HONORS COURSES

Course Code	COURSE NAME	L-T-P	CR	PRE-REQ.
POOL1[Design]				
MEH11	Advanced Strength of Materials	3-1-0	4	Strength of Materials
MEH12	Fracture Mechanics	3-1-0	4	Strength of Materials, Metalurgy
MEH13	Design for Manufacturing & Assembly	3-1-0	4	Strength of Materials
MEH14	Advanced Optimization Techniques	3-1-0	4	Dynamics of machinery
POOL2 [Production]				
MEH21	Advanced Materials & Processing	4-0-0	4	Manufacturing Process
MEH22	Computer Integrated Manufacturing & Automation	4-0-0	4	Manufacturing Technology
MEH23	Non-Traditional Machining	4-0-0	4	Manufacturing Technology
MEH24	Additive Manufacturing	4-0-0	4	Manufacturing Processes & Manufacturing Technology
POOL3 [Thermal]				
MEH31	Computational Fluid Dynamics	3-1-0	4	Fluid Mechanics
MEH32	Gas Dynamics and JET Propulsion	3-1-0	4	Basic Thermodynamics
MEH33	Alternate Fuels and Energy Systems	3-1-0	4	Basic Thermodynamics, I.C Engines
MEH34	Advanced IC Engines	3-1-0	4	IC Engines
POOL4[Industrial]				
MEH41	Design Of Experiments	3-1-0	4	Mathematics-III
MEH42	Production Planning and Control	3-1-0	4	Industrial Engineering
MEH43	Supply Chain Management	4-0-0	4	Industrial Engineering
MEH44	Quality Control & Reliability	4-0-0	4	Industrial Engineering

Note:

1. **Students has to acquire 16 credits with minimum one subject from each pool. (04 courses@4 creditseach)**
2. **Compulsory MOOC/NPTEL Courses for 04 credits (02 courses@ 2 creditseach)**

MEH11	ADVANCED STRENGTH OF MATERIALS	L	T	P	C	Int	Ext
		3	1	-	4	30	70
	HONORS-DESIGN POOL						

COURSE OBJECTIVES:

1. To make the students imbibe the concepts, principles and mathematical correlations in analysis of engineering structures like curved beams andcolumns.
2. To assist the students, understand and apply the principles and theory in analysis of various indeterminatebeams.
3. To introduce to the students, the theory and applicability of significant concepts such as shear centre, stresses in rotating members, citing real worldexamples.
4. To make the students understand various concepts like body force, surface force, state of stress and strain in three dimensions, principal stresses and strainsetc.

COURSE OUTCOMES:

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

1. Analyse engineering structures like curved beams, columns and solve pertinentproblems.
2. Understand the concepts of indeterminate beams and apply various approaches like Macaulay's method and three moment method to solve problems.
3. Imbibe the significance and theory behind concepts like shear centre, rotating rings and discs and will be able to solve pertinentproblems.
4. Understand various forces, apply concepts and mathematical correlations for three-dimensional state of stress, strain, principal stresses and strains and solve problems on engineering structures subjected to combined state of stress /strain.

CO – PO MATRIX:

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

COURSE CONTENT:

UNIT-1	CO1	12
Columns: Buckling and Stability, Columns with Pinned ends, Columns with other support conditions, Limitations of Euler's Formula, Rankine's Formula, Columns with eccentric Axial Loads, Secant formula. **Curved Beams:** Introduction, Winkler-Bach theory, Stresses in Crane Hook and C-Clamp with Rectangular, Circular and Trapezoidal cross-sections.		
UNIT-2	**CO**	**12**
Fixed and Propped Cantilever Beams: Introduction to fixed and propped cantilever beams, analysis by the differential equations of the deflection curve, Macaulay's Method. **Continuous Beams:** Clapeyron's theorem of three moments Beams with constant andvarying moments of inertia.		
UNIT-3	**CO3**	**12**

Shear Centre: Bending Axis and Shear Centre, Position of Shear Centre, Shear flow, Shear Centre of Channel section, Angle section, T- section and I- section. **Centrifugal Stresses:** Introduction, Rotating Ring, Rotating Disc, Rotating Disc of uniform strength.		
UNIT-4	**CO4**	**12**
Three-Dimensional State of Stress and Strain: Introduction, Body force, surface force, stress vector, state of stress at a point. State of stress at a point in Cartesian coordinates. State of strain at point.Deformationsintheneighbourhoodofapoint.DerivationofCauchy'sequilibriumrelations, principal stresses and directions of principal planes in three dimensions.		

LEARNING RESOURCES:

TEXT BOOK(S):

1. Advanced mechanics of solids, L.S. Srinath, Tata-Mc-Graw hillpublishers
2. Mechanics of Materials, James M. Gere and Barry J. Goodner, Published by Cengage Learning,8th edition.
3. Strength of materials by Sadhu Singh, KhannaPublishers, 11thEdition

REFERENCE BOOK(S):

1. Engineering Mechanics of Solids by E.P.Popov, PHI, 2ndEdition.
2. Strength of Materials by S. Ramamrutham, DhanpatRai Publishing Company (P) Ltd, 18thEdition
3. Introduction to Solid Mechanics by I.H. Shames, PHI, 3rdEdition.
4. Strength of Materials by R.K.Bansal, LaxmiPublications, 6thEdition.

WEB REFERENCE:

1. http://nptel.iitm.ac.in/
2. www.learnerstv.com/Free-Engineering-video-lecture-courses.htm
3. http://en.wikibooks.org/wiki/Strength_of_Materials

MEH12	FRACTURE MECHANICS	L	T	P	C	Int	Ext
		3	1	-	4	30	70
	HONORS-DESIGN POOL						

COURSE OBJECTIVES:

1. To treat linear and nonlinear fracture mechanics principles and their applications to Structural design and to study Fracture phenomena in metals and non-metals will be Discussed and testing methods will behighlighted.
2. To Express Stress strain relations along withmodes
3. To Characterize brittle and ductile fractures from the macroscopic and microscopic point Of view and to describe basic conditions for crack initiation for the brittle and ductile Failuremode
4. To study Crack initiation under plasticitycondition

COURSE OUTCOMES:

1. Predict material failure for any combination of appliedstresses
2. Estimate failure conditions of astructure.
3. Determine the stress intensity factor for simple components of simplegeometry
4. Predict the likelihood of failure of a structure containing adefect

CO – PO MATRIX:

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

COURSE CONTENT:

UNIT-1	CO1	12

Introduction to Fracture Mechanics: Kinds of Failure, Historical Aspects of failure, Brittle and Ductile Fracture, Modes of Fracture Failure, influence of crack.
Energy Release Rate: Introduction, Griffith's Dilemma, Surface Energy, Griffith's Realization, Griffith's Analysis, Mathematical Formulation, Change in Compliance Approach, Change in the Strain Energy Approach.

