AC Branch

SYLLABUS OF
M. TECH MECHANICAL ENGINEERING

HIMACHAL PRADESH UNIVERSITY
SUMMER HILL
SHIMLA-5

M. Tech Syllabus of Mechanical Engineering as enclosed is approved.

M. TECH

IN

MECHANICAL ENGINEERING

DETAILED SYLLABUS FOR THE PROPOSED COURSE

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING WITH SPECIALIZATION IN PRODUCTION ENGINEERING

STUDY AND EVALUATION SCHEME

Course No	Subjects	Study scheme hours / week				Evaluation Scheme						Total Marks
		L	T	P/D	Total	Internal Assessment Marks		External Assessment Marks				
						Theory	Practical	Theory	Hrs	Practical	Hrs	
FIRST SEMESTER												
PE-101	Metal Casting	3	1	0	4	50	---	100	3	---	---	150
PE-102	Metal Cutting	3	1	0	4	50	---	100	3	---	---	150
PE-103	Metal Forming	3	1	0	4	50	---	100	3	---	---	150
PE-104	Welding Technology	3	1	0	4	50	---	100	3	---	---	150
PE-105	Computer Aided Design & Manufacturing	3	1	0	4	50	---	100	3	---	---	150
PE-106	Laboratory -1	0	0	4	4	---	50	---	---	100	3	150
Total		**15**	**5**	**4**	**24**	**250**	**50**	**500**	**---**	**100**	**---**	**900**
SECOND SEMESTER												
PE-207	Non Conventional Machining Processes	3	1	0	4	50	---	100	3	---	---	150
PE-208	Jig, Fixtures & Die Design	3	1	0	4	50	---	100	3	---	---	150
PE-209	Production Planning & Control	3	1	0	4	50	---	100	3	---	---	150
PE-	*Elective -1	3	1	0	4	50	---	100	3	---	---	150
PE-	*Elective-2	3	1	0	4	50	---	100	3	---	---	150
PE-218	Laboratory -2	0	0	4	4	---	50	---	---	100	3	150
Total		**15**	**5**	**4**	**24**	**250**	**50**	**500**	**---**	**100**	**---**	**900**
THIRD SEMESTER												
PE-	*Elective -3	3	1	0	4	50	---	100	3	---	---	150
PE-	*Elective -4	3	1	0	4	50	---	100	3	---	---	150
PE-	*Elective -5	3	1	0	4	50	---	100	3	---	---	150
PE-380	Project	0	0	8	8	---	200	---	---	100	3	300
PE-390	Seminar	0	0	4	4	---	50	---	---	100	3	150
Total		**9**	**3**	**12**	**24**	**150**	**250**	**300**	**---**	**200**	**---**	**900**

FOURTH SEMESTER					
			Assessment Marks		
			Internal		External / University Exam
Course No	Subjects	Hrs / Week	Continual Assessment by Supervisor (a)	**Mid-Semester Evaluation(b)	Final Viva – Voce Examination (c)
PE-400	Dissertation	24	300	200	400
			Total Marks(a+b+c)		900

**Higher weightage will be given for publication in Journal/Paper Presentation in Conference

Abbreviations used: L = Lecture, T = Tutorial, P/D = Practical / Demonstration

Explanation:

- For evaluation of the dissertation the rules regulations and ordinances of the Himachal Pradesh University are to be followed

GRAND TOTAL MARKS OF ALL SEMESTERS	3600

ELECTIVES [*One Elective Subject may be considered from Each Group]

Course No	Subjects	Study scheme hours / week				Evaluation Scheme						Total Marks
	Subjects	L	T	P/D	Total	Internal Assessment Marks		External Assessment Marks				
						Theory	Practical	Theory	Hrs	Practical	Hrs	
ELECTIVE GROUP ONE												
PE-E10	Machine Tool Design	3	1	0	4	50	—	100	3	—	—	150
PE-E11	Cutting Tool Design	3	1	0	4	50	—	100	3	—	—	150
PE-E12	Industrial Tribology	3	1	0	4	50	—	100	3	—	—	150
ELECTIVE GROUP TWO												
PE-E13	Diagnostic Maintenance & Monitoring	3	1	0	4	50	—	100	3	—	—	150
PE-E14	Advanced Operations Research	3	1	0	4	50	—	100	3	—	—	150
PE-E15	Management of Production System	3	1	0	4	50	—	100	3	—	—	150
ELECTIVE GROUP THREE												
PE-E16	Simulation of Industrial Systems	3	1	0	4	50	—	100	3	—	—	150
PE-E17	Materials Technology	3	1	0	4	50	—	100	3	—	—	150
PE-E19	Mechatronics	3	1	0	4	50	—	100	3	—	—	150
ELECTIVE GROUP FOUR												
PE-E20	Robotics and Industrial automation	3	1	0	4	50	—	100	3	—	—	150
PE-E21	Metrology and Industrial Inspection	3	1	0	4	50	—	100	3	—	—	150
PE-E22	Computer aided Process Planning	3	1	0	4	50	—	100	3	—	—	150
ELECTIVE GROUP FIVE												
PE-E23	Methods, Engineering and Ergonomics	3	1	0	4	50	—	100	3	—	—	150
PE-E24	Product Design and Development	3	1	0	4	50	—	100	3	—	—	150
PE-E25	Entrepreneurship	3	1	0	4	50	—	100	3	—	—	150
PE-E26	Statistics and Reliability Engineering	3	1	0	4	50	—	100	3	—	—	150

METAL CASTING PE – 101

Course Code	PE – 101	Credits : 4	L-3, T-1, P/D-0
Name of the Course	METAL CASTING		
Lectures to be delivered	52(1 Hr Each) (L = 39, T= 13 for each semester)		
Semester End Examination	Max. Time: 3 hrs.	Max. Marks: 100	Min. Pass Marks: 40
Continuous Assessment (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)		Max. Marks: 50	

Instructions:

Eight questions out of entire syllabus and well-distributed are to be set; students are required to attempt 5 questions. Each question carries equal marks.

SYLLABUS

UNIT I

Structure of silica and different types of clays, bonding mechanism of silica, Water-clay systems. Swelling of clays, sintering adhesion and colloidal clay; silica grain shape and size distribution standard permeability A.F.S. clay Characteristics, Ingredients and additives of moulding sand, core sands.

UNIT II

Solidifications of Metals, nucleation, free energy concept, critical radius of nucleus. Nucleation and growth in metals and alloys. Constitutional super cooling. Columnar equi acquiesced and dendritic structures.

UNIT III

Freezing of alloys centreline feeding resistance. Rate of solidification, time of solidification, mould constant. Fluidity of metals, volumes re- distribution. Analysis of the process. Riser design shape, size and placement. Effect of appendages on risering. Effective feeding distances for simple and complex shapes. Use of chills,

UNIT IV

gating design, filling time. Aspiration of gases. Top, bottom and inside gating. Directional solidifications stresses in castings. Metal mould reactions. Expansion scale and metal penetration. Analysis of the process

UNIT V

Various moulding and casting processes, Hot box, Cold Box Process, Investment, Shell Moulding, Full Mould Process, Die Casting, Ceramic Shell Mould, Vaccum Moulding etc.Non-ferrous Die-casting of Aluminium and its alloys, brass and bronze.

Text Books:

1. Fundamentals of Metals Casting by Flin R.A; Addison Wesley.
2. Principles of Metal Casting by Heine Loper and Resenthal; McGraw Hill.

Reference Books:

3. Product Design & Process Engineering by Hielel and Draper; McGraw Hill.
4. Foundry Practice by Salman & Simans; Issac Pitman.
5. Metals Handbook- Metal Casting; ASME.

METAL CUTTING

PE – 102

Course Code	PE – 102	Credits : 4	L-3, T-1, P/D-0
Name of the Course	METAL CUTTING		
Lectures to be delivered	52(1 Hr Each) (L = 52, T = 0 for each semester)		
Semester End Examination	Max. Time: 3 hrs.	Max. Marks: 100	Min. Pass Marks: 40
Continuous Assessment (based on sessional tests 50%, Assignments 30%, Quiz/Seminar 10%, Attendance 10%)		Max. Marks: 50	

Instructions:

Eight questions out of entire syllabus and well-distributed are to be set; students are required to attempt 5 questions. Each question carries equal marks.

SYLLABUS

UNIT I

Introduction, System of tool nomenclature, Tool Geometry, Mechanism of Chip, formation and forces in orthogonal cutting, Merchant's force diagram. Oblique Cutting: Normal chip reduction coefficient under oblique cutting, true shear angle, effective rake, influx region consideration for deformation, direction of maximum elongation, effect of cutting variables on chip reduction co-efficient, forces system in oblique cutting, effect of wear land on force system, force system in milling, effect of helix angle.

UNIT II

Fundamentals of Dynamometry, Theoretical determination of forces, angle relations, heat and temperature during metal cutting; distribution, measurement, analysis, theoretical estimation of work piece temperature, hot machining Fundamental factors, which effect tool forces: Correlation of standard mechanized test. (Abuladze –relation), nature of contact and stagnant phenomenon, rates of strains, shear strain and normal strain distributions, cutting variables on cutting forces.

UNIT III

Cutting Tools, Tools materials analysis of plastic failure (from stability criterion), Analysis failure by brittle fracture, wear of cutting tools, criterion, flank and crater wear analysis, optimum tool life, tool life equations, (Taylor's woxen etc) Tool life test,

UNIT IV

Machining optimization, predominant types of wear; abrasive, adhesive, diffusion wear models, wear measurements and techniques, theory of tool wear oxidative mathematical modeling for wear, test of machinability and influence of metallurgy on machinability. Economics of metal machining

UNIT V

Abrasive Machining, Mechanics of grinding, cutting action of grit, maximum grit chip thickness, energy and grit force temperature during grinding, wheel wear, grinding, process simulation, testing of grinding wheels, mechanics of lapping and honing, free body abrasion.

Text Books:

1. Principles of Machine Tools by Sen & Bhattacharya, Publisher; New Central Book Agency.
2. Machining of Metals, by Brown; Prentice Hall.

Reference Books:

3. Principles of Metal Cutting by Shaw; Oxford I.B.H. Publication
4. Metal Cutting Theory & Cutting Tool Design by Asimov & Alekree, MIR Publications.
5. Machining Science & Application by Knowenberg Publisher; Longman Press.

METAL FORMING

PE – 103

Course Code	PE – 103	Credits : 4	L-3, T-1, P/D-0
Name of the Course	METAL FORMING		
Lectures to be delivered	52(1 Hr Each) (L = 39, T= 13 for each semester)		
Semester End Examination	Max. Time: 3 hrs.	Max. Marks: 100	Min. Pass Marks: 40
Continuous Assessment (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)		Max. Marks: 50	

Instructions:

Eight questions out of entire syllabus and well-distributed are to be set; students are required to attempt 5 questions. Each question carries equal marks.

SYLLABUS

UNIT I

Plasticity, True stress and true strain, true stress-strain curves, selection of stress-strain curves for cold and hot working, yield of isotropic plastic material, yield criteria. Tresca maximum sheer-strain-energy criterion, plastic incompressibility, Poisson's ratio for plastic deformation flow rule, strain hardening function, heat generation and heat transfer in metal forming processes, temperatures in Quasi continuous forming operations. Examination of metal forming processes.

