Title of the Course: Metal Cutting Technology	L	T	P	C
Course Code: UPRD0501	3	-	-	3

Course Pre-Requisite: Machine tools and processes

Course Description:

The metal cutting theory includes the process, measurements, design and selection of various cutting tools and their industrial specifications.

Course Objectives:

1. Understand the various concepts and terms used in metal cutting theory.
2. Study of different methods of cutting force measurements.
3. Study of sources of heat generation and different types of cutting fluids.
4. Study of cutting tool materials.
5. To acquire the knowledge of design procedure of single point cutting tool and form tool.
6. Design and selection of various cutting tools and their industrial specifications.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive level	Descriptor
CO1	**Understand** the theory of metal cutting process.	2	Understanding
CO2	**Identify** the effect of cutting conditions and other input parameters (man, machine, material) on metal cutting process.	2	Understanding
CO3	**Select** the cutting tool as per the requirement of metal cutting process.	5	Evaluate
CO4	**Develop** the cutting tool to suit the metal cutting processes.	6	Create

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2									2			2	
CO2		2											2	
CO3			2			2	1	1	2					2
CO4				1	1		1			2		1		2

Strength of Correlation: Key: 3: High, 2:Medium, 1:Low

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with 60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit 1: Theory of Metal Cutting: Speed, Feed, Depth of Cut, Orthogonal Cutting and Oblique Cutting, Geometry of single pint cutting tool, Mechanism of chip formation, Chip Breaker, Strain in Chip, Shear plane angle, Cutting ratio, Force relationship, Velocity relationship, Merchant circle **9 Hrs.**

Unit 2: Machinability: Concept of Machinability, **9 Hrs.**
i) Cutting force: Effect of various paramters on cutting force, introduction to measurement of cutting forces.
ii) Tool life: Mechanism of wear, effect of cutting parameter on tool life, Taylor's tool life equation, introduction to measurement of tool wear etc.
iii) Surface Roughness: : Effect of various paramters on surface roughness.

Unit 3: Sources of Heat Generation and Economics of Machining: Sources of heat generation, Types of cutting fluids, Selection of cutting fluids. **4 Hrs.**

Unit 4: Cutting Tool Materials: Single point tools - Definition of angles as per ASA system and ORS system, tool signature, Study of modern tool materials, Desirable properties of tool material, Selection of tool grades and styles including specifications from commercial catalogues for different processes like turning, milling, drilling, grinding for different operations. **5 Hrs.**

Unit 5: Design of Form Tool: Design of flat form tool and circular form tool. Geometry, nomenclature, types, selection and applications of drills, reamers, milling cutters and broach. **5 Hrs.**

Unit 6: Design of single Point Cutting Tool: Design procedure of single point turning tool, High speed machining, Minimum Quantity Lubrication. **7 Hrs.**

Textbooks:

[1]Machine Tool Engineering: K. R. Nagpal, Khanna Publication.
[2]Metal cutting Theory and Practice- A. Bhattacharya, New Central Book Agency.
[3]Text Book of Production Engineering (Tool Design) by K. Surendar and Umesh Chandra.
[4]Fundamentals of Metal Cutting and Machine Tools B. L. Juneja, Nitin Seth.

References:

[1]Cutting tools - P.H. Joshi - Tata McGraw Hill Publishing Co. Ltd..
[2]Production Technology - HMT Handbook (TMH)
[3]Metal Cutting Theory and Cutting Tool Design -Arshinov V. and Alekseev G., Mir Publication.
[4]Metals Handbook, Vol. 16 Machining, A.S.M., Metals Park, Ohio.
[5] Metal Cutting and Tool Design - Dr. Ranganath - Vikas Publishing House.
[6] Metal Cutting Principals - Shaw M.C. - Oxford Calrendon Press, 1984.
[7] Theory of Metal Forming and Metal cutting by Sinha, Prasad (DhanpatRai).
[8] Tool Engineering handbook - ASTME, Frank Wilson (Editor) (TMH)
[9]Commercial catalogues of tool manufacturers like SANDVIK, KENNAMETAL,TAEGUTECH, ISCAR, MITSUBISHI, Grindwell Norton, Carborundum Universal etc.

Unit wise Measurable students Learning Outcomes:

[1]Perform various methods of cutting force measurements.
[2]Understand effect of process parameters on performance measures for different machining Operations.
[3] Know the Sources of heat generation and economics of metal cutting.
[4] Explain the design procedure of form tool.
[5] Explain the design procedure of single point cutting tool.
[6] Realize the importance of cutting tool materials, various types and their applications.

Title of the Course: Mechanical Measurement & Metrology **L T P C**
Course Code: UPRD0502

4 - - 4

Course pre-requisite: Knowledge of basics of Physics and Mathematics.

Course Description:
Introduces measuring instruments to measure the different properties and dimensions of component

Course Objectives:
A Student should be -
1. Able to explain the principles of measurement and its techniques.
2. Able to demonstrate the design, construction and accuracy features of various measuring instruments.
3. Able to acquire hands-on skills of measurement by using different instruments and gauges.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive	
		level	Descriptor
CO1	Define different measurement principles of measuring instruments	1	Define
CO2	Demonstrate the different instrument in detail	2	Demonstrate
CO3	Select suitable instrument for appropriate measuring	3	Applying
CO4	Develop hands on skill in solving problem encountered during inspection	4	Develop
CO5	Evaluate the measurement data	5	Evaluating

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1					2			2	2				
CO2	2								1	2				
CO3	3	3					2		1	2		2		
CO4	3	3	3	2					2	2		2	2	3
CO5	3	3		3	2			3	2	2		2	2	3

Strength of Correlation: Key: 3: High, 2:Medium, 1:Low

Assessments :
Teacher Assessment:
Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one EndSemester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

UNIT 1. **15Hrs.**

Definition, significance of measurement, generalized measurement system, definitions and concept of accuracy, precision, calibration, threshold, sensitivity, hysteresis, repeatability, linearity, loading effect**.**

Displacement Measurement : Transducers for displacement, displacement measurement, potentiometer, LVDT, Capacitance Types, Digital Transducers (optical encoder)

Strain Measurement:, Bridge circuit, Strain gauge based load cells and torque sensors Measurement of Angular Velocity: Tachometers, Digital tachometers and Stroboscopic Methods.

Temperature Measurement: Electrical methods of temperature measurement Resistance thermometers, Thermistors and thermocouples, Pyrometers

UNIT 2. **6Hrs.**

primary, secondary, tertiary and working, standards, advantages of optical standard precautions to minimize errors , Basic measuring instruments -types, specifications, applications, Slip gauge box - Grades, materials, wringing, setting to sizes, precautions while use and storage, Accessories - Bench centres, surface plates, V-blocks, angle plates.

UNIT 3 **6Hrs.**

Comparators & gauges

Need for comparators, dial indicator, bore gauges and master rings, optical profile projector, tool makers microscope, electrical and electronic comparators, differential pneumatic comparator, Concept of limit gauging, Taylor's principle, various types of plug, ring and snap gauges for plain and taper dimensions, gauge design for a given dimension

Measurement of Angles and Geometric Features **6Hrs.**

Bevel protractor, sine bar, angle dekor, angle slip gauges, measurement of taper, angle and radius with the help of simple inspection set-ups using standard pins and balls Measurement of straightness, flatness, parallelism, squareness, circularity, roundness, concentricity and other geometrical features, Straightedge, level beam comparator, autocollimator.

Unit-5 **11Hrs.**

Gear, Thread and Surface Finish Measurement

a) Measurement of Screw Threads

Basic terminology, measurement of major, minor and effective diameter, Screw thread micrometer, floating carriage diameter measuring machine, two wire and three wire method, measurement of pitch and pitch error, thread pitch gauges, limit gauges for thread measurements

b) Measurement of gears

Basic terminology, measurement of pitch, profile, back lash and tooth thickness, Chordal thickness, constant chord and base tangent method, Gear tooth Vernier calliper, David Brown tangent comparator, measurement of composite error, Parkinson gear tester

c) Measurement of surface properties

Waviness and roughness, causes of variation in surface quality, different parameters for assessment of surface roughness, methods of calculation, instruments for surface roughness measurement.

6Hrs.

UNIT 6.

Advances in Industrial Metrology

Types, applications, Principle of digital measurement instruments and examples, Co-ordinate Measuring Machines (CMM), construction, working principle and applications, Objectives, Non Contact inspection methods, Inspection robots.

Textbooks:

1. Anand Bewoor, Vinay Kulkarni, " Metrology & Measurement" The McGraw-Hill Comp.
2. R.K.Jain: Mechanical Measurement Khanna publications
3. Engineering Metrology and Measurements by Bentley Publisher : Pearson Education
4. The Quality Technician‟s Handbook,- Garry Griffith, Prentice Hall
5. Engineering Metrology,- I. C. Gupta, DhanpatRai Publications
6. Principles of Machine Tool Design, -Sen, Gupta, New Central Book Agency
7. Basic Machine Technology, -C. Thomas Olivo, Bobbs-Merrill Educational Publishing
8. Machine Tool Practices,-Kibbe, Neely, Meyer, White, Prentice Hall
9. Engineering Metrology, -R. K. Jain, Khanna Publishers, Delhi
10. Testing of Machine Tools, -Dr. George Schlesinger, Pergamon Press
11.Basic Rules on using Measuring Tools, -Mitutoyo Metrology Institute
12 A Manual of Measurement System Analysis, Ford, General Motors, Chrysler Corporation
13. Metrology Laboratory Manual, -R. Bahl, M. Adithan, Technical Teacher‟s Training Institute, Chandigarh
14. A Text Book of Metrology, -M. Mahajan, DhanpatRai and Co.

References:

1.Fundamentals of Dimensional metrology by Connie i. Dotson, Publisher :Cengage Learning, Inc

Unit wise Measurable students Learning Outcomes:

1) To describe the basic principle and acquire the skill in using property measuring instrument.
2) To define and explain the basic principle of linear measuring instruments.
3) To select , describe and explain the comparator and gagues.
4) To use different instruments and prepare set ups to measure angular dimensions and geometric features.
5) To describe and appraise the characteristics of thread,gear and surface roughness of component.
6) To describe advanced measuring instruments.

Title of the Course: Metal forming & plastic Technology **L T P C**
Course Code: UPRD0503 **3 - - 3**
Course Pre-Requisite: strength of material and machine tool processes

Course Description: Metal forming techniques are use create different sheet metal product for engineering and residential applications. Theories of forming processes are good application of theory of plasticity like yielding criteria, application of two and three dimensional problem.
Plastic product manufacturing processes are detail explain in plastic engineering.

Course Objectives:
1. Gain the fundamental knowledge about metal forming and plastic tech. processes
2. Understand the analysis of flow of material and it‟s properties during the processes
3. Selection the process of metal forming as per the applications such as wire drawing, extrusion, rolling forging etc.
4. To introduce the students to the theory and practices of metal forming and plastics processing

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom‟s Cognitive level	Descriptor
CO1	Explain theoretical concepts of metal forming and plastics processing.	1	Remember
CO2	Interpret the analysis of flow of material and it‟s properties during the processes	4	Analyze
CO3	Select process parameter of different metal forming process	3	Apply
CO4	Select the process of metal forming as per the applications	3	Apply
CO5	Estimate the design parameters for dies pertaining to forming and plastic processes.	6	Create

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	3											
CO2		1	2											
CO3			2		3								2	3
CO4			2	2										2
CO5				2										

Indicate mapping strength as 3 (High), 2 (Medium), 1 (Low)

Assessments :
Teacher Assessment:
Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one EndSemester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit 1:--- Theory of Plasticity 8 **Hrs.**

Flow curve, Concepts of true stress and true strain, plane stress condition ,stress tensor, yield criteria and their comparison., plastic stress-strain relationships.

Unit 2:- Introduction to Workability and rolling 7 **Hrs.**

Introduction to Workability

Overview at the workability, Strain tensor, strain hardening. Strain rate, Friction and Lubrication in metal forming

Introduction to Rolling:

Classification of rolling processes, rolling mill types, deformation of metal in rolling, roll bite, elongation, reduction, defects in rolling, rolling of sheets, plates, bars, sections and tubes, application--

Unit 3:--- Introduction to Extrusion and Drawing 6 **Hrs.**

Introduction to Extrusion

Equipment and principles, types of extrusion, direct, indirect, impact, hydrostatic, tube extrusion, metal flow in extrusion, defects, factors affecting extrusion load,

Introduction to Drawing:

Types of Drawing, Rod/wire drawing, equipment and principles of process, defects, Tube drawing, Seamless pipe manufacturing

Unit 4:--- Introduction to Forging and Advanced Metal forming Processes 6**Hrs.**

Introduction to Forging :

Basic operations, types of forging, forging hammers/ presses, forging stress and force calculations, die design considerations, forging defects, applications.

Advanced Metal forming Processes:

Explosive forming, Electromagnetic forming, Magnetic pulse forming, hydro forming, Rubber pad forming.

Unit 5:--- Introduction to Plastic Materials and processes 6**Hrs.**

Types, thermosetting plastics, thermoplastics plastic introduction.

a) Injection Molding: Process, equipment, applications, Injection Molding die design considerations.

b) Plastic extrusion: Process, equipment, extruders.

c) Calendaring- various calendaring processes, applications .

Unit 6:--- Introduction to plastic molding and Thermoforming 6 **Hrs.**

a) Blow molding: Principles, , production of parison, and application of Blow molding

b) Compression molding and transfer molding: Process, equipment, transfer molding.

c) Thermoforming- Process, heating equipment

d) Rotational molding process for making hollow plastic articles

Textbooks:

1. Manufacturing Processes – Begman, Amstead etc.(John Wiley)
2. Rowe, Principles of Industrial Metal working Processes,
3. Forging and Forging Die Design - Sharan, Prasad, Saxena.
4. Rolling of Metals: Ivankove and Chaturvedi (Yantrik Publications, Mumbai)
5. Extrusion - Pearson (McGraw Hill)
6. Manufacturing Technology: Foundry, Forming and Welding by P.N. Rao (TMH)
7. Plastic Technology: Theory, Design & Manufacture – William J. Patton
8. Plastics-6/e, J. Harry DuBOIS, Frederick W. John, Van Nostrand Reinhold Co.
9. Manufacturing Engineering Technology by Kalpakjian (Addison Wesley)
10. Manufacturing Processes for Engineering Materials by Kalpakjian (Addison Wesley)
11. Injection Mold Design, R.G.W. Pye 4/e, Affiliated East West Press Pvt. Ltd. New Delhi.

References:

1] ASM Handbook on Forming
2] Mechanical Metallurgy (S.I. Units) - Dieter, McGraw Hill
3] Plastics for Industrial Use- Sasse John

Unit wise Measurable students Learning Outcomes:

1] Understand basic concepts of deformation and metal forming.
2] Understand flow of material and it"s properties during the deformation processes
3] Know the applications of extrusion and drawing process.
4] Know the applications of forging and HERF.
5] Select the plastic molding process as per the applications.
6] Select the plastic molding process as per the applications.

Title of the Course: Machine Design

L	T	P	C
3	1	-	4

Course Code: UPRD0504

Course Pre-Requisite: Types of loads, stresses ,Bending Moment Diagram

Course Description: Machine design is the use of imagination, scientific principles and engineering techniques to create a machine or structure economically, in order to satisfy the requirements of a customer.

Course Objectives:

1. To teach students how to apply the concepts of stress analysis, theories of failure and material science to analyze, design and/or select commonly used machine components
2. To illustrate to students the variety of mechanical components available and emphasize the need to continue learning.
3. To teach students how to apply mechanical engineering design theory to identify and quantify machine elements in the design of commonly used mechanical systems.
4. To teach students how to apply computer based techniques in the analysis, design and/or selection of machine components.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom"s Cognitive level	Descriptor
CO1	Select suitable material according to purpose of application.	1	Remember
CO2	Select size of bolted and welded joint for static loading.	3	Apply
CO3	Determine different dimensions of spring.	5	Evaluate
CO4	Estimate different forces exerting on gears during power transmission for deciding gear hub dimensions	6	Create
CO5	Design power screw for power transmission.	6	Create
CO6	Design and draw coupling for power transmission purpose.	6	Create

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2													
CO2		2		1									1	
CO3		1	3		2				1			1	2	
CO4		1	2										1	
CO5				2										
CO6	2													

Indicate mapping strength as 3 (High), 2 (Medium), 1 (Low)

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one EndSemester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit 1: Concept of machine design, general design considerations, design procedure; factor of safety for different types of loading its significance and selection ;theories of failures, Selection of engineering materials for a component considering functionality, raw material generating process, strength, cost, quantity and aesthetics, use of IS codes. **5Hrs.**

Unit 2: A)Design for static loading: Knuckle joint, turnbuckle, cotter joint, levers **8 Hrs.**
B) Design for fluctuating loads: Fatigue phenomena, concept of stress vs. number of cycles diagram and endurance limit, stress concentration and remedies, use of Goodman and Soderberg diagram in design of machine elements like shafts, springs and couplings

Unit 3: Design of shafts, keys, splines and couplings: Design of solid and hollow shafts for strength and rigidity against pure torsion, pure bending, combined bending, torsion and axial loads; design of keys and splines; design of rigid and flexible couplings. **6 Hrs**

Unit 4: A) Design of pressure vessels: Classification and design of thick a thin pressure vessels and cylinders. **5 Hrs.**
B) Design of joints: Design of bolted, riveted, and welded joints subjected under transverse and eccentric loading, materials for bolts, initial tightening loads on bolts, effect of washer and gasket, uniform strength bolts.

Unit 5: A) Design of springs: Types, applications, spring materials, stress deflection equation of helical spring, Wahl‟s stress factor, style of ends, design of springs for valves, clutches, buffers etc.,design considerations for leaf spring. **8 Hrs.**
B) Design of power screw: Types, materials used, thread forms and their applications. types of stresses induced, overhauling and self-locking properties, re-circulating ball screw, design of nuts, methods of pitch error compensation for machine tools.

Unit 6: A) Design of gears: a) Spur gears- materials, gear tooth loads, number of teeth, face width, strength of gear teeth, static beam strength (Lewis equation), dynamic tooth load, Wear strength (Buckingham‟s equation), estimation of module based on beam strength and wear strength, gear design for maximum power. **7 Hrs.**
b) Helical gears- No. of teeth, force analysis, beam and wear strength, effective load and design procedure

Design and Modeling of following components by using suitable CAD and FEA software's.

1. Protected Flange coupling
2. Any one joint from Knuckle joint, turnbuckle, cotter joint.
3. Simple stress concentration case study using suitable FEA software.

For every ISE, one component from above must be considered.

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Textbooks:

1. Design of Machine Elements, V. B. Bhandari, (Tata McGraw-Hill Publishing Company Ltd.)
2.Elements of Machine Design, N. C. Pandya and C. S. Shaha, (Charotar Publishing House)
3. Machine Tool Design, N. K. Mehta, (Tata McGraw-Hill Publishing Company Ltd.)
4. A Text Book of Machine Design, R. S. Khurmi, (S. Chand)
5. Machine Design, R. K. Jain, (Khanna Publishers.)

References:

1. Mechanical Engineering design, J. E. Shigley, Mitchell, (McGraw-Hill Publishing Co. Ltd)
2. Design of Machine Elements, Dbrovalsky(MIR Publisher)
3. Design of Machine Elements by M. F. Spoots, T.E.Shoup (PHI)
4. Engg. Design, a Materials & Processing Approach, G. Dieter, (Tata McGraw-Hill Publishing Company Ltd.)
5. Computer Aided Analysis and Design of Machine Elements by Dukki Patti, Rao,Bhat , (New Age, Delhi)
6. Design of Machine Elements, An Integrated Approach by Robert and Norton,(Pearson)
7. Machine Design by Black and Adams (McGraw-Hill Publishing Company Ltd)

Unit wise Measurable students Learning Outcomes:

1. Selection of materials considering different aspects.
2. Finalization of parameters of joints considering stress induced.
3. Design, analysis and sizing of shaft.
4. Deciding diameter of threaded joint, riveted joint and throat thickness of welded joint.
5. Design, analysis and sizing various parameters of springs and power screw.
6. Design of spur gears using Lewis equation.

Title of the Course: Rapid Prototyping (Audit Course)	L	T	P	C
	2	-	-	-

Course Code: UPRD0561

Course Pre-Requisite: Knowledge of 3D modeling is essential

Course Description: With explosive growth of additive manufacturing along with consumer interests, so many unique and interesting application areas are being developed. The objective of the course is to develop an understanding of the principles of the current additive manufacturing processes that produce parts by a layer at a time from solid 3D computer model so that optimal geometry, machine, and material can be selected to satisfy the functional requirement of the designed shape. The course will conclude with a perspective in pushing the current envelop of additive manufacturing spanning many technical domains such as biomedical, aerospace, and biotechnology industries.

