Course Contents

Course	Title	Code	Credits-4C			Theory Papers
Interdisciplinary DID-2	Operations Management	AU/IP/ME/TX 601	L	T	P	Max.Marks-100 Min.Marks-35 Duration-3hrs.
			3	1		

Unit 1 **Operations Management (OM):** Definition, history, industrial and IT revolution (ERP); tangible and service products continum, employment shift from agriculture, manufacturing to service; customer orientation; basic process formats on product volume-variety graph; concept of raw process time, critical WIP, bottle neck thruput and cycle-time with example of Penny-Fab-1,2; Littles law, best and worst case performance, thruput and cycle time formula in practical-worst-case; criteria of performance, decision area business strategy, environment scan, SWOT, Porters' five forces, core competency, competitive priorities of cost, quality, time and flexibility, order winners; production strategy of Make To Order-MTO, MTS and ATO (assemble to order); productivity, standard of living and happiness.

Unit 2 Product:-Life Cycle and PLC management; design steps, evolution and innovation, traditional v/s concurrent design, form and functional design, simplification and standardization, differentiation/ mass customization, modular design, design for mfg and environment (DFM, DFE), technologies used in design. Service characteristics and classification based on people-things v/s direct-indirect service actions, service triangle of customer, provider and system; technical and functional (delivery) service quality and other service performance factors, Valerie's service quality model; globalization of services.

Unit 3 Processes: transformation and value addition, selection based on cost, quality and flexibility considerations; reliability, bath-tub curve, series and parallel components, MTBF; availability and maintainability, preventive maintenance, TPM; value analysis; replacement models; Quality-definition, Taguchi loss function, cost of quality, chain action of improving quality to productivity to motivation and low cost; product and process specs; the funnel-marble experiment and variance reduction, process capability, six sigma and its implementation by DMAIC, QFD, TQM and ISO-9000.

Unit 4 Plant-facilities: Impact of organization strategies on choice of region and site, existing or new organization, decision-affecting factors for location, load distance, dimensional and factor analysis methods, Brown-Gibson model, foreign locations, non-profit govt. services (health, school) locations. facility layout objectives and factors, basic layouts, merits and optimization; subjective relationship ranking method, computer programs CRAFT and 3-d modeling; problems of inventories flow and operators in process layout and inflexibility in product layout, flexible cellular layout, group technology; capacity and equipment selection, importance of spare capacity to reduce Q-length and cycle time.

Unit 5 Programs/ procedures of production control (PPC): corporate and production planning process, aggregate plan, master production schedule and material planning; matching supply to demand fluctuations over time horizon, Forecasting elements, time series, regression, causal and Delphi methods; use of LP in aggregate plan and HMMS model, assembly line balancing, elemental task, station time and cycle time, balance delays; sequencing, Johnson method for n-job 2/3 m/c, NP hard job-shop sequencing, heuristic dispatch rules; synchronous mfg, TOC, drum-buffer-rope and focus on bottleneck as control point; JIT lean mfg, Kanban and CONWIP shop floor controls, Kaizen.

References:

1. Chary SN; Production and Operations Management; TMH
2. Hopp W and Spearman M; Factory Physics; TMH
3. Gitlow Howard et al; Quality Management; TMH
4. Khanna RB; Production and Operations Management; PHI
5. Vollman, berry et al; Manufacturing planning and control for SCM; TMH.
6. Chase Richard B et al; Operations management; SIE-TMH

Course Contents

Category	Title	Code	Credits-4C			Theory Papers
Departmental Core DC-12	Total Quality Management and SQC	AU/IP 602	L	T	P	Max.Marks-100
			3	1		Min.Marks-35
						Duration-3hrs.

Unit 1 Evolution of total quality management, historical perspective, teamwork, TQM and ISO 9000; information technology and Business Process Re-engineering (BPR); TPM and quality awards; aids and barriers to quality mgt, creating vision and initiating transformation, establishing programs for education and self improvements, measurement of key indicators; quality mgt leader; cross functional teams and coordination, policy setting and review, flowchart of policy mgt and relation with daily mgt.