UNIT II

Prediction of working loads and maximum deformation analysis of the processes of wire drawing/tube drawing, strip drawing and extrusion. Various parameters/variables affecting the processes of wire drawing, tube drawing, strip drawing and extrusion; various methods of tube drawing and their comparison. Working loads for plain strain forging of strip and disc under conditions of well lubrications and sticking of material with die and under mixed conditions, prediction of working loads under above approach (simple plain strain and axis symmetric problems)

UNIT III

Lubrication in metal forming processes, Principles and mechanism of lubrications, hydrodynamic and their film lubrication, boundary and extreme pressure lubricants, solid lubricants, lubricants used for rolling and cold drawing, forging, extrusion and deep drawing processes; defects in various metal forming processes like rolling, forging, extrusion, wire drawing and deep drawing and their causes and remedial measures.

UNIT IV

Theory and deep drawing of circular blanks, analysis of the process, prediction of radial stress and punch load, ironing, wrinkling, blank holding and various parameters/variables affecting the deep drawing process.

UNIT V

Rolling, Classification of rolling mills, analysis of the process. Prediction of roll pressure for flat strip rolling in the leading and lagging zones, roll separating forces, torque on the roll, affect of front and back tensions, affect of support rolls, various factors which affect rolling force.

Text Books:

1. An Introduction to the Principles of Metal Working by Rowe, Arnold.
2. Metal Forming Analysis by Avitzer, McGraw Hill.

Reference Books:

3. Plasticity for Mechanical Engineering by Johnson & Merlore; Van Northand.
4. High Velocity Working Metals by ASME.

WELDING TECHNOLOGY PE – 104

Course Code	PE – 104	Credits : 4	L-3, T-1, P/D-0
Name of the Course	WELDING TECHNOLOGY		
Lectures to be delivered	52(1 Hr Each) (L = 39, T= 13 for each semester)		
Semester End Examination	Max. Time: 3 hrs.	Max. Marks: 100	Min. Pass Marks: 40
Continuous Assessment (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)		Max. Marks: 50	

Instructions:

Eight questions out of entire syllabus and well-distributed are to be set; students are required to attempt 5 questions. Each question carries equal marks.

SYLLABUS

UNIT I

Introduction, Basic classification of welding processes, weldability, weld thermal cycle, metallurgy of fusion welds, solidification mechanism and micro structural products in weld metal, epitaxial, cellular and dendritic solidification, metallurgical changes in weld metal, phase transformation during cooling of weld metal in carbon and low alloy steel, prediction of microstructures and properties of weld metal. Heat affected zone, re-crystallization and grain growth of HAZ, gas metal reaction, effects of alloying elements on welding of ferrous metals.

UNIT II

Welding Arc, Arc efficiency, temperature distribution in the arc; arc forces, arc blow, electrical characteristics of an arc, mechanism of arc initiation and maintenance, role of electrode polarity on arc behaviour and arc stability, analysis of the arc.

UNIT III

Coated Electrodes, Electrode coatings, classification of coatings of electrodes for SMAW, SAW fluxes, role of flux ingredients and shielding gases, classification of solid and flux code wires, Fusion Welding reviews: Critical reviews of manual metal arc welding (MMAW) GTAW, GMAW, FCAW and CO welding processes, plasma arc, submerged arc welding, electro gas and electro slag welding, analysis of the process.

UNIT IV

Welding power sources, Arc welding power sources basic charters tics of power sources for various arc welding processes, duty cycles, AC, DC welding power source, DC rectifiers, thyristor controlled rectifiers, transistorized units, inverter systems. Arc length regulation in mechanized welding processes, Metal Transfer and Melting Rate: Mechanism and types of metal transfer, forces affecting metal transfer, modes of metal transfer, metal transfer in various welding processes, effective of polarity on metal transfer and melting rate.

UNIT V

Solid State welding, Theory and mechanism of solid sate welding. Techniques and scope of Friction Welding, Diffusion Welding, Cold Pressure Welding and Ultrasonic Welding. High energy rate welding. Analysis of the Process. Welding Techniques using Radiation energy, Technique, scope and application of the electron beam and laser welding processes.

Text Books:

1. Welding Processes & Technology by Dr. R.S.Parmar Khanna Publishers
2. Welding Engineering & Technology by Dr. R.S.Parmar Khanna Publishers
3. Modern Arc Welding Technology by S.V. Nandkarni Oxford & IDH publishing Co.
4. Principles of Welding Technology by L.M. Gourd ELBS/ Edward Arnold
5. The Physics of Welding by Lancaster; Pergaman Press.

Reference Books:

6. The Metallurgy of Welding by Lancster; George Allen & Unwin Ltd. U.K.
7. Welding handbook, Vol. 1 & 2, seventh edition; American welding society.
8. The Solid Phase Welding Of Metals by Tylecote; Edward Arnold Pvt. Ltd.
9. Welding & Welding Technology Richard L. Little, McGraw Hill.
10. Welding Technology by Rossi; McGraw Hill.
11. Welding Technology by Koenigsberger and Adaer; Macmillan.

COMUTER AIDED DESIGN & MANUFACTURING PE – 105

Course Code	PE – 105	Credits : 4	L-3, T-1, P/D-0
Name of the Course	COMPUTER AIDED DESIGN & MANUFACTURING		
Lectures to be delivered	52(1 Hr Each) (L = 39, T = 13 for each semester)		
Semester End Examination	Max. Time: 3 hrs.	Max. Marks: 100	Min. Pass Marks: 40
Continuous Assessment (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)		Max. Marks: 50	

Instructions:

Eight questions out of entire syllabus and well-distributed are to be set; students are required to attempt 5 questions. Each question caries equal marks.

SYLLABUS

UNIT I

Introduction: CAD/CAM contents and tools; history of CAD/CAM development; CAD/CAM market trends; Definition of CAD/CAM tools, Industrial look at CAD/CAM.**CAD/CAM Hardware:** Introduction; types of systems; CAD/Cam systems evaluation criteria; input devices; output devices, hardware integration and networking; hardware trends.

UNIT II

CAD/CAM Software: Introduction; graphics standards; basic definition and modes of graphic operations; user interface; software modules, modeling and viewing; software documentation; software development; efficient use of CAD/CAM Software; Software trends. **Microprocessor based CAD/CAM:** Introduction; several features, system implementation; hardware components and configuration; micro-based CAD software; file translation; operating systems, mechanical applications; micro-CAD trends; product distribution trends.

UNIT III

Mathematical Representation of Curves: Introduction; wire frame models; wire frame, entities, curves representation, parametric representation of analytical and synthetic curves, curve, manipulation; design and Engineering applications. **Mathematical Representation of Surfaces:** Introduction, surface models, surface entités, surface representation, parametric representation of analytic and synthetic surfaces, surface manipulation.

UNIT IV

Mathematical Representation of Solids: Introduction, solid models, solid entities, solid representation, fundamentals of solid modeling, half –spaces; boundary representation; constructive solid geometry sweep representation, solid modeling based applications; design and engineering applications.

UNIT V

Geometric Transformations:
Introduction; transformation of geometric models, mappings of geometric models; inverse transmission and mappings; projections of geometric models; design and Engineering applications. **Mechanical Assembly and Tolerancing:** Introduction; modeling, representative schemes, generation of assembling sequences; tolerance concepts. Part Programming and Manufacturing: NC, CNC and DNC machines, part programming, manufacturing processes, process planning, tool path generation; design and Engineering applications.

Text Books:

1. CAD/CAM Theory and practice by Ibrahim Zeid; Tata McGraw Hill, New Delhi
2. CAD/CAM by Mikell P. Groover and M W Zimmers, Jr..

Reference Books:

3. Automation, Production Systems, and Computer Aided Manufacturing, Prentice Hall by Groover M.P.
4. Numerical Control and Computer Aided Manufacturing by Pressman, R.N. and William, J.E. John Wiley & Sons, New York.
5. The CAD/CAM Hand Book by Bedford Published by MIT Press.

LABORATORY I

PE – 106

Course Code	PE-106	Credits : 4	L-0, T-0, P/D-4
Name of the Course	**LABORATORY I**		
Lectures to be delivered	52 hours of Lab sessions		
Semester End Examination	Maximum Time: 3 hrs.	Max. Marks: 50	Min.Pass Marks : 20
Laboratory	Continuous Assessment (based on Lab work 30%, Lab record 25%, Viva 25%, Attendance 20%)	Max. Marks: 50	Min.Pass Marks: 25

Instructions:

One Laboratory / Field / Industrial oriented project / problem will be allocated to each student related to the subjects taught in 1st semester.

CONTENTS OF THE LABORATORY I

The laboratory areas include on a subject of

UNIT I

CAM & Manufacturing Science Laboratory: Metal Cutting, Metal Forming, Manufacturing Automation, Tool Wear Monitoring, Welding Technology, Accelerated Cutting, Part Programming and manufacturing of NC, CNC and DNC machines.

UNIT II

Machining of Advanced Engineering Materials, Die and Mold Design, Condition Monitoring, Tribology, Micro electromechanical systems, Nanofabrication.

UNIT III

CAD and RP Laboratory: Engineering Design & Manufacturing, Reverse Engineering, Rapid Prototyping & Rapid Tooling, CAD/CAM, Computer Graphics & Computational Geometry, Use of Pro-e, Catia etc for development of all shapes as per syllabus and their manipulation.

UNIT IV

Smart Materials & Structures Laboratory: Material Testing and Comparison of Properties, Sensors & Actuators, Smart Composites, Shape Memory Alloy Based Actuators, Robotic Grasping Mechanism, and Space Antenna Shape Control.

UNIT V

Representative Industry Projects / Field Visits

LIST OF THE PRATICALS

1. Inspection of Arc Welded Joint at Macro and Micro levels using Destructive Testing.
2. Study of Surface topology produced in EDM.
3. Measurement of Surface characteristics produced on Cylindrical Grinding Machine.
4. Study of cutting forces using Lathe Dynamometer or Drilling Dynamometer.
5. Determination of Compacting characteristics of the given metal powder using single die compaction.
6. Determination of Sintering properties of the given compacts using controlled gas sintering.
7. Determination of wear of the given specimen using pin on disc wear test rig.
8. Evaluation of Permeability number for a given sand specimen.
9. Determination of Grain fineness number using sieve shaker or Determination of Clay Content in a given sand sample.
10. Testing of Sand Specimen for various strengths.
11. Component Modeling in CAD / Pro-e / Catia.
12. Creating Drawing views from 3 D Model.

Text Books:

1. Fundamentals of Metals Casting by Flin R.A; Addison Wesley.
2. Principles of Metal Casting by Heine Loper and Resenthal; McGraw Hill.
3. Principles of Machine Tools by Sen & Bhattacharya, Publisher; New Central Book Agency.
4. Machining of Metals, by Brown; Prentice Hall.
5. An Introduction to the Principles of Metal Working by Rowe, Arnold.
6. Metal Forming Analysis by Avitzer, McGraw Hill.
7. Welding Processes & Technology by Dr. R.S.Parmar Khanna Publishers
8. CAD/CAM Theory and practice by Ibrahim Zeid; Tata McGraw Hill, New Delhi
9. CAD/CAM by Mikell P. Groover and M W Zimmers, Jr..

NON CONVENTIONAL MACHINING PROCESSES PE – 207

Course Code	PE – 207	Credits : 4	L-3, T-1, P/D-0
Name of the Course	NON CONVENTIONAL MACHINING PROCESSES		
Lectures to be delivered	52 (1 Hr Each) (L = 39, T=13 for each semester)		
Semester End Examination	Max. Time: 3 hrs.	Max. Marks: 100	Min. Pass Marks: 40
Continuous Assessment (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)		Max. Marks: 50	

Instructions:

Eight questions out of entire syllabus and well-distributed are to be set; students are required to attempt 5 questions. Each question carries equal marks.

SYLLABUS

UNIT I

New Technology, Introduction, Mechanical Processes, Abrasive Jet Technology, Ultrasonic Machining, Whirling Jet Machining. Fundamental principles, process parameters, characteristics, Tool design, Metal removal rate-analysis, important part design, Analysis of the Process.