UNIT-2	CO2	12

Stress Intensity Factor: Introduction, Linear Elastic Fracture Mechanics (LEFM), stress and displacement fields in isotropic elastic materials, stress intensity factor.
Field Equations: Equilibrium Equations, Strain Displacement and Compatibility Relations, Stress-Strain Relations, Bi-harmonic Differential Equation, Elementary Properties of Complex Variables, Westerguard's approach-Mode I (Opening Mode).

UNIT-3	CO3	12

An elastic Deformation at the Crack Tip: Further investigation at the crack tip, approximate shape and size of the plastic zone, Plastic Zone Shape for Plane Stress.
Plastic Zone Shape for Plane Strain: Effective crack length, approximate approach, The Irwin Plastic Zone Correction, Plastic Zone Size through the Dugdale Approach, effect of platethickness.

UNIT-4	CO4	12

J-Integral: Relevance and scope, Definition of the J-integral, Path Independence,stress-strain relation, further discussion on j-integral, A Simplified Relation for the J-Integral, Applications to Engineering Problems, Equivalence of G and J for Elastic Materials

LEARNING RESOURCES:

TEXT BOOK(S):

1. Elements Of Fracture Mechanics, Prashant Kumar, Tata Mcgraw Hill, -Mar-09
2. Fracture Mechanics – Fundamentals and Application, T.L. Anderson, CRC press1998
3. Fracture of Engineering Brittle Materials, Jayatilake, Applied Science, London,2001

REFERENCE BOOK(S):

1. Introduction to Fracture Mechanics, Karen Hellan, McGraw Hill Pub.2000
2. Elementary Engineering Fracture Mechanics, David Broek, ArtinusNiihoff, London, 1999.
3. ProblemsofFractureMechanics&Fatigue,GdoutosE.E,RodoPoulusC.A,YatesJ.R,Kluwer Academic Publishers
4.

WEB REFERENCE:

1. http://nptel.ac.in/downloads/112101098/
2. http://nptel.ac.in/courses/112101099/
3. http://nptel.ac.in/courses/112108093/
4. http://www.ohio.edu/people/williar4/html/PDF/IntroRob.pdf

MEH13	DESIGN FOR MANUFACTURING & ASSEMBLY	L	T	P	C	Int	Ext
		3	1	-	4	30	70
	HONORS-DESIGN POOL						

COURSE OBJECTIVES:

The objectives of this course are to:

1. To study and know about basics of DFMA, selection of various materials and processes required for product.
2. To study the concepts of DFM for machining and injection molding.
3. To study the concepts of DFM for sand casting, die casting and sheet metal working.
4. To study about the design for manual as well as automatic assembly and robot assembly.

COURSE OUTCOMES:

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

1. To understand the quality aspects of design for manufacture and select best materials and processes to manufacture.
2. Apply the concept of DFM for machining and injection molding.
3. Apply the concept of DFM for casting and sheet metal working.
4. Apply Boothroyd method of DFMA for product design and manual assembly as well as automatic assembly.

CO – PO MATRIX:

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

COURSE CONTENT:

UNIT-1	CO1	12

Introduction: Design philosophy, steps in design process, general design rules for manufacturability, basic principles of designing for economical production, creativity in design.

Selection of materials and processes: General Requirements for Materials and Process Selection, Selection of Manufacturing Processes, Process Capabilities, Selection of Materials, Primary Process/Material Selection, Systematic Selection of Processes and Materials.

UNIT-2	CO2	12

Design for Machining: Machining Using Single-Point & Multi point cutting tools, Choice of Work Material, Shape of Work Material, Machining Basic Component Shapes, Cost Estimating for Machined Components,

Design for Injection Molding: Injection Molding Materials, The Molding Cycle, Injection Molding Systems, Molding Machine Size, Molding Cycle Time, Estimation of the Optimum Number of Cavities, Design Guidelines.

UNIT-3	CO3	12
Design for sand casting and die casting: Sand Casting Alloys, Basic Characteristics and Mold Preparation, Sand Cores, Melting and Pouring of Metal, Cleaning of Castings, Cost Estimating, Design Rules for Sand Castings, Example Calculations. The Die Casting Cycle, Auxiliary Equipment for Automation, Determination of the Optimum Number of Cavities, Determination of Appropriate Machine Size, Die Casting Cycle Time Estimation, Die Cost Estimation, Design Principles. **Design for Sheet Metal working:** Dedicated Dies and Press-working, Press Selection, Turret Press working, Press Brake Operations, Design Rules.		
UNIT-4	**CO4**	**12**
Design for Manual Assembly: General Design Guidelines for Manual Assembly, Development of the Systematic DFA Methodology, Assembly Efficiency, Effect of Part Symmetry, Thickness, and Weight on Handling Time, Effects of Combinations of Factors, Application of the DFA Methodology. **High speed Automatic Assembly & Robot Assembly:** Design of Parts for High-Speed Feeding and Orienting, Additional Feeding Difficulties, High-Speed Automatic Insertion, General Rules for Product Design for Automation, Design of Parts for Feeding and Orienting, Product Design for Robot Assembly.		

LEARNING RESOURCES:

TEXT BOOKS:

1. Product Design for Manufacture and Assembly by Geoffrey Boothroyd, Peter Dewhurst and Winston A. Knight, 3rd Edition, CRC Press, 2010.

REFERENCES:

1. Product Design and Manufacturing, A K Chitale and R C Gupta, PHI, New Delhi, 2003.
2. Engineering Design, George E Deiter, McGrawHill International, 2002

WEB RESOURCES:

1. http://nptel.ac.in/courses/107103012/1
2. http://nptel.ac.in/downloads/112101005/
3. https://www.routledge.com/Product-Design-for-Manufacture-and-Assembly-ThirdEdition/Boothroyd-Dewhurst-Knight/p/book/9781420089271

MEH14	MACHINERY VIBRATION AND CONTROL	L	T	P	C	Int	Ext
		3	1	-	4	30	70
	HONORS-DESIGN POOL						

COURSE OBJECTIVES:

The objectives of this course are to make the students:

1. To write the differential equations of motion of vibratory systems of 2 DOF and study the applications of2DOF
2. To write the differential equations of motion of vibratory systems of multi DOF and study the applications of multi DOF
3. To find the natural frequency of multi DOF by Exact methods and know the effects of critical speeds
4. To study various techniques of vibration control andmeasurement.

COURSE OUTCOMES:

At the end of the course the students should be able to:

1. Determine vibratory responses of two DOFsystems
2. Determine vibratory responses of multi DOFsystems
3. DeterminethenaturalfrequencyofmultiDOFsystemsbyExactmethodsandeffectsofcritical speeds.
4. Applysensors,othervibrationcontrolandmeasuringinstrumentsforthenecessityofindustrial applications.