Course Objectives:

1] To describe the current available additive manufacturing systems, their fundamental operating principles, characteristics and limitations.
2] To distinguish between traditional and rapid manufacturing process.
3] To explain the principles and key characteristics of commonly used processes in additive manufacturing.
4] To select the appropriate materials and rapid prototyping processes for a given prototyping task.
5] To apply criterion for selecting appropriate additive manufacturing process for any given application in the areas like automotive, aeronautics, tooling, and biomechanics.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom"s Cognitive level	Descriptor
CO1	Describe the current available additive manufacturing systems, their fundamental operating principles, and their characteristics along with its limitations.	2	Describe
CO2	Distinguish between traditional and rapid manufacturing process and assess impact of additive manufacturing on design for manufacturing and assembly.	4	Distinguish
CO3	Explain the principles and key characteristics of commonly used processes in additive manufacturing.	2	Explain
CO4	Select the appropriate materials and rapid prototyping processes for a given prototyping task	5	Select
CO5	Apply criterion for selecting appropriate additive manufacturing process for any given application in the areas like automotive, aeronautics, tooling, and biomechanics etc.	5	Apply

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3											2		
CO2				3								2		
CO3	3											2		
CO4					2							2		
CO5				3								2	3	3

Indicate mapping strength as 3 (High), 2 (Medium), 1 (Low)

Assessments:

Teacher Assessment:

Only End Semester Examination.

Assessment	Marks
ESE	100

ESE: Assessment is based on 100% course content

Course Contents:

Unit 1: Introduction to Additive Manufacturing: Definition of additive manufacturing (AM), and rapid manufacturing, introduction to solid freeform fabrication, areas of application. historical development, fundamentals of additive manufacturing, advantages and limitations of additive manufacturing, commonly used terms, classification. 4 **Hrs.**

Unit 2: Design Potential and management issues of Additive Manufacturing: 4 **Hrs.**
Difference between conventional and additive manufacturing process, Conventional design for manufacturing and assembly (DFM, DFMA), impact of AM on DFA and DFMA, Geometrical freedom, design complexity/optimization, parts consolidation, body fitting customization and multiple assemblies manufactured as one, Customer input and customization, CAD environment for AM.

Unit 3: Additive Manufacturing Processes: Liquid based processes, powder based processes and solid based processes; process overviews, STL file Generation, file verification & repair, part construction, part cleaning and finishing, process strength & limitations, 4 **Hrs.**

- Liquid-Based Systems: (Stereolithography)
- Solid-Based Systems: (Fused Deposition Modeling, Laminated Object Manufacturing, Ultrasonic Consolidation, Polyjet)
- Powder-Based Systems: (Selective Laser Sintering, Laser Engineered Net Shaping, Electron Beam Melting)

Unit 4: Materials in RM: Viscous flow, photo-polymerization, sintering, infiltration, mechanical properties, materials for AM processes, Prototype properties: dimensional accuracy, stability, surface finish, machinability, environmental resistance, functionally graded materials (FGM composites), processing technologies for FGMs, thermal and mechanical properties of FGM, deposition systems and applications, 4 **Hrs.**

Unit 5: Applications of AM: Design, concept models, form and fit checking, ergonomic studies, functional testing, applications in automotive, aerospace industry, construction industry, archeology, paleontology and forensic science, miniaturization, biomechanics, medical field. 4 **Hrs.**

Unit 6: Rapid Tooling: Mold making, metal spraying, rapid tooling for die, squeeze and permanent mold casting, rapid manufacturing of sheet metal forming tools, casting pattern plates by rapid tooling, RP for series production investment casting. 6 **Hrs.**

Textbooks:

1. Rapid Manufacturing: An Industrial Revolution for the Digital Age – Editors N. Hopkinson, R.J.M. Hague and P.M. Dickens, (2006) John Wiley & Sons, Ltd., ISBN-10 0-470-01613-2.
2. A. Pereira, J.A. Pérez, J.L. Diéguez, G. Peláez and J.E. Ares, "Design and manufacture of casting pattern plates", by rapid tooling, Archives of Materials Science, Vol. 29, No. 1- 2, 2008 63.

References:

1] T. A. Grimm & Associates, Users Guide to Rapid Prototyping, Society of Manufacturing Engineers (SME) ISBN 0872636976.
2] Frank W. Liou, Rapid Prototyping & engineering applications, CRC Press, ISBN 978-0-8493-3409-2.

Unit wise Measurable students Learning Outcomes:

1] Students shall be able to describe the current available additive manufacturing systems, their fundamental operating principles, characteristics and limitations.
2] Students shall be able to distinguish between traditional and rapid manufacturing process.
3] Students shall be able to explain the principles and key characteristics of commonly used processes in additive manufacturing.
4] Students shall be able to select the appropriate materials and rapid prototyping processes for a given prototyping task.
5] Students shall be able to apply criterion for selecting appropriate additive manufacturing process for any given application in the areas like automotive, aeronautics, tooling, and biomechanics etc.

Title of the Course: Mechanical Measurement & Metrology lab	L	T	P	C
	-	-	2	1

Course Code: UPRD0531

Course Pre-Requisite: Knowledge of basics of physics and mathematics.

Course Description:

Introduces measuring instruments to measure the different properties and dimensions of component

Course Objectives:

A Student should be -

1) Able to explain the principles of measurement and its techniques.
2) Able to demonstrate the design, construction and accuracy features of various instruments.
3) Able to acquire hands-on skills of measurement by using different instruments and gauges.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom"s Cognitive level	Descriptor
CO1	Define different measurement principles of measuring instruments	1	Define
CO2	Demonstrate the different instrument in detail	2	Demonstrate
CO3	Select suitable instrument for appropriate measuring	3	Applying
CO4	Develop hands on skill in solving problem encountered during inspection	4	Develop
CO5	Evaluate the measurement data	5	Evaluating

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1					2			2	2				
CO2	2								1	2				
CO3	3	3					2		1	2		2		
CO4	3	3	3	2					2	2		2	2	3
CO5	3	3		3	2			3	2	2		2	2	3

Indicate mapping strength as 3 (High), 2 (Medium), 1 (Low)

Assessments :

Teacher Assessment:

One component of In Semester Evaluation (ISE) and one End Semester Examination (ESE) having 50%, and 50% weights respectively.

Assessment	Marks
ISE	25
ESE(O.E.)	25

ISE are based on practical performed/ Quiz/ Mini-Project assigned/ Presentation/ Group Discussion/ Internal oral etc.
ESE: Assessment is based on Practical - oral examination

Course Contents: A) :

Experiment No. 1: **2Hrs.**
Measurement of linear dimensions using vernier, micrometer and bore gauge

Experiment No. 2: **2 Hrs.**
Measurement of angle by using bevel protractor and sine bar

Experiment No. 3: **2 Hrs.**
Dimensional measurement by using pneumatic comparator

Experiment No. 4: **2Hrs.**
Measurement of effective diameter of a screw thread by using floating carriage diameter measuring Machine

Experiment No. 5: **2Hrs.**
Measurement of gear tooth thickness by using Chordal thickness and Base tangent method.

Experiment No. 6:- **2 Hrs.**
Measurement of roundness and concentricity by using dial indicator b) Measurement of radius by using inspection setup like rollers and pins

Experiment No. 7:- **2 Hrs**
Measurement of displacement by LVDT

Experiment No. 8:- **2 Hrs**
Measurement of velocity by digital tachometer
B) One industrial visit to study inspection practices and submission of the report

Textbooks:

1. Anand Bewoor, Vinay Kulkarni, " Metrology & Measurement" The McGraw-Hill Comp.
2. R.K.Jain: Mechanical Measurement Khanna publications
3. Engineering Metrology and Measurements by Bentley Publisher : Pearson Education
4. The Quality Technician‟s Handbook,- Garry Griffith, Prentice Hall
5. Engineering Metrology,- I. C. Gupta, DhanpatRai Publications
6. Principles of Machine Tool Design, -Sen, Gupta, New Central Book Agency
7. Basic Machine Technology, -C. Thomas Olivo, Bobbs-Merrill Educational Publishing
8. Machine Tool Practices,-Kibbe, Neely, Meyer, White, Prentice Hall
9. Engineering Metrology, -R. K. Jain, Khanna Publishers, Delhi
10. Testing of Machine Tools, -Dr. George Schlesinger, Pergamon Press
11.Basic Rules on using Measuring Tools, -Mitutoyo Metrology Institute
12. A Manual of Measurement System Analysis, Ford, General Motors, Chrysler Corporation
13.Metrology Laboratory Manual, -R. Bahl, M. Adithan, Technical Teacher‟s Training Institute,Chandigarh

14. A Text Book of Metrology, -M. Mahajan, DhanpatRai and Co.

References:

1) Fundamentals of Dimensional metrology by Connie i. Dotson, Publisher :Cengage Learning, Inc

Experiment wise Measurable students Learning Outcomes:

1) Classify, Choose and appraise the instrument for inspection linear dimension.
2) Demonstrate and appraise the angular dimensions of a given component
3) Assemble and appraise the dimensions of given component by comparator.
4) Examine and appraise the significant dimension of screw thread.
5) Appraise and compare the Spur gear tooth thickness by two methods.
6) Select and appraise the geometrical features of component.
7) Appraise the linear dimension by LVDT
8) Appraise the velocity by digital tachometer.

Title of the Course: Metal forming & Technology lab

L	T	P	C
-	-	2	1

Course Code:UPRD0532

Course Pre-Requisite:

1. Fundamentals of Strength of material
2. Fundamentals of material
3. Fundamentals of forming processes

Course Description:

Theories of forming processes are good application of theory of plasticity like yielding criteria, application of two and three dimensional problem.
forming processes use to produce different forming product for industrial application.

Course Objectives:

1] Gain the fundamental knowledge of metal working and formability.
2] Understand the analysis of flow of material and it"s properties during the processes
3] Selection the process of metal forming as per the applications such as wire drawing, extrusion, rolling forging etc.
4] To introduce the students to the theory and practices of metal forming .

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom"s Cognitive level	Descriptor
CO1	Explain concepts of deformation in forming process	1	Remember
CO2	Demonstrate the knowledge of stresses in metal forming process.	2	Demonstrate
CO3	Interpret the analysis of flow of material and it"s properties during the processes	4	Analyze
CO4	Select process parameter of different metal forming process	3	Apply
CO5	Select the process of metal forming as per the applications	3	Apply

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	3											
CO2		1	2											
CO3			2		3								2	3
CO4			2	2										2
CO5				2										

Indicate mapping strength as 3 (High), 2 (Medium), 1 (Low)

Assessments :

Teacher Assessment:

In Semester Examination (ISE)

Assessment	Marks
ISE	50

ISE are based on practical performed/ Quiz/ Mini-Project assigned/ Presentation/ Group Discussion/ Internal oral etc.

Course Contents:

Experiment No. 1:--- Assignments based on the **Fundamentals of MFT** topics including exercises of practical application — 4 **Hrs.**

Aim and Objectives: Gain the fundamental knowledge of metal working and formability

Outcomes: Explain concepts of deformation in forming process

Experiment No. 2:--- Die design for a simple forged component including calculations and drawing — 4**Hrs.**

Aim and Objectives: Selection the process of metal forming as per the applications such as forging

Outcomes: Explain concepts of Die design forged component

Experiment No. 3:-- Industrial visits in **Forging** industry for studying the metal forming- — 4 **Hrs.**

Aim and Objectives: Selection the process of metal forming as per the applications such as forging.

Outcomes: Select process parameter of different metal forming process

Experiment No. 4:-- Industrial visits in **Rolling** industry for studying the metal forming- — 4 **Hrs.**

Aim and Objectives: Selection the process of metal forming as per the applications such as Rolling.

Outcomes: Select process parameter of different metal forming process

Experiment No. 5:-- Making simple components of suitable material using the following processes — 4 **Hrs.**

a) Hot Forging ,b) Wire Drawing. c) Extrusion,d) Rolling,e) Injection Molding

f) Plastic Extrusion

Aim and Objectives: Select the process of metal forming as per the applications

Outcomes: Select process parameter of different metal forming process

4 **Hrs..**

Experiment No. 6:-- Designing layout for multi-pass wire drawing

Aim and Objectives: Selection the process of metal forming as per the applications such as wire drawing .

Outcomes: Select process parameter of different metal forming process

Aim and Objectives: Select the process of metal forming as per the applications

Textbooks:

1] George E. Dieter - Mechanical Metallurgy, McGrew Hill, London, 1988
2] R. Sharan, S.N. Prasad - Forging Design and Practice
3] Forging Equipment, Material and Processes, J. Altan, F. W. Boulger - Metals Ceramic Information Center, Columbus 1973.
4] Metal Forming Fundamentals & Applications – Alan T, American Society of Metals, Metal Park 1983
5] Metal Forming Mechanics & Metallurgy, Hosford WF and Cadell R.M. , Prentice Hall, Englewood Cliffs, 1993

References:

1] G. E. Dieter - Workability Testing Techniques, American Society for Metals, Metals Park, 1984
2] Metal Forming Handbook, -Schuler, Springer-Verlag Berlin Heidelberg New York, (2008) ISBN 3- 540-61185-1
3] Roll Forming Handbook, - Geotge T. Halmos, (CRC Press, Taylor & Francis), (2006) ISBN 0-8247- 9563-6
4] ASM Hand Book - Forming and Forging, 9/e, Volume 14, (1998)

Experiment wise Measurable students Learning Outcomes:

[1] Understand basic concepts of deformation and metal forming.
[2] Understand design parameter of forging die.
[3] Know the applications of extrusion and drawing process.
[4] Know the applications of forging and HERF.
[5] Select the plastic molding process as per the applications.
[6] Select the plastic molding process as per the applications.

Title of the Course: Metal Cutting Technology lab

L	T	P	C
-	-	2	1

Course Code: UPRD0533

Course Pre-Requisite: Basic knowledge of machining processes.

Course Description:

It includes the machining process parameters, performance measures, force measurement and its relationship, design and selection of various cutting tools and their industrial applications.

Course Objectives:

1] Understand the various concepts and terms used in metal cutting and machine Tools.
2] Study method of cutting forces measurement
3] Understand design procedure of form tool
4] To acquire the fundamental knowledge of machining and single point cutting tool geometry
5] Study various tooling practices for industrial applications

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive level	Descriptor
CO1	**Understand** the theory of metal cutting process.	2	Understanding
CO2	**Identify** the effect of cutting conditions and other input parameters (man, machine, material) on metal cutting process.	2	Understanding
CO3	**Select** the cutting tool as per the requirement of metal cutting process.	5	Evaluate
CO4	**Develop** the cutting tool to suit the metal cutting processes.	6	Create

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2									2			2	
CO2		2											2	
CO3			2			2	1	1	2					2
CO4				1	1		1			2		1		2

Indicate mapping strength as 3 (High), 2 (Medium), 1 (Low)

Assessments :

Teacher Assessment:

In Semester Examination (ISE)

Assessment	Marks
ISE	50

ISE are based on practical performed/ Quiz/ Mini-Project assigned/ Presentation/ Group Discussion/ Internal oral etc.

Course Contents:

Experiment No. 1: **2Hrs.**

Measurement of Cutting force with the help of Tool Dynamometer (Any one)

a. Drill tool dynamometer

b. Milling tool dynamometer

Aim and Objectives: Measurement of cutting forces

Outcomes: Cutting forces during machining

Experiment No. 2: **2 Hrs.**

Machining of jobs of different materials such as C.I., Steel, Aluminium etc. and measurement of surface roughness to study the effect of parameters such as feed, tool nose radius, depth of cut on the surface roughness.

Aim and Objectives: Effect of cutting conditions on surface roughness.

Outcomes: Variation in surface roughness with the change in cutting conditions.

Experiment No. 3: **2 Hrs.**

Design of form tool and broach for given components

Aim and Objectives: Development of tools for required operation.

Outcomes: Development of tools for required operation.

Experiment No. 4: **4Hrs.**

Selection of turning and drilling inserts from catalogue

Aim and Objectives: Selection of inserts for required operation from manufacturers catalogue.

Outcomes: Identification of cutting tool/insert for the given operation

Experiment No. 5:- **2 Hrs.**

Industrial visit to study applications of tools for different metal cutting processes.

Aim and Objectives: Industrial visit to study applications of tools for different metal cutting processes.

Textbooks:

1] Machine Tool Engineering: K. R. Nagpal, Khanna Publication.
2] Metal cutting Theory and Practice- A. Bhattacharya, New Central Book Agency.
3] Text Book of Production Engineering (Tool Design) by K. Surendar and Umesh Chandra.
4] Fundamentals of Metal Cutting and Machine Tools B. L. Juneja, Nitin Seth.

References:

1] Cutting tools - P.H. Joshi - Tata McGraw Hill Publishing Co. Ltd..
2] Production Technology - HMT Handbook (TMH)
3] Metal Cutting Theory and Cutting Tool Design - Arshinov V. and Alekseev G., Mir Publication.
4] Metals Handbook, Vol. 16 Machining, A.S.M., Metals Park, Ohio.
5] Metal Cutting and Tool Design - Dr. Ranganath - Vikas Publishing House.
6] Metal Cutting Principals - Shaw M.C. - Oxford Calrendon Press, 1984.
7] Theory of Metal Forming and Metal cutting by Sinha, Prasad (DhanpatRai).
8] Tool Engineering handbook - ASTME, Frank Wilson (Editor) (TMH)
9] Commercial catalogues of tool manufacturers like SANDVIK, KENNAMETAL, TAEGUTECH, ISCAR, MITSUBISHI, Grindwell Norton, Carborundum Universal etc.

Experiment wise Measurable students Learning Outcomes:

1] Understand the various types of cutting forces and their relationship
2] Understand the machining process parameters and its effect on surface roughness
3] Understand the design procedure of simple form tool
4] Know the fundamentals of selection of cutting tools for turning and drilling from catalogues
5] Realize the importance of cutting tool materials, various types and their applications.

Title of the Course: Computer Aided Solid Modeling lab **L T P C**
Course Code: UPRD0534 **0 0 2 1**

Course Pre-Requisite: Knowledge of machine drawing, isometric, and orthographic projection is essential.

Course Description: Under this course the student will be introduced to the principles of parametric design using computer aided design software. Students will construct 3 models and surfaces. Topics will include sketching, constraining, solid modeling, surface modeling, drafting and assembly modeling and kinematics.

Course Objectives:

1. To explain the computer aided design process by taking into account current CAD practices.
2. To build/construct build 2D sketches fulfilling appropriate dimensional and geometrical constraints using CAD software.
3. To design 3D solid models and surface models of parts using CAD software.
4. To construct 2D projections from 3D models and assemblies. To find the physical properties like volume, surface area, centre of gravity and moment of inertia of a given 3D solid model using suitable CAD software.
5. To develop 3D assemblies using CAD software taking into consideration appropriate assembly approach.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive level	Descriptor
CO1	Explain the computer aided design process by taking into account current CAD practices.	2	Explain
CO2	Build 2D sketches fulfilling appropriate dimensional and geometrical constraints using CAD software.	3	Build
CO3	Design basic and advanced 3D solid Models and surface models of parts using CAD software.	4	Design
CO4	Construct 2D projections from 3D models and assemblies	4	Construct
CO5	Determine the physical properties like volume, surface area, centre of gravity and moment of inertia of a given 3D solid model using suitable CAD software	5	Determine

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						3						1	1	
CO2						3						1		2
CO3						3						1		
CO4						3						1		
CO5						3						1	3	3

Indicate mapping strength as 3 (High), 2 (Medium), 1 (Low)

Assessments :

Teacher Assessment:

One component of In Semester Evaluation (ISE) and one End Semester Examination (ESE) having 50%, and 50% weights respectively.

Assessment	Marks
ISE	25
ESE (P.O.E.)	25

ISE are based on practical performed/ Quiz/ Mini-Project assigned/ Presentation/ Group Discussion/ Internal oral etc.

ESE: Assessment is based on oral examination

Course Contents:

1: Introduction to CAD: **4 Hrs.**

Concept of CAD/CAM/CAE Need for implementing CAD, application and benefits of CAD, hardware requirements, different software packages used for 3D Modeling.

2: Sketching: **4 Hrs.**

2D sketching of elements like line, circle, arc, spline etc. Dimensioning these elements, Geometrical constraints like parallel, perpendicular, co-incident, vertical, horizontal, tangent, symmetric etc

3: Generation of Solid models: **4 Hrs.**

Generation of Solid models of any five industrial components using any suitable 3D modeling software package, import and export of 3D solid models between two different software packages, physical properties like volume, surface area, center of gravity etc of solid model.

4: Introduction to Surfacing: **4 Hrs.**

Generation of surface models of any three simple components using any suitable 3D modeling software.

5: Assembly Modeling and Kinematics: **4 Hrs.**

Concept of bottom up and top down approach, building two composite assemblies of components (consisting at least five components) along with all relevant details, exploded views using assembly features in any suitable 3D modeling software, kinematic simulation of assembly using appropriate tool in the high end CAD software.

6: Generation of 2D Drawings: **6 Hrs.**

Generation of orthographic views of individual components required for shop floor [working drawings] from 3D model which will include all relevant views like front, side, top, bottom views, sectional views, dimensioning, dimensional and geometrical tolerances etc. generation of title block in sheet, orthographic views of assembly drawings, generation of bill of materials (BOM), plotting of drawings.