UNIT I

Chemical and Electro-Chemical Machining, Introduction. Principles & scheme, process parameters, metal removal rate, dynamic and hydro-dynamic & hydro-optimization, electrolytes.

UNIT III

Electro Discharge Machining: Introduction, basic principles & scheme, circuitry controls, metal removal rate, machining accuracy, optimization, selection of tool material and tool design, Di-electric, Analysis.

UNIT IV

Laser Beam Machining & Electron Beam Machining, Introduction, back ground, production of Laser, machining by Laser and other applications, Electron beam action, Dimensionless analysis to establish correlation, behaviour EBM parameters.

UNIT V

High Velocity forming of metals, Explosive forming principles and applications, Electro-hydraulic and other applications, Analysis of the process.

Text Books:

1. Non-Traditional Machining Methods; ASME.
2. New Technology by Bhattayacharya; Institution of Engineers (India)
3. Ultrasonic Cutting by Rozenberg; Consultants Bureau; New York.

Reference Books:

4. Electro-Spark Machining of Metals; Vol. 2 by Lazarenko; Consultant Bureau; New York
5. Electro Chemical Machining by DE Baar; McDonald.

JIGS, FIXTURES & DIE DESIGN

PE – 208

Course Code	PE – 208	Credits : 4	L-3, T-1, P/D-0
Name of the Course	JIGS,FIXTURES & DIE DESIGN		
Lectures to be delivered	52 (1 Hr Each) (L = 39, T= 13 for each semester)		
Semester End Examination	Max. Time: 3 hrs.	Max. Marks: 100	Min. Pass Marks: 40
Continuous Assessment (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)		Max. Marks: 50	

Instructions:

Eight questions out of entire syllabus and well-distributed are to be set; students are required to attempt 5 questions. Each question carries equal marks.

SYLLABUS

UNIT I

Jigs and Fixtures: Elements of Jigs and Fixtures, Costs Calculations. Locating Element, Clamping Elements, Procedure in Designing. Jig and Fixtures: Fits and Tolerances Analysis.

UNIT II

Non-Standard Clamping Devices, Centerlizers, Equalizers, Actuators (Pneumatic, Hydraulic Electric and Electronic.) Automatic Loading and Unloading Devices.

UNIT III

Types of Trunions: Single, Double and Multi-Axis and Indexers. Transfer Line Jigs & Fixtures for the Operation of Multi-Drilling, Boring, Milling and Grinding.

UNIT IV

Assembly Line Fixtures. Universal Jigs and Fixtures. Transfer-Devices, Transfer Machine, Modulation-Design Concept, In Process Gauging.

UNIT V

Design of Dies: Elements of Dies and Punch. Types and Design Procedure, Progressive Dies, Drawing Die, Bending Die etc and their Analysis.

Text Books:

1. Jigs and Fixtures Design by Franklin-D-Jones.
2. Jigs and Fixtures by Colovin; F.H. Publisher; Massachusetts Institute of Technology.
3. Jigs and Fixtures Design by Hardy; H.W.

Reference Books:

4. Jigs and Fixtures Design by Haughton; P.S.
5. Jigs and Fixtures Published by Pearson Publication.

PRODUCTION PLANNING & CONTROL PE – 209

Course Code	PE – 509	Credits : 4	L-3, T-1, P/D-0
Name of the Course	PRODUCTION PLANNING & CONTROL		
Lectures to be delivered	52(1 Hr Each) (L = 39, T= 13 for each semester)		
Semester End Examination	Max. Time: 3 hrs.	Max. Marks: 100	Min. Pass Marks: 40
Continuous Assessment (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)		Max. Marks: 50	

Instructions:

Eight questions out of entire syllabus and well-distributed are to be set; students are required to attempt 5 questions. Each question carries equal marks.

SYLLABUS

UNIT I

Introduction, Pre-planning, market survey, machine and process capacity, capacity analysis; Effects of cyclic and random variations; Routing route sheets, common charts; Scheduling; various techniques of scheduling; Production order, dispatching of production orders, job card Inventory control, inventory costs, lot size models, back orders and last sales, quantity discounts, safety, stock, elementary control under risk; Materials purchasing, quotations; Rate controls; Introduction to value analysis.

UNIT II

Functions of Production Planning & Control (PPC), Scheduling techniques - Gantt Charts, analytical techniques, Documentation - Production Work Order. Introduction to PERT / CPM, Network Crashing. **Concept of World-Class Manufacturing,** Quality Management System, manufacturing, challenges of information age, Lean and Agile Manufacturing, Reconfigurable Manufacturing, Green Production, Computerized Production Management System.

UNIT III

Forecasting, Future mapping, invocating rates of technological change, methods of technology, forecasting such as relevance trees, morphological methods and mission flow diagram, combining forecast of different technologies, uses in manufacture alternative.

UNIT IV

Operations Management, Nature, Scope, Importance and Functions, Evolution from manufacturing to operations management - Evolution of the factory system - manufacturing systems –quality – mass customization. Contribution of Henry, Ford, Deming, Crosby, Taguchi, Scale of Operations. Methods of Manufacturing - Project / Jobbing, Batch Production, Flow/Continuous Production, Process Production - Characteristics of each method

UNIT V

Facilities Location & Layout, Strategic importance - Factors affecting location & layout - Installation of facilities – Single location, multi-location decisions. Principles and Types of Facilities Layout.

Text Books:

1. Elements of Production Planning and Control by Eilon Macmillan.
2. Operations Management – by Krajewski
3. Operations Management – by Mahadevan
4. Production & Operations Management – by Chary
5. Production & Operations Management – by Chase

Reference Books:

6. Production & Operations Management – by Adam & Ebert
7. Manufacturing & Operations Management – by L.C.Jhamb
8. The Machine that Changed the World – by James Womack (Reference book)

MACHINE TOOL DESIGN

PE – E10

Course Code	PE – E10	Credits : 4	L-3, T-1, P/D-0
Name of the Course	MACHINE TOOL DESIGN		
Lectures to be delivered	52 (1 Hr Each) (L = 39, T-13 for each semester)		
Semester End Examination	Max. Time: 3 hrs.	Max. Marks: 100	Min. Pass Marks: 40
Continuous Assessment (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)		Max. Marks: 50	

Instructions:

Eight questions out of entire syllabus and well-distributed are to be set; students are required to attempt 5 questions. Each question carries equal marks.

SYLLABUS

UNIT I

Introduction, Classification of machine tools, elements of machine tools, selection of speed and feed, gear box design various types of clutch systems, Sohopke and Report drives, double bond gears analysis, Lohr criterion for optimizing double bond gear. Stepless drives, mechanical stepless drive analysis, hydraulic step less drive & circuit analysis, design features, throttle valves, tracer controlled hydraulic circuit, hydraulic servo controls, electrical stepless drive circuits and characteristics. Strength and rigidity consideration, process capability and compliance, design of lathe bed, use of stiffness in bed, design of radial drill column and milling machine column.

UNIT II

Analysis of spindle bearings, slides and guides, design of spindle/arbor, antifriction and journal bearings, hydro-dynamic action in slides, analysis of hydrostatic bearings, roller guides, recirculating ball analysis, stick slip motion in guides-models, force analysis of lathe guide ways.

UNIT III

Vibrations of machine tools and dynamic rigidity: Effects of vibrations, source of vibrations, self excited vibration, single degree of freedom chatter, velocity principle and related models, regenerative principles, chatter in lathe, drilling milling and grinding. Tlusty and palace model, Peter's model, elimentation of machine tool structures matrix, finite elements and lumped constant models.

UNIT IV

Automation: Automation drives for machine tools, degree of automation, semi-automatics, analysis of collect action, design, of collet, bar feeding mechanism, tooling layout, single spindle, multi- spindle automatic, transfer machine, indexing Geneva mechanism, analysis, Swiss type automatic machine loading and unloading. Transfer-devices, modular –design concept in process gauging.

UNIT V

Control system of machine tools, Control: Mechanical, electrical, hydraulic, numerical, basic principle of cam control, hydraulic controls, fluid controls, numerical controls, feed back systems, primary systems programming. Basic devices, adaptive control.

Text Books:

1. Machine Tool Design by Mehta; Tata Mc Graw Hill.
2. Principles of Machine Tools by Sen & Bhattacharya; New Central Book Agency.
3. Machine Tool Design by Basu & Pal; Oxford & IBH

Reference Books:

4. Machine Tool Design Vol. I to IV by Acherkan; Mir Publishers.
5. Design Principles of Metal Cutting Machine Tools: Koerigsberger; Pergaman Press.

CUTTING TOOL DESIGN PE – E11

Course Code	PE – E11	Credits : 4	L-3, T-1, P/D-0
Name of the Course	CUTTING TOOL DESIGN		
Lectures to be delivered	52 (1 Hr Each) (L = 39, T= 13 for each semester)		
Semester End Examination	Max. Time: 3 hrs.	Max. Marks: 100	Min. Pass Marks: 40
Continuous Assessment (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)		Max. Marks: 50	

Instructions:

Eight questions out of entire syllabus and well-distributed are to be set; students are required to attempt 5 questions. Each question carries equal marks.

SYLLABUS

UNIT I

Fundamentals of Cutting Tools Design, Cutting tools and their principal elements, tool geometry, system of nomenclatures and their interrelations, setting for the grinding of various basic cutting tool (turning, drilling, milling).

UNIT II

Tool Materials, Developments of various tool materials, their relative characteristics, modern trend in tool development, concept of tool life. Single point tools; purpose and principle types and their characteristics, design procedure of single point tools, design of various high production tools, design of carbide tools. Form tools; purpose and types, design procedure and sharpening. **Drills** Purpose and principal types and their construction and geometry, development in the shape of twist drills analysis.

UNIT III

Milling Cutters, Purpose and types and their construction procedure of profile sharpened and form relieved cutters, design of hobs, analysis. **Broaches:** Purpose and types, design features of various broaches.

UNIT IV

Introduction of numerically controlled tools and their applications. Design of Feed Drives: Feed Drive using Feed Boxes, Axes Feed of CNC Drives, DC and AC Servomotors, Types characteristics Controllers and Their Selection, Ball Screws and Friction Screws- Guide Ways, Linear Motion System,

UNIT V

Design Calculations of Drives, Closed Loop Operations of Feed Drives, Linear Indexing Drives. Design of Special Purpose Machines: Modular Design Concepts, Standard Modules Example of Design of a typical SPM with CNC, Transfer Machines

Text Books:

1. Principles of Machine Tools by Sen & Bhattacharya; New Central book Agency.
2. Metal Cutting Theory and Cutting Tool Design by Arshinov & Alekreev; Mir Publishers.

Reference Books:

3. Principles of Metal Cutting By Shah; Oxford. IBH Publication

INDUSTRIAL TRIBOLOGY PE – E12

Course Code	PE – E12	Credits : 4	L-3, T-1, P/D-0
Name of the Course	INDUSTRIAL TRIBOLOGY		
Lectures to be delivered	52 (1 Hr Each) (L = 39,T=13 for each semester)		
Semester End Examination	Max. Time: 3 hrs.	Max. Marks: 100	Min. Pass Marks: 40
Continuous Assessment (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)		Max. Marks: 50	

Instructions:

Eight questions out of entire syllabus and well-distributed are to be set; students are required to attempt 5 questions. Each question carries equal marks.