CO – PO MATRIX:

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

COURSE CONTENT:

UNIT-1	CO1	12
Two Degrees of Freedom Systems: Introduction, Principal modes of vibration, Simple two degrees of freedom system –Two masses fixed on tightly stretched string, Double pendulum, Torsional System. Systems with damping, Undamped forced vibration with harmonic excitation. **Vibration absorbers-** Undamped dynamic vibration absorber, Centrifugal pendulum Absorber, Dry friction Damper and untuned viscous damper (Theoretical explanation only)		
UNIT-2	**CO2**	**12**
Multi-degree of Freedom Systems – Exact Analysis: Introduction, Undamped free vibrations, Influence numbers and Maxwells'sreciprocal theorem, Undampedforced vibrations, torsional vibration of multi rotor system- vibration of geared systems. Generalisedco-ordinates and co-ordinate couplings-only static coupling, only dynamiccoupling,staticanddynamiccoupling.Principleco-ordinates, **Continuous systems-** vibration of strings, longitudinal vibration of bars, torsional vibration of circular shafts, lateral vibration of beams.		
UNIT-3	**CO3**	**12**

Multi-degree of Freedom Systems – Numerical Methods: Introduction, Rayleigh's Method, Dunkerley's method, Stodala's method, Method of matrix iteration. (problems limited to maximum of 3 DOF). **Critical Speeds of Shafts:** Introduction, Critical Speed of a light shaft having a single disc without damping and with damping, Critical speeds of a shaft having multiple discs, Secondary critical speed, Critical speed of a light cantilever shaft with a large heavy disc at its end		
UNIT-4	**CO4**	**12**
Vibration Control: Introduction, Vibration Nomograph and Vibration Criteria, Reduction of Vibration at the Source, Balancing of Rotating Machines, Balancing of Reciprocating Engines, Control of Vibration, Control of Natural Frequencies, Introduction of Damping, Vibration Isolation, **Vibration Measurement and Applications:** Introduction, Transducers, Vibration Pickups, Frequency-Measuring Instruments, Vibration Exciters, Signal Analysis, Machine Condition Monitoring and Diagnosis.		

LEARNING RESOURCES:

TEXT BOOKS:

1. G K Grover , Mechanical Vibrations 8th Ed. ,Nem Chand & Bros , 2009 [For Units I – III]
2. S.S.Rao,MechanicalVibrations,PearsonEducationIndia;4edition2003[ForUNITIV]

REFERENCE BOOKS:

1. William T. Thomson, Theory of Vibrations with Applications, Pearson Education; 5th edition,2008.
2. VPSingh,MechanicalVibrations,DhanpatRai&Co.Pvt.Ltd.
3. SGrahamKelly,MechanicalVibrations,Schaum'sOutlineseries.

WEBRESOURCES:

1. http://nptel.ac.in/courses/112103111/
2. https://engfac.cooper.edu/pages/tzavelis/uploads/Vibration%20Theory.pdf
3. http://sv.20file.org/up1/541_0.pdf

MEH21	ADVANCED MATERIALS & PROCESSING	L	T	P	C	Int	Ext
		4	0	-	4	30	70
	HONORS-PRODUCTION POOL						

Course Objectives:

1. To provide the basics of materials andcharacteristics.
2. To give an idea of Non- ferrous alloys in the presentscenario.
3. To provide knowledge on Ceramics andPolymers.
4. To introduce to Composites and Processing of Microelectronicdevices.

Course outcomes

1. Students learn the basics of materials, properties andapplications
2. Students understand the non-ferrous alloys and itsapplications.
3. Students gain knowledge regarding the processing and properties of Polymers andCeramics.
4. Understand the processing of composites and their application in modernworld.

CO – PO MATRIX

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

COURSE CONTENT:

UNIT-1	CO1	12
Classification and characteristics: Metals, Ceramics, Polymers and composites. General properties and structure: Atoms, molecules bonds in solids, Crystalline Structure - Defects in Metallic structure, Dislocations and plastic deformation, Dislocations and Strengthening mechanisms, Cold work, Precipitation hardening, Dispersion hardening fatigue and Creep behavior.		
UNIT-2	**CO2**	**12**
Non Ferrous alloys: Alloys of Copper, Aluminum, Nickel, Magnesium, Titanium, Lead,Zinc - composition, Heat treatment-Annealing processes, Properties and Applications.		
UNIT-3	**CO3**	**12**
Polymers and Processing: Structure and properties of Thermoplastics and Thermo sets Engineering Applications Mechanical and thermal behavior. Processing of Polymers **Ceramics and Processing:** Ceramic Structures, Abrasive Ceramics and Glass ceramics - Advanced Ceramics Processing techniques. Tribological applications.		
UNIT-4	**CO4**	**12**
Composites: Definition - classification and characteristics of composite materials - Volume fraction - Particulate Reinforced composites, Fiber reinforced composites, Structural Composites. Metal Matrix composites and Ceramic matrix composites Metal matrix Nano composites-Applications. **Fabrication of Microelectronic devices**: Crystal growth and Film Deposition-Oxidation, Lithography.		

LEARNING RESOURCES:

TEXTBOOK(S)

1. Engineering Metallurgy - Raymond and Higgens -ELBS/EA
2. Introduction to Material Science and Engineering James.F.Shackleford - McMillan, NY - 7th edition

REFERENCE BOOK(S)

1. Powder Metallurgy-Metals Hand Book -ASM, USA - Vol.7,1974
2. Composite Materials - Science and Engineering - Chawla K.K., Springer - Verlag, Newyork - 2nd edition,1998.
3. Cast Metal Matrix Composites ASM Metals Hand Book - P.K. Rohagti -VI5.
4. Elements of Material science and Engineering - Van Vlack L.H. - Addison Wesley, NY – 198

MEH22	COMPUTER INTEGRATED MANUFACTURING & AUTOMATION	L	T	P	C	Int	Ext
		4	0	-	4	30	70
	HONORS-PRODUCTION POOL						

Course Objectives:

1. To learn various concepts related part transfermechanisms.
2. To acquire a functional understanding of automated flow lines and linebalancing.
3. To know about automated process planningtechniques
4. To understand computer aided quality control methods andtechniques.

Course outcomes:

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

1. Understand various part transfer mechanisms in transferlines.
2. Analyze computer aided quality control methods andtechniques.
3. Analyze CIM planning system and computer network formanufacturing.
4. Understand and analyze the flow lines and transfermechanisms.