References:

1] Various 3D modeling Software Manuals.
2] CAD/CAM, Theory and Practice by Zeid, (TMH)
3] CAD/CAM, Principles & Applications by P. N. Rao (TMH)

Experiment wise measurable students learning outcomes:

1] Students shall be able to explain the computer aided design process by taking into account current CAD practices
2] Students shall be able to build/construct build 2D sketches fulfilling appropriate dimensional and geometrical constraints using CAD software
3] Students shall be able to design 3D solid models and surface models of parts using CAD software.
4] Students shall be able to construct 2D projections from 3D models and assemblies.
5] Students shall be able to find the physical properties like volume, surface area, centre of gravity and moment of inertia of a given 3D solid model using suitable CAD software
6] Students shall be able to develop 3D assemblies using CAD software taking into consideration appropriate assembly approach.

Title of the Course: CAM Lab-I

Course Code: UPRD0535

L	T	P	C
0	0	2	1

Course Pre-Requisite:

1] Fundamentals of machine tools and cutting operations
2] Fundamentals of machine drawing and process sheet
3] Cutting machine information

Course Description:

The CAM Lab-I providing practical experience in production of components as well as knowledge and understanding about materials and their machining and finishing. It deals with the various machining operations such as turning, milling, shaping, thread cutting, slotting, drilling etc. CAD/CAM applications are used to both design a product and program manufacturing processes, specifically, CNC machining. CAM software uses the models and assemblies created in CAD software to generate tool paths that drive the machines that turn the designs into physical parts. CAD/CAM software is most often used for machining of prototypes and finished parts.

Course Objectives:

1. To select a machine and plan for job operations.
2. To perform machining operations on various metal removing machines.
3. To study advanced features of Computer Aided Manufacturing practices followed in the industry.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom"s Cognitive level	Descriptor
CO1	Explain fundamentals of machining parameters for various operations like turning, drilling, threading, tapping, milling, grinding.	2	Explain
CO2	Plan sequence of operations for given component drawing in prescribe format of process sheet.	3	Plan
CO3	Perform operations like turning, drilling, threading, tapping, milling, grinding using conventional machine.	5	Perform
CO4	Carry out CNC turning program generation from CAD model.	5	Carry out
CO5	Perform turning operation on CNC machine as per specified drawing.	5	Perform

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1													
CO2		2												
CO3				2								2		
CO4					3									
CO5						2		2				2	3	3

Indicate mapping strength as 3 (High), 2 (Medium), 1 (Low)

Assessments :

Teacher Assessment:

Assessment	Marks
ISE	25
ESE	25

ISE: Assessment is based on 50% assignment and 50% lab work.
ESE: Assessment is based on 100% lab work.

Course Contents:

Lab section 1: One composite job consisting of two parts employing following operations such as drilling, threading, tapping. **4Hrs**

4Hrs

Lab section 2: Selection of cutting parameters including tool specifications for various operations on CNC machines–Turning Center. **4Hrs**

Lab section 3: CNC Part Programming-Detailed Manual part programming on Turning Center, using G & M codes for various operations. **4Hrs**

Lab section 4: CNC Part Programming for Turning Center: Stock Removal Cycles: Facing and turning, Finishing Cycles, Drilling cycles. **4Hrs**

Lab section 5: Create a manual part program and executing it on a CNC lathe machine (at least one exercise each). **6Hrs**

Lab section 6: Generating and simulating CNC turning part programs from the CAD models using any suitable CNC simulation software.

Note:

1] The composite job assembly is to be carried out by using conventional and CNC machine.
2] The term work of 25 marks based on conventional and CNC machining.
3] The student shall maintain a diary of the work consisting of the process plan.
4] The print outs of CAM & CNC programs and relevant reports of the above mentioned laboratory work shall be included in the journal.

Textbooks:

1] Workshop Technology Vol. I & II by Hajra Chaudhary, (Media Promoters & Publishers Pvt. Ltd.).
2] Workshop Technology Vol. I , II and III by W.A.J. Chapman, (ELBS).
3] Workshop Technology Vol. II by Bawa H. S. (TMH).
4] Course on Workshop Technology – Vol. 1 by B. S. Raghuvanshi; (Dhanpat Rai & Co.).
5] Workshop Technology Vol. III – Chapman (ELBS).
6] Jon Stenerson and Kelly Curran "Computer Numerical Control"", Prentice-Hall India Pvt. Ltd. New Delhi, 2008.
7] Ibrahim Zeid "CAD/CAM – Theory and Practice" Mc Hill, International edition, 1998.
8] P. N. Rao "CAD/Cam principles and operations", Tata McGraw Hill.
9] Thomas M. Crandell "CNC Machining and Programming, Industrial Press ISBN-0-831-3118-7.
10] Bedworth, Wolfe and Henderson-Computer aided design and manufacturing, McGraw Hill.
11] Ghosh and Malik "Manufacturing Science" Affiliated East West Press Pvt. Ltd.
12] Tilak Raj "CNC Technology and Programming", Dhanpat Rai Publication Company.
13] Robert Quesada, T. Jeyapoovan "Computer Numerical Control: Machining and Turning Centers", Pearson Education.
14] Programming Manuals of various CNC machines (Lathes and Machining Centers) e.g. FANUC, SINUMERIC, MAZAK etc.
15] Catalogs of Commercial Tool Manufacturers e.g. SANDVIK, KENNAMETAL, ISCAR, TAEGUTECH, MITSUBISHI etc.
16] Manuals of CNC Simulation and CAM Software.
17] Reference Manuals of controllers like FANUC, Siemens, Mazak, etc.

Experiment wise Measurable students Learning Outcomes:

1] Student shall be able to perform machining on conventional machine.
2] Student shall be able to select proper tooling for CNC machine.
3] Student shall be able to create turning part programming.
4] Student shall be able to generate a CAD model and CNC program by using CAM software.
5] Student shall be able to perform turning, threading operation of CNC turning centre.

Title of the Course: Numerical Methods

L	T	P	C
2	1	-	3

Course Code: UPRD0521

Course Pre-Requisite: Engineering Mathematics-I and Engineering Mathematics-II

Course Description: Students will understand the concepts numerical methods use in engineering application.

Course Objectives:

1. To introduce various numerical methods for solving algebraic and transcendental equations.
2. To introduce numerical methods for solving partial differential equations.
3. To introduce numerical methods for evaluation of derivatives and definite integrals.
4. To study fundamental tools of statistics.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom"s Cognitive level	Descriptor
CO1	To understand need of numerical methods in mechanical engineering	1	Understand
CO2	Apply numerical methods for solving problems in different areas of engineering.	3	Apply
CO3	Develop skills effectively in the numerical solutions of problem, principally in the area of mechanical engineering.	6	Develop
CO4	Apply interpolation and approximation for mechanical engineering problems	6	Apply
CO5	Use of statistics in Mechanical Engineering.	6	Apply

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1													
CO2		2	2	2									1	2
CO3			3	2	3									
CO4		1		2										
CO5			2	2										

Indicate mapping strength as 3 (High), 2 (Medium), 1 (Low)

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one EndSemester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.

MSE: Assessment is based on 50% of course content (Normally first three modules)

ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

Unit 1 **6 Hrs.**

Numerical solution of algebraic and transcendental equations Bisection Method, iterative methods, False Position Method, Rate of convergence, Muller's Method, Newton-Raphson method for solution of system of non-linear Equations, Secant Method.

Unit 2: **3Hrs.**

Interpolation and Approximation Lagrange‟s interpolation formula, forward and backward difference interpolation formula, Newton‟s divided difference interpolation formula, Hermite interpolation formula, Cubic Spline interpolation.

Unit 3: **6Hrs.**

Numerical differentiation and Integration, methods based on interpolation, numerical integration, Error analysis, methods based on interpolation, Newton cotes methods, Error estimates for trapezoidal and Simpson‟s rule

Unit 4: Statistics **7 Hrs.**

Statistics Mean and standard deviation. Quartiles, percentiles , Quartiles deviation,

Unit 5 Probability, **4Hrs.**

Probability, addition and multiplication laws of probabilities. Random variable, Probability mass function and probability density function, Binomial, Poisson and Normal distributions.

Unit 6 Mathematical Programming **4Hrs.**

Linear Optimization problems, Standard and Canonical forms, Basic solutions and feasible solutions, Optimal solutions by simplex method.

Term work: Any seven assignments using following topics. **2Hrs each**

1] Assignment on topic Numerical solution of algebraic

2] Assignment on topic Numerical solution of partial differential equations

3] Assignment on topic Interpolation and Approximation

4] Assignment on topic Numerical differentiation and Integration
5] Assignment on topic Probability.
6] Assignment on topic Mathematical Programming

Textbooks:

1] Numerical methods for scientific and Engineering Computation, M. K. Jain, S. R. K. Iyengar, R. K. Jain, New Age International Limited Publishers.
2] Fundamental of Statistics by S. C. Gupta.

References:

1] A text book of Applied Mathematics: Vol. I, II and III, Wartikar J. N. & Wartikar P. N. , Vidyarthi Griha Prakashan, Pune
2] Numerical methods for scientific and Engineering Computation, M. K. Jain, S. R. K. Iyengar, R. K. Jain, New Age International Limited Publishers.
3] Numerical method for Engineers - S.C. Chapra, R.P. Canale (Tata McGraw Hill Publications)
4] Numerical Methods – Dr. B.S. Grewal (Khanna Publications)
5] Numerical methods – E Balguruswamy (Tata McGraw Hill Publications)
6] Numerical Heat transfer and Fluid flow - S.U. Patankar (McGraw Hill Publications)
7] Introductory Methods of Numerical Analysis- S.S.Sastry (Prentice Hall Publication)
8] Fundamental of Statistics by S. C. Gupta.
9] Operations Research by S. D. Sharma

Unit wise Measurable Learning Outcomes:

1] Students will be able to solve algebraic and transcendental equations
2] Students will be able to solve partial differential equations
3] Students will be able to solve Interpolation and Approximation problems.
4] Students will be able to solve Numerical differentiation and Integration problems
5] Students will be able to solve Statistics and Probability problems
6] Students will be able to solve Mathematical Programming.

Title of the Course: Ergonomics & work study

L	T	P	C
2	1	-	3

Course Code:UPRD0522

Course Pre-Requisite: No specific pre-requisite required
Course Description: Work Study, Method Study, Introduction to Ergonomics, Human factor Engineering, Display system and anthropometric data.

Course Objectives:
1. Evaluate work places, work methods and work measurements from physiological, biomechanical, and anthropometric perspectives.
2. Define Ergonomics and the various disciplines that contribute to the field.
3. Demonstrate ergonomically effective strategies in various applications in industry.
4. Understand recent trends in ergonomics.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom"s Cognitive level	Descriptor
CO1	Understand the concept of work study	2	Understanding
CO2	Analyze existing methods of working for a particular job and techniques of work measurement	4	Analyze
CO3	Understand and interpretation of ergonomics to various disciplines.	2	Understand
CO4	Applying ergonomics principles to various real life problems.	3	Applying
CO5	Understand recent trends and advances in ergonomics.	2	Understanding

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1											2	1
CO2	2	1	2										2	1
CO3	1		2	1		1	1					1	1	
CO4							2							
CO5						1						1		

Indicate mapping strength as 3 (High), 2 (Medium), 1 (Low)

Assessments:
Teacher Assessment:
Two components of in Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.

MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit 1: Work Study-Basic Concept, Steps Involved in Work Study, Human Aspects of Work Study, Techniques of Work Study, Concept of Work Content. **4Hrs**

Unit 2: Method Study-Basic Concept, Steps Involved in Method Study, Recording Techniques, Operation Process Charts, Operation Process Charts: Examples. Flow Process Charts, Flow Process Charts: Examples, Two-Handed-Process Charts, Multiple Activity Charts, Flow Diagrams **4Hrs**

Unit 3: Work Measurement: Definition, objectives, basic procedure, Techniques of work measurement, Time study, steps in time study, breaking the job into elements, timing the elements; Rating in time study – standard rating and standard performance, factors affecting rate of working, standard time determination, use of time standards, allowances; Work sampling – Need, procedure for work sampling, determining time standard by work sampling. Predetermined time standards (PTS) – definition, MOST, Therbligs **8Hrs.**

Unit 4: Introduction to Ergonomics- History of Ergonomics and Human Factors, Inter Disciplinary Nature of Ergonomics, types and characteristics of man machine systems, Modern Ergonomics Human Performance, Information Processing, Factors Affecting Human Performance, Physical Workload and Energy Expenditure **4Hrs.**

Unit 5: Work Space Design- Anthropometry, Workspace Design for Standing and Seated workers, Anthropometric measuring technique Arrangements of Components Within a Physical Space, Interpersonal Aspect of Workplace Design, Visual performance, Visual displays, **6Hrs.**

Term work:

1. Assignment on work study. **2Hrs each**
2. Assignment on method study.
3. Assignment on work measurement.
4. Assignment on introduction to ergonomics.
5. Assignment on work space design.
6. Assignment on visual displays and performance.
7. Assignment on physical workload and energy expenditure.

Textbooks:

1. Martin Helander, A Guide To Ergonomics Of Manufacturing, TMH, 1996.
2. Work Study & Ergonomics, L.C. Jhamb (Everest)
3. Work Study: - I L O
4. Work Study: - Curie and Faraday (ELBS)
5. Industrial Engineering and Production Management: M. Telsang, S. Chand and Company Ltd.
6. Time and Motion Study Design, Barnes, R.M. (John Wiley)

References:

1. Bridger, R.S. “Introduction to Ergonomics”, McGraw Hill, 1995.
2. Dul, J. and Weerdmeester, B. Ergonomics for beginners, a quick reference guide, Taylor & Francis, 1993.
3. Industrial Engineering Handbook, Maynard (Mc Graw Hill)
4. Work Study by O.P. Khanna (Dhanapat Rai and Sons)

Unit wise Measurable Students Learning Outcomes:
After the completion of respective unit, the student should be able to

1. Understand the concept of Work Study.
2. Analyze existing methods of working for a particular job.
3. Understand of interdisciplinary nature of Ergonomics.
4. Apply of Ergonomics to product, process.
5. Understand recent trends in Ergonomics.

Title of the Course: Total Quality Management

Course Code:UPRD0523

L	T	P	C
2	1	-	3

Course pre-requisite: Knowledge of inspection and management is required,

Course Description: Course describes about the basics of quality management and deals with the basics all aspects of quality**.**

Course Objectives:

To enhance the ability implement the quality system in the organization

Course Learning Outcomes:

1. Student should able to demonstrate to the core concepts and the emerging trends in Quality Management.
2. Student should able develop hands-on-skills on tools and techniques of Quality management for industrial problem-solving.
3. To student should able to demonstrate implementation and documentation requirements for Quality system.

CO	After the completion of the course the student should be able to	Bloom"s Cognitive level	Descriptor
CO1	Ability to describe quality.	2	Demonstrate
CO2	Ability to use statistical tools and techniques	3	Applying
CO3	Ability to document and implement quality systems.	4	Develop
CO4	Hands on skill in problem solving and controlling and improvement of quality.	5	Evaluating
CO5	Ability to design quality based manufacturing system.	6	Design

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2													
CO2		3											2	2
CO3						2		2						
CO4			1		3		2			2				
CO5	3								1		2		2	2

Indicate mapping strength as 3 (High), 2 (Medium), 1 (Low)

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one EndSemester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE

Course Contents:

Unit 1:

Principles and Practice **3Hrs.**

Definition, basic approach, gurus of TQM, TQM Framework, awareness, defining quality, historical review, obstacles, benefits of TQM.

Unit 2:

Leadership **5 Hrs.**

Definition, characteristics of quality leaders, leadership concept, the Deming philosophy, role of TQM leaders, core values, concepts and framework, strategic , decision making,

Unit 3 **6Hrs.**

Quality Management Tools

Why-Why analysis, nominal group technique, affinity diagram, interrelationship digraph, tree diagram, prioritization matrices, process decision program chart, activity network diagram.

Unit 4

Statistical Process Control **6 Hrs.**

Pareto diagram, process flow diagram, cause and- effect diagram, check sheets, histograms, statistical fundamentals, Control charts, state of control, out of control process, control charts for variables, control charts for attributes, scatter diagrams, case studies.

Unit 5:

Quality Improvement: Single parameter experiments, Orthogonal array, Analysis of Variance ANOVA (one - way), Process capability, Correlation analysis and Linear regression models. **6Hrs.**

Tutorial work:

1. Assignment of problems on Quality loss function.
2. Case study using any quality control tool.
3. Industrial case study on Variables control charts (X-bar &R charts).
4. Industrial case study on Attributes control charts (P-chart). **2Hrs**
5. Process capability study. **each**
6. Single parameter experiment and statistical inferences using one-way ANOVA.

Textbooks:

1] Dale H. Besterfiled, "Total Quality Management", Pearson Education Asia
2] Rose, J.E. Total Quality Management, Kogan Page Ltd. 1993.
3] John Bank, The essence of total quality management, Prentice Hall, 1993.
4] Masaki Imami, KAIZEN, McGraw Hill, 1986.
5] Phil Crosby, Quality Without Tears, McGraw Hill
6] Six Sigma: Hemant Urdhwareshe Statistical Process Control
7] Design and analysis of experiments, Douglas C. Montegomery, WILEY INDIA publications.
8] Total Quality Management,B.Sentil Arasu, SCITECH publications.
9] Total Quality Management, NVR Naidu, NEW AGE INTERNATIONAL PUBLICATIONS.
10] Quality Engineering Using Robust Design, Madhav S. Phadke
11] Statistical Quality Control, M. Mahajan, Dhanpat Rai & Co.
12] Research Methodology, C.R.Kothari, New Age International Publications.

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References:

1] John Bank, The essence of total quality management, Prentice Hall, 1993.
2] Greg Bounds and Lyle Yorks, Beyond Total Quality Management, McGraw Hill, 1994.
3] Managing For Total Quality ,N. LOGOTHETIS, Prentice Hall

Unit wise Measurable students Learning Outcomes:

1] To define quality and explain the evolution of quality
2] To select and explain tools and techniques for problem solving.
3] To select and explain management tools used for problem solving.
4] To choose and demonstrate the statistical process control.
5] To describe a quality system

Title of the Course: Entrepreneurship Development-I **L T P C**

Course Code: UPRD 0524 **2 1 - 3**

Course Pre-Requisite: Genuine interest in development of entrepreneurial mindset. Planning competency and global awareness competency.

Course Description: Familiarize students with fundamentals of entrepreneurship, study government support organizations for entrepreneurs, study the process of starting the small scale industry besides studying the ecosystem available for new entrepreneurs.

Course Objectives:

1. To gain basic knowledge about entrepreneurial process and to understand relationship between entrepreneurship and economic development
2. To understand role of SSI, planning of SSI, Govt. and policies and facilities and to understand role of government support organizations for SSI .
3. To know the basic concepts and the process of Business Plan Preparation
4. To know the techniques of small business management and to understand business aspects like export procedure, IP Act, etc.
5. To gain knowledge about various aspects of project report preparation and understand statutory requirements for SSI.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom"s Cognitive level	Descriptor
CO1	Discuss entrepreneurial competencies required taking into account consideration case studies of successful entrepreneurs	2	Understand
CO2	Identify the working capital requirement for proposed SSI business	3	Applying
CO3	Apply qualitative and quantitative forecasting techniques for business opportunity identification.	3	Applying
CO4	Classify government facilities and support systems for SSI and interpret the support match for SSI.	2	Understand
CO5	Demonstrate application of small business planning principles taking into account product selection, machinery selection, site selection, marketing, finance to prepare a sample report of a business plan	2	Understand
CO6	To Classify different types crisis faced by SSI in life cycle stages.	2	Understand

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO 6	PO 7	PO8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO2
CO1	2										1			2
CO2	2	2									2			2
CO3	2	2	2	1							2		2	2
CO4	3	2	2	2						1	2	1	2	3
CO5	3	2	2	2							2	2		3
CO6	3			2							2		2	3

Indicate mapping strength as 3 (High), 2 (Medium), 1 (Low)

Assessments:

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit 1: --- 06- **Hrs.**

Entrepreneurship: Definition of Entrepreneur and Entrepreneurship, entrepreneurial process, Entrepreneurship and economic development, job creation, classification. (3)

Entrepreneurial Motivation: Self-disclosure, personality effectiveness, risk taking, entrepreneurial competencies, case studies. (3)

Unit 2: --- 04- **Hrs.**

Small Scale Units: Concept and definition of MSME, role of S.S.I. in Indian economy, government policies and facilities. (4)

Unit 3: --- 04- **Hrs.**

Planning Small Scale Business: Business opportunity identification, idea generation, ideas from marketplace, market assessment, demand estimation. (4)

04- **Hrs.**

Unit 4: ---

Business plan preparation: Need, scope, value, information sources of economical and technical knowhow, selection of location, working capital, identification of raw material, suppliers, plants/machinery, process, manpower and other inputs such as power, water etc. (4)

Unit 5: --- 04- **Hrs.**

Government Support Organizations:

a) Central Government
b) State government
c) Financial support organizations. (2)

Preparation of project report: Technical, financial, economic and marketing feasibility. (2)

Unit 6: ---

Small Business Management 04- **Hrs.**

- Techniques of materials, production, finance, manpower resources and marketing management (2)

- Crisis management, study process, reasons of failure. (2)

Term work: Any seven assignments using following topics. 02- **Hrs.** each

1. Assignment on Entrepreneurial Competencies.
2. Assignment on Entrepreneurship and Economic Development and Job Creation.
3. Assignment on Business Opportunity Identification.
4. Assignment on Central and State Governments Organizations.
5. Assignment on Business Plan Preparation.
6. Assignment on Small Business Management.
7. Assignment on Viability Analysis or SSI.
8. Assignment on Crisis Management.