SYLLABUS

UNIT I

Introduction

Friction, wear and lubrication, types of egg. Contacts: conforming and non-conforming. Types of motion; rubbing sliding. Oscillating. Rolling. and Surface of interactions: elastic and plastic deformations. Properties of materials. Surface energy and flash temperature theory

UNIT II

Friction

Laws of sliding friction, concept of adhesion, Tabor's mode off friction elastic thermo friction, rolling friction, measurement of friction.**Wear:**Laws of wear. Types of wear such as adhesive, declamination, abrasive, fatigue, corrosive, fretting, erosive, electrical and oxidative. Measurement of wear in dry at me sphere and different environments. Prevention and control of wear and friction in machines, wear of cutting tool and dies, study of abrasion in grinding, lapping and honing.

UNIT III

Lubrication, Mechanisms of lubrication, Boundary. Squeeze film hydrodynamic and elasto hydro-dynamic and hydro static lubrications plasto hydrodynamic lubrication, solution of Reynolds's equation in two and three-dimensional flow. Pressure distribution load carrying capacity friction forces in oil film and Co-efficient of friction in joumal bearing. Sold lubricants types and applications.

UNIT IV

Bearing Design, Design of bearing: clearance in journal bearing. Minimum film thickness, sommar-field Number, Oil grooves and flow of oil in axial and circumferential grooves cavitations and turbulence in oil bearings. Heat generation and cooling or bearing Hydrostatic and dynamic and their applications in machine tools. Design of air bearing and other gas bearing.

UNIT V

Rolling Friction, Reynold's slip, Heathe cote concept selection of roller bearings and their methods of lubrication design aspects and modes of bearing failures and elasto hydro dynamic lubrication, **Solid Lubricants,** Their applications in metal forming processes.

Text Books:

1. Fundamentals of Tribology by Basu & Sengupta; Published by PHI
2. Engineering Tribology by Prashant Sahu; Published by PHI
3. Industrial Tribology: A Text Book by Sharma and Aggarwal,, S.K. Kataria & Sons, New Delhi

Reference Books:

4. Industrial Tribology: failures and their analysis, Dr. B.S. Prabhu
5. Fundamentals of Machine Elements by B.J. Harnock; Published by Mc Graw Hill

DIAGNOSTIC MAINTENANCE & MONITORING PE – E13

Course Code	PE– 513	Credits : 4	L-3, T-1, P/D-0
Name of the Course	**DIAGNOSTIC MAINTENANCE & MONITORING**		
Lectures to be delivered	52 (1 Hr Each) (L = 39, T=13 for each semester)		
Semester End Examination	Max. Time: 3 hrs.	Max. Marks: 100	Min. Pass Marks: 40
Continuous Assessment (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)		Max. Marks: 50	

Instructions:

Eight questions out of entire syllabus and well-distributed are to be set; students are required to attempt 5 questions. Each question carries equal marks.

SYLLABUS

UNIT I

Introduction to Maintenance Technique, Preventive and predictive Maintenance, Introduction: Evolution of maintenance, objective of maintenance, maintenance and philosophies, maintenance concept maintenance management & technology, relationship with other functional areas, importance of maintenance, elements of good maintenance economics of maintenance, training and safety aspects in maintenance.

UNIT II

Maintenance strategies, Classification of maintenance programs. Corrective, preventive and predictive maintenance, comparison of maintenance programs, preventive maintenance concept, functions, benefits, limitations.

UNIT III

Non-destructive Testing (NDT), Purpose and challenges; techniques, visual aids boroscopes, endoscopes fiber obtics scanner, magnetic particles inspection, liquid penetrants. Ultrasonic radiography, selection of NTD techniques, merits/demerits and application of various techniques. Wear Analysis through thermography and Ferrography.

UNIT IV

Application of Diagnostic Maintenance to Industrial Machines and plants such as Sugar Industry, Textile Mills, Thermal Power plants and Railways.

UNIT V

Maintenance planning and control of a large factory, work planning and work control. Replacement Analysis. Maintenance Planning and Control: Basic ingredients, basic steps in maintenance management, maintenance planning and control system, documentation, maintenance productivity areas for improvement

Text Books:

1. Maintenance Planning and Control- Kelly, A. Buttersworth & Co.
2. Maintenance and spare parts Management – Krishanan G, Prentice Hall
3. Maintainability principal and practices Blanchard B.S. Lowey E.E. Mc Graw Hill.

Reference Books:

4. Practical NDT – Raj B, Jayakumar T, Thavasimutyi K, Narosa Publishing House.
5. Engineering Maintenance Management – Nieble Benjamin and W, Marcel Dekher

ADVANCED OPERATIONS RESEARCH PE – E14

Course Code	PE – E14	Credits : 4	L-3, T-1, P/D-0
Name of the Course	ADVANCED OPERATIONS RESEARCH		
Lectures to be delivered	52 (1 Hr Each) (L = 39, T=13 for each semester)		
Semester End Examination	Max. Time: 3 hrs.	Semester End Examination	Max. Time: 3 hrs.
Continuous Assessment (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)		Max. Marks: 50	

Instructions:

Eight questions out of entire syllabus and well-distributed are to be set; students are required to attempt 5 questions. Each question carries equal marks.

SYLLABUS

UNIT I

Linear Programming, The Theory of simplex solution, alternative optimal solution, unbounded solutions, infeasible solutions, formulation of LP models for Production scheduling, network planning, inventory, maintenance and capital budgeting and similar industrial problems. Two phase method, revised simpler method and dual simplex method sensitivity analysis. The dual problem and its role for post optimality analysis.

UNIT II

The transportation and assignment models, Traveling sales man model, and their industrial applications. **Dynamic Optimization Models** Formulation of dynamic optimisation models for common Industrial problems. Optimisation of non-linear objective function by dynamic programming.

UNIT III

Queuing Theory, Queuing with single and parallel channels with limited and unlimited service. Bulk input, bulk service, priority queue discipline. **Non-linear Optimization Models,** Non-linear objective queuing function of unconstrained variables, quadratic programming, **Simulation Models:** Generation of Random number. Use of Coefficient. Random numbers for system simulation. Use of computers for system simulation.

UNIT IV

Heuristic Models, Need for heuristic programming, examples of heuristic models for travelling salesman problems, facilities design and assembly line balancing. **Optimization Techniques** Introduction, theory and algorithms; classical method; unconstrained optimisation, constrained optimisation; langrangian multiplier method.

UNIT V

Decision Theory, Examples on the application of theory of games 2 XM and MX2 Problems, graphic dominance and linear programming method for different problems, decision trees. **Replacement Models,** Replacements of items that deteriorate, gradually, fail suddenly, group placement policy, concept of system reliability.

Text Books:

1. Fundamental of Operation Research by Ackoff & Sasieni: Wiley Eastern Ltd.
2. Principles of OR with Applications to Managerial Decisions by Wagner; Prentice Hall

Reference Books:

3. Introduction to OR by Hillier & Lieberman Holder Day.
4. Operation Research by PK Gupta & DS Hira, S. Chand & Co. New Delhi.

MANAGEMENT OF PRODUCTION SYSTEMS PE – E15

Course Code	PE – E15	Credits : 4	L-3 T-1, P/D-0
Name of the Course	MANAGEMENT OF PRODUCTION SYSTEMS		
Lectures to be delivered	52 (1 Hr Each) (L = 39, T=13 for each semester)		
Semester End Examination	Max. Time: 3 hrs.	Semester End Examination	Max. Time: 3 hrs.
Continuous Assessment (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)	Max. Marks: 50		

Instructions:

Eight questions out of entire syllabus and well-distributed are to be set; students are required to attempt 5 questions. Each question carries equal marks.

SYLLABUS

UNIT I

Systems theory and concepts, Systems defined, functional elements of a system, general system theory, systems theory and organization, systems concept and management. The systems approach, planning and systems concepts. Control and systems concepts, Information and systems concepts.

UNIT II

Quantitative techniques of system analysis, Systems analysis, problem solving, scientific method, mathematical analysis, models, computer techniques of analysis. Linear programming input output analysis, queuing Monte-Carlo techniques, Simulation, Industrial dynamics

UNIT III

Behavioural Aspects of System Design, The motivation factors in System design, leadership factors in system design. The need for systematic human relationships, the need for systems change, resistance to change, behavioural consequences of system changes, Microanalysis of complex, man machine open systems, concept as a basis of human integration, meeting the human and social problems.

UNIT IV

Flow system, Increasing complexity in distribution and production, increasing cost of a distribution, the total flow system, planning the transformation, service system, integrating systems. **Program Management,** Impact of advancing Technology, large scale integrating system. Program Management, concept functional stages of program-management organisational modifications, matrix organization, applications of program Management.

UNIT V

Management Cybernetics, Management cybernetics in controlling a manufacturing firm, production and inventory control systems, production, inventory, and employment control systems, the enterprise control systems.

Books:

1. Elements of Production Planning and Control by Eilon; Macmillan.
2. Automatic Production System & Computer Integrated Manufacturing by Groover; Prentice Hall.
3. Manufacturing Systems Engineering by Hitachi; Taylor & Francis. Hitogni.
4. Manufacturing Systems and Analysis by Baudin; Yourdon.

Reference Books:

5. Management of Systems by Nauhria, R.N. & Parkash, Rajnish.
6. Modern Production Management by Elwood, S. BuffaWiley, Eastern
7. Production / Operations Management by Rishards I. Koin; Tata Mc Graw Hill

SIMULATION OF INDUSTRIAL SYSTEMS PE – E16

Course Code	PE – E16	Credits : 4	L-3, T-1, P/D-0
Name of the Course	SIMULATION OF INDUSTRIAL SYSTEMS		
Lectures to be delivered	52 (1 Hr Each) (L = 39, T=13 for each semester)		
Semester End Examination	Max. Time: 3 hrs.	Semester End Examination	Max. Time: 3 hrs.
Continuous Assessment (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)		Max. Marks: 50	

Instructions:

Eight questions out of entire syllabus and well-distributed are to be set; students are required to attempt 5 questions. Each question carries equal marks.

SYLLABUS

UNIT I

Introduction and overview, concept of system, system environment, elements of system, system modeling, types of models, Monte Carlo method, system simulation, simulation - a management laboratory, advantages & limitations of system simulation, continuous and discrete systems. **Simulation of Continuous Systems** characteristics of a continuous system, comparison of numerical integration with continuous simulation system. Simulation of an integration formula.

UNIT II

Simulation of Discrete Systems, Time flow mechanisms, Discrete and continuous probability density functions. Generation of random numbers, testing of random numbers for randomness and for auto correlation, generation of random variates for discrete distribution, generation of random variates for continuous probability distributions-binomial, normal, exponential and beta distributions; combination of discrete event and continuous models.

UNIT III

Simulation of Queuing Systems, Concept of queuing theory, characteristic of queues, stationary and time dependent queues, queue discipline, time series analysis, measure of system performance, Kendall's notation, auto covariance and auto correlation function, auto correlation effects in queuing systems, simulation of single server queues, multi server queues, queues involving complex arrivals and service times with blanking and reneging.

UNIT IV

Simulation of Inventory Systems, Rudiments of inventory theory, MRP, in-process inventory. Necessity of simulation in inventory problems, forecasting and regression analysis, forecasting through simulation, generation of Poisson and Erlang variates, simulation of complex inventory situations. **Design of Simulation Experiments,** Length of run, elimination of initial bias, Variance, Variance reduction techniques, stratified sampling, antipathetic sampling, common random numbers, time series analysis, spectral analysis, model validation, optimization procedures, search methods, single variable deterministic case search, single variable non-deterministic case search, regenerative technique.

UNIT V

Simulation of PERT: Simulation of maintenance and replacement problems, capacity planning, production systems, reliability problems, computer time sharing problem, the elevator system. Simulation Languages: Continuous and discrete simulation languages block structured continuous languages, special purpose simulation languages, SIMSCRIPT, GPSS SIMULA importance and limitations of special purpose languages.

