

JALPAIGURI GOVERNMENT ENGINEERING COLLEGE
JALPAIGURI- 735 102

(An Autonomous Government College)



COURSE STRUCTURE AND SYLLABUS
FOR
M.TECH. IN MECHANICAL ENGINEERING
(PRODUCTION TECHNOLOGY & MANAGEMENT)

(Implemented from the Academic Year 2021-22 for the new batch only)

Phone: 03561 – 255131 (Principal), Fax: 03561 – 256143

255465 (EPABX)- 105(EE)

www.jgec.ac.in

First Semester

A. THEORY							
Sl. No.	Field	Theory	Contact Hours/Week				Credits
			L	T	P	Total	
01	PTM 101	Production Management	3	0	0	3	03
02	PTM 102	Production Planning & Control	3	0	0	3	03
03	PTM 103	Elective-I	3	0	0	3	03
04	PTM 104	Elective-II	3	0	0	3	03
05	RMI-101	Research Methodology and IPR	2	0	0	2	02
06	AUD-101	One from the pool of Audit subjects	2	0	0	2	00
Total of Theory			16	00	00	16	14
B. PRACTICAL							
01	PTM-191	Computer Aided design Lab.	0	0	4	4	02
02	PTM-192	Computer Aided Manufacturing Lab.	0	0	4	4	02
Total of Practical			00	00	08	08	04
C. SESSIONAL							
Total of Sessional			00	00	00	00	00
Total of Semester			16	00	08	24	18

Second Semester

A. THEORY							
Sl. No.	Field	Theory	Contact Hours/Week				Credits
			L	T	P	Total	
01	PTM 201	Automation in Manufacturing system & Process	3	0	0	3	03
02	PTM 202	Non Traditional machining Processes	3	0	0	3	03
03	PTM 203	Elective-III	3	0	0	3	03
04	PTM 204	Elective-IV	3	0	0	3	03
05	AUD-201	Second One from the pool of Audit subjects	2	0	0	2	00
Total of Theory			14	00	00	14	12
B. PRACTICAL							
01	PTM-291	Manufacturing System& Process Lab	0	0	4	4	02
02	PTM-292	Simulation, Modeling & Analysis Lab	0	0	4	4	02
Total of Practical			00	00	08	08	04
C. SESSIONAL							
01	PTM-281	Mini Project with Seminar	0	0	4	4	02
Total of Sessional			00	00	04	04	02
Total of Semester			14	00	08	26	18

Third Semester

A. THEORY							
Sl. No	Field	Theory	Contact Hours/Week				Credits
			L	T	P	Total	
01	PTM-301	Elective-V	3	0	0	3	03
02	OEL-301	One from the pool of Open Elective subjects	3	0	0	3	03
Total of Theory			06	00	00	06	06
B. PRACTICAL							
Total of Practical			00	00	00	00	00
C. SESSIONAL							
01	PTM-381	Dissertation Phase-I	0	0	20	20	10
Total of Sessional			00	00	20	20	10
Total of Semester			06	00	20	26	16

Fourth Semester

A. THEORY							
Sl. No.	Field	Theory	Contact Hours/Week				Credits
			L	T	P	Total	
Total of Theory			00	00	00	00	00
B. PRACTICAL							
Total of Practical			00	00	00	00	00
C. SESSIONAL							
01	PTM-481	Dissertation Phase-II	0	0	32	32	16
Total of Sessional			00	00	32	32	16
Total of Semester			00	00	32	32	16

List of Elective Subjects

Elective-I: (A) Theory of Machining (B) Design for Manufacturing (C) Advanced Material & Processing (D) Theory of Metal Forming

Elective-II:(A) Production Planning & Material Management (B) Operations Research (C) Reliability Engineering and Maintenance (D) Rapid Prototyping and Tooling

Elective-III:(A) Management Information system (B) Multi-Criteria Decision Making Techniques (C) Quality Assessment & Control

Elective-IV:(A) Supply Chain Management (B) Energy Management & Audit (C) Advanced Optimization Techniques

Elective-V:(A) Robot Application & Design (B) Computer Aided Design & Manufacturing (C) Industrial Tribology

Audit 1 & 2 : (A) English for Research Paper Writing (B) Disaster Management (C) Sanskrit for Technical Knowledge (D) Value Education (E) Constitution of India (F) Pedagogy Studies (G) Stress Management by Yoga (H) Personality Development through Life Enlightenment skills.

Open Elective: (A) Business Analytics (B) Industrial Safety (C) Cost Management of Engineering Projects (D) Composite Materials (E) Waste to Energy.

Code	Sub.	Contact Hrs./Week		Code	Sub.	Contact Hrs./Week	
		L -T-P-T	Cr			L -T-P-T	Cr.
PTM 101	Production Management	3-0-0-0	3	PTM 201	Automation in Manufacturing system & Process	3-0-0-0	3
PTM 102	Production planning & Control	3-0-0-0	3	PTM 202	Non Traditional machining Processes	3-0-0-0	3
PTM 103	Elective-I	3-0-0-0	3	PTM 203	Elective-III	3-0-0-0	3
PTM 104	Elective-II	3-0-0-0	3	PTM 204	Elective-IV	3-0-0-0	3
RMI-101	Research Methodology and IPR	2-0-0-2	2				
PTM 191	Computer Aided design Lab.	0-0-4-4	2	PTM 291	Manufacturing System& Process Lab	0-0-4-4	2
PTM 192	Computer Aided Manufacturing Lab.	0-0-4-4	2	PTM 292	Simulation, Modeling & Analysis Lab	0-0-4-4	2
AUD-101	One from the pool of Audit subjects	2-0-0-2	0	PTM-281	Mini Project with Seminar	0-0-4-4	2
				AUD-201	One from the pool of Audit subjects	2-0-0-2	0
		16-0-8-24	18			14-0-8-26	18
PTM-301	Elective-V	3-0-0-0	3	PTM-481	DissertationPhase-II	0-0-32-32	16
OEL-301	One from the pool of Open Elective subjects	3-0-0-0	3				
PTM-381	DissertationPhase-I	0-0-20-20	10				
		6-0-20-20	16			0-0-24-24	22

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Elective-III:(A) Management Information system (B) Multi-Criteria Decision Making Techniques (C) Quality Assessment & Control

Elective-IV:(A) Supply Chain Management (B) Energy Management & Audit (C) Advanced Optimization Techniques

Elective-V:(A) Robot Application & Design (B) Computer Aided Design & Manufacturing (C) Industrial Tribology

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Open Elective: (A) Business Analytics (B) Industrial Safety (C) Cost Management of Engineering Projects (D) Composite Materials (E) Waste to Energy.