Textbooks:

1. Developing New Entrepreneurs - Entrepreneurship Development Institute of India, Ahmedabad.
2. Handbook of New Entrepreneurs
3. Management of Small Scale Industry - Vasant Desai (Himalaya Publication)
4. Entrepreneurship Playing to Win- Gordon Betty (Taraporwala & Co.)
5. Motivating Economic Achievement- David C. McClelland, David G. Winter
6. Industrial Maharashtra- Facts, Figures and Opportunities (M.I.D.C. Mumbai).
7. Project Planning & Entrepreneurship Development - T. R. Banga
8. Dynamics of Entrepreneurial Development & Management- Vasant Desai (Himalaya Publication)
9. S.S.I. and Entrepreneurship- Vasant Desai (Himalaya Publication)
10.Petersen and Lewis : Managerial Economics, 4/e, Pearson/PHI, 2002. 2. Managerial Economics, Ahuja. H.L, S. Chand, New Delhi.
11. M.L. Trivedi: Managerial Economics, Tata Mc-Graw Hill, New Delhi 2004.
12. PindyckRubinfeld& Mehta, ―Micro Economics‖, Pearson
13. Ramachandran, and Kakani, ―How to Analyze Financial Statements‖, Tata McGraw Hill
14. Palat, Raghu, ―How to Read Annual Reports and Balance Sheets‖, JAICO Publishing House
15. Dash A.P., ―Financial Wisdom – Finance for Non-Finance Executives‖, Biztantra ISBN 978-81-7722-378-1

References:

1. Dynamics of Entrepreneurial Development & Management- Vasant Desai (Himalaya Publication)
2. Entrepreneurship Playing to Win- Gordon Betty (Taraporwala & Co.)
3. S.S.I. and Entrepreneurship- Vasant Desai (Himalaya Publication).
4. Developing New Entrepreneurs - Entrepreneurship Development Institute of India, Ahmedabad.
5. Motivating Economic Achievement- David C. McClelland, David G. Winter.
6. Project Planning & Entrepreneurship Development - T. R. Banga

Unit wise Measurable Students Learning Outcomes:

1] Understand concept of entrepreneurship and entrepreneurial motivation.
2] Understand role of M.S.M.E. and S.S.I. from Indian economy point of view.
3] Apply ideas on planning small scale business
4] Model feasible business plan
5] Identify role of government support organizations
6] Formulate techniques for managing small businesses.

Title of the Course: Composite Materials Technology	L	T	P	C
Course Code: UPRD 0525	2	1	-	3

Course Pre-Requisite: Physics, chemistry, metallurgy, strength of material

Course Description:
Material selection is the important part for any component. Metals are having higher weight as well as corrosion tendency is more. Composites are having higher strength, light weight, corrosion is less hence it is treated as future advanced material in all the fields like electronic, concrete, optical and electromagnetic field.

Course Objectives

1. List applications of composite materials used in various engineering fields
2. Explain fabrication processes of polymer matrix composites, ceramic matrix composites and metal matrix composites.
3. To study various characterization methods of composites.
4. Solve the properties such as strengths, mass and volume fractions, fiber length, and densities of different composite materials by using analytical expressions.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive level	Descriptor
CO1	List applications of Composite Materials used in various engineering fields.	2	List
CO2	Explain use and Fabrication of polymer matrix, Ceramic matrix composites and Metal matrix composites	2	Explain
CO3	Explain various characterization methods of composites	2	Explain
CO4	Solve the properties such as strengths, mass and volume fractions, fibre length, and densities of different composite materials by using analytical expressions	5	solve

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1												3		
CO2		2	3											
CO3					3									
CO4				2									3	3

Indicate mapping strength as 3 (High), 2 (Medium), 1 (Low)

Assessments:

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.

MSE: Assessment is based on 50% of course content (Normally first three modules)

ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE

Course Contents:

Unit 1: Introduction to different fillers and matrix. **6Hrs**

Unit -1 Composite materials in engineering, reinforcing materials: fibers, whiskers and particles. Fiber materials for composites, fibers of glass, boron, carbon, organic, ceramic and metallic fibers, matrix materials, interfaces between matrix and fibers and other dispersed phases.

Unit 2: Polymer matrix composite **6Hrs**

Polymer matrix composites, characteristics and applications, fabrication of polymer matrix composites.

Unit 3: Metal matrix composites (MMC) **6Hrs**

Metal matrix composites (MMC), fabrication of MMCs by liquid state, solid state methods, powder metallurgy route and in site fabrication methods, discontinuous reinforcement of MMCs, ceramic matrix composites, fabrication methods and applications.

Unit 4: Mechanical properties in composites **8Hrs**

Mechanical properties in composites, large particle composites and the rule of mixtures for elastic constants, mechanical properties of fiber reinforced composites, effect of fiber length, critical fiber length, strength of continuous and aligned fiber composites, discontinuous and aligned fiber composites, toughening mechanism, impact resistance.

Unit 5: Different defects and characterization techniques of composites **6Hrs**

Effects defects in polymeric matrix composites and method of non-destructive evaluation, optical inspection, radiographic methods, thermal imaging, ultrasonic techniques, optical fibre sensors, microwave methods, dynamic mechanical analysis, acoustic emission methods.

Characterizations techniques:

SEM, TEM, XRD, DSC, DTA, TGA, DMA etc.

Unit 6: Application of composites in different field **6Hrs**

Composite materials for electrical, electromagnetic and dielectric applications, microelectronics and resistance heating, electrical insulation, capacitors, piezoelectric, ferroelectric functions, electromagnetic windows, solid electrolytes, microwave switching

,optical and magnetic applications, optical waveguide, optical filters and lasers, multilayer for magnetic applications.

Textbooks and reference books:

1] Principles of Materials Science and Engineering, William F. Smith, Third Edition, 2002, McGraw-Hill
2] Composite Materials: Engineering and Science, Matthews F.L., and Rawlings R. D., 1999, Woodhead Publishing Limited, Cambridge England.
3] Composite Materials-Functional Materials for Modern Technology, DDL Chung, Springer- Verlag Publications London
4] The nature and Properties of Engg. Materials, Jastrzebaski, John Wiley & Sons, New York.
5] Fundamentals of material science and Engineering, William D.Callister, John Wiley & Sons, New York
6] Engineering Composite Materials, Bryan Harris, The Institute of Materials London 1999.
7] Electron Microscopy and Analysis, Peter J Goodhew, John Humphreys, Richard Beanland, Taylor and Francis London and New york.

Reference books

1] Composite Materials Handbook, Mel M. Schwartz (R), 2nd Edition, 1992, McGraw-Hill, New York.
2] Fundamentals of Fiber Reinforced Composite Materials, A. R. Bunsell, J. Renard , 2005, IOP Publishing Ltd.
3] Composite Materials Science and Engg., Chawla K.K., Second Edition, 1998, Springer Verlag.

Unit wise Measurable students Learning Outcomes:

1] Students shall be able to list applications of Composite Materials used in various engineering fields.
2] Students shall be able to explain use and Fabrication of polymer matrix, Ceramic matrix composites and Metal matrix composites.
3] Students shall be able to explain various characterization methods of composites.
4] Students shall be able to solve the properties such as strengths, mass and volume fractions, fiber length, and densities of different composite materials by using analytical expressions

Title of the Course: Control Engineering

L	T	P	C
2	1	-	3

Course Code: UPRD0526

Course Pre-Requisite: Physics, Chemistry

Course Description: The goal of this course is to provide an introduction to control systems also Prepare mathematical model of physical simple systems.

Course Objectives

1. Study the control system, its type and applications.
2. Prepare mathematical model of physical simple systems.
3. Study concept of system stability and system response.
4. Study various control actions.
5. Learn to use MATLAB software to analyze control system.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom"s Cognitive level	Descriptor
CO1	Understand control system, its type and applications.	2	Understand
CO2	Understand model of physical simple systems.	2	Understand
CO3	Determine system stability and system response.	3	Determine
CO4	Understand various control actions.	2	Understand
CO5	Use MATLAB software to analyze control system.	5	Use

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1		1	2										
CO2		2												2
CO3			3	2	3									
CO4		1	2											
CO5				2										

Indicate mapping strength as 3 (High), 2 (Medium), 1 (Low)

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit 1: Introduction to Automatic Control **5.Hrs**

Generalized Control System Types, Open Loop and Closed Loop, Linear and Non-Linear, Time Variant and Time invariant Systems with Examples. Advantages of Automatic Control Systems Mathematical Model of Control System: Mechanical Translational Systems, Rotational System, Grounded Chair Representation, Electrical Elements, Analogous Systems, Force – Voltage Analog, Force – Current Analog

Unit 2: Representation of Control System **4Hrs**

Linearization of Non Linear Functions, Linearization of Operating Curves, Block Diagram Algebra, Rules for Reduction of Block Diagram

5Hrs

Unit 3: Transient Response:

General Form of Transfer Function, Concept of Poles and Zeros, Distinct, Repeated and Complex Zeros. Response of Systems (First and Second Order) to Various Inputs (Impulse, Step, Ramp and Sinusoidal).

Unit 4: Stability and Root Locus Technique **4 Hrs**

Stability and Root Locus Technique: Routh"s Stability Criteria, Significance of Root Locus, Construction of Root Loci, General Procedure,

Unit 5: Frequency Response Analysis: **4Hrs**

Frequency Response Log Magnitude Plots and Phase angle Plots, Gain Margin, Phase Margin, Evaluation of Gain „K", Polar Plots (No Numerical), and Stability Analysis. Introduction to System Compensation: Types of Compensators, Lead,Lag, Lead-Lag Compensators (No Numerical).

Unit 6: State Space Analysis: **4Hrs**

State Space Analysis: System Representation, Direct, Parallel, Series and General Programming

Tutorial Work:

1] Assignment on Introduction to Automatic Control **2Hrs**
2] Assignment on Representation of Control System **each**
3] Assignment on Transient Response
4] Assignment on Stability and Root Locus Technique
5] Assignment on Frequency Response Analysis.
6] Assignment on State Space Analysis:

Textbooks :

1. "Control System Engineering", R Anand Natarajan, P. Ramesh Babu, SciTech Publication, 2nd Edition.
2. "Control Systems" ,A. Anand Kumar, Prentice Hall Publication.
3. "Automatic Control Engineering", F.H. Raven Tata McGraw Hill Publication, 5th Edition.

Reference books

1. "Modern Control Systems", K Ogata, , Prentice Hall Publication ,3rd Edition.
2. "Automatic Control Systems", B.C. Kuo, Willey India Ltd. / Prentice Hall Publication, 7th Edition.
3. "Automatic Control Engineering", D. Roy and Choudhari, Orient Longman Publication Calcutta.
4. "Modern Control Engineering", K. Ogata, Pearson Education.

Unit wise Measurable students Learning Outcomes:

1] To understand general Control System
2] To understand how to Representation of Control System.
3] To select Transfer Function for Control System.
4] To understand Stability and Root Locus Technique for Control System.
5] To describe Analysis of Frequency Response
6] To describe Analysis of State Space

Title of the Course: Computer Graphics

L	T	P	C
2	1	-	3

Course Code: UPRD0527

Course Pre-Requisite: Basics of C or C++ programming language, Engineering Graphics and background of mathematics.

Course Description:
The goal of this course is to provide an introduction to computer graphics. The course will assume a good background in programming in C or C++ and a background in mathematics including familiarity with the theory and use of coordinate geometry and of linear algebra such as matrix multiplication. Students can use the standards based OpenGL library in several programming projects illustrating the theory and practice of programming computer graphics applications.

Course Objectives:
1) To introduce student about computer graphics leading to the ability to understand contemporary.
2) To study basic concepts of computer graphics techniques, focusing on 3D modeling, Image synthesis.
3) To study physical significance of Curves and Surfaces.
4) To study need for hidden surface removal.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive level	Descriptor
CO1	**Acquire** the knowledge of basics of computer graphics.	1	Knowledge
CO2	**Apply** basic programming in C for line, rectangle, circle etc for different shapes.	1	Knowledge
CO3	**Recognize** the importance of using three dimensional transformations like translation, scaling and rotating.	1	Knowledge
CO4	**Analyzing** the hidden unwanted parts in graphics and do the program on animation.	2	Skill
CO5	**Choose** the different of curves and surfaces while drawing CAD models.	2	Skill

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		1												1
CO2			2								1			
CO3							3							
CO4		2									1			2
CO5						2								

Indicate mapping strength as 3 (High), 2 (Medium), 1 (Low)

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End. Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE	25
ESE(POE)	25

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit 1:- **06 Hrs.**

Introduction and background of Computer Graphics, Need of Computer Graphics, Importance of Computer Graphics in the area of CAD/CAM/CAE, Display devices: Refresh Cathode ray Tubes, Random Scan and Raster Scan monitors, Colour CRT Monitors, Direct view Storage Tubes, Continuous Refresh and Storage display, LED and LCD Monitors.

Unit 2:- **06Hrs.**

Points & Lines, Line drawing Algorithm, DDA and Bresenham"s Algorithm. Fill Algorithm: Scan-Line Polygon Fill algorithm, Boundary Fill Algorithm, Flood Fill Algorithm, Seed fill algorithm. Attributes of primitives: Line style, Type, Width, Colour, Character Attributes, Area Filling.

Unit 3:- **06Hrs.**

Analytical & Synthetic curve: C0, C1 & C2 Continuity, Convex hull, Parametric & non parametric representation of curves. Analytic curves: Circle, Ellipse, Parabola, Hyperbola, Splines: linear, quadratic, cubic, hermite, Bezier curves, Synthetic Curves: Circle and ellipse drawing, Parametric and Breshenham"s algorithm.

Unit 4:- **04 Hrs.**

2D Transformation: Basic transformation- Translation, Scaling, Rotation, Reflection, Twist, Matrix Representation, Composite Transformations.3D Transformation: Basic Transformations, 3D Display parallel & perspective projection.

Unit 5:- **04 Hrs.**

Viewing: Viewing world co-ordination system, Normalized co-ordinate system, Device/Image co-ordination system, Window definitions, View port definitions, Viewing transformation.

Clipping: Point clipping, Line clipping, Cohen- Sutherland clipping, Midpoint clipping method, Sutherland and Hodgeman Clipping.

Lab Work : All the algorithms are to be practiced in the computer Programming Laboratory using suitable programming language
Computer Graphics Assignments

Write a C++ or C program for following

1. Draw a straight line
2. Draw a rectangle of given dimensions
3. Fill any colour inside a rectangle
4. Draw a circle of given radius.
5. Fill colour inside a circle
6. Draw en ellipse of given dimensions
7. Fill colour inside ellipse
8. Draw a circle inside a square of given dimensions
9. Move the geometry of any given shape.

Text books:

1. Computer Graphics-Donald hearn and M.Pauline Baker-Prentice Hall of India Pvt Ltd.
2. Introduction to Computer Graphics – N. Krishnamurhy - TMH Publication.
3. Fundamentals of Computer Graphics.- Peter Shirley
4. Computer Graphics, C Version, 2e – Donald D. Hearn- Pearson

References:

1. Computer Graphics –Harrington S. – TMH Publication.
2. Computer Graphics - Schaum‟s Outline –TMH Publication

Unit wise Measurable students Learning Outcomes:

1. The student shall be able to understand the concept of computer graphics.
2. The student shall be able to apply basics of C Programming to draw lines.
3. The student shall be able to understand the concept of Analytical & Synthetic curve.
4. The student shall be able to use 2D and 3D transformation
5. The student shall be able to understand the concept of clipping.

Title of the Course: Human Behavior at Work

L	T	P	C
2	1	-	3

Course Code: UPRD0528

Course Pre-Requisite: Fundamental knowledge of Organisational working

Course Description: Organisational structure, human behaviour in Organisation, motivational techniques, Group Behaviour, Group Decisions, leadership, human resource management functions

Course Objectives:

1. To Understand Organisational structure, Organisational behavior.
2. To Identify various motivational techniques and skill required to work in a group for group decision making.
3. To learn about various leadership styles and the role of leader for achieve organizational objective.
4. To identify reasons of organizational change
5. To apply concept of human resource management functions in organization

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom"s Cognitive Level	Descriptor
CO1	Know about Organisational structure, Organisational behavior	2	Understanding
CO2	Learn about motivational techniques and skill required to work in a group and the process of group decision making.	2	Understanding
CO3	Define leadership styles and the role of leader in achievement of Organisational objective.	1	Remembering
CO4	Find out reasons of organizational change	1	Remembering
CO5	Apply concept of human resource management functions in organization	3	Applying

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO 6	PO 7	PO8	PO 9	PO1 0	PO1 1	PO1 2	PSO1	PSO2
CO1							2		1	1		2		
CO2										2	2			1
CO3										3				
CO4										1		1		
CO5												2		

Indicate mapping strength as 3 (High), 2 (Medium), 1 (Low)

Assessments:

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.

MSE: Assessment is based on 50% of course content (Normally first three modules)

ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

UNIT-1-Introduction to Organization and Organizational Behaviour: **3 Hrs.**

Meaning and definition of organization, features and principles of organization, Organizational structures and nature of organizational behavior.

UNIT-2-Personality, Perception and Motivation: **6 Hrs.**

Meaning of Personality, Personality Development, Determinants of personality, Application of personality in the organizational level.

Perception: Meaning & Definition, Perceptual process, Importance of Perception in OB

Motivation: Nature & Importance, Herzberg‟s Two Factor theory, Maslow‟s Need Hierarchy theory, Alderfer‟s ERG theory, Hygiene theory, Theory X and Theory Y

UNIT-3-Leadership: **6 Hrs.**

Meaning, Theory of leadership, Trait theory, Behavioural theory, Leadership styles, Leadership in Indian Organisation. Group Dynamics-Concept of Group Dynamic, Types of Group, Group Behaviour, Group Decisions, Techniques to improve group decision, merits and de-merits of group decision.

UNIT-4- Organizational Culture and organizational change: **6Hrs.**

Organisational culture: meaning & definition, culture & organisational effectiveness

Organisational change: importance of change, Factors of organizational change, Resistance to change, Factors in resistance, Overcoming resistance to change, & OB techniques

International OB: An introduction to individual & interpersonal behaviour in global perspectives case study analysis

UNIT-5- Introduction to Human resource Management **4Hrs.**

Human resource management: introduction to hrm, selection, orientation ,training

& development development, performance appraisal, incentives

Tutorials:

1. Assignment on organizational structure
2. Assignment on theories of motivation
3. Assignment on leadership styles
4. Assignment on group behaviour
5. Assignment on organizational change
6. Assignment on Human resource management functions
7. Assignment on performance appraisal.

Textbooks:

1. Organizational Behaviour Dr S.S.Khanka, S.Chand, 2014.
2. Organisational Behaviour. Arun Kumar and N.Meenaskshi .Vikas Publishing House, 2009.
3. Shankar, M. (2013). Organizational behavior. International Book House
4. Sharma, S. (2013). Organisational behavior. New Delhi: Tata McGraw Hill.
5. Singh, K. (2012). Organizational behaviour text and cases. New Delhi: Pearson Education

References:

1. Human Behaviour at Work. Keith Davies, 2002.
2. Managing Organisational Behaviour, Moorhead & Griffin. CENGAGE Learning, 2014.
3. Robbins, S. P. Judge, T. A. & Vohra, N. (2013). Organizational Behavior. (15th ed.), Indian subcontinent adaptation, New Delhi: Pearson Education,
4. Pareek, U. & Khanna, S. (2011). Understanding organizational behavior. Oxford University press

Unit wise Measurable students Learning Outcomes:

1. Know about Organisational structure, Organisational behavior
2. Learn about motivational techniques and skill required to work in a group and the process of group decision making.
3. Learn leadership styles and the role of leader in achievement of Organisational objective.
4. Understand concept of organizational change
5. Know about human resource management functions in organization

Title of the Course: Mechatronic Systems **L T P C**
Course Code: UPRD0601 **3 - - 3**
Course Pre-Requisite:

1. Fundamentals of Electronics
2. Electrical Machines and Electronics

Course Description:

Mechatronics refers to a flexible, multi-technological approach for integration of mechanical engineering, computer engineering, electronics and information sciences. Mechatronics is essential in the design of intelligent products. It allows engineers to transform their virtual concepts into real life applications. It is a relatively new concept relating to the design of systems, devices and products aimed at achieving an optimal balance between basic mechanical structure and its overall control.