Text Books:

1. Simulation and Modeling By Loffick published from Tata McGraw Hill
2. System Simulation with Digital Computer By Deo Narsingh published from Prentice Hall
3. System Simulation By Hira, D.S. S. published from Chand & Co New Delhi.

Reference Books:

4. Computer Simulation and Modelling By Meelamkavil published from John Willey
5. System Simulation By Gordon published from Prentice Hall

MATERIALS TECHNOLOGY PE – E17

Course Code	PE – E17	Credits : 4	L-3, T-1, P/D-0
Name of the Course	MATERIALS TECHNOLOGY		
Lectures to be delivered	52 (1 Hr Each) (L = 39, T=13 for each semester)		
Semester End Examination	Max. Time: 3 hrs.	Semester End Examination	Max. Time: 3 hrs.
Continuous Assessment (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)		Max. Marks: 50	

Instructions:

Eight questions out of entire syllabus and well-distributed are to be set; students are required to attempt 5 questions. Each question carries equal marks.

SYLLABUS

UNIT I

Plastic Deformation of Single Crystals, Concept of crystal geometry, Lattice defects, Deformation by slip, slip in a perfect lattice, slip by dislocation movement, critical resolved shear stress for slip, deformation of single crystal, deformation of face centered cubic crystals, deformation by twinning, stacking faults, deformation bands and kink bands, micro strain behaviour, strain hardening of single crystal

UNIT II

Dislocation Theory, Introduction, observation of dislocation, Berger's vector and dislocation loop, dislocations in face centered cubic lattice, dislocations in hexagonal close packed lattice, dislocation in the body centered cubic lattice, stress fields and energies of dislocations, dislocation climb, intersection of dislocation Jogs, dislocation sources, multiplication of dislocations, dislocation point defect interactions, dislocation pile up.

UNIT III

Strengthening Mechanisms, Grain boundaries and deformation strengthening from grain boundaries, low angle grain boundaries, yield point, phenomenon of strain aging, solid solution hardening, deformation of two phase aggregates, strengthening from fine particles, strengthening due to point defects. Martensite strengthening, cold worked structure, strain hardening, annealing of cold worked metal, Bauschinger effect, preferred orientation

UNIT IV

Mechanical Behaviour of Polymeric Materials, Introduction, time dependent mechanical behaviour of polymeric materials, structure of polymers, deformation of polymers, yielding criteria for polymers, Rheology, viscoelastic behaviour, rubber elasticity, fracture and toughness

UNIT V

Fundamental of Metalworking, Mechanics of Metalworking, Flow stress determination, strain rate effects, deformation zone geometry, workability, residual stresses

Text Books:

1. Fundamentals of Material Science and Engineering- by William F Smith
2. Mechanical Metallurgy- by Dieter
3. Physical Metallurgy- by Reedhill
4. Physical Metallurgy- by Van Vlack

Reference Books:

5. Physical Metallurgy and Heat Treatment – by Lakhtin
6. Physical Metallurgy by Avner
7. Theory of Dislocations by Hull

LABORATORY II

PE – 218

Course Code	PE-218	Credits : 4	L-0, T-0, P/D-4
Name of the Course	**LABORATORY II**		
Lectures to be delivered	52 hours of Lab sessions		
Semester End Examination	Maximum Time: 3 hrs.	Max. Marks: 50	Min. Pass Marks : 20
Laboratory	Continuous Assessment (based on Lab work 30%, Lab record 25%, Viva 25%, Attendance 20%)	Max. Marks: 50	Min. Pass Marks: 25

Instructions:

One Laboratory / Field / Industrial oriented project / problem will be allocated to each student related to the subjects taught in 2nd semester.

CONTENTS OF THE LABORATORY I

The laboratory areas include on a subject of

UNIT I

Unconventional Machining Processes:

The lab research areas include on a suitable topic of Electro Chemical Machining (ECM), Abrasive Jet Machining (AJM), Abrasive Flow Machining (AFM), Wire Drawing Process, Tool Wear Monitoring Facility using Optical Fibers and Lasers

UNIT II

Jigs Fixture and Die design, The lab research areas include on a suitable topic of Jigs and Fixture Design, Die Design and Design of Non standard clamping devices

UNIT III

Computer Aided Production Planning and Control, The lab research areas include on a suitable topic of Production Planning and Control for a manufacturing set up with the aid of advanced tools and techniques

UNIT IV

Vibration, Robotics and Automation Laboratory. The research of the Vibration laboratory mainly focuses on Conditioning Monitoring, Kinematics, Design of Mechanisms, Diagnosis of Machinery, Non linear Vibration, Robotics and Automation Techniques.

UNIT V

Representative Industry Projects / Field Visits

LIST OF THE PRATICALS

1. Review of 2 D drafting features using CAD Software.
2. Introduction to 3 D Part Modeling.
3. Creating Assembly Modeling and advanced part modeling.
4. Creating Drawing views from 3 D Model.
5. Working with Standard Libraries
6. 1 D , 2 D and 3D Stress Analysis
7. Part Programming on CNC Lathe for generation of steps and taper on a cylindrical work piece or for generation of threads.
8. Programming for Drilling on CNC Milling Machine or Programming for a Profile on a flat surface using CNC Milling Machine.
9. Design and drawing of Jigs and Fixtures for production components using CAD / Pro-e / Catia.
10. Exploratory study of Computer Aided Production Planning and Control
11. Determination of Vibration of Machine Tools, Diagnosis of Machine and comparison with design criteria.
12. Design and development of pick and place Robot for manufacturing

Text Books:

1. Non-Traditional Machining Methods; ASME.
2. New Technology by Bhattayacharya; Institution of Engineers (India)
3. Ultrasonic Cutting by Rozenberg; Consultants Bureau; New York.
4. Jigs and Fixtures Design by Franklin-D-Jones
5. Fundamentals of Material Science and Engineering- by William F Smith
6. Analytical Robotics and Mechatronics, Wolfram Stadler, McGraw Hill
7. CAD / CAM Handbook, Bed ford, Massachusetts.
8. Automation Production Systems & Computer Aided Manufacturing.
9. Robotics for Engineers by Royen MIT Press

MECHATRONICS PE – E19

Course Code	PE – E19	Credits : 4	L-3, T-1, P/D-0
Name of the Course	MECHATRONICS		
Lectures to be delivered	52 (1 Hr Each) (L = 39, T=13 for each semester)		
Semester End Examination	Max. Time: 3 hrs.	Semester End Examination	Max. Time: 3 hrs.
Continuous Assessment (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)		Max. Marks: 50	

Instructions:

Eight questions out of entire syllabus and well-distributed are to be set; students are required to attempt 5 questions. Each question carries equal marks.

SYLLABUS

UNIT I

Introduction, What is Mechatronics, Systems, Measurement Systems, Control Systems; Microprocessor- based controllers, The Mechatronics Approach. **Sensors & Transducers,** Sensors and Transducers, Performance Terminology, (Displacement, Position & Proximity Sensors), (Velocity & Motion, Force, Fluid Pressure, Liquid Flow, Liquid Level, Temperature & Light Sensors), Selection of Sensors.

UNIT II

Electronic Fundamentals, Signal Conditioning Process, Operational Amplifier, Digital Logic, Logic Gates, Boolean Algebra, Data Acquisition Systems, Measurement Systems, Testing and Calibration. **Actuators,** Mechanical Actuation Systems, Hydraulic & Pneumatic Actuation Systems, Electrical Actuation Systems, A.C. Motor, D.C. Motor, Stepper Motor.

UNIT III

System Modeling & Control

Mathematical Models, Engineering Systems, Electromechanical & Hydraulic- Mechanical Systems, Modeling Dynamic Systems, Transfer Functions, Introduction to METLAB & SIMULINK, Control Modes, PID Controller.

UNIT IV

Microprocessor & Computer

Computer and Interfacing, Microcomputer Structure, Microcontrollers, Application of Microcontrollers, PLC.

UNIT V

Design & Mechatronics

Designing, Possible Design Solutions, Case Studies of Mechatronic Systems.

Books

1. Mechatronics, W. Bolton, Pearson Education Asia
2. Analytical Robotics and Mechatronics, Wolfram Stadler, McGraw Hill
3. Mechatronics, Dan Necsulescu, Pearson Education Asia
4. Introduction to Digital Computer Electronics, A.P. Mahind, TMH

Reference Books:

5. Measurement Systems, E.O. Doeblin, McGraw Hill
6. Automatic Control Systems, B.C. Kuo, Ogata, PHI
7. Understanding Electromechanical Engineering; An Introduction to Mechatronics Lawrence J K, PHI

ROBOTICS AND INDUSTRIAL AUTOMATION PE – E20

Course Code	PE – E20	Credits : 4	L-3, T-1, P/D-0
Name of the Course	ROBOTICS AND INDUSTRIAL AUTOMATION		
Lectures to be delivered	52 (1 Hr Each) (L = 39, T=13 for each semester)		
Semester End Examination	Max. Time: 3 hrs.	Semester End Examination	Max. Time: 3 hrs.
Continuous Assessment (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)		Max. Marks: 50	

Instructions:

Eight questions out of entire syllabus and well-distributed are to be set; students are required to attempt 5 questions. Each question carries equal marks.

SYLLABUS

UNIT I

Introduction to Robot Technology, Robot Physical configuration, basic Robot motions. Types of Manipulators: Constructional features, advantages and disadvantages of various kinematic structures, servo and Non- servo manipulator. **Actuators and Transmission System:** Pneumatic, Hydraulic and Electrical actuators and their characteristics and control systems. Feed Back Systems and Sensors: Encoders and other feed back systems, vision, ranging systems, textile sensors.

UNIT II

Programming Languages, Robot programming languages, Introduction to intelligent robots, Artificial Intelligence: Logged Locomotion, Export system. Concept of spatial description and transformations, manipulator Kinematics; Inverse manipulator, Kinematics Jacobians; velocities and static forces; manipulator dynamics, position control of manipulators, force control of manipulators, robot programming languages and systems.

UNIT III

Concept of automation in Industry, Mechanization and automation classification of automation systems. Air Cylinders- their design and mountings, pneumatic and hydraulic valves, flow control valves metering valves, direction control valves, hydraulic servo systems, pneumatic safety and remote control circuits.

UNIT IV

Basis of Automated work piece handling: Working principles and techniques, job orienting and feeding devices. Transfer mechanisms automated feed out of components, performance analysis. Material handling and processing, Metal cutting processes, Welding, Spray coating, Inspection, Assembly and hazardous operating conditions,

UNIT V

Safety in robotics, Social and labour issues in robotics, Metal handling using Automatic Guided Vehicles (AGV's), Automated storage systems using mobile robots, Issues in implementation of robotics in industry. Assembly automation, automatic packaging and automatic Inspection.

Text Books:

1. CAD / CAM by Groover and Zimmers (Jr.)
2. CAD / CAM Handbook, Bed ford, Massachusetts.
3. Automation Production Systems & Computer Aided Manufacturing.
4. Robotics for Engineers by Royen MIT Press

Reference Books:

5. Robot Manipulators by Paul MIT Press.
6. Robotics by Hall & Hall.
7. Robot Motion by Brady MIT Press.
8. Numerical Controlled Computer Aided Manufacturing by Pressman & Zimmers, J Wiley & Sons

METROLOGY & INDUSTRIAL INSPECTION PE – E21

Course Code	PE – E21	Credits : 4	L-3, T-1, P/D-0
Name of the Course	METROLOGY & INDUSTRIAL INSPECTION		
Lectures to be delivered	52 (1 Hr Each) (L = 39, T=13 for each semester)		
Semester End Examination	Max. Time: 3 hrs.	Max. Marks: 100	Min. Pass Marks: 40
Continuous Assessment (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)		Max. Marks: 50	

Instructions:

Eight questions out of entire syllabus and well-distributed are to be set; students are required to attempt 5 questions. Each question carries equal marks.