**DETAILED SYLLABUS FOR M TECH ON PRODUCTION TECHNOLOGY & MANAGEMENT IN
MECHANICAL ENGINEERING**

FIRST SEMESTER

PTM 101 : PRODUCTION MANAGEMENT

Structure : 3-0-0

Credit : 3

Introduction to production / operations management for competitiveness of corporate, Product life cycle, types of productive systems, process life cycles and technology, focus of an organization.

Forecasting, inventory planning and control, MRP, operations scheduling, statistical quality control.

Product and process design and technological choice, capital cost and criteria for investment, capacity planning, MRP-II, location theory and distribution, work measurement, facility layout and assembly line balancing, multiple criteria decision making methods.

Generic enterprise strategies, role of productivity improvement, components of operations strategy and its implementation,

Operations systems of the future; Computer integrated factory of the future, customer-centric system.

References:

1. Industrial Sociology – E.V. Schneider, McGraw-Hill, 1982.
2. Industrial Sociology-D.C. Miller & W.H. Form Herper & row , 1980.
3. The Sociology of Industry – S.R. Parlar, R.K. Brown & Others, George Allen & Unwin,1970.
4. The Affluent Worker in the class structure – J.H. Goldtherpe,etc. All Camridge University Press, 1989.

PTM102 : PRODUCTION PLANNING AND CONTROL

Structure : 3-0-0

Credit : 3

Organisation, organisational structure, types of organisation structure, multi-plant organisation.

Production, Types of Production System and its element, Generalized model Production System.

Products and Services, Design & Development.

Forecasting: Importance the marketing interface, the materials interface, Basic Techniques.

System Economics: Tactics & Strategies, Break-Even-Analysis, Life Cycle analysis and capacity planning.

The plant or facilities - Location and design of the plant or facilities, Layout of the facilities, Equipment selection, Maintenance of the facilities and equipment.

Material and Inventory Management

Demand analysis, Resource Planning, Aggregate Production Planning, Line Balancing.

Materials requirement planning, Sequencing and Scheduling .

Human Factors, Manpower planning, Placement, Training, Motivation, Safety.

Production Monitoring and Control, Performance Criteria and evaluation, Case Studies and Example.

References:

1. "Production and Operations Management" - E. S. Buffa, New Age International (P) Ltd., New Delhi.
2. "Production Systems: Planning, analysis and Control" - J. L. Riggs, John Wiley & Sons, New York.
3. "Production and Operations Management" - S. N. Chary, Tata McGraw-Hill Publishing Co. Ltd., New Delhi

PTM- 103 : ELECTIVE-I

Structure : 3-0-0

Credit : 3

(A) : THEORY OF MACHINING

Machining definition and objectives. Geometry of cutting tools; turning, milling and drilling - in different reference systems like machine reference systems, tool reference system and work reference systems. Sharpening and re-sharpening of cutting tools.

Mechanism of chip formation by single point tools, drills and milling cutters. Types of chips and their characteristics. Effective rake.

Mechanics of machining, theoretical estimation and experimental determination of cutting forces and experimental determination of cutting forces & power consumption. Dynamometers; types, design, construction and use.

Thermodynamics of machining, sources of heat generation, cutting temperature modeling, measurement of cutting temperature. Cutting fluids; purpose, essential characteristics, selection and methods of application.

Cutting tools; methods of failure, mechanics of tool wear, essential properties, assessment of tool life and cutting tool materials.

Economics of machining; principal objectives, main parameters and their role on cutting forces, cutting temperature, tool life and surface quality, selection of optimum combination of parameters.

Advanced machining techniques- cryomachining & high speed machining.

Causes of vibration and chatter in machining, and their remedy.

Mechanics of grinding, characteristics, specification and selection of grinding wheels. Process and wheel parameters in grinding. Grinding forces, grinding fluid applications, grinding ratios and surface integrity. Advanced techniques of grinding and modern grinding wheels.

References:

1. "Metal Cutting : Theory and Practice" - A. Bhattacharyya , Central Book Publishers, Kolkata

2. "Metal Cutting Principles" - M. C. Shaw, Oxford University Press CBS
3. "Fundamentals of Metal Machining & Machine Tools" - G. Boothroyd, McGraw Hill
4. "Introduction to Machining Science" - G. K. Lal ,New Age International Pub., New Delhi
5. "Metal Cutting Theory and Cutting Tool Design" - V. Arshinov and G. Alekseev Mir Publishers, Moscow
6. "Manufacturing Science" - A. Ghosh and A. K. Mallik, Affiliated East-West Press Pvt. Ltd., New Delhi
7. "Metal Cutting" - E. M. Trent and P. K. Wright, Butterworth Heinemann Publication
8. "Metal Cutting Mechanics" - N. N. Zorev, Pergamon Press.
9. "Grindings Technology: Theory and Application of Machining with abrasives" - S.Malkin, Ellis Harwood Publication, U. K., 1990
10. "Micromachines" - I. Fujimasa, Oxford Univ. Press.

(B) : DESIGN FOR MANUFACTURING

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

Unit - II Materials: Selection of materials for design-developments in material technology-criteria for material selection-material selection interrelationship with process selection-process selection charts.

Unit – III Machining processes: Overview of various machining processes-general design rules for machining-dimensional tolerance and surface roughness-Design for machining – ease – redesigning of components for machining ease with suitable examples. General design recommendations for machined parts.

Unit – IV Metal casting: Appraisal of various casting processes, selection of casting process,-general design considerations for casting-casting tolerance-use of solidification, simulation in casting design-product design rules for sand casting.

Unit – V Metal joining: Appraisal of various welding processes, factors in design of weldments – general design guidelines-pre and post treatment of welds-effects of thermal stresses in weld joints-design of brazed joints.

Unit – VI Forging: Design factors for forging – closed die forging design – parting lines of dies – drop forging die design – general design recommendations.