Course Objectives:

1. Be able to work efficiently in multidisciplinary teams.
2. Be able to classify different sensors
3. Be able to construct PLC ladder program for given application

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom"s Cognitive level	Descriptor
CO1	Explain different types of control systems	2	Explain
CO2	Select appropriate sensor for given application	1	Select
CO3	Construct PLC ladder program	3	Construct
CO4	Select appropriate microcontroller for given application	3	Select
CO5	Classify different signal conditioning tech.	4	Classify
CO6	Explain various types of Micro manufacturing processes.	2	Explain

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2													
CO2		2		1									1	
CO3		1	3		2				1			1	2	
CO4		1	2										1	
CO5				2										
CO6	2													

Indicate mapping strength as 3 (High), 2 (Medium), 1 (Low)
Assessments :

Teacher Assessment:
Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one EndSemester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit 1:--- 6 **Hrs.**

Introduction to Mechatronics and Control System
Scope, components of mechatronic systems
Control Systems: Automatic control, open loop and closed loop control, servo system. Types of standard inputs (signals), , Modes of control: on/off, P, PI, PD and PID
Applications of mechatronics systems:- Household, Automotive, Shop floor (industrial).

Unit 2:--- 7 **Hrs.**

Sensors and Transducers:
Performance, terminology, characteristics, types, Contact and non-contact type switches and proximity sensors- inductive, capacitive, optical, pneumatic, thermal, incremental and absolute encoders, tachogenerator; Smart sensors.
Applications in position, displacement, velocity, force, torque and temperature measurement

Unit 3:--- 5 **Hrs.**

Actuators – working principle and applications: Variable frequency AC drives, Pulse width modulation and cycloconvertor for controlling AC frequency, Brushless DC servomotors, timing motors, SCR (Silicon Controlled Rectifiers) motors, Stepper motors

Unit 4:--- 7 **Hrs.**

Signal Conditioning: Signal conditioning processes, clock signal, voltage divider, rectification, Operational Amplifiers: inverting and non-inverting, summing, integrating, differential, logarithmic, comparator; 555 timer, sample and hold, analog to digital and digital to analog converters, multiplexing and de-multiplexing

Unit 5:--- 8 **Hrs.**

Microcontroller and Programmable Logic Controllers (PLC):
Microcontroller: Architecture and pin diagram of 8051 controller, Programming of microcontroller, selection of microcontroller for automation applications.
Programmable Logic Controllers (PLC): Structure, input/output units and i/o processing, programming, ladder diagrams, logic functions, latching, sequencing, timers, jumps, Practical Examples of Ladder Programming.
SCADA system, basics of Arduino Programming

Unit 6:---
MEMS: Overview of MEMS and Microsystems, typical MEMS and Micro system products and applications. (i) Micro sensors and micro actuators: 6 **Hrs.**

phototransistors, pressure sensors, thermal sensors, micro grippers, micro motors, micro valves, micro pumps (ii) Micro-manufacturing: bulk manufacturing, surface manufacturing, LIGA process.
Case study of Mechatronic systems in manufacturing and automation.

Textbooks:

1. Mechatronics 3/e - W. Bolton (Addison Wesley) ISBN 81-7758-284-4
2. Mechatronics Principles, Concepts & Applications – N.P.Mahalik (TMH) ISBN 0-07-0483744
3. Ogata – Modern Control Engineering (Pearson Education) ISBN 81-7808-579-8
4. Industrial Automation – David. W. Pessen (John Wiley & Sons) ISBN 9971- 51-054-5.
5. Automated Manufacturing Systems: Sensors, Actuators – S. Brain Morriss (McGraw Hill) ISBN 0-07-113999-0
6. MEMS & Microsystems Design & Manufacture – Tai – Ran Hsu – TMH 0-07-048709.
7. MEMS – Mahalik, N.P. (TMH) ISBN :13 978-0-07-063445-9
8. Webb and Reis,"Programmable Logic Controller – Principles and Applications",Prentice Hall of India,2002.

References:

1] Mechatronics – Dan Necsulescu (Pearson Education) ISBN 81-7808 -676 – X. 8. The 8051 Microcontroller: Architecture, Programming & Applications, 2/e – Kenneth J. Ayala (Penram International) ISBN – 81-900828-7
2] Introduction to Mechatronics & Measurement System – David G. Alciatore & Michael B. Histand (TMH) ISBN 0-07-052908

Unit wise Measurable students Learning Outcomes:

1. The student shall be able to understand different control systems
2. The student shall be able to select appropriate sensor and controller for given application
3. The student shall be able to select appropriate actuators for given application
4. The student shall be able to understand different signal conditioning tech
5. The student shall be able to construct PLC ladder program
6. The student shall be able to design Micro electromechanical components

Title of the Course: Industrial Management and Psychology	L	T	P	C
Course Code: UPRD0602	3	1	-	4

Course Pre-Requisite: Communication Competency, Judgmental Analysis Ability essential

Course Description: To study evolution of management theory and various functions of management essential for efficient and effective working of an industrial organization besides understanding behavioral aspects human resource.

Course Objectives:

1. To discuss development of management thought and different approaches to management.
2. To explain framework of core management functions such as planning, organizing, staffing, directing essential for efficient and effective working of industrial organizations.
3. To discuss different motivation theories and types of leadership and controlling technique for industrial management.
4. To explain different forms of organization and its influence on functions of management
5. To discuss application of management functions to different functional areas such as production, marketing, finance, materials and Human Resource Management.

Course Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive Level	Bloom's Cognitive Descriptor
CO1	Discuss major contributions of Taylor, Fayol, Mayo, Drucker, Porter and modern management approaches	2	Understanding
CO2	Describe planning hierarchy and types of organization structures taking into account form of organization.	2	Understanding
CO3	Apply manpower planning principles to human resource requirement of organization for different time periods.	3	Applying
CO4	Demonstrate significance of application of management functions such as planning, organizing, and staffing to HRM, Production Management.	2	Understanding
CO5	Distinguish appropriate staffing role requirement taking into account personality characteristics	4	Analyzing
CO6	Demonstrate significance of application of management functions such as planning, organizing, staffing to finance and marketing management	2	Understanding

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1												1	
CO2	2	1												
CO3	2	2	1							2			1	
CO4	2	2	1	1									1	
CO5	2	2	2								1		1	
CO6	2	2	2					2			2		2	

Indicate mapping strength as 3 (High), 2 (Medium), 1 (Low)

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/Moodle quiz/Topic seminar/Group Discussions, Industrial case study etc.

MSE: Assessment is based on 50% of course content (Normally first three modules)

ESE: Assessment is based on 100% course content with60-70% weightage for course content (Normally last three modules) covered after MSE.

Course Contents:

Unit 1: Management: An Overview **06 Hrs.**

Introduction, definition, scope, functions, levels of management, management skills, contribution to the development of management thought by Fayol, Taylor, Mayo, Drucker, Porter, modern management approaches, social responsibilities of a management.

Planning: Definition, nature of planning, significance, types of plans, planning skills, steps in planning process, barriers to planning, planning premises, concepts of strategic planning

Unit 2:Organizing **06 Hrs.**

Definition, process, principles of organization, types of organization – line, staff, project, functional, organization structure, organization chart, span of management, departmentalization, informal organizations, delegation of authorities and decentralization.

Staffing: Definition, functions of staffing, need, manpower planning, recruitment and selection, training and development, performance appraisal.

Unit 3: **08 Hrs**

Motivation: Definition, importance, determinants of motivation, Maslow"s need hierarchy theory, Herzberg"s two factor theory, theory X and theory Y.

Leadership: Definition, characteristics of leadership, functions of leader, styles of leadership, types of leader, traits and behavioral theories.

Communication: Definition, significance, communication process, forms of communication, formal and informal communications, barriers to effective communication. Gateways to effective communication.

Controlling: definition, need, essentials of effective control system, step in control process, conventional and modern control techniques. Requirements of effective control process.

Unit 4:

06 Hrs.

Industrial Psychology: Basic concepts, definition, scope, objective, functions.

Individual behavior: biographical characteristics, personality, learning implementation for performance and satisfaction. Perception and individual decisions making, values, attitudes and job satisfaction.

Unit 5: Foundation of group behavior **06 Hrs.**

Communication and group decision making, learning cycle, personality and personal effectiveness, conflict and intergroup behaviors effective teams.
Definition and classification of groups, functions of groups, group characteristics, roles, norms, status and size.

Unit 6: --- **06 Hrs.**

The organization: organization and climate, dimensions of organizational climate, determinants, types of organizational climate, organizational learning and organization, maintenance factors of organizational culture, HRD culture, organizational change, organizational development.

Textbooks:

1. Industrial Engineering and Production Management -By M. Mahajan, Dhanpat Rai and Co.
2. "Industrial Engineering and Management", Khanna, O.P., Dhanpat Rai and Sons.
3. Personnel Management and Human Resources, C.S. Venkataraman, B.K. Srivastava
4. Principles of Management, Tripathi, Reddy, Tata Macgraw Hill publications
5. L.C. Jhamb, Savitri Jhamb, "Industrial Management – I", Everest Publishing House.
6. Management by James A. F. Stoner, R. Edward Freeman, PHI
7. Management Today: Principles and Practice by Gene Burton and Manab Thakur
8. Essentials of Management by Koontz and O„Donell, TMH
9. Organizational Behavior by Keith Davis, TMH
10. Management (Tasks, responsibilities and Practices) by Peter Drucker, Harper Business
11. Production Management by Lockyer, ELBS
12. Modern Production Management by E. S. Buffa (John Wiley)
13. Financial Management by Vanhorne, PHI
14. Financial Management (Theory and Practice) by Prasanna Chandra, TMH
15. Marketing Management by Philip Kotler, Pearson Edition
16. Marketing Management by Rajan Saxena, TMH
17. Personnel Management by Edward Flippo, TMH
18. Managing Human Resources by Gorrez, Balkin, Candy, PHI

References:

1. Management by James A. F. Stoner, R. Edward Freeman, PHI
2. Micormic, J. "Human factors in Engineering and Design", McGraw Hill
3. Banga, Sharma, "Industrial Organization and Management", Khanna Publication Ltd.
4. B. Davis and Margrethe H. Olson, "Management Information Systems", Mc-Graw Hill International Editions.

Unit wise Measurable students Learning Outcomes:
After the completion of respective unit, the student should be able to

1. Discuss development of management thought and different approaches to management.
2. Explain framework of core management functions such as planning, organizing, staffing,
3. Discuss different motivation theories and significance of communication, leadership and controlling techniques.
4. Understand industrial psychology and individual behaviour.
5. Analyze psychology behind group behaviour.
6. Interpret concepts of organizational culture and organizational change

Title of the Course: Design of jigs, fixtures and dies **L T P C**
Course Code: UPRD0603 **3 1 - 4**
Course Pre-Requisite: Machine Drawing , Machine Tool Processes

Course Description: Design of jigs and fixtures,explain different techniques of designing jig and fixture by analyzing component and using different parts like locating, clamping and tool guiding system.
Design of dies explain different techniques of designing dies like progressive and drawing die according to shape of product.

Course Objectives:
1. To understand concepts of different clamping and locating system use in jig and fixure
2. The student shall be able to design drilling jig and milling fixtures for simple components
3. To understand concepts of different system use in die design.
4. The student shall be able to design progressive and drawing dies for simple components

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom"s Cognitive level	Descriptor
CO1	Define of locating and clamping system used in designing of jig and fixture	1	Remember
CO2	Plan sequence of operation for given component for machining	3	Apply
CO3	Design of drilling jig and milling fixture	6	Create
CO4	Classify sheet metal operation on basis of cutting and non cutting operation.	5	Evaluate
CO5	Design drawing and progressive die	6	Create

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1		2	2										
CO2		2	2	2									3	2
CO3			3	2	3									
CO4		1	2	2										
CO5			2	2										

Indicate mapping strength as 3 (High), 2 (Medium), 1 (Low)

Assessments :
Teacher Assessment:
Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit 1:--- Introduction to Jigs and Fixtures : Necessity, applications and types, basic concept of jigs and fixtures for different manufacturing processes, dependency of jig and fixture design on operation sequence. 4 **Hrs.**

Unit 2:- Location and clamping system : Principles, types, applications, locating pins, pads, diamond pins, adjustable supports, Vee and post locators, clamping system -principle, types, screw clamp, strap, lever, hinge type, cam operated, toggle clamps, centralizer and equalizer clamp, multiple clamping, quick acting clamps, pneumatically operated clamps. 8 **Hrs.**

Unit 3:--- Design of Jigs & fixtures : 16**Hrs.**

A) Design of jigs: Principles of jig design, types of jigs- plate, template, box, channel, sandwich, latch, turn-over, tumble jig etc., types of bushes, selection of bushes and liners, construction of jig and fixture bodies, use of standard parts.

B) Design of fixtures: Principles of fixture design, types of fixtures- gang, straddle, vertical, slot, string milling fixture etc, selection of the suitable type, design of milling fixtures, use of setting block, tennons, T-bolts etc, : Development of modular fixtures, T- slot based and Dowel pin based Modular Fixture systems,

Unit 4:--- Introduction to press tools: Dies, punches, types of presses, types of dies, simple, compound, combination and progressive dies, press tools for operations like blanking, piercing, drawing, shaving, trimming, etc. 5**Hrs.**

Unit 5:--- Design of die set for cutting operations: Theory of metal cutting, cutting force and blank holding force estimation, punch and die clearance, scrap strip layout, design of punches, design of dies, pilots, strippers, stock stops, finger stops, auto stops, center of pressure, selection of die set. 10**Hrs.**

Unit 6:--- Design of drawing die: blank size determination, no. of draws, stage wise achievement of drawn component, stage wise component drawings, drawing radii and clearance, drawing forces, defects in drawing, multistage drawing operation. 7 **Hrs.**

Unit 7:--- Miscellaneous dies like- cut off dies, shaving, bulging, bending, curling dies, spinning operation and die design, new advancement in die design etc. 3 **Hrs.**

Textbooks:

1)Tool Design, Donaldson, (TMH)
2) Tool Design, Pollock, Reston Pub. Co. Inc.
3) An Introduction to Jig & Tool Design, M.H.A. Kempster, (ELBS)
4) Fundamentals of Tool Design, Ed. Frank Wilson, ASTME (TMH)
5) Jigs and Fixture Design Manual, Henrikson (Industrial Press, NY)
6) A Text Book of Prod. Engineering, P. C. Sharma, S. Chand
7) Jigs and Fixture, P. H. Joshi, Tata Mc-Graw Hill Pub. Co
8) Techniques of Press Working of Metals by Eary and Reed

References:

1] Handbook of Die Design- Suchy, (McGraw Hill)
2] Die Design Fundamentals, J. R. Paquin, R. E. Crowley, Industrial Press Inc
3]CMTI Machine Tool Design Handbook, (TMH)
4] Design Data Handbook –PSG College of Tech., Coimbtore

Unit wise Measurable students Learning Outcomes:

1] The student shall be able to understand various elements of jigs and fixtures
2] The student shall be able to Design and drawing of drilling jig.
3] The student shall be able to Design and drawing of milling fixture.
4] The student shall be able to understand various elements and types of dies.
5] The student shall be able to Design die for stretch drawing operation.
6] The student shall be able to Design progressive die

Title of the Course: Internet of Things

L	T	P	C
2	-	-	-

Course Code: UPRD0661

Course Pre-Requisite: Basics of programming, sensor application

Course Description: Students will understand the concepts of Internet of Things (IoT) and can able to build IoT applications.

Course Objectives:

1. To understand the concepts of IoT.
2. The student shall be able to analyze basic protocols in wireless sensor network.
3. The student shall be able design IoT applications in different domain and be able to analyze their performance.
4. To implement basic IoT applications on embedded platform.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom"s Cognitive level	Descriptor
CO1	Understand the concepts of IoT	1	Understand
CO2	Understand basic applications in wireless sensor network	3	Analyze
CO3	Design IoT applications in different domain and be able to analyze their performance	6	Apply
CO4	Implement basic IoT applications on real life applications	5	Apply

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1		2	2										
CO2		2	2	2									3	2
CO3			3	2	3									
CO4		1	2	2										

Indicate mapping strength as 3 (High), 2 (Medium), 1 (Low)

Assessments:
Teacher Assessment:
End Semester Examination (ESE) only

Assessment	Marks
ESE	100

ESE: Assessment is based on 100% course content.

Course Contents:
Unit 1: Introduction to IoT 6 **Hrs.**
Important features of IoT, advantages, disadvantages, standard devices-desktop, tablet, cell phone and network devices like routers and switches

Unit 2: IoT–Hardware 6**Hrs.**

Accelerometers temperature sensors magnetometers proximity sensors, gyroscopes image sensors, acoustic sensors light sensors, pressure sensors, gas RFID sensors humidity sensors, micro flow sensors applications only.

Unit 3: IoT–Software 6**Hrs.**

Data collection, device integration , Real-Time analytics, application and process extension

Unit 4: IoT−Technology and Protocols 6**Hrs.**

NFC and RFID introduction , low-energy bluetooth, low-energy wireless, low-energy radio protocols, LTE-A, and WiFi-Direct.

Unit 5: Wireless Technologies & Governance of The Internet Of Things 4**Hrs.**

Dedicated short range communication (DSRC) & related protocols. Comparison of WPAN technologies cellular & mobile network technologies for IoT/M2M. Introduction, Notion of governance, aspects of governance, Aspects of governance Bodies subject to governing principles , IoT infrastructure governance, robustness, availability, reliability

Unit 6: **IoT – Common applications** 4**Hrs.**

Government and safety, manufacturing applications, transportation applications, engineering, industry, marketing, & advertising, environmental monitoring, energy applications, government applications, security

Textbooks:

1] Hakima Chaouchi, The Internet of Things, Connecting Objects to the Web, Wiley Publications (for Units 1, 3, 5, 6)
2] Daniel Minoli,"Building the Internet of Things with IPv6 and MIPv6 The Evolving World of M2M Communications", Wiley Publications (for Units 2,4)
3] Vijay Madisetti, Arshdeep Bahga, "Internet of Things: A Hands-On Approach"
4] Waltenegus Dargie,Christian Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice"

References:

1] Bernd Scholz-Reiter, Florian Michahelles, "Architecting the Internet of Things", ISBN 978-3842-19156-5, Springer.

Unit wise measurable students learning outcomes:

1] Student shall able to understand the concepts of IoT.
2] Student shall be able to analyze basic protocols in wireless sensor network.
3] Student shall be able design IoT applications in different domain and be able to analyze their performance.
4] Student shall be able to implement basic IoT applications on embedded platform.

Title of the Course: Mechatronics Systems Lab

L	T	P	C
-	-	2	1

Course Code: UPRD0631

Course Pre-Requisite:

1] Fundamentals of Electronics

2] Electrical Machines and Electronics

Course Description:

Mechatronics refers to a flexible, multi-technological approach for integration of mechanical engineering, computer engineering, electronics and information sciences. Mechatronics is essential in the design of intelligent products. It allows engineers to transform their virtual concepts into real life applications. It is a relatively new concept relating to the design of systems, devices and products aimed at achieving an optimal balance between basic mechanical structure and its overall control.

Course Objectives:

1. Be able to work efficiently in multidisciplinary teams.
2. Be able to classify different sensors
3. Be able to construct PLC ladder program for given application

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive level	Descriptor
CO1	Explain different types of control systems	2	Explain
CO2	Select appropriate sensor for given application	1	Select
CO3	Construct PLC ladder program	3	Construct
CO4	Select appropriate microcontroller for given application	3	Select
CO5	Classify different signal conditioning tech.	4	Classify
CO6	Explain various types of Micro manufacturing processes.	2	Explain

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2													
CO2		2		1									1	
CO3		1	3		2				1			1	2	
CO4		1	2										1	
CO5				2										
CO6	2													

Indicate mapping strength as 3 (High), 2 (Medium), 1 (Low)

Assessments :

Teacher Assessment:

One components of In Semester Evaluation (ISE) and one End Semester Examination (ESE) having 25 marks each

Assessment	Marks	Min of Passing
ISE	25	10
ESE (P.O.E)	25	10

ISE is based on lab experiment.