SYLLABUS

UNIT I

Standards of Measurement, Line, End and Wavelength standards. Primary secondary and working standards. Limits, Fits & tolerances, Interchangeability, design & manufacture of gauges, use of slip gauges, dial indicators, sine bars, auto-collimators, taper gauges, optical projectors and microscopes, Straightness, flatness and squareness testing.

UNIT II

Instruments for Measuring Surface finish & Roughness, Classes of instruments, the Taylor-Hobson Telesurf, plastic replica techniques, numerical assessment of roundness.

UNIT III

Calibration of Working Standards by Interferrometry, Application of interferometry, calibration of gauges by interference, by interference method, the gauge length interferometer, obliquity correction the absolute length gauge interferometer. The Calibration of working standards by direct comparison in series: Different types of comparators such as the pneumatic, optical, electrical and electronic comparators principle of amplification- magnification, sensitivity and response, the calibrations of end gauges in sets, ruling and calibration of standard scales.

UNIT IV

Measurement of Gear and Screw Threads, Measuring methods for run out, pitch, profile, lead, backlash, tooth thickness, composite elements, inspection equipment quality control screw thread terminology, measurement over wires, one wire measurement, three wire measurement, standard specifications and formulas, tolerances, thread gauge measurement, measurement, measuring equipment, application of thread gauges.

UNIT V

Management of Inspection and quality control, Communication of specifications, the nature of dimensions, selection of gauging equipment, kind of inspection, quality control Management

Books:

1. Metrology and Measuring Instruments by Taher
2. Dimensional Metrology by Miller
3. Dimensional Metrology by Khare & Vajpayee
4. Engineering Metrology by R.K.Jain

Reference Books:

5. Engineering Metrology by IC Gupta
6. Industrial Inspection Methods by Michelon, Leno C. Harper & Brothers
7. The Science of Precision Measurement Inspection & Gauging by The Do All Co, Des Plaines Illinois / The Industrial Press, New York

COMPUTER AIDED PROCESS PLANNING PE – E22

Course Code	PE – E22	Credits : 4	L-3, T-1, P/D-0
Name of the Course	COMPUTER AIDED PROCESS PLANNING		
Lectures to be delivered	52 (1 Hr Each) (L = 39, T=13 for each semester)		
Semester End Examination	Max. Time: 3 hrs.	Max. Marks: 100	Min. Pass Marks: 40
Continuous Assessment (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)		Max. Marks: 50	

Instructions:

Eight questions out of entire syllabus and well-distributed are to be set; students are required to attempt 5 questions. Each question carries equal marks.

SYLLABUS

UNIT I

Introduction, Traditional process planning, process planning elements, product design evaluation; selection of tooling and process parameters; operation sequence evaluation., Group Technology Production, advantages; part families; classification and coding systems, production analysis.

UNIT II

Design of Machine Cells. Production Systems at Operation Level Manufacturing support systems and concepts at the level of production processes; computer generated time standards; machinability data system; cutting condition optimization.

UNIT III

Production Systems at Plant Level, Communication oriented production information and control system (COPICS); material requirements planning capacity planning; shop floor control and operation scheduling.

UNIT IV

Automated Process Planning Advantages of automated process planning; Standardization of manufacturing process plans; variant process planning_ its features_ and different stages; different variant systems; advantages and limitations of variant process planning; generative process planning; its features; design strategies;

UNIT V

Planning; Modeling and Coding Scheme

Decision mechanism for software; decision trees for process; process, information; artificial intelligence; overview & application; search strategies for production systems; resolution and reduction systems; knowledge acquisition; machine selection; cutting tool selection; software; various generative process planning systems; advantages of generative process planning systems; case studies.

Text Books:

1. An Introduction to the Automated Process Planning by Chand & Wyske, Prentice Hall
2. Computer Aided Design & Manufacturing by Groover & Zimmers, Prentice Hall
3. Group Technology; Production Method in Manufacturing Gallagher & Knight Ellis Hosewood

Reference Books:

4. Principle of Artificial Intelligence by Nilson Publisher Springer Verlag
5. Automation; Production System & Computer Integrated Manufacturing by Groover Prentice Hall

METHODS ENGINEERING AND ERGONOMICS PE – E23

Course Code	PE – E23	Credits : 4	L-3, T-1, P/D-0
Name of the Course	METHODS ENGINEERING AND ERGONOMICS		
Lectures to be delivered	52 (1 Hr Each) (L = 39, T=13 for each semester)		
Semester End Examination	Max. Time: 3 hrs.	Max. Marks: 100	Min. Pass Marks: 40
Continuous Assessment (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)		Max. Marks: 50	

Instructions:

Eight questions out of entire syllabus and well-distributed are to be set; students are required to attempt 5 questions. Each question carries equal marks.

SYLLABUS

UNIT I

Introduction to Industrial Engineering and productivity measurement of productivity Introduction to work study, methods-study principles and motion economy, filming techniques and micro-motion analysis, Introduction to work measurement. Time study, performance allowances, work sampling, predetermined motion system, standard data system, job evaluation of merit rating. Wage incentive plans, MTM (Methods Time Measurement)

UNIT II

Introduction of Ergonomics, Man / Machine/Environment systems concept, Development of ergonomics. Design Approach: A new design, modification, of existing design, assessment of design. Limitation of man and machine with respect to each other, posture-standing at work, seated at work, work station heights and seat geometry. Human anthropometry and its use in work place layout, Analysis.

UNIT III

Controls, Hand controls and foot controls, location of controls and work place envelope. Recommendation about hand and foot push buttons, rotary selector switches, hand wheels, crank levers etc. Instruments and displays.

UNIT IV

Work Load, Static and dynamic muscular work. Human motor activity, metabolism, physical work load, measurement of physical work load, mental work load, measurement of mental work load, repetitive and inspection work, work duration and rest pauses, principles of motion economy, **Climates,** Heat Humidity: Body heat balance, effective temperature scales, zones of discomfort, effect of heat on body and work performance.

UNIT V

Vibration, Terminology, Response of body to low frequency (LF) vibration, vibrations and discomfort, effect on health of worker, high frequency vibration, effect of H.F. vibrations, methods of reducing vibrations, analysis. **Noise,** Terminology, physiological effects of noise, annoyance of noise, speed interference, hearing loss, temporary and permanent thresh hold shift, effect of noise on performance, reduction of noise, personal noise protection.

Text Books:

1. Methods Engineering Study – by Krick, EV.
2. Work study and Ergonomics – by Shah, H.S. Dhanpat Rai & Sons.
3. Introduction of Ergonomics – by Bridger- Tata McGraw Hill.

Reference Books:

4. Work Study – by Khanna, OP- Dhanpat Rai & Sons.
5. Sound, Noise and Vibration Control- by Lyle, F.Yerges-Van Nostrand.

PRODUCT DESIGN AND DEVELOPMENT PE – E24

Course Code	PE – E24	Credits : 4	L-3, T-1, P/D-0
Name of the Course	PRODUCT DESIGN AND DEVELOPMENT		
Lectures to be delivered	52 (1 Hr Each) (L = 39, T=13 for each semester)		
Semester End Examination	Max. Time: 3 hrs.	Max. Marks: 100	Min. Pass Marks: 40
Continuous Assessment (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)		Max. Marks: 50	

Instructions:

Eight questions out of entire syllabus and well-distributed are to be set; students are required to attempt 5 questions. Each question carries equal marks.

SYLLABUS

UNIT I

Introduction: to Product Design, Design by Evolution and Innovation, Essential factors of product design, Production consumption cycle, Flow and value addition in Production consumption cycle, The Morphology of Design, Primary design phases and flowcharting, Role of Allowances, process capability and tolerances in detailed design and assembly, **Product Design and Industry,** The Designer- his role, myth and reality, the industrial design organization, basic design considerations, Role of Aesthetics in product design, Functional design practice

UNIT II

Design for Production, Producibility Requirements in the design of machine components, Forging design, Pressed component design, Casting design for economical molding, eliminating defects and features to aid handling, Design for machining ease, the role of process Engineer, Ease of location and Clamping, Some additional aspects of production design, Design of powder metallurgical parts

UNIT III

Economic Factors Influencing Design, Product value, Design for safety, reliability and Environmental considerations, manufacturing operations in relation to design, Economic analysis, profit and competitiveness, break even analysis, Economics of a new product design

UNIT IV

Value Engineering and Product Design, Introduction, Historical perspective, Value, Nature and measurement of value, Maximum value, Normal degree of value, Importance of value, The value Analysis Job Plan, Creativity, Steps to problem solving and value analysis, Value Engineering, Idea generation check list, Cost reduction , materials and process selection in value engineering

UNIT V

Modern Approaches to product Design, Concurrent Design, Quality Function Deployment, reverse engineering, **Rapid Prototyping,** Stereo lithography, Solid ground cutting, Selective laser sintering, Laminated object manufacturing, data transfer to RPT, Constraints on the Model, RPT in manufacturing, tooling, RPT in Industrial Design, Medical applications verses conventional technologies

Text Books

1. Product Design and Development by Kail T Ulrich and Steven D Eppinger
2. Product Design and Development by AK Chitale and Gupta
3. Design of Systems & Devices by Middendorf Marcel DekkerIndustrial Design Mayall Mc Graw Hill

Reference Books:

4. Product Design &Process Engineering by Niebel &Draper Mc Graw Hill
5. Introduction to Design by Asimov Prentice Hall
6. Value Engineering by Mudge Mc Graw Hill

ENTREPRENEURSHIP **PE – E25**

Course Code	PE – E25	Credits : 4	L-3, T-1, P/D-0
Name of the Course	ENTREPRENEURSHIP		
Lectures to be delivered	52 (1 Hr Each) (L = 39, T=13 for each semester)		
Semester End Examination	Max. Time: 3 hrs.	Max. Marks: 100	Min. Pass Marks: 40
Continuous Assessment (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)		Max. Marks: 50	

Instructions:

Eight questions out of entire syllabus and well-distributed are to be set; students are required to attempt 5 questions. Each question carries equal marks.

SYLLABUS

UNIT I

Introduction, Factors leading to Industrial development Entrepreneur definition and various concepts, self awareness. Motivational aspects, attitude development, creativity, copying with uncertainties, resilience.

UNIT II

Information, Industrial potential, environmental scanning, Identification of opportunities, dynamics of an opportunity, business opportunities recognition. Government policy for Industrial development. Choice of Technology Research for patents, product development.

UNIT III

Planning, Planning of an Industrial unit, project planning, identification of market and demand for product, role of significant variables, execution of projects legal aspects, financial aspects and labour laws, feasibility studies, sectoral, Industrial and unit level feasibility, exposure to past, present and future.

UNIT IV

Entrepreneurial Management, Business finance Management through elementary concept-break even, working capital knowledge of various institutions and their mode of assistance. Elements of Production processes, quality control, Inspection methods. Production planning group dynamics.

UNIT V

Indian Industrial Environment, Project Planning and Financial management, SWOT Analysis. Five year plans and Industrial Policy of Government of India

Text Books:

1. Entrepreneurship Development Programme in India and its Relevance to Developing Countries by VG Patel; EDI- Ahmedabad, India.
2. Developing of New Entrepreneurship by EDI Ahmedabad, India.