Unit – VII Extrusion & Sheet metal work: Design guide lines extruded sections-design principles for punching, blanking, bending, deep drawing-Keeler Goodman forging line diagram – component design for blanking.

Unit VII Plastics: Visco elastic and creep behavior in plastics-design guidelines for plastic components-design considerations for injection moulding – design guidelines for machining and joining of plastics.

Text Books:

1. Design for manufacture, John cobert, Adisson Wesley. 1995
2. Design for Manufacture by Boothroyd,

(C) : ADVANCED MATERIAL & PROCESSING

Introduction of advanced materials and its manufacturing processes for engineering applications.

Piezoelectric materials (PZT): piezoelectric effect, Di-electric hysteresis, piezoelectric constants, piezoelectric charge constants, dynamic behaviour of PZT transducers, piezoelectric materials and manufacturing techniques (stability, poling and depolarisation).

Shape memory alloys (SMA): Shape memory effect and the metallurgical phenomenon of SMA, Temperature assisted shape memory effect, Visco-elastic behaviour, magnetic shape memory effect. Various shape memory alloys. Manufacturing technology of SMAs.

Electro rheological (ER) and magneto-rheological (MR) materials: Characteristics of ER and EM fluids. ER and EM materials.

Composite materials: Design and manufacturing of polymer matrix, metal matrix and ceramic matrix composites. Various forms and type of reinforcements, fillers and additives. Design of composites for structural, wear resistance and high temperature applications. Micro-electro-mechanical (MEMS) systems. Introduction, characteristics of silicon wafers and other materials for MEMS applications.

Various manufacturing techniques of MEMS components Materials for high temperature applications: Ni-Cr alloys, ODS materials, Ni base and Co based super alloys, carbon-carbon composites. Diffusion bond coating of high temperature materials.

Powder metallurgy: Introduction and feature of powder metallurgy processes. Advanced solidification techniques: directional solidification, single crystal growth and levitation melting.

References:

1. Introduction to Materials Science for Engineers – J.F.Shackelford and M.K.Muralidhara, Pearson
2. Degarmo's Materials & Processes in Manufacturing – J.T.Black and R.A.Kohser, Wiley India Pvt. Ltd.

(D) : THEORY OF METAL FORMING

Unit I : Theory of plasticity

Theory of plastic deformation – Yield criteria – Tresca and Von-mises – Distortion energy – Stress-strain relation – Mohr's circle representation of a state of stress – cylindrical and spherical co-ordinate system – upper and lower bound solution methods – Overview of FEM applications in Metal Forming analysis.

Unit II : Theory and practice of bulk forming processes

Analysis of plastic deformation in Forging, Rolling, Extrusion, rod/wire drawing and tube drawing – Effect of friction – calculation of forces, work done – Process parameters, equipment used – Defects – applications – Recent advances in Forging, Rolling, Extrusion and Drawing processes – Design consideration in forming.

Unit III : Sheet metal forming

Formability studies – Conventional processes – H E R F techniques – Superplastic forming techniques – Hydro forming – Stretch forming – Water hammer forming – Principles and process parameters – Advantage, Limitations and application

Unit IV : Powder metallurgy and special forming processes

Overview of P/M technique – Advantages – applications – Powder preform forging – powder rolling – Tooling, process parameters and applications. - Orbital forging – Isothermal forging – Hot and cold isostatic pressing – High speed extrusion – Rubber pad forming – Fine blanking – LASER beam forming.

Unit V : Surface treatment and metal forming applications

Experiment techniques of evaluation of friction in metal forming selection – influence of temperature and gliding velocity – Friction heat generation – Friction between metallic layers – Lubrication carrier layer – Surface treatment for drawing, sheet metal forming, Extrusion, hot and cold forging. Processing of thin Al tapes – Cladding of Al alloys – Duplex and triplex steel rolling – Thermo mechanical regimes of Ti and Al alloys during deformation – Formability of welded blank sheet – Laser structured steel sheet - Formability of laminated sheet. OUTCOMES : At the end of this course the students are expected to upgrade their knowledge on plasticity, surface treatment for forming of various types of metal forming process.

REFERENCES:

1. Altan T., Metal forming – Fundamentals and applications – American Society of Metals, Metals park, 2003
2. Altan.T, SOO-IK-oh, GEGEL, HL – Metal forming, fundamentals and Applications, American Society of Metals, Metals Park, Ohio, 1995.
3. ASM Hand book, Forming and Forging, Ninth edition, Vol – 14, 2003
4. Dieter G.E., Mechanical Metallurgy (Revised Edition II) McGraw Hill Co., 1988
5. Helmi A Youssef, Hassan A. El-Hofy, Manufacturing Technology: Materials, Processes and Equipment, CRC publication press, 2012.
6. Marciniak,Z., Duncan J.L., Hu S.J., ‘Mechanics of Sheet Metal Forming’, Butterworth-Heinemann An Imprint of Elsevier, 2006
7. Nagpal G.R., Metal Forming Processes- Khanna publishers, 2005.
8. Proc. Of National Seminar on “Advances in Metal Forming” MIT, March 2000
9. SAE Transactions, Journal of Materials and Manufacturing Section 5, 1993-2007
10. SHIRO KOBAYASHI, SOO-IK-oh-ALTAN, T,Metal forming and Finite Element Method, Oxford University Press, 2001.
11. Surender kumar, Technology of Metal Forming Processes, Prentice Hall India Publishers,2010

PTM- 104 : ELECTIVE-II

Structure : 3-0-0
Credit : 3

(A) : PRODUCTION PLANNING & MATERIALS MANAGEMENT

Production Planning & Control; Industrial: Job-shop planning.

Demand Forecasting- Methods & Uses

JIT Manufacturing-Kanban System

Synchronous Manufacturing & Theory of Constraints

Operations Strategies, Hierarchical Planning System-Aggregate Planning & Manufacturing Resource Planning.

Materials Management Concepts & Objectives for materials function, administrative practices, purchasing system purchasing cycle, Make or Buy decisions, Vendor Development & Evaluation, Inventory Planning Control & Management. Selective Inventory Control. EOQ Models & variants safety stock stocking policy & Procedure Manuals.

Demand Assessment, Materials Requirement Planning.
Material Handling, Physical Distribution & logistics Standardizations
Computer application in Material Management & MIS.