ESE: Assessment is based Oral examination based on 100% course content

Course Contents:

Experiment No. 1 **2 Hrs.**

To study the Basic Logic Gates using bread board

Outcome : Able to understand the Basic Logic Gates

Experiment No. 2 **2 Hrs.**

To study the Universal Logic Gates using breadboard

Outcome : Able to understand the Universal Logic Gates

Experiment No. 3 **2 Hrs.**

To study the Inverting OPAMP

Outcome : Able to learn the working of Inverting OPAMP

Experiment No. 4 **2 Hrs.**

To study the Non inverting OPAMP

Outcome : Able to learn the working of Non inverting OPAMP

Experiment No. 5 **2 Hrs.**

Addition and subtraction of two 8 bit numbers using 8051 microcontroller

Outcome : Able to learn working of microcontroller

Experiment No. 6 **2 Hrs.**

Stepper motor interfacing using microprocessor

Outcome : Able to understand interfacing with microprocessor

Experiment No. 7 **2 Hrs.**

PLC Programming – Basic Gates

Outcome : Able to understand basics of ladder programming

Experiment No. 8 **4 Hrs.**

PLC Programming – Sequencing

Outcome : Able to understand advanced concept in ladder programming

Experiment No. 9 **2 Hrs.**

Mini project to demonstrate the working of various sensors

Outcome : Able to select appropriate sensor for given application

Textbooks:

1] Mechatronics 3/e - W. Bolton (Addison Wesley) ISBN 81-7758-284-4
2] Mechatronics Principles, Concepts & Applications – N.P.Mahalik (TMH) ISBN 0-07-0483744
3] Ogata – Modern Control Engineering (Pearson Education) ISBN 81-7808-579-8
4] Industrial Automation – David. W. Pessen (John Wiley & Sons) ISBN 9971- 51-054-5.
5] Automated Manufacturing Systems: Sensors, Actuators – S. Brain Morriss (McGraw Hill) ISBN 0-07-113999-0
6] MEMS & Microsystems Design & Manufacture – Tai – Ran Hsu – TMH 0-07-048709.
7] MEMS – Mahalik, N.P. (TMH) ISBN :13 978-0-07-063445-9
8] Webb and Reis,"Programmable Logic Controller – Principles and Applications",Prentice Hall of India,2002.

References:

1] Mechatronics – Dan Necsulescu (Pearson Education) ISBN 81-7808 -676 – X. 8. The 8051 Microcontroller: Architecture, Programming & Applications, 2/e – Kenneth J. Ayala (Penram International) ISBN – 81-900828-7
2] Introduction to Mechatronics & Measurement System – David G. Alciatore & Michael B. Histand (TMH) ISBN 0-07-052908

Experiment wise Measurable students Learning Outcomes:

1] The student shall be able to understand different control systems
2] The student shall be able to select appropriate sensor and controller for given application
3] The student shall be able to select appropriate actuators for given application
4] The student shall be able to understand different signal conditioning tech
5] The student shall be able to construct PLC ladder program
6] The student shall be able to design Micro electromechanical components

Title of the Course: Design of jig fixture & dies lab

L	T	P	C
-	-	2	1

Course Code: UPRD0632

Course Pre-Requisite:

1. Fundamentals of Strength of material
2. Fundamentals of material
3. Fundamentals of forming processes

Course Description:

Design of jigs, and fixtures explain different techniques of designing jig and fixture by analyzing component and using different parts like locating, clamping and tool guiding system. **Modular Fixture Systems is use for flexibility in product** shape.

Design of dies explain different techniques of designing according to shape of product and machine.

Course Objectives:

1. To understand concepts of different clamping and locating system use in jig and fixure
2. The student shall be able to design drilling jig , milling fixtures and Modular Fixture Systems for different product.
3. To understand concepts of different system use in die design.
4. The student shall be able to design dies for different processes of metal forming.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive level	Descriptor
CO1	Define of locating and clamping system used in designing of jig and fixture	1	Remember
CO2	Plan sequence of operation for given component for machining	3	Apply
CO3	Design of drilling jig and milling fixture	6	Create
CO4	Classify sheet metal operation on basis of cutting and non cutting operation.	5	Evaluate
CO5	design dies for different processes of metal forming	6	Create

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1		2	2										
CO2		2	2	2									3	2
CO3			3	2	3									
CO4		1	2	2										
CO5			2	2										

Indicate mapping strength as 3 (High), 2 (Medium), 1 (Low)

Assessments:

Teacher Assessment:

One component of In Semester Evaluation (ISE) and one End Semester Examination (ESE) having 50%, and 50% weights respectively.

Assessment	Marks
ISE	25
ESE	25

ISE are based on practical performed/ Quiz/ Mini-Project assigned/ Presentation/ Group Discussion/ Internal oral etc.

ESE: Assessment is based on oral examination

Course Contents:

Experiment No. 1: **4 Hrs**

Assignment of Study of various elements of jigs and fixtures

Aim and Objectives: The student shall be able to design drilling jig , milling fixtures and Modular Fixture Systems for different product

Outcomes: Design of jig and fixture

Experiment No. 2: **4 Hrs**

Design and drawing of two drilling / reaming jigs. (Details of at least one sheet showing manufacturing drawing with tolerances, material specification and heat treatment.)

Aim and Objectives: The student shall be able to design drilling jig , milling fixtures and Modular Fixture Systems for different product

Outcomes: Design of modular fixture design

Experiment No. 3: **4 Hrs**

Design and drawing of two milling fixtures. (Details of at least one sheet showing manufacturing drawing with tolerances, material specification and heat treatment.)

Aim and Objectives: The student shall be able to design drilling jig , milling fixtures and Modular Fixture Systems for different product

Outcomes: Design of modular fixture design

Experiment No 4: **4 hrs**

Die Design for stretch drawing operation for a component

Aim and Objectives: The student shall be able to design dies for different processes of metal forming.

Outcomes: design dies for drawing die

Experiment No 5: **4 Hrs**

Design and drawing of one progressive die.

Aim and Objectives: The student shall be able to design dies for different processes of metal forming.

Outcomes: design dies for progressive die.

Experiment No. 6 **4 Hrs**

Industrial visits for studying the metal forming Dies, and jig and fixture

Aim and Objectives: To understand concepts of different system use in die design and jig and fixture design.

Outcomes: To understand die design and failure of die and jig and fixture.

Textbooks:

1] Rong, Yeming; "Computer Aided Fixture Design", Marcel Dekker, ISBN 0-8247-9961-5
2] Dies for Plastic Extrusion – M.V. Joshi – Mc Millan.
3] Design of Jigs and Fixtures – Hoffman (Pearson)
4] An Introduction to Jig & Tool Design, M.H.A. Kempster, (ELBS)
5] Jigs and Fixture Design Manual, Henrikson (Industrial Press, NY)
6] Die Design Fundamentals, J. R. Paquin, R. E. Crowley, Industrial Press Inc.
7] Jigs & Fixtures; Design Manual – (2/e), P.H. Joshi, (TMH) (2003)

References:

1] Metal Forming Handbook – Schuler, Springer- Verlag Berlin.
2] ASM Handbook – Forming – ASME
3] Handbook of Die Design, 2/e – Suchy, I (McGraw Hill), 2006.
4] Tool Design – C. Donaldson, LeCain & Goold (TMH)
5] Tool Design – H.W. Pollack (Taraporwalla)

Experiment wise Measurable students Learning Outcomes:

1. The student shall be able to understand various elements of jigs and fixtures
2. The student shall be able to Design and drawing of drilling jig.
3. The student shall be able to Design and drawing of milling fixture.
4. The student shall be able to Design die for stretch drawing operation.
5. The student shall be able to Design progressive die
6. The student shall be gate practical approach of jig, fixture and various dies.

Title of the Course: CAM Lab-II

L	T	P	C
0	0	2	1

Course Code: UPRD0633

Course Pre-Requisite:

1. Fundamentals of machine tools and cutting operations
2. Fundamentals of machine drawing and process sheet
3. Fundamentals of CNC machine and programming

Course Description:

CAD/CAM applications are used to both design a product and program manufacturing processes, specifically, CNC machining. CAM software uses the models and assemblies created in CAD software to generate tool paths that drive the machines that turn the designs into physical parts. CAD/CAM software is most often used for machining of prototypes and finished parts. This laboratory is aimed at providing an introduction to the Know-how of common processes used in industries for manufacturing parts by removal of material in a controlled manner. Auxiliary methods for machining to desired accuracy and quality will also be covered. Evidently, acquaintance with the machine is desirable and the laboratory sessions will provide adequate opportunity.

Course Objectives:

1. To select a machine and plan for job operations.
2. To perform machining operations on various metal removing machines.
3. To study advanced features of Computer Aided Manufacturing practices followed in the industry.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom"s Cognitive level	Descriptor
CO1	Explain fundamental of computer aided manufacturing, computer numerical control and manual CNC programming.	2	Explain
CO2	Develop manual CNC program for turning and milling operation.	3	Develop
CO3	Select proper tool and machining parameters for operation like turning and milling operation on CNC machine.	3	Select
CO4	Carry out CNC program generation from CAD model.	5	Carry out
CO5	Perform turning and milling operation on CNC machine as per specified drawing.	5	Perform

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1													
CO2		2												
CO3				2								2		
CO4					3									
CO5						2		2				2	3	3

Indicate mapping strength as 3 (High), 2 (Medium), 1 (Low)

Assessments:

Teacher Assessment:

Assessment	Marks
ISE	25
ESE (P.O.E)	25

ISE: Assessment is based on 50% assignment and 50% lab work.

ESE: Assessment is based on 100% lab work.

Course Contents:

Lab section 1: Selection of cutting parameters including tool specifications for various operations on CNC machines–Machining Center. **4 Hrs.**

Lab section 2: CNC manual Part Programming for Milling Center **4 Hrs.**

Lab section 3: CNC Part Programming for Milling Center: Canned Cycles, Pattern Repeat cycles, Sub programming and sub routines, Rotation of Coordinate System, Polar coordinate system. **6 Hrs.**

Lab section 4: Create a manual part program and executing it on a CNC lathe machine (at least one exercise each). **4 Hrs.**

Lab section 5: Generating and simulating CNC milling part programs from the CAD models using any suitable CNC simulation software. **6 Hrs.**

Note:

1] The student shall maintain a diary of the work consisting of the process plan.
2] The print outs of CAM & CNC programs and relevant reports of the above mentioned laboratory work shall be included in the journal.
3] During CNC practice each student has to perform the machining on CNC machining center.
4] Each student shall perform the CNC programming as referred to above points.
The external practical examination shall include execution of one assigned job & its operation on CNC machining center followed by an oral examination.

Textbooks:

1] Jon Stenerson and Kelly Curran "Computer Numerical Control"", Prentice-Hall India Pvt. Ltd. New Delhi, 2008.
2] Ibrahim Zeid "CAD/CAM – Theory and Practice" Mc Hill, International edition, 1998.
3] P. N. Rao "CAD/Cam principles and operations", Tata McGraw Hill
4] Thomas M. Crandell "CNC Machining and Programming, Industrial Press ISBN-0-831-3118-7
5] Bedworth, Wolfe and Henderson-Computer aided design and manufacturing, McGraw Hill.
6] A. Ghosh and Malik "Manufacturing Science" Affiliated East West Press Pvt. Ltd.
7] Tilak Raj "CNC Technology and Programming", Dhanpat Rai Publication Company.
8] Robert Quesada, T. Jeyapoovan "Computer Numerical Control: Machining and Turning Centers", Pearson Education.
9] Programming Manuals of various CNC machines (Lathes and Machining Centers) e.g. FANUC, SINUMERIC, MAZAK etc.
10] Catalogs of Commercial Tool Manufacturers e.g. SANDVIK, KENNAMETAL, ISCAR, TAEGUTECH, MITSUBISHI etc.
11] Manuals of CNC Simulation and CAM Software.
12] Reference Manuals of controllers like FANUC, Siemens, Mazak, etc.

Experiment wise measurable students learning outcomes:

1] Student shall be able to select proper tooling for CNC machine.
2] Student shall be able to create milling part programming.
3] Student shall be able to generate a CAD model and CNC program by using CAM software.
4] Student shall be able to perform milling operation of CNC turning centre.

Title of the Course: Industrial Management and Psychology-Lab	L	T	P	C
	-	-	2	1

Course Code: UPRD0634

Course Pre-Requisite: Communication Competency, Judgmental analysis ability essential

Course Description: To study evolution of management theory and various functions of management essential for efficient and effective working of an industrial organization besides understanding behavioral aspects human resource.

Course Objectives:

1. To discuss development of management thought and different approaches to management.
2. To explain framework of core management functions such as planning, organizing, staffing, directing essential for efficient and effective working of industrial organizations.
3. To discuss different motivation theories and types of leadership and controlling techniques for industrial management.
4. To explain different forms of organization and its influence on functions of management
5. To discuss application of management functions to different functional areas such as production, marketing, finance, materials and human resource management.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom"s Cognitive level	Descriptor
CO1	Discuss major contributions of Taylor, Fayol, Mayo, Drucker, Porter and modern management approaches	2	Understanding
CO2	Describe planning hierarchy and types of organization structures taking into account form of organization.	2	Understanding
CO3	Apply manpower planning principles to human resource requirement of organization for different time periods.	3	Applying
CO4	Demonstrate significance of application of management functions such as planning, organizing, and staffing to HRM, Production Management.	2	Understanding
CO5	Distinguish appropriate staffing role requirement taking into account personality characteristics	4	Analyzing
CO6	Demonstrate significance of application of management functions such as planning, organizing, staffing to finance and marketing management	2	Understanding

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1												1	1
CO2	2	1												2
CO3	2	2	1							2			1	2
CO4	2	2	1	1									1	2
CO5	2	2	2								1		1	2
CO6	2	2	2					2			2		2	

CO- Strength of Correlation: Key: 3: High, 2:Medium, 3:Low

Assessments :
Teacher Assessment:
In Semester Evaluation (ISE) only

Assessment	Marks
ISE	25

ISE are based on practical performed/ Quiz/ Mini-Project assigned/ Presentation/ Group Discussion/ Internal oral etc.

Course Contents:

Experiment No. 1: Case Study on Planning and goal setting **2 Hrs.**

Outcome : Able to understand the concept of planning and goal setting

Experiment No.2: Case Study on human resource planning. **2 Hrs.**

Outcome : Able to understand requirements of human resource planning

Experiment No. 3 : Case Study on theories of motivation **2Hrs.**

Outcome : Able to relate theories of motivation with actual work life.

Experiment No.4 : Case Study on leadership approaches **2Hrs.**

Outcome : Able to apply leadership approaches in work life

Experiment No.5 : Case Study on control techniques **2Hrs.**

Outcome : Able to evaluate control techniques for allocated tasks

Experiment No.6:- Case Study on psychological Tests **2 Hrs.**

Outcome : Apply various psychological aspects for managing real time situations

Textbooks:

1. Industrial Engineering and Production Management -By M. Mahajan, Dhanpat Rai and Co.
2. "Industrial Engineering and Management", Khanna, O.P., Dhanpat Rai and Sons.
3. Personnel Management and Human Resources, C.S. Venkataraman, B.K. Srivastava
4. L.C. Jhamb, Savitri Jhamb, "Industrial Management – I", Everest Publishing House.
5. Management by James A. F. Stoner, R. Edward Freeman, PHI
6. Management Today: Principles and Practice by Gene Burton and Manab Thakur
7. Essentials of Management by Koontz and O,,Donell, TMH
8. Organizational Behavior by Keith Davis, TMH
9. Management (Tasks, responsibilities and Practices) by Peter Drucker, Harper Business
10. Production Management by Lockyer, ELBS
11. Modern Production Management by E. S. Buffa (John Wiley)
12. Financial Management by Vanhorne, PHI
13. Financial Management (Theory and Practice) by Prasanna Chandra, TMH
14. Marketing Management by Philip Kotler, Pearson Edition
15. Marketing Management by Rajan Saxena, TMH
16. Personnel Management by Edward Flippo, TMH
17. Managing Human Resources by Gorrez, Balkin, Candy, PHI

References:

1.Management by James A. F. Stoner, R. Edward Freeman, PHI
2.Micormic, J. "Human factors in Engineering and Design", McGraw Hill
3.Banga, Sharma, "Industrial Organization and Management", Khanna Publication Ltd.
4.B. Davis and Margrethe H. Olson, "Management Information Systems", Mc-Graw Hill International Editions.

Unit wise Measurable students Learning Outcomes:
After the completion of respective unit, the student should be able to

1. Explain planning and goal setting in organization
2. Discuss human resource planning.
3. Identify importance of various motivational theories.
4. Discuss significance of leadership
5. Evaluate various controlling technique
6. Analyze human psychology and behavior in practice.

Title of the Course: Seminar

Course Code: UPRD0641

L	T	P	C
-	-	2	1

Course Pre-Requisite:

1. Mini project
2. Project base learning

Course Description:

To train the students to the techniques of conducting a minor research based on the literature review and compiling systematic report and presenting it before a group of peers and faculty.

Course Objectives:

1] To apply the appropriate knowledge and concepts to the seminar; shows understanding of these knowledge and concepts.
2] Demonstrates knowledge and application of modern engineering tools
3] Functions effectively as an individual
4] Properly able to communicate through report and presentation

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive level	Descriptor
CO1	Applies the appropriate knowledge and concepts to the seminar;	1	Remember
CO2	Demonstrates awareness of modern engineering tools	2	Demonstrate
CO3	Demonstrate awareness ethics in project as well as report	2	Demonstrate
CO4	Able to communicate through report and presentation with minor misunderstandings	3	Apply

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	3											
CO2		1	2											
CO3			2		3								2	3
CO4			2	2										2
CO5				2										

Indicate mapping strength as 3 (High), 2 (Medium), 1 (Low)

Assessments :

Teacher Assessment:

In Semester Evaluation (ISE) only

Assessment	Marks
ISE	25

ISE are based on Presentation only etc.
Note: For Seminar a group of nine students shall be considered for workload purpose.

Course Contents:

Contents & Term Work: 1 **Hrs.**

Before the end of Semester VI, each student will deliver a research seminar on a subject related to production engineering. The research seminar topic shall be latest and ahead of the scope of curriculum. The research seminar guide shall help the student in topic selection.

The student, as a part of the term work, shall systematically prepare and submit the report of the research seminar work in duplicate, typed on A4 size sheet in a prescribed format and bound. The report shall be compiled and edited very meticulously right from research problem definition to final conclusions & references. Mere copying and pasting must be avoided.

The student shall present the research seminar before the group of peers & faculty. The performance of the student shall be judged by the research seminar guide along with one more colleague on the basis of the contents, literature review, research problem definition, research objectives, research methodology, results & conclusions, the presentation and discussions.

IMPORTANT INSTRUCTIONS FOR INDUSTRIAL TRAINING & PROJECT WORK:

Each student should undergo an industrial training in a manufacturing industry during the vacation period for at least 15 days after the end of T.E.(Prod) Sem.VI examinations and prepare a training report in the prescribed format under the guidance of the guide allotted during B.E.(Prod) Sem. VII.

The department should guide and orient the students for the said industrial training as well as the selection of suitable problem for the Project Work (B.E.-Prod. Sem. VII & VIII) during T.E.(Prod) Sem.-VI.

Title of the Course: Plant Layout and Material Handling (Professional Elective II)	L	T	P	C
	3	-	-	3

Course Code: UPRD 0621

Course Pre-Requisite: Fundamental knowledge of shop floor activities, production processes, machine design

Course Description: Course comprises of introduction to plant layout, material handling principles, various material handling systems and their applications in manufacturing. It also covers automation in MHS, MHS safety and maintenance aspects.

Course Objectives:

1. To impart students a knowledge about plant layout and principles of Material handling system
2. To make aware students about applications of Material handling equipments/systems in manufacturing environment.
3. To develop within each student a measurable degree of competence in selection, designing and operation of material handling system as per application.
4. To provide students knowledge of automation, safety and maintenance in material handling systems.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom"s Cognitive level	Descriptor
CO1	Understand fundamentals of plant layout and principles of material handling system	2	Understanding
CO2	Develop material handling system as per plant layout considerations	3	Applying
CO3	Select suitable material handling equipment/system as per application	5	Evaluating
CO4	Use modern engineering tools such as computer simulation packages for design and simulation of material handling system	5	Evaluating
CO5	Understand safety and maintenance aspects	2	Understanding

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	1									1		
CO2			2	2								1	1	1
CO3				2								1		
CO4				1	3							1	3	2
CO5				1		3						1		

Strength of Correlation: Key: 3: High, 2:Medium, 1:Low

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one EndSemester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit 2: Introduction to Plant Layout **6 Hrs.**

Objectives and principles of plant layout, Classification of Layouts, Product, Process, Combination, Fixed Position, Service facility layout, cellular manufacturing layout, Advantages and Limitations of different layouts, facility planning, its importance & steps, design considerations for plant layout , relationship of plant layouts with material handling, Material movement , Material movement at receiving, shipping and in-process handling, types of warehouses, design considerations for in-house warehouse

Unit 2: **6 Hrs.**

Introduction to material handling : Definition, scope, importance , principles of material handling, Cost consideration in material handling, Role of management in material handling, Advantages and disadvantages of material handling, terms used in MHS

Unit 3:Equipments for material handling systems **12Hrs.**

Conveying Equipments :Belt, Screw, Bucket, Chain, Roller, Pneumatic, Slat, Vibratory, Wheel, vertical, Chute, Indexing, Carts-on-track, Tow line, Apron pan

Hoisting equipments: Jacks, pulleys, hand trolleys, hoists, power hoist, various types of cranes and elevators

Mobile Equipments: Industrial trucks: Types like sack, hand drawn, electric, hand pallet, powered pallet, forklift truck, order pickers, powered stackers, side loader, four way truck, straddle carrier

Pallets and containers:

Concepts of unit load, containerization and palletization.

