metal forming processes.

Sheet Metal working: Presses and their classification, Die & punch assembly and press work methods and processes. Cutting/Punching mechanism. Blanking vs. Piercing. Compound vs Progressive die. Flat-face vs. Inclined-face punch and Load (capacity) needed. Analysis of forming process like cup/deep drawing. Bending & spring-back.

Unit 4

Unconventional Metal forming processes: Unconventional metal forming processes such as explosive forming, electromagnetic, electro-hydraulic forming.

Powder Metallurgy: Powder metallurgy manufacturing process. The need, process, advantage and applications.

Manufacturing of Plastic components: Injection moulding, Extrusion of plastic section, Welding of plastics.

Unit 5

Jigs & Fixtures: Locating & Clamping devices & principles, Jigs and Fixtures and its applications.

Metrology: Dimensions, forms and surface measurements, Limits, fits and tolerances, measurement of geometric forms like straightness, flatness and roundness; linear and angular measurement devices and systems; comparators; gauge design; interferometry; Metrology in tool wear and part quality including surface integrity, alignment and testing methods.

Reference Books:

1. Kalpakjian and Schmid, Manufacturing processes for engineering materials (5th Edition)- Pearson India, 2014.
2. Mikell P. Groover, Fundamentals of Modern Manufacturing: Materials, Processes, and Systems.
3. Degarmo, Black & Kohser, Materials and Processes in Manufacturing.
4. Ghosh and A. K. Malik (2010) Manufacturing Science, East West Press Private Limited New Delhi.
5. PN Rao, “Manufacturing Technology”, Tata McGraw Hill, 2017.

Course Outcomes

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

CO1: Explain the different metal casting processes.

CO2: Explain the different metal forming and sheet metal operations along with the force calculations.

CO3: Explain the theory of rolling and sheet metal work.

CO4: Explain the different unconventional metal forming processes, powder metallurgy and manufacturing of plastic component.

CO5: Explain the jigs and fixture use and metrology.

Microprocessors and Microcontrollers Lab (RAP-003)

L T P: 0 0 2

Course Objective

The course should enable the students to:

- To provide students with practical experience in designing, implementing, and testing various electronic projects using microcontrollers, specifically focusing on the 8051 microcontroller.
- To gain a solid foundation in microcontroller interfacing, programming, and applications.
- To develop students' skills in project development, troubleshooting, and understanding the integration of microcontroller-based systems in real-world scenarios.

Particulars

1. Controlling Light using Touch Sensor and 8051 Microcontroller.
2. 8051 Microcontroller based Frequency Counter.
3. Android Controlled Robot using 8051 Microcontroller.
4. RFID Interfacing with 8051 Microcontroller.
5. Digital Thermometer using LM35 and Microcontroller.
6. Displaying an Image on Graphical LCD using 8051 Microcontroller.
7. Digital Clock using 8051 Microcontroller.
8. Interfacing ADC0808 with 8051 Microcontroller.
9. Digital Code Lock using 8051 Microcontroller.
10. Bluetooth Controlled Home Automation System using 8051.

Course Outcomes

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

CO1: gain hands-on experience in working with microcontrollers, sensors, actuators, and communication interfaces.

CO2: To program microcontrollers, interface them with various components, and develop functional applications.

CO3: To enhance students problem-solving abilities, project management skills, and teamwork through collaborative project development.

CO4: To equip students with practical skills applicable in fields such as embedded systems, robotics, automation, and IoT-based applications.

Manufacturing Science and Technology – I Lab (MEP-009)

L T P: 0 0 2

Course Objective

The course should enable the students to:

- To provide practical experience in various casting and metal forming processes with different materials.
- Learn the use of jigs and fixtures.
- To inculcate the knowledge of experiments on metrology
- To impart the basic knowledge of powder metallurgy.

Particulars

List of Experiments:

Minimum 10 experiments out of following:

1. Design of pattern for a desired casting (containing hole)
2. Pattern making
3. Making a mould (with core) and casting.
4. Sand testing (at least one such as grain fineness number determination)
5. Forging: hand forging processes.
6. Forging: power hammer study & operation
7. Bending & spring back.
8. Powder metallurgy experiment.
9. Jigs & Fixture experiment.
10. Study of Linear Measuring Instruments.
11. Measurement of Taper Angle Using Slips, Rollers & Sine bar
12. Tool Makers Microscope.
13. Measurement of Surface Finish.
14. Machine Tool Alignment Tests.

Reference Books:

1. Kalpakjian and Schmid, Manufacturing processes for engineering materials (5th Edition)- Pearson India, 2014.
2. Mikell P. Groover, Fundamentals of Modern Manufacturing: Materials, Processes, and Systems.

3. Degarmo, Black & Kohser, Materials and Processes in Manufacturing.
4. Ghosh and A. K. Malik (2010) Manufacturing Science, East West Press Private Limited New Delhi.
5. PN Rao, “Manufacturing Technology”, Tata McGraw Hill, 2017.

Course Outcomes

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

CO1: Perform the different experiments on metal casting.

CO2: Perform the different experiments on metal forming.

CO3: Perform the different experiments on jigs and fixture.

CO4: Perform the different experiments on powder metallurgy.

CO5: Perform the different experiments on metrology.

Mechanics of Machine Lab (MEP-010)

L T P: 0 0 2

Course Objective

The course should enable the student to:

- Provide basic concepts on mechanisms, machines.
- Analyze the velocities of various links in mechanisms using models.
- Introduce with the CAMs and their design.
- Introduce with various model of gears, classification and their types.

Particulars

List of Experiments (Minimum 10)

1. To study various types of Links, Pairs, Chain and Mechanism

2. To study inversion of Four Bar Mechanism, Single Slider Crank Chain Mechanism and Double Slider Crank Chain Mechanism.

3. To study velocity diagram for Slider Crank Mechanism.

4. To study various kinds of belts drives.

5. To study and find coefficient of friction between belt and pulley.

6. To study various types of Cam and Follower arrangement.

7. To plot follower displacement vs cam rotation graph for various cam follower arrangement.

8. To study the working of Screw Jack and determine its efficiency.

9. To study Different types of Gears.

10. To study Different types of Gear Trains.

11. Study of Ackerman's Steering Gear Mechanism

Course Outcomes

At the end of this course, students will be able to:

CO1: Understand principle and functioning of mechanism such as slider crank, four bar chain, Ackerman's steering.

CO2: Gain knowledge about the kinds of belt drives and calculate the coefficient of friction between belt and pulley.

CO3: Plot cam profiles for different arrangements.

CO4: Understand functioning of different gears.

CO5: Determine screw jack efficiency.