References:

1. S. Nahmias, (1997) Production & Operation Analysis, R. Irwin.
2. D.D. Bedworth & J.E. Bailey (1983) Integrated Production Control System Management, Analysis & Design , John Wiley.
3. M. Penido & X Chao (1999) Operations Scheduling Mc Graw Hill.
4. R.B. Chase, N.J. Aquilano & F.R. Jacobs, Production & Operations management Manufacturing & Services 2nd Ed, TMH
5. John E. Biegel – Production Control a Quantitative Approach , PHI.
6. E.G. Coffman (1976) Computer & Jobshop Scheduling Theory, Wiley.
7. Hanke, Wichem & Reitsch Business, Forecasting, 7th Ed, PHI.
8. Bloomberg, Lemay & Hanna, Logistics, Phi.
9. R.B. Ballot (1980) Materials Management, Taraporewala, Bombay.
10. P. Gopalkrishnan (1994) , Handbook of Materials Management , PHI.
11. . P. Gopalkrishnan & M.S. Sandilya (1981) , Inventory Management, PHI.
12. M.S. SHAH (1988) , An Integrated Concept of Materials Management , TMH.
13. J. Buchan, E. Koenigsberg, Scientific Inventory Management , PHI.

(B) : OPERATIONS RESEARCH

Introduction to operations research (OR); History of OR; Principles of modeling, Impact of OR; Implementation of OR projects; Different OR problems.

Linear Programming (LP); Introduction, LP model, problem formulation, examples and case studies, limitations of LP, geometrical interpretation, essence of simplex method, algebra of simplex method, simplex procedure, degeneracy and other complications, dual simplex method, economic interpretation of duality, sensitivity analysis, computer implementation.

Simplex explanation of solution methods of Transportation problem and Assignment problem.

Decision Theory: Structure of decision making problem; Types of Decision making criteria; Decision tree analysis; Utility theory and decision making.

Project scheduling: Critical Path Method (CPM), Network construction and determination of critical path, Crashing, Resource smoothing, Resource leveling, PERT .

Non Linear Programming: Graphical illustrations; Integer Linear Programming applications, Graphical solution, branch and bound solution; Dynamic programming.

Inventory Models: EOQ model, Sensitivity analysis in EOQ model, economic lot size model, EOQ with planned shortage, quantity discounts for EOQ model, probabilistic models.

Waiting Line Models; Structure single channel waiting line model, Multiple channel waiting line models, economic analysis of waiting lines.

Forecasting Techniques.

References:

1. "Introduction to Operations Research" - Frederick S. Hiller, Gerald J. Lieberman, McGraw Inc.
2. "Operations Research, Principles and Practice"- Avindran, Phillips and Solberg, John Willey & Sons.
3. "Fundamentals of Operations Research"- R.L. Ackoff, M. W. Sasieni, West Publishing Co.

4. "An Introduction to Management Science" - Anderson, Sweeney, Williams, West Publishing Co.
5. "Operations Research: An Introduction"- H. A. Taha, PHI
6. "Operations Research : Theory and applications" - J. K . Sharma, MacMillan.

(C) : RELIABILITY ENGINEERING AND MAINTENANCE

Reliability: Definition and basic concepts; Failure data, failure modes, and reliability in terms of hazard rate and failure density function; Hazard models and bath tub curve; applicability of Weibull distribution. Reliability calculations for series, parallel and parallel-series systems; Reliability calculations for maintained and stand-by systems.

Maintenance - its role and scope in total organisational context. Objectives and characteristics of maintenance; basic guidelines for design of organisation structure for maintenance; Centralised vs decentralised maintenance; Types of maintenance - corrective, planned, preventive and predictive maintenance; Factors affecting maintenance; opportunistic maintenance; Measurement of maintenance work; rating and allowances. Maintenance cost budgets. Maintenance planning and scheduling; MIS in maintenance; Measurement of maintenance effectiveness and maintenance audit.

Reference :

1. Mechanical Reliability Engineering by ADS Carter, Macmilan
2. Reliability Evaluation of Engineering Systems by Roy Billington and R.N. Allen, Pitman
3. Introduction to Reliability Engineering by Dhilan & Singh
4. Reliabilities for the Technologies by L.A.Doty, Industrial Press Inc.

(D) : RAPID PROTOTYPING AND TOOLING

Current Trends in Design and Manufacturing; the role of Rapid Prototyping and Rapid Tooling; General features and classifications of Generative Manufacturing Processes. Two dimensional Layer by Layer Techniques : Stereo Lithography with photopolymerisation, liquid thermal polymerisation, solid foil polymerisation, selective laser sintering, selective powder binding, ballistic particle manufacturing, fused deposition modelling, shape melting, laminated object manufacturing, solid round curing, repeatative masking and deposition. Three Dimensional Techniques for Rapid Prototyping : Beam Interference Solidification, Ballistic particle manufacturing, Holographic Interference Solidification. Rapid Tooling : Techniques and procedures; Economics of Rapid Prototype and Rapid Tooling.

References :

1. Rapid Prototyping - A Brief Introduction by Amitabha Ghosh, East West Publishers.

RMI-101 : RESEARCH METHODOLOGY AND IPR:

Unit-1: Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis interpretation, Necessary instrumentations

Unit 2: Effective literature studies approaches, analysis Plagiarism, Research ethics,

Unit 3: Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

Unit 4: Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

Unit 5: Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

Unit 6: New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

References:

- Stuart Melville and Wayne Goddard, “Research methodology: an introduction for science & engineering students”
- Wayne Goddard and Stuart Melville, “Research Methodology: An Introduction”
- Ranjit Kumar, 2nd Edition, “Research Methodology: A Step by Step Guide for beginners”
- Halbert, “Resisting Intellectual Property”, Taylor & Francis Ltd ,2007.
- Mayall , “Industrial Design”, McGraw Hill, 1992.
- Niebel , “Product Design”, McGraw Hill, 1974.
- Asimov , “Introduction to Design”, Prentice Hall, 1962.
- Robert P. Merges, Peter S. Menell, Mark A. Lemley, “ Intellectual Property in New Technological Age”, 2016.
- T. Ramappa, “Intellectual Property Rights Under WTO”, S. Chand, 2008

AUD-101 (one subject from the pool in 1st semester)

AUDIT COURSE 1 & 2

Structure : 2-0-0
Credit : 0

(a) ENGLISH FOR RESEARCH PAPER WRITING

1. Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness
2. Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction
3. Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.
4. Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature,
5. Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions
6. Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission

Suggested Studies:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book .
4. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

(b) DISASTER MANAGEMENT :

1 **Introduction:** Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude.