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

COURSE CONTENT:

UNIT-1	CO1	12
Introduction to CIM: Manufacturing - Types, Manufacturing 0Systems, CIM Definition, CIM wheel, CIM components, Evolution of CIM, needs of CIM, Benefits of CIM. **High Volume Production System:** Introduction Automated flow line symbols, objectives, Work part transport-continuous, Intermittent, synchronous, Pallet fixtures, Transfer Mechanism-Linear-Walking beam, roller chain drive, Rotary-rack and pinion, Ratchet & Pawl, Geneva wheel.		
UNIT-2	**CO2**	**12**
Analysis Of Automated Flow Line & Line Balancing: General terminology and analysis, Analysis of Transfer Lines without storage upper bound approach, lower bound approach and problems, Analysis of Transfer lines with storage buffer, Effect of storage, buffer capacity with example problem, Partial automation-with numerical problem example, Manual Assembly lines line balancing problem.		
UNIT-3	**CO3**	**12**
Automated Process Planning: Group Technology, Part families, Part classification and coding, Production flow analysis, Machine cell design, Applications and Benefits of Group Technology, Structure of a Process Planning, Process Planning function, CAPP - Methods of CAPP, CAD based Process Planning.		
UNIT-4	**CO4**	**12**
Monitoring And Quality Control: Types of production monitoring system, process control & strategies, direct digital control - Supervisory computer control - computer aided quality control - objectives of CAQC, QC and CIM, contact, non-contact inspection methods, CMM and Flexible Inspection systems.		

LEARNING RESOURCES:

TEXTBOOK(S)

(1) Mikell P. Groover, Automation, Production system & Computer Integrated Manufacturing, Prentice Hall India Learning Private Limited,3rdEdition,2008.
(2) Kant Vajpayee. S., Principles of Computer Integrated Manufacturing, Prentice Hallof India,1999.

REFERENCEBOOK(S)

(1) James A. Rehg& Henry W Kraebber, Computer Integrated Manufacturing, Pearson Prentice Hall, 2005.
(2) YoremKoren, Computer Control of Manufacturing Systems, Mc. Graw Hill,1983.
(3) P. Radhakrishnan, S. Subramanyan and V. Raju, CAD / CAM / CIM, New Age International Publishers, 2008.

MEH23	NON-TRADITIONAL MACHINING	L	T	P	C	Int	Ext
		4	0	-	4	30	70
	HONORS-PRODUCTION POOL						

Course Objectives:

1. To learn various concepts related to modern machining processes & theirapplications.
2. To appreciate the differences between conventional and non-conventional machiningprocesses.
3. To acquire a functional understanding of non-traditional manufacturingequipment.
4. To know about various process parameters and their influence on performance and their applications.
5. To impart knowledge on various types of energy involved in non-traditional machiningprocesses.

Course Outcomes:

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

1. Understand the compare traditional and non-traditional machining process and recognize the need and understand the constructional features, performance parameters, process characteristics, applications, advantages and limitations of USM andAJM.
2. Identify the need of Chemical and electro-chemical machining process along with the constructional features, process parameters, process characteristics, applications, advantages and limitations.
3. Understand the constructional feature of the equipment, process parameters, process characteristics, applications, advantages and limitations EDM &PAM.
4. Understand the LBM equipment, LBM parameters, and characteristics. EBM equipment and mechanism of metal removal, applications, advantages and limitations LBM &EBM.

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

COURSE CONTENT:

UNIT-1	CO1	12

Introduction to Non-traditional machining: Need for Non-traditional machining process, Comparison between traditional and non-traditional machining, general classification Non-traditional machining processes, classification based on nature of energy employed in machining, selection of non-traditional machining processes, Specific advantages, limitations and applications of non-traditional machiningprocesses.

Ultrasonic Machining (USM): Introduction, Equipment and material process, Effect of process parameters: Effect of amplitude and frequency, Effect of abrasive grain diameter, effect of slurry, tool & work material. Process characteristics: Material removal rate, tool wear, accuracy, surface finish, applications, advantages & limitations of USM.

Abrasive Jet Machining (AJM): Introduction, Equipment and process of material removal, process variables: carrier gas, type of abrasive, work material, stand-off distance (SOD). Process characteristics-Material removal rate, Nozzle wear, accuracy & surface finish. Applications, advantages & limitations of AJM.

UNIT-2	CO2	12

ELECTROCHEMICAL MACHINING (ECM): Introduction, Principle of electro chemical machining, ECMequipment,elementsofECMoperation,ChemistryofECM.ECMProcesscharacteristics:Materialremoval rate, accuracy, surface finish. Process parameters: Current density, Tool feed rate, Gap between tool & work piece, velocity of electrolyte flow, type of electrolyte, its concentration temperature, and choice of electrolytes. ECM Tooling: ECM tooling technique & example, Tool & insulation materials. Applications ECM: Electrochemical grinding and electrochemical honing process. Advantages, disadvantages and application of ECG, ECH. **CHEMICAL MACHINING (CHM):** Elements of the process, Resists (maskants), Etchants. Types of chemical machining process-chemical blanking process, chemical milling process. Process characteristics of CHM: material removal rate, accuracy, surface finish, advantages, limitations and applications ofchemical machining process.		
UNIT-3	**CO3**	**12**
ELECTRICAL DISCHARGE MACHINING (EDM): Introduction, mechanism of metal removal, EDM equipment: spark erosion generator (relaxation type), dielectric medium-its functions & desirable properties, electrode feed control system. Flushing types; pressure flushing, suction flushing, side flushing, pulsed flushing. EDM process parameters: Spark frequency, current & spark gap, surface finish, Heat Affected Zone. Advantages, limitations & applications of EDM, Electrical discharge grinding, Traveling wireEDM. **PLASMA ARC MACHINING (PAM):** Introduction, non-thermal generation of plasma, equipment mechanism of metal removal, Plasma torch, process parameters, process characteristics. Safety precautions. Safety precautions, applications, advantages and limitations.		
UNIT-4	**CO4**	**12**
LASER BEAM MACHINING (LBM): Introduction, generation of LASER, Equipment and mechanism of metal removal, LBM parameters and characteristics, Applications, Advantages & limitations. ELECTRON BEAM MACHINING (EBM): Introduction, Principle, equipment and mechanism of metal removal, applications, advantages and limitations.		

LEARNING RESOURCES:

TEXTBOOK(S)

1. Modern Machining Process by P.C Pandey and H S Shah McGraw Hill Education India Pvt. Ltd.2000
2. Production technology HMT McGraw Hill Education India Pvt. Ltd2001

REFERENCE BOOKS

1. New Technology Dr. Amitabha Bhattacharyya The Institute of Engineers (India) 2000
Modern Machining process Aditya 200

MEH24	ADDITIVE MANUFACTURING	L	T	P	C	Int	Ext
		4	0	-	4	30	70
	HONORS-PRODUCTION POOL						

Course Objectives:

1. To provide the basics of Additive manufacturingProcess.
2. To give an idea of Reverse Engineering concept in the presentscenario.
3. To provide knowledge on types of Additive manufacturingtechniques
4. To introduce to and development of new tooling techniques formanufacturing.