Reference Books:

3. Self–Made Impact Making Entrepreneurship by G.R. Jain and M.A.Ansari ; by EDI Ahmedabad, India
4. Five year plan documents of Government of India

STATISTISTICS AND RELIABILITY ENGINEERING PE – E26

Course Code	PE – E26	Credits : 4	L-3, T-1, P/D-0
Name of the Course	STATISTISTICS AND RELIABILITY ENGINEERING		
Lectures to be delivered	52 (1 Hr Each) (L = 39, T=13 for each semester)		
Semester End Examination	Max. Time: 3 hrs.	Max. Marks: 100	Min. Pass Marks: 40
Continuous Assessment (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)		Max. Marks: 50	

Instructions:

Eight questions out of entire syllabus and well-distributed are to be set; students are required to attempt 5 questions. Each question carries equal marks.

SYLLABUS

UNIT I

Statistics, Introduction; Inferential Statistics & Probability Models, Principal uses of Statistics, Sampling, Mean, Median & Mode, Central Tendency, Central Limit Theorem, Frequency Distributions; Normal Distribution; Logarithmic Normal Distribution; Poisson Distribution; Correlations; Correlation Coefficient, Regression & Statistical inferences of regression parameters, Probability, Basic Elements of Probability, Axioms of Probability, Conditional Probability,

UNIT II

Bayes Theorem, Tests of significance; the Chi-Square tests; Differences in means of large samples; Differences in means of small samples; The t-test; Confidence limits; Analysis of Variances; One way & Two way analysis of variance, Time Series, Monte-Carlo Method. Parameter Estimation, Likelihood of an event, Maximum Likelihood Estimators, Evaluating a point estimator. **Reliability,** Introduction, Reliability concepts and patterns of failure; Reliability Management; Reliability for system effectiveness, Reliability; Maintainability & Availability techniques for improvement of operation reliability& Safety.

UNIT III

Reliability and Hazard Rates, Failure data; Reliability function; Failure rate and hazard rate functions; Common distributions in failure mechanisms-Exponential, Weibull, Gamma, Lognormal Extreme Value; Model selection for component failures; Failure analysis, Life Testing; Simultaneous Testing, Sequential Testing, Bayesian Approach in life testing,

UNIT IV

Reliability Prediction and Analysis, Reliability prediction based on Exponential Distribution; System Reliability Analysis- Block Diagram Method, Fault Tree and Sconces Tree Methods, Event Tree Method, Failure Mode, Failure Mechanisms.

UNIT V

Reliability Design, Design for Reliability, Design process, assessment methodology, Reliability allocation, Reliability improvements, Selection of Components to improve system Reliability.

Text Books:

1. Reliability Engineering & Terotechnology, by A. K.Gupta, Macmillan India Ltd., Delhi
2. Introduction to Reliability Engineering by E.E,Levis, Wiley & Sons, New York

Reference Books:

3. Reliability Engineering by L.S. Shrinath Affiliated East West Press
4. Probability and Statistics for Engineers by R.A. Johnson, Prentice Hall, New Delhi

DISSERTATION GUIDELINES FOR M.TECH IN MECHANICAL ENGINEERING WITH SPECIALIZATION IN PRODUCTION ENGINEERING

1. ELIGIBILITY

Students are required to submit a dissertation to complete the requirements for awarding **M.Tech in Mechanical Engineering with specialization in Production Engineering.** A Student can take up submission of his / her dissertation only after he / she has completed 1, 2 and 3 semester and obtained at least 50% marks in aggregate. If, a Student fails to get 50 % in aggregate he / she will have to repeat the semester or subject in which he / she wants to improve.

Guidelines for selection of the topic of dissertation work, preparation and submission of dissertation are presented below.

2. APPROVAL

Student should obtain approval of the examination committee for his choice of the guide and topic for the dissertation work before undertaking the detailed dissertation work. Application in this regard should be made in the prescribed form, together with a brief write up in 300 / 500 words of the topic of the dissertation prepared to be under taken and should contain concise summary of essential features of the dissertation work, and should contain Purpose, General Methods and Steps to be followed, apparatus / equipment to be used, engineering techniques and practice employed, expected results and conclusion(s) arising out of the dissertation work .

Student should note that the dissertation work must be relevant to Mechanical Engineering / Production Engineering or related fields in engineering profession, in which he / she is trained. A prior approval from the competent authority is mandatory before proceeding to undertake the work in the prescribed form appended as annexure I

3. SCOPE

The dissertation should demonstrate the ability of Student to apply the techniques of Engineering Science & Technology they have learnt /observed during their course of study for examination to specific situation or any functional area. The area chosen may be one or more of the areas in which papers are prescribed for 1, 2 and 3 semester examination or the area(s) from which Student have chosen their elective papers for 1, 2 and 3 semester examination.

The dissertation should demonstrate the research ability of the Student for data collection, analysis of data collected, formulation of recommendations and for suggesting a viable scheme for implementation of his recommendations.

The data should be collected either by his own observations and measurement or gathered from generally accepted valid first source(s) like performance report from production, etc if general data are used industry wise or nations based, then sources shall be quoted and should be generally from accepted source like industry publication, Government gadgets etc. All the steps of the analysis of data and relevant theory shall be included in the dissertation.

While formulating recommendations with expected costs and benefits, advantages and disadvantage of recommendation shall be clearly discussed. The suggested scheme for implementation of recommendation should be clearly and logically laid out with all details of the steps involved of time schedules for implementing steps. Precautions are to be observed and monitored. A synopsis has also to be submitted along with the dissertation.

4. DISSERTATION CONTENTS:

The dissertation has three basic parts: the preliminary pages, the text and the reference materials. The preliminary materials consist of the Top cover page, Two blank pages, Inside cover page, Dedication page (Optional), Student's declaration / Bonafide Certificate, Certificate from the Supervisor, Acknowledgements, Abstract, Table of Contents, List of Tables, List of Figures, List of Symbols, Abbreviations or Nomenclature (Optional) and other lists. Preliminary pages are paginated separately from the rest of the text.

After that Chapters, References, Appendices, List of papers published as a part of dissertation work and Brief curriculum vitae is to be included. The dissertation shall be presented in a number of chapters, starting with Introduction and ending with Conclusions. Each of the other chapters will have precise title reflecting the contents of the chapter. A chapter can be subdivided into sections, sub- sections and sub sub-section so as to present the content discretely and with due emphasis. Each chapter shall begin on a fresh page.

The dissertation work should be done under the guidance of a faculty member of the institution. A certificate from the guide should be submitted as per Performa given below after receiving declaration from the Student as appended below in annexure II and the declaration certificate and Acknowledgement should be bound along with other contents of the dissertation.

5 LIST OF TABLES

i. The contents shall be followed by a list of table indicating the table number, Table title and the corresponding page number. The table number shall be in decimal notation indicating the chapter number and the table number in that chapter.
ii. Any reference within the text shall be given by quoting the relevant number for eg. Table 2.2
iii. The table number should be mentioned at the top of the table centrally aligned and be bold.

6 LIST OF FIGURES

i. The list of figures shall follow the list of tables indicating the figure numbers, Figures titles and the corresponding page number. The figure shall be in decimal notation indicating the chapter number and the figure number in the chapter. For e.g. 6.4 refers to fig. 4 in chapter 6
ii. Any reference within the text shall be given by quoting the relevant number, e.g. Fig. 4.6
iii. The fig number should be mentioned at the bottom of the fig centrally aligned and be bold.

7. NOMENCLATURE

The 'Nomenclature' follows the 'List of figure' and contains the list of symbols used. They shall be arranged alphabetically in order of Latin Letters, superscripts and subscripts. As far as possible generally accepted symbols shall be used. Symbols not available in keyboard shall be written in permanent black ink.

8 PAGE NUMBERING

i. For items from Student's declaration to Nomenclature the page number shall be in big roman letters of 12mm size, Appendices should be given at the end of the dissertation on small roman at 12mm from the bottom of the page centrally located.
ii. Page numbers in Arabic numerals shall start with 2 on second page of the introduction chapter. There shall be no numbering of pages on which new chapter begin. The number shall be suitably placed at the bottom, centrally located, all pages.

9 CHAPTER NUMBERING

The chapter shall be numbered in Arabic numerals, section and sub-section of any chapter shall be in decimal notation, all chapters shall begin on a new page. The title for chapters, sections, and sub-sections shall be properly centered at the top of the page and have three spaces between them including the chapter number and should be typed in block capitals

10. CHAPTERS

I. **CHAPTER 1: INTROUCTION** The introduction shall form chapter 1.It shall highlight the importance of need for investigation and also define and name topic and scope of work envisaged.

II. **CHAPTER 2: REVIEW OF LITERATURE:** This shall form chapter II it shall present a critical appraisal of the previous work done on the topic. The extent of emphasis shall depend upon the nature of investigation.
   i. Each chapter may have several sections and sub-sections with sub titles.
   ii. Each chapter shall present important a short deviations and representatives data in table and figures. Information such as lengthy derivations, voluminous tables and large number of figures shall be presented in appendices.

III. CHAPTER 3 : METHODOLOGY OF WORK DONE

i.The work carried out shall be presented in one or more chapters depending upon nature of investigations. Each chapter shall have suitable title, eg.
   a) THEORETICAL WORK
   b) EXPERIMENTAL INVESTIGATION
   c) RESULT OBTAINED etc.

ii.Figures and tables shall be on separate sheets and not inserted in pages with running text. Illustrations shall be in colour print, if distinguished by colour. Depending on size, figures and tables shall be accommodated in print size.

iii.If there are longer tables that can not be accommodated on these sheets, there shall be a continuation table. Very large figures shall be placed in a pouch at the end of the dissertation. All figures and tables shall be mentioned in the text and should be so numbered that each one can be placed as close as possible, to the passage in the text, where it is mentioned first.

iv.The figures and tables included in the appendices shall be accordingly mentioned in the text. Lettering on figures shall be uniform either in engineering letters or typed. Each figure and table may follow its first mention in the text and not precede it. The figures should be self-sufficient to provide all the information. There must be a title for every figure and table.

v.Mathematical portion of the text shall be preferably typed. What it is not possible, ample space shall be left, and equations and symbols shall be inserted clearly in permanent black ink.

IV. CHAPTER 4 : DISCUSSION AND CONCLUSIONS

Discussion and Conclusion shall be recorded in last chapter of the dissertation. They shall include a thorough evaluation of the investigation carried out and shall bring out Student's own contribution, if any. The discussion shall logically lead to certain conclusions and inferences. A suggested scheme of implementation should also be included. Scope for future work should also be stated lucidly in the last part of the Chapter.

V. REFERENCES

References shall follow the last chapter. It shall include a list of works (paper, books etc) referred in the body of the text and they shall be arranged in the order they are first cited in the text.

i. For any paper the information shall contain the name of the authors, year of publication, the title of the journals, the volume number and the page number in parenthesis.
ii. In the case of references from the journals and books in languages other than English the titles of the journals or books should be transliterated into Latin script and not translated.
iii. For any book the information shall contain the names of authors, year of publication, the title of the book, the name and the publisher and edition in parenthesis.
iv. For paper and books with joint authorship, the names of all authors shall be reproduced in same order. The author's name shall begin with surname followed by initials.

However, Students are advised to follow the APA latest edition style for preparing the dissertation, for which the complete rules are available at http://www.apa.org.

Some sample references have been produced here for information purpose only

Sample References in Modified APA Format

Books

American Psychological Association. (2010). Publication manual of the American Psychological Association (6th Ed.). Washington, DC:

Author wise.

Gliner, J. A., Morgan, G. A., & Leech, N. A. (2009). Research design and analysis in applied settings: An integrated approach. (2nd ed.) New York, NY: Routledge / Taylor and Francis.

Morgan, G. A., Leech, N. A., Gloeckner, G., & Barrett K. A., (2007). SPSS for introductory statistics: Use and interpretation. Mahwah, NJ: Erlbaum.