Unit 2 Process- definition, variation and feedback, funnel-marble experiment- rules of adjustment and its effects, quality- definition, goalpost and kaizen view, quality of design, conformance and performance; Taguchi loss function, cost of quality, chain action of improving quality to productivity to motivation and low cost; Deming's theory of mgt, fourteen points and variance reduction; attributes enumerative and variables analytic studies.

Unit 3 SQC-Control charts: basic discrete and continuous distributions, measures of central tendency, variability and shapes, sampling, size and central value theorem, control chart structure, process plotting and stability, study of out-of-control evidences, defect detection and prevention, use of control charts in evaluating past, present and future trends; attribute control charts, count and classification charts, construction and interpretation of p , np , c and u charts, PDSA cycle(plan, do, study, act), $\dot{x}$ and R charts, $\dot{x}$ and s charts, individual and moving range chart, trial control limits and out of control points.

Unit 4 Process diagnostics: Between and Within Group variations, periodic and persistent disturbances, control chart patterns-natural, level-shift, cycle, wild, multi-universe, relationship and other out of control patterns; diagnosing a process, brainstorming; cause-effect, Ishikava, interrelationship, systematic and matrix diagrams; change concepts and waste elimination

Unit 5 Process improvement: Performance and technical specifications, attribute-process and variable-process capability studies; unstable and stable process capability studies and examples; attribute and variable improvement studies; Inspection: acceptance sampling(AS)- lot formation, single, double and multiple/sequential sampling plans, operating characteristic (OC) curve, producer and consumer risk, theoretical invalidation of AS, kp rule for stable and chaotic processes.

References:

1. Gitlow HS, Oppenheim et al; Quality Management; TMH
2. Juran J. M., Quality Planning and Analysis
3. Sharma P. D, TQM, Sultanchand
4. Crosby Philips; Quality is still free; New Amer Library
5. Naidu Babu and Rajendran; TQM; New age International pub;
6. Chase Richard B et al; Operations management; SIE-TMH
7. Chary SN; Production and Operations Management; TMH

Course Contents

Category	Title	Code	Credits-6C			Theory Papers
Departmental Core DC-13	Metal Cutting and CNC machines	IP/ ME 603	L	T	P	Max.Marks-100
			3	1	2	Min.Marks-35 Duration-3hrs.

Unit I: Lathe: Classification of machine tools and their basic components; lathe- specification, components & accessories, various operations on lathes, capstan & turret lathes, tool layout, methods of thread production, machining time, single point cutting tools, tool signature and nomenclature

Unit II: Grinding: Types of grinding machines, surface, cylindrical and internal grinding, grinding wheels, specifications, wheel turning and dressing without eccentricity, centre-less grinding.

Unit III: Milling: Vertical, horizontal and universal type machines, specifications and classifications of milling machines, universal dividing head plain and different indexing, gear cutting, milling cutters.
Drilling & Broaching: Fixed spindle, radial and universal drilling machines, drilling time, broaching principle, broaches and broaching machines.

Unit IV: Shapers: Classification and specifications, principle parts, quick return mechanism, shaper operations, speed feed, depth of cut, machining time. Surface qualities, equipment used for rating surfaces, rms. CLA value, causes for surface irregularities.
Gear Cutting: Die casting, methods of forming gears, generating process, Gear shaping, gear shaving, gear grinding gear testing.

Unit V: Mechatronics: Introduction to control systems, analog control, transfer function, procedure for writing transfer function, signal flow diagram, introduction to electronic components like switches, magnetic type, electromagnetic type, transducers and other sensors, servo motors, basics of CD-ROM players, PLC, applications, CNC machines.

References:

1. Groover MP; Fundamentals of modern manufacturing; Wiley India
2. Kaushish JP; Manufacturing processes; PHI
3. Boothroyd G, Knight WA; Fundamentals of machining and machine tools; CRC-Taylor and francis
4. Munoz J and Oswald PF; Manufacturing processes and systems; Wiley India;
5. Boston; Metal Processing.
6. Hazra Chowdhary; Workshop Tech.II
7. Lindberg – Materials & Processes of Manufacture.
8. Work shop technology by Raghuvanshi-Vol-II
9. Production Processes by HMT

List of Experiment (Pl. expand it):

1. To make a complicate job on lathe machine with all operations like turning, step turning, drilling , tapper turning , thread cutting and knurling .
2. Study of center less grinding machine/ tool and cutter type grinding machine.
3. Study of horizontal/ universal milling machine, diving head and indexing mechanism of it.
4. To cut a spur gear on milling machine using rapid indexing method.
5. Study of radial drilling machine and preparing a job on it.
6. To study a sapping machine to learn about working of quick return mechanism.