Course Outcomes

The students will be able to

1. Understand concepts and terminology of additivemanufacturing
2. Apply the reverse engineering concepts for designdevelopment
3. Understand the variety of additive manufacturingtechniques
4. Design and develop newer toolingmodels

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

UNIT-1	CO1	12

Introduction: Development of AM systems – AM process chain - Impact of AM on Product Development

- Virtual Prototyping- Rapid Tooling – RP to AM -Classification of AM processes-Advantages and Applications.

Reverse Engineering and CAD Modeling: Basic concept- Digitization techniques – Model reconstruction – Data Processing for Rapid Prototyping: CAD model preparation, Data requirements – Geometric modeling techniques: Wire frame, surface and solid modeling – data formats - Data interfacing, Part orientation and support generation, Support structure design, Model Slicing, Tool path generation- Software forAM.

UNIT-2	CO2	12

Tooling: Classification, Soft tooling, Production tooling, Bridge tooling, direct and indirect tooling.
Liquid Based Additive Manufacturing System: Stereo-lithography Apparatus (SLA): Principle, pre- build process, part-building and post-build processes, photo polymerization of SL resins, part quality and process planning, recoats issues, materials, advantages, limitations andapplications.

UNIT-3	CO3	12

Solid Based Additive Manufacturing System: Solid Ground Curing (SGC): working principle, process, strengths, weaknesses and applications. Fused deposition Modeling (FDM)-Principle, details of process, process variables, products, materials and applications. Laminated Object Manufacturing (LOM)-Working Principle, Details of processes, materials, advantages, limitations and applications.

UNIT-4	CO4	12

Powder Based Additive Manufacturing System: Selective Laser Sintering (SLS)-Principle, process, Indirect and direct SLS- powder structures, materials, post processing, surface deviation and accuracy, Applications. Laser Engineered Net Shaping (LENS)-Processes, materials, advantages, limitations, Applications.

LEARNING RESOURCES:

REFERENCE BOOKS

1. Chua, C.K., Leong K.F. and Lim C.S., “Rapid prototyping: Principles and applications”, second edition, World Scientific Publishers,2010.
2. Gebhardt, A., “Rapid prototyping”, Hanser Gardener Publications,2003.
3. Gibson, I., Rosen, D.W. and Stucker, B., “Additive Manufacturing Methodologies: Rapid Prototyping to Direct Digital Manufacturing”, Springer,2010.
4. Hilton, P.D. and Jacobs, P.F., Rapid Tooling: Technologies and Industrial Applications, CRC press, 2005.14
5. Kamrani, A.K. and Nasr, E.A., “Rapid Prototyping: Theory and practice”, Springer,2006.
6. Liou, L.W. and Liou, F.W., “Rapid Prototyping and Engineering applications : A tool box for prototype development”, CRC Press,2011.

MEHN31	COMPUTATIONAL FLUID DYNAMICS	L	T	P	C	Int	Ext
		3	1	-	4	30	70
	HONORS-THERMAL POOL						

COURSE OBJECTIVES:

1. To know the various applications of CFD and basic governing equations of fluidflow
2. To know the classification of PDE and discretizationtechniques
3. To know the implicit and explicit methods and VN stability criteria for parabolic and hyperbolic equations
4. To know different CFD techniques

COURSE OUTCOMES:

1. Understand the philosophy of CFD and derive governing equations of fluidflow
2. Understand the principles ofdiscretization.
3. Formulate solution techniques for parabolic and hyperbolicequations.
4. Apply some of the popular FD techniques in the solution of fluid flowproblems

CO – PO MATRIX:

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

COURSE CONTENT:

UNIT-1	CO1	12

Importance and applications of CFD, Models of flow, governing equations of fluid flow – Navier Stokes and Euler's equations: Continuity, Momentum and Energy equations in differential form, Physical boundary conditions

UNIT-2	CO2	12

Classification of partial differential equations, Discretization techniques- FDM, FEM, FVM, Finite Difference equations- Taylor series, order of accuracy, forward, backward and central differences for first order and second order differential equations.

UNIT -3	CO3	12

Difference equations, Explicit and Implicit approaches, Thomas Algorithm (TDMA). Analysis of stability, VN stability criteria for parabolic (1-D unsteady heat equation) and Hyperbolic (1st order wave equation) equations, Courant number.

UNIT -4	CO4	12

Simple CFD techniques: Lax-Wendroff technique, MacCormack's technique and Iterative and Relaxation techniques. Pressure correction technique, staggered grid, SIMPLE algorithm, Boundary conditions for pressure correction method

LEARNING RESOURCES:

TEXT BOOK(S):

1. Computational Fluid Dynamics - Basics with Applications - John. D. Anderson, JR. McGraw Hill Education (India) Edition2012.
2. Computational Fluid Dynamics - T. J. Chung, Cambridge University Press, 2nd Edition,2014.

REFERENCE BOOK(S):

1. Introduction to computational fluid mechanics - Niyogi, Chakravarty, Laha, Pearson pub. 1st Edition, 2009.
2. Numerical heat transfer and fluid flow - S.V. Patankar, Hemisphere Pub., 1stEdition.
3. Computational Fluid flow and Heat transfer - K. Muralidhar and T. Sundararajan-, Narosa Pub. 2nd Edition,2003.

WEB REFERENCE:

1. http://ocw.mit.edu/courses/mecharlical-engineering/2-29-numerigal-fluidmechanicsfall2011/
2. http:/inptel.ac.in/courses/112105045/ (IITKharagpur)
3. http://nptel.ac.in/courses/112107080/ (IITRoorkee)
4. http://nptel.ac.in/courses/112104030/ (IITKanpur)

MEH32	GAS DYNAMICS & JET PROPULSION	L	T	P	C	Int	Ext
		3	1	-	4	30	70
	HONORS-THERMAL POOL						

COURSE OBJECTIVES:

1. To understand the behaviour of compressible fluid & Governing equations.
2. To understand the Non-isentropic flow behaviour.
3. To understand the principle of Jet Propulsion and Working Principles of various jet engines.
4. To understand the working principle of rocket engine and its propellants.

COURSE OUTCOMES:

1. Able to analyse the isentropic compressible flow systems.
2. Able to analyse the non-isentropic compressible flow.
3. Able to estimate the Thrust, Power and various efficiencies of Jet Propulsion units.
4. Able to analyse the rocket engines.

CO – PO MATRIX:

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

COURSE CONTENT:

UNIT-1	CO1	12

Compressible flow, definition, Mach waves and Mach cone, stagnation states, Mass, momentum and energy equations of one-dimensional flow, Isentropic flow through variable area ducts, nozzle s and diffusers, subsonic and supersonic flow I variable area ducts, choked flow, Area-Mach number relations for isentropic flow.