2 **Repercussions Of Disasters And Hazards:** Economic Damage, Loss Of Human And Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

3 **Disaster Prone Areas In India:** Study of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics

4 **Disaster Preparedness And Management:** Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard;

Evaluation of Risk: Application of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.

5 Risk Assessment: Disaster Risk: Concept And Elements, Disaster Risk Reduction, Global And National Disaster Risk Situation. Techniques Of Risk Assessment, Global Cooperation In Risk Assessment And Warning, People's Participation In Risk Assessment. Strategies for Survival.

6 Disaster Mitigation: Meaning, Concept And Strategies of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation And Non-Structural Mitigation, Programs of Disaster Mitigation In India.

SUGGESTED READINGS:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies" "New Royal book Company.
2. Sahni, Pardeep Et. Al. (Eds.), "Disaster Mitigation Experiences And Reflections", Prentice Hall of India, New Delhi.
3. Goel S. L. , "Disaster Administration And Management Text And Case Studies" , Deep & Deep Publication Pvt. Ltd., New Delhi.

(c) SANSKRIT FOR TECHNICAL KNOWLEDGE:

1. Alphabets in Sanskrit, Past/Present/Future Tense, Simple Sentences
2. Order Introduction of roots Technical information about Sanskrit Literature
3. Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

Suggested reading

1. "Abhyastakam" – Dr. Vishwas, Samskrita-Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit" Prathama Deeksha-Vempati Kutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

(d) VALUE EDUCATION

- 1 Values and self-development – Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non-moral valuation. Standards and principles. Value judgements
- 2 Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism. Love for nature, Discipline
- 3 Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoid fault Thinking. Free from anger, Dignity of labour. Universal brotherhood and religious tolerance. True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature
- 4 Character and Competence – Holy books vs Blind faith. Self-management and Good health. Science of reincarnation. Equality, Nonviolence, Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively

Suggested reading

1. Chakroborty, S.K. "Values and Ethics for organizations Theory and practice", Oxford University Press, New Delhi

(e) CONSTITUTION OF INDIA

1. **History of Making of the Indian Constitution:** History Drafting Committee, (Composition & Working)
2. **Philosophy of the Indian Constitution:** Preamble Salient Features
3. **Contours of Constitutional Rights & Duties:** Fundamental Rights Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights Right to Constitutional Remedies, Directive Principles of State Policy Fundamental Duties.

4. **Organs of Governance:**ParliamentCompositionQualifications and DisqualificationsPowers and FunctionsExecutivePresident, GovernorCouncil of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications Powers and Functions
5. **Local Administration:**District's Administration head: Role and Importance,Municipalities: Introduction, Mayor and role of Elected Representative,CEO of Municipal Corporation.Pachayati raj: Introduction, PRI: ZilaPachayat.Elected officials and their roles, CEO ZilaPachayat: Position and role.Block level: Organizational Hierarchy (Different departments),Village level: Role of Elected and Appointed officials,Importance of grass root democracy
6. **Election Commission:**Election Commission: Role and Functioning.Chief Election Commissioner and Election Commissioners.tate Election Commission: Role and Functioning.Institute and Bodies for the welfare of SC/ST/OBC and women.

Suggested reading

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

(f) PEDAGOGY STUDIES

1. **Introduction and Methodology:**Aims and rationale, Policy background, Conceptual framework and terminologyTheories of learning, Curriculum, Teacher education.Conceptual framework, Research questions.Overview of methodology and Searching.
2. **Thematic overview:** Pedagogical practices are being used by teachers informal and informal classrooms in developing countries.Curriculum, Teacher education.
3. **Evidence on the effectiveness of pedagogical practices:**Methodology for the in depth stage: qualityassessment of included studies.How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?Theory of change.Strength and nature of the body of evidence for effective pedagogicalpractices.Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.
4. **Professional development:** Alignment with classroom practices and followup support.Peer Support from the head teacher and the community.Curriculum and assessmentBarriers to learning: limited resources and large class sizes
5. **Research gaps and future directions:** Researchdesign, ContextsPedagogyTeacher educationCurriculum and assessment, Dissemination and research impact.

Suggested reading:

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2):245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal ofCurriculum Studies, 36
3. Akyeamong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeamong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning ofbasicmaths and reading in Africa: Does teacher preparation count? International JournalEducational Development, 33 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education.Oxford and Boston: Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

(g) STRESS MANAGEMENT BY YOGA:

1. Definitions of Eight parts of yog. (Ashtanga)
2. Yam and NiyamDo`s and Don`ts in life.i) Ahinsa, satya, astheya, bramhacharya and aparigrahaaii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan
3. Asan and Pranayami) Various yog poses and their benefits for mind &bodyii)Regularization of breathing techniques and its effects-Types of pranayama

Suggested reading:

1. 'Yogic Asanas for Group Training-Part-I' :Janardan Swami YogabhyasiMandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, AdvaitaAshrama(Publication Department), Kolkata

(h) PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS:

1. Neetisatakam-Holistic development of personality, Verses- 19,20,21,22 (wisdom), Verses- 29,31,32 (pride & heroism), Verses- 26,28,63,65 (virtue), Verses- 52,53,59 (don't's), Verses- 71,73,75,78 (do's),
2. Approach to day to day work and duties. ShrimadBhagwadGeeta : Chapter 2-Verses 41, 47,48,. Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35, . Chapter 18-Verses 45, 46, 48.
3. Statements of basic knowledge.ShrimadBhagwadGeeta: Chapter2-Verses 56, 62, 68. Chapter 12 - Verses 13, 14, 15, 16,17, 18. Personality of Role model. ShrimadBhagwadGeeta:Chapter2-Verses 17, Chapter 3-Verses 36,37,42,. Chapter 4-Verses 18, 38,39. Chapter18 - Verses 37,38,63.