Course Content

Category	Title	Code	Credits-6C			Theory Papers
Departmental Core DC -14	NC machines and Non conventional machining	IP 604	L	T	P	Max.Marks-100
			3	1	2	Min.Marks-35
						Duration-3hrs.

Unit 1.Numerical Control: Concepts and types, position and motion control, constructional features of NC machines, CNC, DNC and machining center, adaptive control, programming of CNC machines MIRAC and TRIAC, machine axis definition, programming words, EIA codes, CNC canned cycles, G-codes and M-codes for CNC lathe, absolute and incremental programming; canned cycles of CNC milling machine.

Unit 2 Computer Assisted Part Programming: The APT System, continuous path part programming, geometry statements, part programming and debugging, computations; decisions and looping, subscripted variables, macro definitions, characteristics and limitations of macro, introduction to multi-axis programming, pocket machining methods, surface machining methods, automated part program generation.

Unit 3 Rapid Prototyping: fundamental of rapid prototyping, rapid prototyping technologies, liquid based rapid prototyping system, solid based rapid prototyping system, application issues in rapid prototyping, design, engineering analysis and planning, micro fabrication and nanofabrication technologies, micro fabrication process, Introduction to nano-technology.

Unit 4 Modern Machining Process: Introduction and classification, **abrasive** jet m/c: principles, process parameters, metal removal rate, effect of parameters, application & limitations; **ultrasonic** m/c: principles, process parameters, cutting tool design, tool feed mechanism, transducer, design of velocity transformers, mechanics of cutting, effect of parameters, economic considerations, application & limitations; **chemical** m/c: chemical milling, chemical engraving, chemical blanking, principles and process parameters; **electrochemical** m/c: classification, principles, elements of process, metal removal rate, electro-chemistry of process, dynamics and hydrodynamics of process, optimization analysis, choice of electrolytes, **electrochemical grinding, deburring and honing**: principles and process parameters.

Unit 5 Electrical Discharge M/c (EDM): Mechanisms of metal removal, basic circuitry, evaluation of metal removal rate, m/c accuracy, surface finish, analysis for optimization, tool material, dielectric fluid, application & limitation; **Laser Beam** m/c: features, metal removal, thermal analysis, cutting speed and accuracy, application & limitation, micro-drilling by laser; **Electron Beam** m/c: theory, forces in m/c, process capability. **Plasma Arc** M/c: Non-thermal generation of plasma, mechanics of metal removal, various parameters, accuracy and surface finish, applications.

References:

1. Groover, Production System & CIM, P.H.I.
2. Ghosh & Malik; Production Process
3. Zeid, CAD/CAM Theory & Practice, McGraw-Hill
4. Numerical Control Programming in APT Irvin H Kral Prentice Hall
5. CNC Programming Manual TRIAC; CNC Programming Manual MIRAC
5. Rowe; Industrial Manufacturing Process; Arnold.
6. Pandey & Singh; Production Engg. Science; Standard Publishers.
7. Avitzur; Metal working; T.M.H.

List of Experiments (Pl. expand it):

1.Manual and computer assisted programming for machining parts on CNC lath and milling machines
2.Study and operation of non-conventional machines

Course Content

Category	Title	Code	Credits-6C			Theory Papers
Interdisciplinary DID-3	Operation Research I	IP 605	L	T	P	Max.Marks-100
			3	1	2	Min.Marks-35 Duration-3hrs.

Unit 1 Linear Programming: Introduction, history and development of OR, model building, process of OR, linear programming– formulation, graphical method, simplex method, big-M-method, two-phase method, degeneracy in LPP, unrestricted variables, duality in LP, convex sets, revised simplex, sensitivity analysis, parametric linear programming, introduction to integer programming, branch and bound algorithm, cutting plane algorithm, single and multiple goal programming algorithms.

Unit 2 Allocations in LPP- **assignment** model- hungarian method, unbalanced, traveling sales man and miscellaneous problem; **transportation**- optimality test, degeneracy unbalanced problems, trans-shipment.