UNIT-2	CO2	12

Non-isentropic flow in constant area ducts, Rayleigh and Fanno flows, Normal shock relations, oblique shock relations, isentropic and shock tables.

UNIT -3	CO3	12

Theory of jet propulsion, thrust equation, thrust power and propulsive efficiency, Operating principle and cycle analysis of ramjet, turbojet, turbofan and turboprop engines.

UNIT -4	CO4	12

Types of rocket engines, propellants & feeding systems, ignition and combustion, theory of rocket propulsion, performance study, staging, terminal and characteristic velocity, spaceflights.

LEARNING RESOURCES:

TEXT BOOK(S):

1. Gas Dynamics and Jet Propulsion --- P.L.Somasundaram
2. Gas Dynamics - E.Radhakrishnan

REFERENCE BOOK(S):

1. Gas Dynamics - JohnJames
2. Fundamentals of Gas Dynamics - Chen, ReceyHung

WEB REFERENCES:

1. https://lecturenotes.in/video-tutorial/63871-gas-dynamics-and-propulsion?reading=true
2. https://www.youtube.com/watch?v=2INUkeutjBY&list=PLbMVogVj5nJR0Vt9CLGK7ck2yrS1zQjMo
3. https://www.youtube.com/watch?v=lPoU8Cu9ffw&list=PLY6be7r7PT8Jecyts018SmNqWPMA-JpQA
4. https://www.youtube.com/watch?v=csxn_ek8HSE
5. https://www.youtube.com/watch?v=xSpqILSumek

MEH33	ALTERNATE FUELS & ENERGY SYSTEMS	L	T	P	C	Int	Ext
		3	1	-	4	30	70
	HONORS-THERMAL POOL						

COURSE OBJECTIVES:

1. To know about the different fuels and the required qualities to use as engine fuels,potential alternative fuels, their merits and demerits.
2. To Understand the need for alternative fuels, availability of different alternative fuels for both SI and CI engines and t the suitability of alcohols as fuels for both SI and CI engines.
3. To know about the suitability of Hydrogen as a fuel for both SI and CI engines, different production methods along with storage and safety aspects of Hydrogen and toknow about the different vegetable oils suitable as fuels
4. To know about the working of electric, hybrid and fuel cell vehicles.

COURSE OUTCOMES:

1. Able to understand the different fuels and required qualities to use as fuels for IC engines and potential alternative fuels along with their merits and demerits.
2. Abe to understand the need for alternative fuels, availability of different alternative fuels to and suitability of alcohols as fuels for both SI and CI engines
3. Able to understand the suitability of Hydrogen as a fuel for both SI and CI engines, production, storage and safety of Hydrogen along with different vegetable oils suitable for both SI and CI engines.
4. Able to understand the working of Electric, Hybrid and Fuel cell vehicles, their relative merits and limitations in using them.

CO – PO MATRIX:

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

COURSE CONTENT:

UNIT-1	CO1	12

Introduction: solid fuels, gases fuels, liquid fuels, petroleum refining process, important requisite qualities of engine fuels, SAE rating of fuels.

FUELS: Availability and Suitability to Piston Engines, Concept of conventional fuels, potential alternative fuels - Ethanol, Methanol, DEE/DME - Hydrogen, LPG, Natural gas, Producer gas, Bio gas and Vegetable oils - Use in I.C.Engines-Merits and Demerits of various fuels.

UNIT-2	CO2	12

Introduction to alternative fuels. - Need for alternative fuels - Availability of different alternative fuels for SI and CI engines. Alcohols as fuels. Production methods of alcohols. Properties of alcohols as fuels. Methods of using alcohols in CI and SI engines. Blending, dual fuel operation, surface ignition and oxygenated additives.

UNIT-3	CO3	12

GASEOUS FUELS: Hydrogen - Properties - Use in C.I Engines - Use in S.I Engines - Storage methods - Safety precautions -Production methods. LPG & Natural gas - Properties - Use in S.I. and C.I. Engines.

VEGETABLE OILS: Properties - Esterification - Performance in Engines.		
UNIT-4	**CO4**	**12**
ELECTRIC, HYBRID AND FUEL CELL VEHICLES Layout of Electric vehicle and Hybrid vehicles – Advantages and drawbacks of electric and hybrid vehicles. System components, Electronic control system – Different configurations of Hybrid vehicles. Power split device. High energy and power density batteries – Basics of Fuel cell vehicles.		

LEARNING RESOURCES:

TEXT BOOK(S):

1. S.S. Thipse, “Alternative Fuels”, Jaico Publishing House; First edition,2010.
2. Erjavec Jack Et.Al, “Alternative Fuel Technology: Electric, Hybrid, and Fuel-Cell Vehicles”,Cengage Learning,2007.

REFERENCE BOOK(S):

1. Ganesan. V.“Internal Combustion Engines”, Tata McGraw-Hill Publishing Co,2012.
2. Mathur D.S., Sharma. R.P. “A course in internal combustion engines”, Dhanpatrai publication, 2014.

WEB REFERENCE:

1. https://scholarworks.umt.edu/cgi/viewcontent.cgi?referer=https://www.google.com/&httpsredir=1&article=1296&context=syllabi
2. NPTEL-https://nptel.ac.in/courses/121/106/121106014/
3. https://nptel.ac.in/content/storage2/courses/112104033/pdf_lecture/lecture39.pdf

MEH34	ADVANCED IC ENGINES	L	T	P	C	Int	Ext
		3	1	-	4	30	70
	HONORS-THERMAL POOL						

COURSE OBJECTIVES:

1. To know about SI engineair fuel requirements, various fuel injection systems, combustion phenomena of both normal and abnormal, detonation and its problems, combustion chamber types
2. To know about CIcombustion phenomena, different fuel injection systems and concepts of turbocharging and supercharging as applied to CI engines.
3. To know about the IC engine exhaust emissions, measurement methods and their controlling methods.
4. To know about the gaseous fuels and their suitability to SI, CI engines and modifications required along with recent trends like HCCIE, Lean burn engine, Stratified charge engine and surface ignition engines,

COURSE OUTCOMES:

1. Able to understand SI engine air fuel requirements, fuel injection systems like single point, multipoint etc, along with combustion and its problems, combustion chamber importance and types.
2. Able to know about different CI engine fuel injection systems, combustion and its problems along with application of turbocharging and supercharging to CI engines.
3. Able to know about the different exhaust emissions from both SI and CI engines, their measurement methods, and different ways of controllingemissions.
4. Able to know about the suitability of different gaseous fuels to both SI and CI engines, and working of HCCIE, Lean burn Stratified charge and Surface ignition engines etc.,

CO – PO MATRIX:

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

COURSE CONTENT:

UNIT-1	CO1	12

SPARK IGNITION ENGINES

Air-fuel ratio requirements,Fuel injection systems – Monopoint, Multipoint & Direct injection, Stages of combustion normal and abnormal combustion, Factors affecting knock, Importance of Combustion chamber and Types.