Dissertations

Tungate, S. L. (2008). Welfare and child welfare collaboration. Available from ProQuest Dissertation and Theses data base (publication number AAT 3346472).

Periodicals and Journals

Herbst-Damm, K. L., & Kulik, J. A. (2005). Volunteer support, marital status, and the survival times of terminally ill patients. Health Psychology, 24, pp. 225-229. Doi:10.1037/0278-6133.24.2.225

Technical and Research Reports

American Psychological Association, Task Force on the Sexualization of Girls. (2007). Report of the APA Task Force on the Sexualization of Girls. Retrieved from http://www.apa.org/pi/wpo/sexualization.html 5 6

Meetings and Symposia
Matheson, J., Gloeckner, G. W., Rein, M., & Miller, L. (2009, April). Correlates of success among clients in the Back on TRAC Alcohol Treatment Program: A Model of Student Drug Court. American Educational Research Association, Education, Health, and Human Services SIG, San Diego, CA.

11. TIME-LIMIT

The dissertation should be submitted to the university / institution within a period of six months from the date obtaining final examination and can be extendable to one year from the date of obtaining final pass in the subjects under study.

12. FEES

The stipulated fee as decided by the university / Institution should be remitted in the same manner as examination fee along with the dissertation, if any.

13. COPIES OF THE DISSERTATION

i. Six typed copies of the dissertation as well as of the synopsis are to be prepared and four copies of each are to be submitted to the University / Institution.
ii. Students will hand over one copy of each to the Guide and retain one of each for him. Therefore, altogether a Student has to prepare 6 copies of the dissertation
iii. None of the copies submitted will be returned to Students.

14. EVALUATION

i. There shall be an examination at the end of the each semester.
ii. Four typed copies of the dissertation shall be submitted by the Student within a period already specified under Ordinance 15.4 of the HPU.
iii. The dissertation shall be evaluated by an external examiner to be appointed by the Principal / HOD of the department / authorized representative of the HP University out of a panel of three examiners submitted by the Principal / HOD of the Department concerned in consultation with the Supervisor.
iv. The external examiner will submit the report on the dissertation and shall either approve/disapprove or recommend revision in the light of Ordinance, 15.5 of the HPU.
v. In case the dissertation is approved, the external examiner, supervisor of the Student (Internal Examiner) and the Principal or his nominee (only in those cases where the Principal is Supervisor) shall conduct an open viva-voce test.
vi. In case the dissertation is to be revised, it will be examined by the same examiner. In case the dissertation is rejected, it shall be sent to another examiner. If it is rejected by the second examiner also, the Student shall have to rework on the dissertation or could be assigned another topic for dissertation work and upon satisfaction of the supervisor, the Student can resubmit his / her dissertation for reevaluation. In case a new topic is being given to the Student, a fresh evaluation process will be followed.
vii. If the Student qualifies in the viva-voce, the degree shall be awarded provided the Student has cleared all the theory papers and the seminars.
viii. In case the Student is unable to clear the viva-voce, he/she will be given one more chance to clear it and the viva-voce shall be conducted by the same external examiner. In case the dissertation is approved, marks shall be awarded for dissertation by the external examiner and

these awards along with the report and Internal assessment marks by the supervisor will be submitted directly to the Controller of Examinations.

ix. In order to expedite the viva-voce test of the Student, the Institute / University may take suitable action as may be necessary in consultation with the Principal / HOD of the Department concerned.

15. PUBLISHING RIGHTS

i. The dissertation in the form of research manuscript(s) / paper(s) may be submitted and published before the decision of the examination committee for its acceptance or otherwise.

ii. The University / Institution will have the right to use the dissertation in any manner that may be deemed as suitable.

iii. In case the author wishes to publish the full dissertation with due acknowledgement to the University / Institution that it was a dissertation prepared for the University's examination, a declaration has to be made by the Student in this effect prior permission for its publication must be obtained from the University / Institution.

16. FORMAT OF THE DISSERTATION

The format to be followed for submission of the dissertation is as follows.

i. **Paper:**
The Dissertation shall be typed double spaced on white paper, print size.80 gsm Bond of the original typescript and carbon copy..

ii. **Margin:** The typed sheet shall have the following margins.
Left 38mm, Top25mm, Right 25mm, Bottom 25mm.

iii. **Binding:** The dissertation shall be cloth / resin bound in black.

iv. **Lettering**
   a. The lettering shall be inscribed on the bound back and the front cover.
   b. The bound back shall contain the title and the last name of Student in **12 mm** size letters.

v. **Front Cover**
   a. A **1.25 inch X 1.25** inch size of the **Institute emblem** should be properly placed in the centre of the front page
   b. The front cover should be **Black colour** and contain the following details.
      ⇒ Top-the title in block capitals of **18mm size letters**, properly centered.
      ⇒ Center-Full name of Students and University Roll No. in block capitals of **12mm** size letters, properly centered.
      ⇒ Bottom- Name of institution (University) with address, year of submission-all in block capitals of **14 mm** size letters in separate lines with spacing and properly centered.

vi. **Blank Sheets:** At the beginning and at the end of the dissertation two white blank sheets of 80 gsm, bond paper shall be provided one for the purpose of binding and another to be left blank.

vii. **Title Sheet:** The Title sheet shall be the first typed sheet and shall follow immediately the blank sheet. This shall be the first printed page of the dissertation and shall contain the submission statement: the Dissertation submitted in partial fulfillment of the requirements of the Degree, M.Tech in Mechanical Engineering with specialization in Production Engineering., the name and Roll No. of the Student, name(s) of the Supervisor and Co supervisor (s) (if any), Department, Institute and year of submission. Sample copy of the 'Title Sheet' is appended (Specimen 'A')

viii. **Acknowledgements**
Acknowledgements shall be on a separate sheet and it shall indicate the extent to which assistance has been received by the Student in his work from various sources.It is used to thank those persons

who have been instrumental to the student in completing the degree requirements. Acknowledgement of grants and special funding received to support the research also may be made on this page.

ix. **Abstract:** Every dissertation shall have an abstract following the title sheet. The abstract shall be a concise summary of essential features of the material contained in the dissertation. The abstract shall not exceed 200 words. It should contain Purpose, Methods, Results and Conclusions of the Dissertation Work.

x. **Contents**
The contents shall follow the abstract indicating the title of Chapters, Section and Sub- section etc. using decimal notation and S.I System of units of scientific and laboratory data with corresponding page numbers.

xi. **Appendices**
Appendices shall follow references of the dissertation and will be numbered in small Roman. The appendices shall normally contain detailed or lengthy derivations, sample calculation, voluminous large figures and calculations.

17 FONT AND LANGUAGE

The dissertation must be in English language having times new roman font with suitable differentiation of heading subheading and running text with uniform approach. The heading may be in upper case subheading in title case and running text with in sentence case.

18. POWER TO MODIFY

Notwithstanding all that has been stated above the University / Institution has the right to modify any of the regulations from time to time.

ANNEXURE I

THE CONTROLLER OF EXAMINATION
HIMACHAL PRADESH UNIVERSITY, SHIMLA

Sir,

We are pleased to inform you that Mr._____
_____

a student of the (Name of the institution)_____has sought our guidance for carrying out his / her dissertation work as part of the requirements for awarding **M.Tech in Mechanical Engineering with specialization in Production Engineering**

We have studied the proposed dissertation work in detail and of the opinion that it will bring out the effective application of Mechanical Engineering / Production Engineering / related fields / technique and practices in the following area:

_____

_____

We are also of the opinion that the proposed dissertation work can enable the student to meet the dissertation requirements laid down by the examination committee.

We give our consent to guide him / her for the dissertation work.

Name of the Guide _____

Professional Qualification_____

Designation _____

Address (Office) _____

_____

Address (Permanent Residential) _____

_____

Signature of the Guide **Signature of the HOD** **Signature of the Principal**

Date: _____ _____ _____

Place: _____ _____ _____

ANNEXURE II

STUDENT'S DECLARATION

I hereby, certify that the work, which is being presented in the dissertation, entitled "-----

---

----" in fulfillment of the requirement for the award of Degree of M.Tech in Mechanical Engineering with specialization in Production Engineering, submitted in the Department of Mechanical Engineering of -----(Name of Institution and Place)----, Affiliated to Himachal Pradesh University, Shimla, India is an authentic record of my work under the supervision of ---- ----------(Name of Guide)----------.

The results embodied in this thesis have not been submitted by me or any body else to any other University or Institute for the award of any Degree or Diploma.

The dissertation contains my own work and it does not include any copyright material of any person or publication.

(NAME OF THE STUDENT)

CERTIFICATE

This is to certify that the above statement made by the Student is correct to the best of our knowledge.

(NAME OF THE GUIDE)
Institution

(HEAD OF THE DEPARTMENT)
Institution

PRINCIPAL
Institution

The Student has passed the viva-voce examination held on..... (Date)..... at ---- (Institute) ----- -------. -------- (Place) --------.

The dissertation is recommended for the award of M.Tech in Mechanical Engineering with specialization in Production Engineering.

Internal Examiner

External Examiner

SPECIMEN 'A':

TITLE SHEET

SIZE
18 POINTS BOLD
CENTRE

(TITLE)

Submitted in partial fulfillment of the requirements
of the degree of
(Master of Technology in ——————————) of
——————University——————————

by
(NAME OF THE STUDENT)
(ROLL NO._____)

SIZE
12 POINTS BOLD
CENTRE

Under the Supervision of

_____

_____

A 1.25 inch X 1.25 inch size of the Institute emblem

LOGO

NAME OF THE DEPARTMENT
INSTITUTION
UNIVERSITY
PLACE
(MONTH, YEAR)

SIZE
14 POINTS
BOLD CENTRE

DISSERTATION AT A GLANCE

The sequence in which the thesis material should be arranged and bound should be as follows:

1. Top cover page
2. Two blank pages
3. Inside cover page
4. Dedication page (Optional)
5. Student's declaration / Bonafide Certificate
6. Certificate from the Supervisor
7. Acknowledgements
8. Abstract
9. Table of Contents
10. List of Tables
11. List of Figures
12. List of Symbols, Abbreviations or Nomenclature (Optional)
13. Chapters
14. References
15. Appendices
16. List of papers published as a part of dissertation work.
17. Brief Curriculum Vitae
18. Two blank pages

QUICK REFERENCE

PAGE DIMENSIONS

Paper size: 80 gsm. Standard A4 size (210 mm X 297 mm)

MARGINS

Top edge: 1 inch (25 mm)

Left side: 1 ½ inch (38 mm)

Bottom edge: 1 inch (25 mm)

Right side: 1 inch (25 mm)

Print out: LaserJet or Inkjet printer, **printed on only one side**

Font size (regular Text): Times New Roman of 12 pts

Spacing: Single line, Normal

CHAPTERS: 14 PTS BOLD TOP CENTRE ALIGNED (CAPITAL LETTERS) (1, 2, 3...)

SECTIONS: 12 PTS BOLD LEFT ALIGNED (CAPITAL LETTERS) (1.1, 1.2...)

Subsections: 12 pts bold left aligned (Title case) (1.1.1, 1.1.2...)

Page numbers (Chapters): Bottom – centered – 12 pts (1, 2, 3...)

Page numbers (Preliminaries): Bottom – centered – 12 pts / Roman numerals (I, II, III....)

Appendices: Bottom – centered – 12 pts / Roman numerals (i, ii, iii....)

Units: Prefer SI units

BINDING:

Hard binding with black color

NUMBER OF COPIES

M.Tech.: 6

[Student (as individual), Guide, Department, Examiner, Library 2 copies]