Storing Equipments: Pallets and its types, skids, dolly, container, crates, trays, bins, bags, jars, cartons

Factors considered in equipment selection, Fundamental considerations in design of electric hoist and conveyor, case studies

Unit 4:Storing and sorting system **4 Hrs.**

Objective, performance, types of storage system, ASRS(Automatic storage and retrieval system)

Sorting system selection, fundamentals in designing sorting system, sortation conveyor

Unit 5:-Automation in material handling system **6 Hrs.**

Main parts of Robot, types of robot and its application in material handling, Automated guided vehicles, types and uses, Use of simulation software in material handling system

6 Hrs.

Unit 6:Safety and maintenance in material handling

Material handling safety, norms, operator training, crane, conveyor, forklift safety, Planned and unplanned maintenance of material handling equipments

Textbooks:

1. Material Handling Principles & Practice - Theodore H. Allegre Sr. (CBS Publishers & Distributors)
2. Aspects of Materials Handling,Dr. K.C. Arora, Vikas Shinde, Laxmi Publications

References:

1. Introduction to materials handling, Siddhartha Ray, New Age International Publisher
2.Plant Layout & Material Handling - James Apple (John Wiley)
3. Work Study - O. P. Khanna (Dhanpatrai & Sons)

Unit wise Measurable students Learning Outcomes:

After the completion of respective unit, the student should be able to

1. Identify type of layout and decide material movement as per plant layout and manufacturing stages
2. Understand economics and principles of material handling
3. Understand various types of MH equipments and their applications.
4. Use various storage and sorting systems as per material type
5. Apply automation aspects in material handling
6. Maintain and effectively use MH system with safety

Title of the Course: Industrial Engineering

L	T	P	C
3	-	-	3

Course Code: UPRD0622

Course Pre-Requisite:

1. Basic concept of Quality
2. Knowledge of manufacturing processes
3. Basics of business ethics

Course Description:

To acquire interdisciplinary knowledge of method study, work measurement techniques and ergonomics for the overall improvement of productivity and effectiveness.

Course Objectives:

1. The student shall demonstrate an interdisciplinary knowledge of method study
2. The student shall demonstrate, work measurement techniques.
3. The student shall understand ergonomics for the overall improvement of productivity and effectiveness.
4. The student should apply industrial engineering knowledge in industrial application

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom"s Cognitive level	Descriptor
CO1	Demonstrate the fundamental knowledge about Work Study	2	Demonstrate
CO2	Analyze the existing methods of working for a particular job	4	Analyze
CO3	Summarize different environmental factors which will affect the productivity	2	Summarize
CO4	Apply the knowledge of value engineering	3	Apply
CO5	Make use of different work measurement techniques.	3	Make use of
CO6	Plan and design plant and production layouts through basic strategies and with computer applications	4	Plan

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3													
CO2	1	2											2	
CO3							3							
CO4	2	1												
CO5			2		2							1		
CO6	1	1	3									1		1

Strength of Correlation: Key: 3: High, 2:Medium, 1:Low

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one EndSemester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit 1: Introduction to Industrial Engineering. Role of an Industrial Engineer, Productivity, Wastes Generation and Elimination, The Right Apporach (7 rights), IE Approach (DMAIC, PDCA cycles) 4 Hrs.

Unit 2:Operations Research 10 Hrs.

Linear Programming – Graphical Method, Assignment Problems, Sequencing Problems, Probability Distribution (Binomial, Poisson, Normal Distributions) (Numerical Treatment for the chapter).

Unit 3: Inventory Management 6 Hrs.

Definition of inventory, Necessity of inventory, Inventory as a Necessary Evil. Inventory Control Models – EOQ, EPL, Newsvendor Model, Made to Order model, Just-in-time philosophy. (Numerical Treatment for the chapter)

Unit 4: Logistics Management 6 Hrs.

Definition and Importance of Logistics, Role of Logistics in Nation Building, Logistics Network, Flow of material and information in a Logistics Network, Case Study: Walmart, FedEx, Flipkart, Amazon, Dell. Hub and Spoke model of Logistics Network building.

Unit 5:Planning and Forecasting 6 Hrs.

MRP, MRP II, ERP, Aggregate Planning, Forecasting – Moving Averages Method, Weighted Moving Averages Method, Trends- Positive and Negative Trends, Secular Trends, Seasonality, Cyclical Variation, Unexpected variations. (Numerical Treatment for the chapter)

Unit 6: Industrial Simulation 8 **Hrs.**

Definition of Simulation, Need and Necessity of Simulation, Tools of Simulation (Softwares), Theory of Constraints, Drum Buffer Rope philosophy, Differences between Cost Accounting and Manufacturing.

Textbooks:

1. Work Study: - I L O
2. Work Study: - Curie and Faraday (ELBS)
3. Industrial Engineering Handbook, Maynard (Mc Graw Hill)
4. Time and Motion Study Design, Barnes, R.M. (John Wiley)
5. Work Study & Ergonomics, L.C. Jhamb (Everest)
6. Facility Layout and Location – An Analytical Approach, Francis et. al.(PHI)
7. James Apple, Plant layout and Material Handling, John Wiley, 1977

References:

1. Facilities Planning – 3/e, Tompkins, White, Bozer, Tanchoco (John Wiley & Sons)

2. Job Evaluation – ILO
3. Payment by Results, - ILO
4. Work Study by O.P. Khanna (Dhanapat Rai and Sons)

Unit wise Measurable students Learning Outcomes:
After the completion of respective unit, the student should be able to

1. Understand the concept of productivity.
2. Use different types of charts for method study.
3. Understand the importance of ergonomics.
4. Differentiate between Value Engineering and Value Analysis
5. Use different work measurement techniques.
6. Construct a plant layout for given application.

Title of the Course: Energy Engineering

Course Code: UPRD0623

L	T	P	C
3	-	-	3

Course Pre-Requisite: Basic Mechanical Engineering

Course Description: Students will understand about what sources of energy are and how to utilize.

Course Objectives:

1. Acquire the knowledge of renewable sources of energy and utilization.
2. Enable the student to estimate the potential of energy sources.
3. Study various power stations , Performance and economic analysis
4. Understand the new trends in power and energy sectors

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom"s Cognitive level	Descriptor
CO1	Demonstrate need of different energy sources and their importance	2	Demonstrate
CO2	Analyze the utilization of solar, wind energy etc.	4	Analyze
CO3	Comprehend various equipments/systems utilized in power plants	5	Develop
CO4	Illustrate power plant economics	2	Illustrate

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2													
CO2		2		1									1	
CO3		1	3		2				1			1	2	
CO4		1	2										1	

Indicate mapping strength as 3 (High), 2 (Medium), 1 (Low)

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one EndSemester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.

MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with 60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit 1: Introduction to Renewable Energy sources , Solar potential, Solar radiation spectrum, Solar radiation geometry (Numerical on angle of incidence only), Solar radiation data, ,Solar Collectors (Flat plate, evacuated tube, Cylindrical parabolic, Concentrating paraboloid),Graphical representation of efficiency of various Collectors , Testing of Solar flat plate collectors – BIS code (No numerical), Thermal Energy storage (Introduction and types) 8 **Hrs.**

Unit 2:- Operating Principle of Photovoltaic cell concepts, Photo-cell materials, Cell module array, Series and parallel connections, Maximum power point tracking, Design of standalone system with battery and AC or DC load (Descriptive Treatment), Applications, Introduction, Principle and operation of fuel cells, classification and types of fuel cell. Fuel for fuel cells, Application of fuel cells. 7 **Hrs.**

Unit 3:--- Wind parameters and wind data, Power from wind, Site selection, Wind energy conversion systems and their classification, Construction and working of typical wind mill, Introduction to OTEC and Hybrid systems (Diesel-PV, Wind-PVBiomass-Diesel systems). 5**Hrs.**

Unit 4:--- Power scenario in India and world, NTPC, NHPC and their role in Power development in India, Power generation in Private sector, Power distribution, Power grid corporation of India, State grids, Railway grids and International grids, Different types of power plants – Thermal, Hydro, IC Engine, Gas Turbine, Nuclear and their characteristics, Combined Cycle, Pumped storage, Compressed Air storage power plants and their characteristics. Comparison of Power plants with respect to various parameters. Issues in Power plants. 7 **Hrs.**

Unit 5:--- Load Curves and Load duration curves (Numerical treatments), Performance and operational characteristics of power plants, Peak load, Intermediate load and Base load plants and their characteristics, Input output characteristics of power plants 6 **Hrs.**

Unit 6:--- , Economic division between base load plant and peak load plants, Tariff methods (Numerical Treatments).Energy Management, Energy Marketing: Navigating the financial, legal and accounting environment, Human Resources issues, India"s business culture in energy sector. 6**Hrs.**

Textbooks:

1] "Solar Energy",S.P.Sukhatme and J.K.Nayak, Tata McGraw-Hill, 3rd Edition, (2008).
2] "Non Convent Ional Energy Sources", G.D.Rai.- Khanna Publisher, 4th Edition.
3] "Power Plant Technology", M.M.El Wakil, Tata Mc Graw Hill. Int , 2nd Edition.Reprint, (2010).

4] "Power Plant Engineering", Domkundwar and Arora, Dhanpatrai and Sons.
5] "Modern Power Engineering" John Weisman and L.E. Eckart, , Prentice Hall of India, (1985).

References:

1] "Solar Photovoltaic Fundamentals, Technologies and Applications", Chetan Singh Solanki, Prentice Hall of India Publications.
2] "Modern Power Station Practice", Vol.6, Instrumentation, Controls and Testing, by Pergamon Press, Oxford, (1971).
3] "Power System Analysis", Grainger John J, and Stevenson Jr. W.D.,Tata McGraw Hill, (2003).
4] "Economic Operation of Power Systems", L.K.Kirchmeyer,John Wiley and Sons, (1993).
5] "Power System Analysis", C.A.Gross, John Wiley and Sons, Inc. (1986).

Unit wise Measurable students Learning Outcomes:
After the completion of respective unit, the student should be able to

1 Identify type of Renewable Energy sources
2 Understand non conventional energy sources.
3 Understand wind energy applications.
4 Use various type of power plant in INDIA.
5 Understand working condition of power plant.
6 Understand Energy Management in INDIA.

Title of the Course: Entrepreneurship Development -II

L	T	P	C
3	-	-	3

Course Code: UPRD 0624

Course Pre-Requisite: Genuine interest in development of entrepreneurial mindset. Planning competency and global awareness competency.

Course Description: To familiarize students with fundamentals of entrepreneurship, study government support organizations for entrepreneurs, study the process of starting the small scale industry besides studying the ecosystem available for new entrepreneurs, understand project management and project report, understand intellectual property, new ventures, business ethics

Course Objectives:

1. To gain basic knowledge about entrepreneurial process and to understand relationship between entrepreneurship and economic development
2. To understand role of SSI, planning of SSI, Govt. policies and facilities and to understand role of government support organizations for SSI.
3. To know the basic concepts and the process of business plan preparation
4. To know the techniques of small business management and to understand business aspects like export procedure, IP Act etc.
5. To gain knowledge about various aspects of project report preparation and understand statutory requirements for SSI.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom"s Cognitive level	Descriptor
CO1	Discuss entrepreneurial competencies required taking into consideration case studies of successful entrepreneurs.	2	Understand
CO2	Identify legal framework, organization structure for proposed SSI business.	3	Applying
CO3	Apply knowledge of incentives, subsidies and grants while considering SSI business.	3	Applying
CO4	Classify government facilities and support systems for SSI and interpret the support match for SSI.	2	Understand
CO5	Demonstrate application of small business planning principles taking into account product selection, machinery selection, site selection, marketing, and finance to prepare a sample report of a business plan.	2	Understand

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2										1			2
CO2	2	2									2			2
CO3	2	2	2								2		1	2
CO4	3	2	2								2	1	2	3
CO5	3	2	2								3	2		3

CO- Indicate mapping strength as 3 (High), 2 (Medium), 1 (Low

Assessments:

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one EndSemester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.

MSE: Assessment is based on 50% of course content (Normally first three modules)

ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit 1: --- 06**Hrs.**

- Innovation, creativity, Sources of innovation & creative ideas, Meaning & concept, The linkage of innovation, Creativity & Entrepreneurship, Process of Creativity
- New generations of entrepreneurship viz. social entrepreneurship, Health entrepreneurship, Tourism entrepreneurship, Women entrepreneurship. (3)

Unit 2: --- Small Scale Industry: 06**Hrs.**

- Definition of MSME, role of small scale industry in economic development, Legal framework of small scale industry, Organizational structure for small scale industry, Startup Process for small scale industries (3)
- . Government Policies towards SSI ,Different Central Government policies for SSI, Different State government policies for SSI

Unit 3: --- Institutional Support to Small Scale Industry: 10**Hrs.**

- Introduction, Supporting agencies of Government for SSI, Nature of Support, Central Government agencies and State Government agencies.
- Introduction to various incentives, subsidies and grants -Export Oriented Units - Fiscal and Tax concessions available

- Role of following agencies in the Entrepreneurship Development - District Industries Centers (DIC), Small Industries Service Institute (SISI), Entrepreneurship Development Institute of India (EDII), National Institute of Entrepreneurship & Small Business Development (NIESBUD), National Entrepreneurship Development Board (NEDB)

Unit 4: ---Preparation of Project

- Meaning of Project, steps to start SSI in India, Need and Significance of Report, Contents of Project Report, Formulation of Project Report, Errors in Project Formulation. 06**Hrs.**

Unit 5: ---Project Management: -08**Hrs.**

- Meaning of Project, Characteristics, Classification of Project, Aspects of Project, Project Cycle, Criteria for selection of Project, Project Feasibility, Importance of Project Identification, Project Appraisal, Scope of Appraisal, Steps to be followed in Project Appraisal.
- Crisis Management in terms of Start-up, Finance, Growth Succession, Marketing, Technology, Product Selection.

Unit 6: --- Managing &Growing an entrepreneurial firm: 06**Hrs.**

- Importance of Intellectual Property, Strategies for firm growth, Franchising, Segmenting the Market, Key Marketing Functions for New Ventures, 4P"s of Marketing for New Ventures,
- Business Ethics, Patents, Types of Patents, Process of Obtaining a Patent.

Textbooks:

1. Developing New Entrepreneurs - Entrepreneurship Development Institute of India, Ahmedabad.
2. Handbook of New Entrepreneurs
3. Management of Small Scale Industry - Vasant Desai (Himalaya Publication)
4. Entrepreneurship Playing to Win- Gordon Betty (Taraporwala & Co.)
5. Motivating Economic Achievement- David C. McClelland, David G. Winter
6. Industrial Maharashtra- Facts, Figures and Opportunities (M.I.D.C. Mumbai).
7. Project Planning & Entrepreneurship Development - T. R. Banga
8. Dynamics of Entrepreneurial Development & Management- Vasant Desai (Himalaya Publication)
9. S.S.I. and Entrepreneurship- Vasant Desai (Himalaya Publication)
10. Petersen and Lewis: Managerial Economics, 4/e, Pearson/PHI, 2002. 2. Managerial Economics, Ahuja. H.L, S. Chand, New Delhi.
11. M.L. Trivedi: Managerial Economics, Tata Mc-Graw Hill, New Delhi 2004.
12. PindyckvRubinfeld& Mehta, ―Micro Economics‖, Pearson
13. Ramachandran, and Kakani, ―How to Analyze Financial Statements, Tata McGraw Hill
14. Palat, Raghu, ―How to Read Annual Reports and Balance Sheets, JAICO Publishing House
15. Dash A.P., ―Financial Wisdom – Finance for Non-Finance Executives, Biztantra ISBN 978-81-7722-378-1

References:

1. Dynamics of Entrepreneurial Development & Management- Vasant Desai (Himalaya Publication)
2. Entrepreneurship Playing to Win- Gordon Betty (Taraporwala & Co.)
3. S.S.I. and Entrepreneurship- Vasant Desai (Himalaya Publication)
4. Developing New Entrepreneurs - Entrepreneurship Development Institute of India, Ahmedabad.

5. Motivating Economic Achievement- David C. McClelland, David G. Winter.
6. Project Planning & Entrepreneurship Development - T. R. Banga

Assignments:

1. Assignment on Entrepreneurship development.
2. Assignment on Small Scale Industry.
3. Assignment on Planning Small Scale Business
4. Assignment on Business Plan Preparation.
5. Assignment on Government Support Organizations
6. Assignment on Small Business Management

Unit wise Measurable Students Learning Outcomes:

After the completion of respective unit, the student should be able to

1] Understand concept of innovation, creativity and new generation entrepreneurship
2] Understand role of MSME in economic development
3] Identify role of various government supporting agencies in supporting SSI
4] Develop industrial project reports
5] Understand project management and crisis management
6] Apply concepts of intellectual property, new ventures, business ethics in practice

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Title of the Course: Reliability Engineering

L	T	P	C
3	-	-	3

Course Code: UPRD 0625

Course Pre-Requisite: Basic mathematics and statistic

Course Description: To familiarize students with fundamentals of reliability, maintainability and availability of sources and analyze field failure using reliability analysis

Course Objectives:

1. Introduce principles of reliability in engineering design.
2. Develop understanding of concepts of failures and availability of the intended products/systems and services.
3. Develop understanding of concepts of maintainability of the systems and services.
4. Develop an ability to apply various reliability techniques to solve interdisciplinary reliability problems

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom"s Cognitive level	Descriptor
CO1	Explain basics of reliability, maintainability and availability and differentiate among them.	2	Understand
CO2	Apply fundamentals of reliability to estimate reliability of manufacturing systems.	3	Apply
CO3	Analyze field failure data for reliability analysis.	4	Analyze
CO4	Evaluate costing of reliability techniques.	5	Evaluate

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1		2	2										
CO2		2											1	2
CO3			3	2	3									
CO4		1	2											

Indicate mapping strength as 3 (High), 2 (Medium), 1 (Low)

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit1- 5 **Hrs.**

Introduction to reliability, Definitions, Reliability in product life-cycle, Quality, Failures, Failure data, Failure models, Causes of failures, Maintainability and availability, System effectiveness, Redundancy techniques

Unit 2:- 7 **Hrs.**

Probability, Axiomatic probability, Statistical probability, Rules of probability, Random variables, Discrete distributions: Binomial and Poisson distribution, Continuous distributions: Uniform, Exponential, Weibull, Normal, Rayleigh, Gamma distribution

Unit 3: 8 **Hrs.**

Component reliability, Mean time to failure (MTTF), Time-dependent hazard models: Field-data, Constant hazard, Linear hazard, Nonlinear hazard, Gamma model, Stress-dependent hazard models, Markov model

Unit4: 8**Hrs**

System reliability, Components in series, Components in parallel, k-out-of-m systems, Mixed-mode failures, Fault-tree technique, Failure mode effect analysis (FMEA), Risk priority number (RPN)

Unit 5: 6**Hrs.**

Maintainability function, Mean time to repair (MTTR), Availability function, Preventive maintenance, Redundancy techniques, Unit redundancy, Component redundancy, Weakest-link technique, Mixed redundancy, Standby redundancy

Unit 6: **5Hrs.**

Economics of reliability, Manufacturer‟s cost, Customer‟s cost, Reliability achievement cost, Reliability utility cost, Depreciation cost, Availability cost for parallel systems

Textbooks:

1] Reliability Engineering and Life Testing, V N A Naikan, Prentice Hall, 2008
2] Reliability Engineering, E Balagurusamy, Tata McGraw Hill, 2008

References:

1] Principles of Reliability Engineering, K B Misra, Reliability Engineering Centre, IIT Kharagpur, 2004.
2] Maintenance Engineering and Management, S K Srivastava, S Chand, 2008
3] Terotechnology: Reliability Engineering and Maintenance Management, B Bhadury and S K Basu, Asian Books, 2003.

Unit wise Measurable students Learning Outcomes:
After the completion of respective unit, the student should be able to
1. Know about fundamentals of reliability engineering.
2. Understand mathematical modelling in reliability engineering
3. Know concepts of failure and hazard model in reliability engineering
4. Understand failures analysis in reliability engineering.
5. Know concepts of availability of sources.
6. Know concepts of Economics of reliability.

Title of the Course: Lean Manufacturing **L T P C**
Course Code: UPRD0626

3 - - 3

Course pre-requisite: The course is open to graduate students, advanced undergraduates and practicing engineers who wish to learn more about lean principles and practice.

Course Description:
This course will introduce graduate and advanced undergraduate students and practicing engineers to lean production principles and practice. Industrial engineers and others responsible for continuously improving operational performance must develop systems that are fast, flexible, focused and friendly for their companies, customers and production associates.

Course Objectives:
Course Learning Outcomes:
It is desired that at the end of the course, the student will be equipped with the basic knowledge of lean manufacturing, tools, techniques and implementation outcomes

CO	After the completion of the course the student should be able to	Bloom"s Cognitive	
		level	Descriptor
CO1	Ability to Lean manufacturing concept	2	Demonstrate
CO2	Ability to use Lean tools and techniques	3	Applying
CO3	Ability to understand the design, operation and control of lean manufacturing systems	4	Develop
CO4	Hands on skill in problem solving and controlling and improving Lean manufacturing system.	5	Evaluating
CO5	Ability to use quantitative methods to model, analyze, and optimize such systems.	6	Design

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2													
CO2		3												
CO3						2		2						
CO4			1		3		2			2		3		
CO5	3								1		2	3	2	

Indicate mapping strength as 3 (High), 2 (Medium), 1 (Low)

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one EndSemester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit 1 : **5Hrs.**
INTRODUCTION TO LEAN MANUFACTURING , Conventional Manufacturing versus Lean Manufacturing – Principles of Lean Manufacturing – Basic elements of lean manufacturing – Introduction to LM Tools.