UNIT-2	CO2	12

COMPRESSION IGNITION ENGINES

Stages of combustion-normal and abnormal combustion – Factors affecting knock, Direct and Indirect injection systems, Importance of Combustion chamber and Types.

Turbo Charging-Turbo Charging Methods

Supercharging-Supercharging and Scavenging of IC Engines, Supercharging limits.

UNIT-3	CO3	12

ENGINE EXHAUST EMISSIONS, MEASUREMENT AND CONTROL

Formation of oxides of nitrogen, carbon monoxide, hydrocarbon, aldehydes and Smoke Particulate emission, effects of pollutions on environment.

Pollution Measurements: Non dispersive infrared gas analyzer, gas chromatography, chemiluminescent analyzer and flame ionization detector, smoke measurement, noise pollution,

measurement and control.

Control of Engine Pollution: Engine component, fuel modification, evaporative emission control, EGR, air injection thermal reactors, in cylinder control of pollution, catalytic converters,SCR.

UNIT-4	CO4	12

ALTERNATE FUELS

Use of gaseous fuels like biogas, LPG, hydrogen, natural gas, producer gas etc. in SI/CI engines, Merits and Demerits - Engine Modifications.

RECENT TRENDS

Homogeneous Charge Compression Ignition Engine, Lean Burn Engine, Stratified Charge Engine, Surface Ignition Engine.

LEARNING RESOURCES:

TEXT BOOK(S):

1. Heinz Heisler, „Advanced Engine Technology," SAE International Publications,USA,1998
2. Ganesan V.." Internal Combustion Engines" , Third Edition, Tata Mcgraw-Hill,2007

REFERENCE BOOK(S):

1. John B Heywood," Internal Combustion Engine Fundamentals", Tata McGraw-Hill1988
2. Patterson D.J. and HeneinN.A,"Emissions from combustion engines and their control," Ann Arbor Science publishers Inc, USA,1978

WEB REFERENCE:

1. MIT OPENCOURSEWARE - https://ocw.mit.edu/courses/mechanical-engineering/2-61-internal- combustion-engines-spring-2017/
2. https://nptel.ac.in/courses/112/103/112103262/
3. https://www.slideshare.net/books5884/me6016-advanced-icengines

MEH41	QUALITY CONTROL AND RELIABILITY ENGINEERING	L	T	P	C	Int	Ext
		4	0	-	4	30	70
	HONORS-INDUSTRIAL POOL						

COURSE OBJECTIVES:

1. To introduce the concept ofSQC
2. To understand processcontrol
3. To acceptance sampling procedure and theirapplication.
4. To learn the concept ofreliability.

COURSE OUTCOMES:

After completion of the course, the students will be able to

1 .Summarize the concept of Quality and Process control for variables and attributes
2. Explain the concept of sampling and to solveproblems
3. Explain the concept of Lifetesting
4. Explain the concept Reliability and techniquesinvolved

CO – PO MATRIX:

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

COURSE CONTENT:

UNIT-1	CO1	12
Introduction, definition of quality, basic concept of quality, definition of SQC, benefits and limitation of SQC, Quality assurance, Quality cost-Variation in process- factors – process capability – process capability studies and simple problems – Theory of control chart- uses of control chart – Control chart for variables – X chart, R chart and σ chart. Control chart for attributes –control chart for proportion or fraction defectives – p chart and np chart – control chart for defects – C and U charts, State of control and process out of control identification in charts.		
UNIT-2	**CO2**	**12**
Lot by lot sampling – types – probability of acceptance in single, double, multiple sampling techniques – O.C. curves – producer's Risk and consumer's Risk. AQL, LTPD, AOQL concepts-standard sampling plans for AQL and LTPD- uses of standard sampling plans.		
UNIT-3	**CO3**	**12**
Life testing – Objective – failure data analysis, Mean failure rate, mean time to failure, mean time between failure, hazard rate, system reliability, series, parallel and mixed configuration – simple problems. Maintainability and availability – simple problems. Acceptance sampling based on reliability test – O.C Curves.		
UNIT-4	**CO4**	**12**
Reliability improvements – techniques- use of Pareto analysis – design for reliability – redundancy unit and standby redundancy – Optimization in reliability – Product design – Product analysis – Product development – Product life cycles.		

LEARNING RESOURCES:

TEXT BOOK(S):

1. GRANT, EUGENE .L “Statistical Quality Control “, McGraw-Hill,1996
2. L.S.SRINATH, “Reliability Engineering” Affiliated East west press,1991

REFERENCE BOOK(S):

1. MONOHAR MAHAJAN, “Statistical Quality Control”, DhanpatRai& Sons,2001.
2. R.C.GUPTA, “Statistical Quality control”, Khanna Publishers,1997
3. BESTERFIELD D.H., “Quality Control”, Prentice Hall,1993
4. SHARMA S.C., “Inspection Quality Control and Reliability”, Khanna Publishers,1998
5. DANNY SAMSON, “Manufacturing & Operations Strategy”, Prentice Hall,1991
6. CONNOR, P.D.T.O., “Practical Reliability Engineering”, John Wiley,1993.

MEH42	DESIGN OF EXPERIMENTS	L	T	P	C	Int	Ext
		3	1	-	4	30	70
	HONORS-INDUSTRIAL POOL						

COURSE OBJECTIVES:

1. Use statistics in experimentation and understand the important role of experimentation in new product design, manufacturing process development, and processimprovement;
2. Learn the experimental designs most widely used in practice and choose an appropriate experimental design based on the studyobjectives.
3. Identify the importance of factorialdesigns
4. Explain how to choose an orthogonal array for anexperiment

COURSE OUTCOMES:

After successful completion of the course, the students are able to

1. Formulate objective(s) and identify key factors in designing experiments for a givenproblem.
2. Develop appropriate experimental design to conduct experiments for a givenproblem.
3. Analyze experimental data to derive validconclusions.
4. Design the experiments using the orthogonalarrays.

CO – PO MATRIX:

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

COURSE CONTENT:

UNIT-1	CO1	12

INTRODUCTION: Strategy of experimentation, some typical applications of experimental design, Basic principles, Guidelines for designing experiments, a brief history of statistical design, using statistical design in experimentation.

SIMPLE COMPARATIVE EXPERIMENTS: Introduction, Basic statistical concepts, Sampling and Sampling Distribution, Inferences about the Differences in means, randomized designs, paired comparison Designs, Inferences about the Variances of Normal Distributions.

UNIT-2	CO2	12

Simple designs of ANOVA: Need for ANOVA, Randomized Block Designs, Randomized complete block design, Latin square design, and balanced incomplete block design.