Unit 3 Decision and Game theory: Decision tree, decision making models under certainty, risk and uncertainty; rectangular, two persons zero sum games, maximin and minimax principles, saddle point, dominance, graphical and algebraic methods of solution, solution by transforming into linear programming problem

Unit 4 Dynamic programming: Characteristics of dynamic optimization model, Bellman's principle, typical problems, salesmen problem, forward and backward recursion, use of software to solve LP and DP problems.

Unit 5 Network (NW) models for projects: Activity and event presentation on NW, summary and detailed blowup NW, work breakdown structure, manageable work units; dummy activity, node numbering rule, time scaled NW, activity and event times, forward and backward pass calculations of earliest/ latest start/ finish time, slack and floats, critical path; resource leveling and critical chain; activity-cost tradeoff and crashing of NW; use of PERT for activity duration uncertainty, probability of completing project in estimated times.

References:

1. Taha H. A., Operation Research, PHI.
2. Hillier and Lieberman Introduction to OR; TMH
3. Sharma JK; OR Theory and Application; macMillan Pub;
4. Banerjee B., Operation Research; Business Publicity, Bombay.
5. Hira & Gupta, Operation Research, S. Chand.
6. Rao S. S., Optimization, Jain Bros., Delhi.
7. Chitale A. K., J. Negi, Text Book of Operation Research, Jain Bros., Delhi.
8. Sharma S. D., Kedarnath, Operation Research, Ramnath & Co., Meerut.

Suggested List of Experiments (Pl. expand it):

Use computer and software to solve problems contained in the syllabus

Course Contents

Category	Title	Code	Credits-3 C			Practical
IT 5	Computer Aided Engineering (CAE)	IP/ME 607	L	T	P	Max.Marks-30 Min.Marks-15
			-	-	3	

Practical in CAD/CAM lab covering following topics:

Unit 1 Methods to solve engineering problems- analytical, numerical, experimental, their merits and comparison, discretization into smaller elements and effect of size/ shape on accuracy, importance of meshing, boundary conditions, Computer Aided Engineering (CAE) and design, chain-bumping-stages vs concurrent-collaborative design cycles, computer as enabler for concurrent design and Finite Element Method (FEM), degree of freedom (DOF), mechanical systems with mass, damper and spring, stiffness constant K for tensile, bending and torsion; Practical applications of FEA in new design, optimization/ cost-cutting and failure analysis,

Unit 2 Types of analysis in CAE, static (linear/ non linear), dynamic, buckling, thermal, fatigue, crash NVH and CFD, review of normal, shear, torsion, stress-strain; types of forces and moments, tri-axial stresses, moment of inertia, how to do meshing, 1-2-3-d elements and length of elements; force stiffness and displacement matrix, Rayleigh-Ritz and Galerkin FEM; analytical and FEM solution for single rod element and two rod assembly.

Unit 3 Two-dimension meshing and elements for sheet work and thin shells, effect of mesh density and biasing in critical region, comparison between tria and quad elements, quality checks, jacobian, distortion, stretch, free edge, duplicate node and shell normal.

Unit 4 Three-dimension meshing and elements, only 3 DOF, algorithm for tria to tetra conversion, floating and fixed trias, quality checks for tetra meshing, brick meshing and quality checks, special elements and techniques, introduction to weld, bolt, bearing and shrink fit simulations, CAE and test data correlations, post processing techniques

Unit 5 Review of linear optimization, process and product optimization, design for manufacturing (DFM) aspects in product development, use of morphing technique in FEA, classical design for infinite life and design for warranty life, warranty yard meetings and functional roles, climatic conditions and design abuses, case studies.

References:

1.Gokhle Nitin; et al; Practical Finite Element Analysis; Finite to Infinite, 686 Budhwar Peth, Pune.
2.Krishnamoorthy; Finite Element Analysis, theory and programming; TMH
3.Buchanan; Finite Element Analysis; Schaum series; TMH
4.Seshu P; Textbook of Finite Element Analysis; PHI.
5.Desai Chandrakant S et al; Introduction to finite element Method ,
6.Zienkiewicz; The finite element Method; TMH
7.Reddy an introduction to finite element method; TMH
8.Martin and Grahm; Introduction to finite element Analysis (Theory and App.)