Suggested reading:

1. "Srimad Bhagavad Gita" by Swami SwarupanandaAdvaita Ashram (Publication2. Department), Kolkata.
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath,
3. Rashtriya Sanskrit Sansthanam, New Delhi.

PTM-191 : COMPUTER AIDED DESIGN LABORATORY

Structure : 0-0-4
Credit : 2

Experiments & Assignments Would be based on the theory subject, computer aided design & Analysis, such as;
. Solving simple structure problems through computer programmers.

. Designing through AUTO CAD , Mechanical Desktop, IDEAS, CATIA,PRO-engineers like softwares.

. Stress Analysis using softwares like ANSYS, etc.

PTM 192 : COMPUTER AIDED MANUFACTURING LABORATORY

Structure : 0-0-4
Credit : 2

Experiments & assignments would be based on the theory subject, Computer Aided Manufacturing Lab.,
such as : . Solving simple structure problems through computer programs.

SECOND SEMESTER

PPTM-201 : AUTOMATION IN MANUFACTURING SYSTEMS AND PROCESSES

Structure : 3-0-0
Credit : 3

Review of basic principles of automation, type and degree of automation, hard automation, flexible automation, stand alone automatic machine tools, transfer machines.

Introduction to computer aided manufacturing (CAM) systems, basic building blocks of computer integrated manufacturing (CIM).

Numerical Control Machines and Systems- CNC, DNC (Direct and Distributed), FMC, FMS; planning and programming CNC machine tools,. EDM and other forming machines, toolings of CNC machines; adaptive control systems, tool. and work handling systems involving robot, AGV and AS/RS and detailed part programming using G and M codes, APT, etc.

Robotics; types, anatomy, drives, kinematics, controls, and applications of the robot.

Automatic inspection systems, use of coordinate measuring machines (CMM), control systems, process monitoring.

Manufacturing from product design- concept of group technology (GT), CAD-CAM interface, CAPP, computer aided production planning and control.

References:

1. "Automation, Production Systems, and Computer-Integrated Manufacturing" M.P. Groover, Prentice Hall of India.
2. "CAD/CAM - Theory and Practice", Ibrahim Zeid, Tata McGraw-Hill PublishingCo. Ltd., New Delhi.
3. "CAD/CAM" - M. P. Groover and E. W. Zimmers Jr., Prentice Hall of India
4. "CAD/CAM/CIM" - P. Radhakrishnan, S. Subramanyan and V. Raju, New Age International Publishers.
5. "Computer Aided Manufacturing"- P.N. Rao, N.K. Tewari and T.K. Kundra, Tata McGraw- Hill Publication.
6. "Robotics Technology and Flexible Automation"- S.R. Deb, Tata McGraw-Hill Publication.
7. "Industrial Robots and Computer Integrated Manufacturing"- S. Kumar, Oxford & IBH Publishing Co. Ltd.
8. "Computer-Aided Production Management"- P.B. Mahapatra, Prentice Hall of India.

PTM-202 : NON TRADITIONAL MACHINING PROCESSES

Structure : 3-0-0
Credit : 3

Non traditional machining: Introduction, Specific Applications and Advantages over Traditional Machining Processes.

Mechanical processes; Ultrasonic Machining, Abrasive Jet Machining, Water Jet Machining, and Abrasive Water Jet Machining; Process details, parametric effects, recent advancements and modelling.

Thermal processes; Electro discharge Machining, Plasma Arc Machining, Electron Beam Machining, and Laser Beam Machining; process, parameters, recent advances and modelling.

Chemical and Electrochemical processes; Chemical Machining, Electro Chemical Machining and Electrochemical grinding.

Hybrid-type systems; Electro Chemical Discharge Machining, Ultrasonic assisted Electro Discharge Machining and other types,

Micro and Nano machining, Environment friendly machining.

References:

1. "Modern Machining Processes"- P.C. Pandey and H.S. Shan, Tata McGraw-Hill Publication.
2. "Non-Conventional Machining"- P.K.Mishra, Narosa Publishers.
3. "Manufacturing Science"- A.Ghosh and A.K. Mallik, E~st-West Publications.
4. "Laser Machining and Welding"- N. Rykalin, A. Uglov and A. Kokora, Mir Publishers, Moscow.
5. "Manufacturing Engineering and Technology"- S. Kalpakjian, Addison Wesley.
6. "Materials and Processes in Manufacturing"- E.P. DeGarmo, J.T. Black and R.A. Kohser, Prentice Hall of India.
7. "A Text Book of Production Technology" - O.P. Khanna and M. Lal, Dhanpat Rai and Sons.
8. "Rapid Prototyping: A Brief Introduction"- A. Ghosh, East West Publication.
9. "Manufacturing Processes"- Amstead, Ostwald and Begeman, John Wiley and Sons.
10. "Micromachines", I. Fujimasa, Oxford University Press.
11. "Precision Engineering in Manufacturing", R.L.Murty, New Age International Publishers.

PTM-203 : ELECTIVE-III

Structure : 3-0-0
Credit : 3

(A) : MANAGEMENT INFORMATION SYSTEM

An Overview of Management Information Systems, Structure of a Management Information System, Need of MIS

Hardware, Software and Communication Technology for Information Systems. Storage and Retrieval of Data, Transaction Processing, Office Automation and Information Processing.

Data processing Systems, The Decision Making Process, Concepts of Information, Human as Information Processors, System concepts, Concepts of Planning and Control, Real Time Systems, Organizational Structure and Management Concepts. Case Studies.

Supports System for Planning Control and Decision Making, Support Systems for Management of Knowledge Work.

Data Communication hardware, Computer Networks, Developing a Long Range Information system Plan, Strategies for the Determination of Information Requirements, Database Requirements, User Interface Requirements.

Data sources and Data Management, Hierarchy of data organisation, Design & development of Application Systems, Quality assurance and Evaluation of Information Systems, Organization and Management of the Information Resources function, Future Developments and Their Organizational and Social Implications. Elements of software Engineering-models design issue.

References:

1. "Management Information System : Conceptual Foundations, Structure and Development" -Gordon B. Dads, Margrethe H. Olson, McGraw-Hill Book Company.
2. "Management Information Systems"- Larry Long, Prentice .Hall Erewood Cliffs, New Jersey

3. "Principles of MIS" - G.M. Scott, McGraw-Hill Publishing Company.
4. Th. & Prob. On Quantitative Techniques, Management information system & Data processing – S.K. Chakaraborty, New Central Book Agency.
5. Software Project Management- B. Hughes & M.Cotterell, 2nd ed.