UNIT-3	CO3	12

Introduction To Factorial Design: Basic definition and principles, Advantages of factorials, the two factor factorial design, complete factorial experiment with three factors.

UNIT-4	CO4	12

Orthogonal arrays: Introduction, degrees of freedom of orthogonal arrays, Design of orthogonal arrays, linear graph, column effect method, ANOVA for orthogonal array.

LEARNING RESOURCES:

TEXT BOOK(S):

1. Douglas C Montgomery, “Design and Analysis of Experiments”, JohnWiley.
2. John P.W.M., “Statistical Design and Analysis of Experiments”,Macmillan.

REFERENCE BOOK(S):

1. R. Panneerselvam “Design and analysis ofexperiments”
2. Taguchi, “Introduction to Quality Engineering”, Asian Productivity Organisation, G. UNIPUB, White Plains, NewYork.

WEB REFERENCE:

1. http://nptel.ac.in/courses/111104075/
2. http://nptel.ac.in/courses/111104078/
3. http://home.iitk.ac.in/~shalab/anova/chapter4-anova-experimental-design-analysis.pdf
4. https://onlinecourses.science.psu.edu/stat503/node/5

MEH43	PRODUCTION PALNNING AND CONTROL	L	T	P	C	Int	Ext
		4	0	-	4	30	70
	HONORS-INDUSTRIAL POOL						

COURSE OBJECTIVES:

1. To provide the students with an understanding of the basics of elements of PPC and types of productionsystems
2. To know the basic Techniques and their application which are used in project management and to grasp basic knowledge about sequencing
3. To expose to Aggregate planning, its methods andRouting
4. Gain knowledge in fundamental concepts in the field of standard Scheduling methods, Dispatching and followup

COURSE OUTCOMES:

After completion of the course, the students will be able to

1. Define and understand concepts of PPC and types of productionsystems.
2. State techniques and their methodology in project management,sequencing
3. Appreciate and distinguish the importance of Aggregate planning and its methods and know about Routing
4. Differentiate the concepts of Scheduling methods, Dispatching and followup

CO – PO MATRIX:

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

COURSE CONTENT:

UNIT-1	CO1	12
Objectives and benefits of planning and control-Functions of production control-Types of production- job- batch and continuous- organization of production planning and control – internal organizations department, Product development and design-Marketing aspect - Functional aspects-Operational aspect-Durability and dependability aspect, aesthetic aspect. Profit consideration-Standardization, Simplification & specialization- Break even analysis-Economics of a newdesign.		
UNIT-2	**CO2**	**12**
Product planning-Extending the original product information-Value analysis -Problems in lack of product planning-Process planning and routing-Pre requisite information needed for process planning- Steps in process planning-Quantity determination in batch production, Machine capacity, balancing- Analysis of process capabilities in a multi-product system.		
UNIT-3	**CO3**	**12**
Routing – Definition – routing procedure- Route sheets – Bill of material, factors affecting routing procedure. Schedule – definition – difference with loading. Scheduling polices – techniques, standard scheduling methods- job shop, flow shop. Line balancing, aggregate planning- methods for aggregate planning- Chase planning, expediting, control aspects		

UNIT-4	CO4	12
Scheduling –definition –Difference with loading, Scheduling and loading guidelines, Standard scheduling methods – forward scheduling and backward scheduling, Johnson's rules. Dispatching – activities of dispatcher – dispatching procedure – follow up –definition –for existence of functions – types of follow up, applications of computer in production planning andcontrol.		

LEARNING RESOURCES:

TEXT BOOK(S):

1. Elements of Production, Planning and Control by SamuelEilon
2. Operations management by Joseph G.Monks,Tata

McGraw-Hill Inc, REFERENCEBOOK(S):

1. Production and Operations management by R.Pannerselvam,PHI, 2nd edition,2006.
2. Production and Operations Management by S.N.Chary, TMH(4th edition).
3. Production Planning and Control, Mukhopadyay,PHI.

MEH44	SUPPLY CHAIN MANAGEMENT	L	T	P	C	Int	Ext
		4	0	-	4	30	70
	HONORS-INDUSTRIAL POOL						

COURSE OBJECTIVES:

1. Understand the basic concepts of Supply Chain Management and identify SCdrivers.
2. Discuss the role of supply chainnetwork.
3. Know the importance of logistics inSCM
4. Learn about aggregate planning and coordination concepts ofSCM.

COURSE OUTCOMES:

After completion of the course, the students will be able to

1. Understand the decision phases and apply competitive & supply chainstrategies.
2. Analyze factors influencing networkdesign.
3 . Analyze the influence of logistics in a supplychain.
4 . Understand the role of aggregate planning, inventory, IT and coordination in a supplychain.

CO – PO MATRIX:

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

COURSE CONTENT:

UNIT-1	CO1	12
Introduction to Supply Chain Management, Decision phases in a supply chain, Process views of a supply chain: push/pull and cycle views, Achieving Strategic fit, Expanding strategic scope. Supply Chain Drivers and Metrics: Drivers of supply chain performance, Framework for structuring Drivers, Obstacles to achieving strategic fit.		
UNIT-2	**CO2**	**12**
Designing Supply Chain Network: Factors influencing Distribution Network Design, Design options for a Distribution network, E-Business and Distribution network, Framework for Network Design Decisions, Models for Facility Location and Capacity Allocation.		
UNIT-3	**CO3**	**12**
Logistics in supply chain: Role of transportation in supply chain – factors affecting transportations decision – Design option for transportation network – Tailored transportation – Routing and scheduling in transportation.		
UNIT-4	**CO4**	**12**
Aggregate Planning and Inventories in SC: Aggregate planning problem in SC, Aggregate Planning Strategies, Planning Supply and Demand in a SC, Managing uncertainty in a SC: Safety Inventory. Coordination in SC: Modes of Transportation and their performance characteristics, Supply Chain IT framework, Coordination in a SC and Bullwhip Effect.		

LEARNING RESOURCES:

TEXT BOOK(S):

1. Sunil Chopra and Peter Meindl, Supply Chain Management - Strategy, Planning and Operation, 4th Edition, Pearson Education Asia,2010.
2. David Simchi-Levi, PhilpKamintry and Edith Simchy Levy, Designing and Managing the SupplyChain
- Concepts Strategies and Case Studies, 2nd Edition, Tata-McGraw Hill,2000.

REFERENCE BOOK(S):

1. Jeremy F.Shapiro, “Modeling the Supply Chain”, Thomson Duxbury,2002.
2. Srinivasan G.S, “Quantitative models in Operations and Supply Chain Management, PHI,2010
3. David J.Bloomberg , Stephen Lemay and Joe B.Hanna, “Logistics”, PHI2002.
4. James B.Ayers, “Handbook of Supply Chain Management”, St.Lucle press,2000.