Unit2 : **8Hrs.**
CELLULAR MANUFACTURING, JIT, TPM Cellular Manufacturing – Types of Layout, Principles of Cell layout, Implementation. JIT – Principles of JIT and Implementation of Kanban. TPM – Pillars of TPM, Principles and implementation of TPM.

Unit 3: **8Hrs.**
SET UP TIME REDUCTION, TQM, 5S, VSM Set up time reduction – Definition, philosophies and reduction approaches. TQM – Principles and implementation. 5S Principles and implementation – Value stream mapping - Procedure and principles.

Unit 4 :. Standardization of Operations. Machine layout, multi function workers and job rotation. Improvement activities to reduce work force and increase worker morale - foundation for improvements. **6Hrs.**

Unit 5 SIX SIGMA Six Sigma – Definition, statistical considerations, variability reduction, design of experiments – Six Sigma implementation **6 Hrs.**

Unit 6: CASE STUDIES Various case studies of implementation of lean manufacturing at industries **3Hrs.**

Textbooks:

1 Productions and Operations Management - Chasel Aquilino - Mcgra-hill company – 9 th edition - 2001.
2 Toyoto Production System -An integrated approach to Just in Time - Yasuhiro Monden - Engineering aild Management Press, Institute of Industrial Engineers Norcross Georgia.- 1983
3 The Machine that Changed the World. The Story of Lean Production - James P Womack, Daniel T Jones, and Daniel Roos - Harper Perennial edition published - 1991.
4 Lean Thinking - James Womack - Simon & Schuster Adult - ISBN: 0743249275, 2003.
5 Japanese Manufacturing Techniques. The Nine Hidden Lessons by simplicity - Richard Schourberger. - Free Press - 1st edition, ISBN-10: 0029291003, 1982.
6.Govindharajan, M., Natarajan, S. and Senthil Kumar, V.S., Engineering Ethics, Prentice Hall of India, (PHI) Delhi, 2004.

References:

1. Charles D, Fleddermann, "Engineering Ethics", Pearson / PHI, New Jersey 2004 (Indian Reprint)
2. Subramainam, R., Professional Ethics, Oxford University Press, New Delhi, 2013.

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Unit wise Measurable students Learning Outcomes:

1. To define, list and recall the principles of lean manufacturing.
2. To classify and describe the different tools used in lean manufacturing.
3. To employ different methods, procedures for achieving lean benefits.
4. To discriminate between lean characteristics and factors.
5. To evaluate the process on basis of six sigma.
6. To acquire hands on training through case study

Title of the Course: Marketing Management (Professional Elective II)	L	T	P	C
	3	-	-	3

Course Code: UPRD0627

Course Pre-Requisite: Fundamental knowledge of communication

Course Description: Course comprises of introduction to fundamentals of marketing management, marketing planning and market segmentation, marketing research and marketing information system, marketing mix, concepts of advertising and sales management, Introduction to export marketing and taxation

Course Objectives:

1. To impart students a knowledge about fundamentals of marketing management.
2. To make aware students about marketing planning, market segmentation, marketing research and marketing information system.
3. To develop within each student an ability to distinguish various marketing mix elements.
4. To provide students knowledge about marketing research and marketing information System.
5. To make aware students about advertising, sales management and export marketing concepts.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom"s Cognitive level	Descriptor
CO1	Understand fundamentals of marketing management	2	Understanding
CO2	Explain marketing planning and market segmentation	2	Understanding
CO3	Interpret knowledge about marketing research and marketing information system	2	Understanding
CO4	Distinguish various marketing mix elements	4	Analyzing
CO5	Apply knowledge of advertising, sales management, export marketing in marketing activities	3	Applying

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1				1		1		2		1		
CO2						1						1	1	
CO3				2	2							1	1	1
CO4		1	1			1				1		1		
CO5									1	3		1		

Strength of Correlation: Key: 3: High, 2:Medium, 1:Low

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one EndSemester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit 1: Introduction to Marketing Management **6 Hrs.**

Marketing – definition, concepts significance functions of marketing, difference between marketing and selling, concept of market, types of markets, role and functions of marketing manager. Concepts of tele-marketing, online-marketing, service marketing, rural marketing, introduction to consumer behavior, need of study of consumer behavior

Unit 2:Marketing planning and Marketing segmentation **6 Hrs.**

Marketing planning meaning and importance, marketing strategies, sales forecasting, methods of sales forecasting, marketing budget

Marketing segmentation meaning, definition, need, bases of market segmentation market coverage strategies adopted for segmenting the market, aggregation strategy, single segment strategy and multiple segment strategy, differential marketing and concentrated marketing

Unit 3: Marketing Research and Marketing Information System **6 Hrs.**

Marketing research, meaning and scope ,marketing research procedure – types and techniques of marketing research, concept and components of a marketing information system

Unit 4:Marketing Mix **10Hrs.**

Introduction to marketing Mix elements - product, place, promotion and rice

Product [Goods and Services]: Concept of product, classification of consumer goods, convenience goods, shopping goods and specialty goods, product life cycle, product mix, product decisions to be made such as brand policy decisions, product modification decisions, product elimination decisions, new product development decisions and product mix decisions, procedure for new product development.

b] Place: Channels of distribution, meaning, types of channels, selecting the type of a channel, channel management, physical distribution wholesaling and retailing.

c] Promotion: An introduction to promotion-mix elements, advertising, personal selling, sales promotion and publicity

d] Pricing: Meaning and importance of price, pricing objectives, procedure for setting the base price, types of pricing

Unit 5:- Advertising and Sales management: Objectives, types of advertisements, developing advertising campaign, deciding advertising media, sales promotion and publicity, ethics, regulations for advertising, case studies in advertising **6Hrs.**

Meaning of sales management and its role in marketing function, responsibilities of sales department, personal selling, sales force, designing a sales force, sales territories, sales quotas

Unit 6: **Export Marketing and taxation** **6Hrs.**

Introduction to export marketing, various documents in export marketing, letter of credit and its procedure, Introduction to taxation, Introduction to GST

Textbooks:

1. Philip Kotler ―Marketing Management‖, Prentice-Hall of India.
2. J.C.Gandhi ―Marketing- A Managerial Introduction, TMH
3. Ramswami and Namkumari―Marketing Management
4. S.A.Sherlekar―Marketing Management
5. David Luck et al, ―Marketing Research, TMH
6. James S. Norris, ―Advertising, Prentice-Hall of India.
7. Hill,― Industrial Marketing

References:

1. Kotler,Armstrong ―Principles of Marketing, 10/e, Pearson Education
2. Mahendra Mohan ―Advertising Management TMH.
3. Handbook of GST in India- Concept and Procedures,- Rakesh Garg-Bloomsbury,India
4. Export Import Procedures- Documentation and Logistics,-C. Rama Gopal-New Age
5. B. Horvard Levy, ― Marketing made simple‖, Rupa Paperback on Business Management

Unit wise Measurable students Learning Outcomes:

After the completion of respective unit, the student should be able to

1. Know about fundamentals of marketing management
2. Define marketing planning and market segmentation
3. Define marketing research and marketing information system
4. Distinguish various marketing mix elements.
5. Know concepts of advertising and sales management
6. Understand export marketing and taxation

Title of the Course: Safety Engineering **L T P C**
Course Code:UOEL0646 **3 - - 3**

Course Pre-Requisite: Basic Knowledge of different industries

Course Description: Students will understand safety issues in industry.

Course Objectives:
1 To understand the fundamental concepts of safety engineering
2. To learn the techniques for identification of hazards
3. To control of industrial hazards
4. To design safety features in industry

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom"s Cognitive	
		level	Descriptor
CO1	To demonstrate the knowledge of fundamental concepts of safety engineering	1	Understand
CO2	To identify the techniques for industrial hazards	3	Identify
CO3	To control the industrial hazards	2	Design
CO4	To design safety parameters in industry	3	Apply

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3		2										2	
CO2		3		1										
CO3				2										
CO4			3										2	

CO- Indicate mapping strength as 3 (High), 2 (Medium), 1 (Low)

Assessments :
Teacher Assessment:

Assessment is based only on ESE

Assessment	Marks
ESE	100

ESE: Assessment is based on 100% course content with 100% weightage for course content (normally last three modules) covered after MSE

Course Contents:

Unit 1: Industrial Safety: Need for Safety, Hazard identification and risk assessment, Preliminary hazard analysis (PHA), Failure mode effect analysis (FMEA), Job Safety Analysis, Accident causation, Accident investigation, Accident Prevention, First Aid. **6Hrs.**

Unit 2: Workplace and Plant Layout Design Safe design of plant layout and facilities, Emergency response preparedness, Designing safety features in machine and equipment, Poka-yoke for safe design and operation, Machine and equipment guarding, Personal protective equipment 6 **Hrs.**

Unit 3: Foundry and Metal Working Processes: Effects of heat, dust, and noise on worker fatigue and productivity, Working in hot environment like forging and rolling operations, Hazards and safety precautions in melting, moulding, core making, fettling, and foundry material handling. Safety precautions in shearing bending, rolling, drawing and other metalworking processes. 6**Hrs.**

Unit 4: Physical Agents at Workplace: Industrial Ventilation, heat stress, Types of ventilations, Industrial illumination, Basic requirements of illuminations, Noise, Noise Control measures, Effect of vibrations, Vibration control, Harmful radiations, Ionizing and Non-ionizing radiations. 8**Hrs.**

Unit 5: Safeguarding Machines: Designing safety features in machine tools, Common hazards in machining processes and their control. Machine guard requirements. Enclosure or barrier guards, Maintenance of machines, safeguard from robot tools, Sources of hazards in robot operations, Safeguarding personnel. 8**Hrs.**

Unit 6: Safety in maintenance operations, Work in confined spaces, Working at height, Fabrication processes: Hazards in welding operations and their control. Safety Training: On the job training, off the job training, Motivation for safety 6**Hrs.**

References:

1) Industrial Accident Prevention, H W Heinrich, McGraw Hill, 1980
2) Occupational Safety Management and Engineering, W Hammer and D Price, Prentice Hall, 2000
3) Industrial Safety Concepts and Practices K. T. Kulkani
4) Occupational Safety and Health: For Technologists, Engineers, and Managers. D Goetsch, Prentice Hall, 1999
5) Probabilistic Risk Assessment and Management for Engineers and Scientists, H Kumamoto and E Henley, IEEE Press, 1996

Unitwise Measurable Outcomes:

Unit 1: Students are able to understand the need for safety, First aid, accident Prevention, failure analysis, etc.

Unit 2: Students are able to understand safety features in machine, safety techniques, design of safety features, etc.

Unit 3: Students are able to understand different hazards and safety precautions in Foundry and Metal Working Processes

Unit 4: Students are able to understand the different effects of machines like vibration, noise, harmful radiations, and heat and safety precautions of that.

Unit 5: Students are able to understand the Maintenance of machines, safeguard from robot tools, Sources of hazards in robot operations, Safeguarding personnel.

Unit 6: Students are able to understand the different safety trainings, Motivation for safety, and work in confined space, hazards in different operations.

Title of the Course: Quality Management
Course Code: UOEL0647

L	T	P	C
3	-	-	3

Course pre-requisite: Knowledge of Statistics and management is required**.**

Course Description: Students gain the knowledge of all aspect of quality to attain the optimum performance of product.

Course Objectives:
To enhance the ability control, monitor and implement the quality system in the organization

Course Learning Objective :
1) Student should able to demonstrate to the core concepts and the emerging trends in Quality Management.
2) Student should able develop hands-on-skills on tools and techniques of Quality Management for industrial problem-solving.
3) To student should able to demonstrate implementation and documentation requirements for Quality system.

CO	After the completion of the course the student should be able to	Bloom"s Cognitive	
		level	Descriptor
CO1	Ability to describe quality.	2	Demonstrate
CO2	Ability to use statistical tools and techniques	3	Applying
CO3	Ability to document and implement quality systems.	4	Develop
CO4	Hands on skill in problem solving and controlling and improvement of quality.	5	Evaluating
CO5	Ability to design quality based manufacturing system.	6	Design

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2											2		
CO2		3											1	
CO3						2		2					2	
CO4			1		3		2			2			1	
CO5	3								1		2	3		

CO- Indicate mapping strength as 3 (High), 2 (Medium), 1 (Low
Assessments:

Teacher Assessment:

Assessment is based only on ESE

Assessment	Marks
ESE	100

ESE: Assessment is based on 100% course content with 100% weightage for course content (normally last three modules) covered after MSE

Course Contents:

Unit 1:-- **3Hrs.**

Principles and Practice

Definition, basic approach, gurus of TQM, TQM Framework, awareness, defining quality, historical review, benefits of TQM.

Unit 2:---Continuous Process Improvement Tools and Techniques **10 Hrs.**

PDCA & The PDSA Cycle, Kaizen, Benching marking, quality function deployment, failure mode and effect analysis, total productive maintenance. Six sigma methology, RAM approach.

6Hrs.

Unit 3:---Quality Management Tools

Why Why, nominal group technique, affinity diagram, interrelationship digraph, tree diagram, prioritization matrices, process decision program chart, activity network diagram.

Unit 4:---Statistical Process Control **8 Hrs.**

Pareto diagram, process flow diagram, cause and- effect diagram, check sheets, histograms, statistical fundamentals, Control charts, state of control, out of control process, control charts for variables, control charts for attributes, scatter diagrams, case studies.

Unit 5. Quality System **5Hrs.**

ISO 9001:2015, ISO 450000, TS16949, ISO 14001.

Unit 6:

Quality Improvement: Single parameter experiments, Orthogonal array, Analysis of Variance ANOVA (one - way), Process capability, Correlation analysis and Linear regression models. **7Hrs.**

Textbooks:

1] 1. Dale H. Besterfiled, "Total Quality Management", Pearson Education Asia
2] Rose, J.E. Total Quality Management, Kogan Page Ltd. 1993.
3] John Bank, The essence of total quality management, Prentice Hall, 1993.
4] Masaki Imami, KAIZEN, McGraw Hill, 1986.
5] Phil Crosby, Quality Without Tears, McGraw Hill
6] Six Sigma: Hemant Urdhwareshe Statistical Process Control
7] Design and analysis of experiments, Douglas C. Montegomery, WILEY INDIA publications.
8] Total Quality Management,B.Sentil Arasu, SCITECH publications.
9] Total Quality Management, NVR Naidu, NEW AGE INTERNATIONAL PUBLICATIONS.
10] Quality Engineering Using Robust Design, Madhav S. Phadke
11] Statistical Quality Control, M. Mahajan, Dhanpat Rai & Co.
12] Research Methodology, C.R.Kothari, New Age International Publications.

References:

1] John Bank, The essence of total quality management, Prentice Hall, 1993.
2] Greg Bounds and Lyle Yorks, Beyond Total Quality Management, McGraw Hill,

1994.
3] Managing For Total Quality ,N. LOGOTHETIS, Prentice Hall

Unit wise Measurable students Learning Outcomes:

1. To define quality and explain the evolution of quality
2. To select and explain tools and techniques for problem solving.
3. To select and explain management tools used for problem solving.
4. To choose and demonstrate the statistical process control.
5. To describe a quality system
6. To develop a improved system.

Title of the Course: Entrepreneurship Development

L	T	P	C
3	-	-	3

Course Code: UOEL0648

Course Pre-Requisite: Genuine interest in development of entrepreneurial mindset. Planning competency and global awareness competency.

Course Description: Familiarize students with fundamentals of entrepreneurship, study government support organizations for entrepreneurs, study the process of starting the small scale industry besides studying the ecosystem available for new entrepreneurs.

Course Objectives:

1. To gain basic knowledge about entrepreneurial process and understand relationship between entrepreneurship and economic development
2. To understand role of SSI, planning of SSI, government policies and facilities and to understand role of government support organizations for SSI.
3. To know the basic concepts and the process of business plan preparation
4. To know the techniques of small business management and to understand business aspects like export procedure, IP Act etc;
5. To gain knowledge about various aspects of project report preparation and understand statutory requirements for SSI.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom"s Cognitive level	Descriptor
CO1	Understand entrepreneurial competencies required taking into consideration case studies of successful entrepreneurs	2	Understand
CO2	Identify the working capital requirement for proposed SSI business	3	Applying
CO3	Apply qualitative and quantitative forecasting techniques for business opportunity identification.	3	Applying
CO4	Classify government facilities and support systems for SSI and interpret the support match for SSI.	2	Understand
CO5	Demonstrate application of small business planning principles taking into account product selection, machinery selection, site selection, marketing, finance to prepare a sample report of a business plan	2	Understand
CO6	Classify different types of crisis faced by SSI in life cycle stages.	2	Understand

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2										1			2
CO2	2	2									2			2
CO3	2	2	2	1							2		2	2
CO4	3	2	2	2						1	2	1	2	3
CO5	3	2	2	2							2	2		3
CO6	3			2							2		2	3

Indicate mapping strength as 3 (High), 2 (Medium), 1 (Low)

Assessment

Teacher Assessment:

Assessment is based only on ESE

Assessment	Marks
ESE	100

ESE: Assessment is based on 100% course content with 100% weightage for course content

Course Contents:

Unit 1: **8 Hrs.**

Entrepreneurship: Definition of Entrepreneur and Entrepreneurship, entrepreneurial process, Entrepreneurship and economic development, job creation, classification. (4)

Entrepreneurial Motivation: Self-disclosure, personality effectiveness, risk taking, entrepreneurial competencies, case studies. (4)

Unit 2:

Small Scale Units: Concept and definition of MSME, role of S.S.I. in Indian economy, government policies and facilities. (4) **4Hrs.**

Unit 3:

Planning Small Scale Business: Business opportunity identification, idea generation, ideas from marketplace, market assessment, demand estimation. (4) **4Hrs.**

Unit 4:

Business plan preparation: Need, Scope, Value, information sources of economical and technical knowhow, selection of location, working capital, identification of raw material, suppliers, plants/machinery, process, manpower and other inputs such as power, water etc. (8) **8Hrs.**

Unit 5:

Government Support Organizations: **8Hrs.**

a) Central Government
b) State government
c) Financial support organizations. (4)
Preparation of project report: technical, financial, economic and marketing feasibility. (4)

Unit 6:
Small Business Management **6Hrs.**

- Techniques of materials, production, finance, manpower resources and marketing management (3)
- Crisis management, study process, reasons of failure. (3)

Textbooks:

1] Developing New Entrepreneurs - Entrepreneurship Development Institute of India, Ahmedabad
2] Handbook of New Entrepreneurs, Management of Small Scale Industry - Vasant Desai (Himalaya Publication)
3] Entrepreneurship Playing to Win- Gordon Betty (Taraporwala & Co.)
4] Motivating Economic Achievement- David C. McClelland, David G. Winter
5] Industrial Maharashtra- Facts, Figures and Opportunities (M.I.D.C. Mumbai).
Project Planning & Entrepreneurship Development - T. R. Banga
Dynamics of Entrepreneurial Development & Management- Vasant Desai (Himalaya Publication)
6] S.S.I. and Entrepreneurship- Vasant Desai (Himalaya Publication)
Petersen and Lewis : Managerial Economics, 4/e, Pearson/PHI, 2002. 2. Managerial Economics, Ahuja. H.L, S. Chand, New Delhi.
7] M.L. Trivedi: Managerial Economics, Tata Mc-Graw Hill, New Delhi 2004.
8] PindyckRubinfeld& Mehta, ―Micro Economics‖, Pearson
9] Ramachandran, and Kakani, ―How to Analyze Financial Statements‖, Tata McGraw Hill
10]Palat, Raghu, ―How to Read Annual Reports and Balance Sheets‖, JAICO Publishing House
11]Dash A.P., ―Financial Wisdom – Finance for Non-Finance Executives‖, Biztantra ISBN 978-81-7722-378-1

References:

1] Dynamics of Entrepreneurial Development & Management- Vasant Desai (Himalaya Publication)
2] Entrepreneurship Playing to Win- Gordon Betty (Taraporwala & Co.)
3] S.S.I. and Entrepreneurship- Vasant Desai (Himalaya Publication).
4] Developing New Entrepreneurs - Entrepreneurship Development Institute of India, Ahmedabad.
5] Motivating Economic Achievement- David C. McClelland, David G. Winter.
6] Project Planning & Entrepreneurship Development - T. R. Banga

Unit wise Measurable Students Learning Outcomes:
After the completion of respective unit, the student should be able to

1] Understand concept of entrepreneurship and entrepreneurial motivation.
2] Understand role of M.S.M.E. and S.S.I. from Indian economy point of view.
3] Apply ideas on planning small scale business
4] Model feasible business plan
5] Identify role of government support organizations
6] Formulate techniques for managing small businesses.