(B) : MULTI-CRITERIA DECISION MAKING TECHNIQUES

Multi-Criteria Decision Making – An Overview – Classification of MCDM methods – Simple Additive Weighting method – Weighted Product method – Principle, steps and illustrative examples.

Network based MCDM methods – Analytic Hierarchy Process – Revised Analytic Hierarchy Process – Analytic Network Process – Principle, steps and illustrative examples.

Outranking MCDM methods – PROMETHEE, ELECTRE, TOPSIS - Compromise Ranking method - VIKOR, ORESTE – DEMATEL – Principle, steps and illustrative examples.

Fuzzy based MCDM methods – Hybrid MCDM methods – Group Decision Making- Graph Theory and Matrix approach – Principle, steps and illustrative examples.

Goal Programming – Balanced Scorecard Approach - MCDM application areas – Case studies on application of MCDM techniques.

References

1. Belton, V., Stewart, T.J. “Multiple Criteria Decision Analysis: An Integrated Approach”, Kluwer Academic Publishers, Dordrecht, 2003.
2. Triantaphyllou, E., “Multi-Criteria Decision Making Methods: A Comparative Study”, Springer, 2010.
3. Pedrycz, W., Ekel, P., Parreiras, R., “Fuzzy Multi Criteria Decision-Making: Models, Methods and Applications”, John Wiley & Sons, 2011.
4. Kahraman, C., “Fuzzy Multi-criteria Decision Making: Theory and Applications with Recent Developments”, Springer, 2008.

(C) : QUALITY ASSESSMENT AND CONTROL

Basic concepts, definitions and history of quality control, Quality function and concept of quality cycle, Quality policy and objectives, Quality considerations in design, Economics of quality and measurement of the cost of quality, definitions, classifications, Quality Cost Matrix, Evaluation of Quality Costs.

Process control: Machine and process capability analysis. Use of control charts and process engineering techniques for implementing the quality plan.

Total Quality Control and Management, definition, vision and philosophy, Concepts of TQM, Concepts of customer centered environment, Golden Rules of TQM, the PDCA Cycle, Tools and Techniques, Implementation of TQM, Waste Elimination, the 5S campaign, Flow Chart, Pareto analysis, Cause and Effect Diagram, Force Field Analysis, Brain Storming, Quality Circle, Quality Function Deployment, Just-In- Time Approach, Quality Standards,

ISO 9000 Standard, Implementation and Registration.

References:

1. "Quality Control Handbook"- J. Juran, McGraw-Hill Book Company.
2. "Quality Planning and Analysis", M. Juran, F. M. Gryana, Tata McGraw Hill (3rd Edition), 1995
3. "Statistical Quality Control"- M. Mahajan, Dhanpat Rai publication
4. "Handbook of Total Quality Management"- R.P. Mohanty and R.R. Lakhe, Jaico Publishing House
5. "Total Quality Management" - D. H. Besterfield et. al., Pearson Education, Asia.
6. "Quality Control and Industrial Statistics"- A.J. Duncan, Richard D. Irwin Inc., USA.
7. "Introduction to ISO 9000 and Total Quality Management"- S. K. Ghosh, Oxford Publishing House, 1994

PTM-204 : ELECTIVE-IV

Structure : 3-0-0
Credit : 3

(A) : SUPPLY CHAIN MANAGEMENT

Introduction: Understanding logistics and supply chain management (SCM); wholistic approach to physical flow; customer focus in SCM: efficient customer response (ECR), quick response (QR), accurate response (AR), corporate goal through competitive advantage, push and pull type system.

Inbound and Outbound Logistic: SCM integration considering material flow, information flow and cash flow; Bullwhip effect, transportation and warehousing.

Cost Analysis: Historical costing, standard costing and estimated costs, marginal costs, concept of cost drivers; activity based costing (ABC), through put accounting.

Benchmarking for SCM: Techniques of performance measurement and its barriers and evaluation of SCM.

Transportation and Warehousing Location: Multi-model transport operation, routing, scheduling, fleet size insurances, sales tax, outsourcing, 3rd and 4th party logistics.

IT and Its Applications in SCM: MRP, ERP, distribution resource planning (DRP/DRPB) and designing SCM.

Supply chain management in service sector, global market and global sourcing, supplier alliance, supplier quality control, supplier chain re-engineering.

Green supply chain management.

References:

1. "Supply Chain Management"- Martin Christopher, Fabrycky and Blanchand.

(B) : ENERGY MANAGEMENT AND AUDIT

Introduction, Energy Scenario : Commercial and Non-Commercial Energy, Primary Energy Production, Final Energy Consumption, Energy Needs of Growing Economy, Long term Energy Scenario, Energy and Environment : Air pollution, Climate Change, Energy Security, Energy Conservation and its importance, Energy Strategy for the Future, Sustainable Development.

Basics of Energy and its various forms : Electricity basics – DC & AC currents, Load Management and Maximum demand control. Thermal basics – Fuels, Thermal energy content of fuel, Sensible and Latent heat, Evaporation, Condensation, Steam, Humidity, Heat transfer.

Energy Management & Audit : Definition, Energy audit-need, Types of energy audit, Energy management (audit) approach – understanding energy costs, Bench marking, Energy performance, Matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirement, Fuel and Energy substitution, Energy audit instruments.

Material and Energy balance : Methods for preparing process flow, Material and energy balance diagrams.

Financial Management : Investment-need, Appraisal and criteria, Financial analysis techniques – Simple pay back period, Return on investment, Net present value, Internal rate of return, Cash flows, Risks and sensitivity analysis; Financing options, Energy performance contracts and role of ESCOs (Energy Service Companies).

Energy Monitoring and Targeting : Defining monitoring & targeting, Elements of monitoring & targeting, Data and information analysis, Techniques – energy consumption, Production, Cumulative sum of differences (CUSUM).

Energy Performance Assessment of Furnace, Pumps, HVAC System, Variable Speed Drives, and Lighting System : Purpose, Performance terms and definitions, methods, efficiency calculation, factors affecting performances, Energy conservation opportunities.

Application of Non Conventional and Renewable Energy Sources : Different forms of renewable energies, Their applications for energy conservation.

Books :

1. Albert Thumann: Plant Engineers & Managers Guide to Energy Conservation (Fairmont Press)
2. Wayhe C. Tuner : Energy Management Handbook (Wiley Interscience Publication)
3. Anthony J. Pansini. : Engineering Economic Analysis Guide Book (Fairmont Press)
4. D. Paul-Mehta : Handbook of Energy Engineering. (Fairmont Press / Prentice Hall (Sd))
5. Paul O'Callaghan : Energy Management. (McGraw Hill Professional Publication)
6. Books of Energy Management & Auditors, Bureau of Energy Efficiency, (A Statutory body under Ministry of Power, Government of India)

(C) : ADVANCED OPTIMIZATION TECHNIQUES

Introduction-Engineering Applications of Optimization-Statement of an Optimization Problem- Classification of Optimization Problems - Optimization Techniques

Classical Optimization Techniques- Single-Variable Optimization - Multivariable Optimization with No Constraints - Multivariable Optimization with Equality Constraints- Multivariable Optimization with Inequality Constraints- Transportation

Nonlinear Programming I: 1D Minimization Methods - Unimodal Function, Elimination Methods-Unrestricted Search, Exhaustive, Dichotomous Search- Interval Halving Method-Fibonacci Method- Golden Section Method, Interpolation Methods -Quadratic, Cubic Interpolation Method - Direct Root Methods -Newton Method-Quasi-Newton, Secant Method

Nonlinear Programming II: Unconstrained Optimization Techniques -Direct Search Methods - Indirect Search (Descent) Methods, Non-linear Programming III: Constrained Optimization Techniques- Direct Methods-Indirect

Methods, Geometric Programming, Dynamic Programming, Integer Programming -Integer Linear Programming - Stochastic Programming.

Modern Methods of Optimization - Genetic Algorithms -Simulated Annealing -Particle Swarm Optimization - Ant Colony Optimization -Optimization of Fuzzy Systems - Neural-Network-Based Optimization, Practical Aspects of Optimization

References

- 1.Kalyanmoy Deb, "Optimization for Engineering design – algorithms & examples", PHI, New Delhi, 1995.
- 2.SingiresuS.Rao, "Engineering optimization – Theory and practices", John Wiley and Sons, 1998.
- 3.Garfinkel, R.S. and Nemhauser, G.L., "Integer programming", John Wiley & Sons, 1972.

AUD-201 (second subject from the same pool in 2nd semester)

Structure : 2-0-0
Credit : 0

PTM-291 : MANUFACTURING PROCESS AND SYSTEMS LABORATORY

Structure : 0-0-4
Credit : 2

Experiments on computer aided manufacturing systems, such as;

- Part programming on a CNC lathe
- Part programming on a CNC milling / machining center
- Using Master CAM for making ajob from AutoCAD drafting
- Computer Aided Process Planning
- Robotic Programming
- Electric Discharge Machining
- Testing for alignment/ error in machine tools
- Finding out speed ratios and constructing ray diagrams of machine tools. Machine Tool Vibration
- Mechatronic elements in automated machine tools
- Design of elements of machine tools

PTM-292 : SIMULATION, MODELING & ANALYSIS LAB

Structure : 0-0-4
Credit : 2

1. Study of simulation software like ARENA , MATLAB, DESIGN EXPERT, MINITAB.
2. Simulation of translational and rotational mechanical systems
3. Simulation of Queuing systems
4. Simulation of Manufacturing Systems
5. Generation of Random number
6. Modeling and Analysis of Dynamic Systems
7. Simulation of mass spring damper system
8. Simulation of hydraulic and pneumatic systems.

- 9. Simulation of Job shop with material handling and Flexible manufacturing systems
- 10. Simulation of Service Operations

PTM-281 : MINI PROJECT WITH SEMINAR

Mini Project will be carried out by the students and they will have to present seminar.

THIRD SEMESTER

PTM-301 : ELECTIVE-V

Structure : 3-0-0
Credit : 3

(A) : ROBOT APPLICATION & DESIGN

Robot definition: Robotic systems - Its role in automated manufacturing; robot anatomy; robot classifications and specifications.

Robot kinematics, forward and reverse transformations, homogeneous transformation,

Robot Dynamics: Introduction to Force Analysis, Trajectory generation

Robot actuators and control; Pneumatic, hydraulic and electrical drives and controls used in robots. Robot end-effectors- mechanical, magnetic and vacuum grippers, gripping forces RCC and design features of grippers. Robot sensors- contact and non-contact sensors, Robot vision and their interfaces.

Robot languages and programming techniques.

Applications of robots in materials handling, machine loading/unloading, inspection, welding, spray painting and finish coating, and assembly, etc.

Economic performance and evaluation strategies, Robot installation and planning. Safety features.

References:

1. "Introduction to Robotics"- J.J. Craig, Addison-Wesley.
2. "Fundamentals of Robotics Analysis and Control"- R.J. Schilling, Prentice Hall of India.
3. "Robotics Technology and Flexible Automation"- S.R. Deb, Tata McGraw-Hill Publication.
4. "Foundations of Robotics Analysis and Control"- T. Yoshikawa, Prentice Hall of India.
5. "Robotics for Engineers"- Y. Koren, McGraw-Hill Book Company, New York.
6. "Industrial Robots and Computer Integrated Manufacturing"- S. Kumar, Oxford & IBH Publishing Co. Ltd.
7. "Automation, Production Systems, and Computer-Integrated Manufacturing" M. P. Groover, Prentice Hall of India.
8. "Computer Aided Manufacturing"- P.N. Rao, N.K. Tewari and T.K. Kundra, Tata McGraw-Hill Publication.
9. "Robotics: Control, Sensing, Vision and Intelligence"- K.S. Fu, R.C. Gonzales and C.S.G. Lee, McGraw Hill, 1997
10. "Analytical Robotics and Mechatronics", W. Stadler, McGraw Hill Book Co.

(B) : COMPUTER AIDED DESIGN AND MANUFACTURING

Basic concepts of product design. Different phases of computer aided design (CAD), integration of CAD-CAM, system software, benefits of CAD

Elements of interactive computer graphics (ICG); introduction, point and line plotting and display techniques, 2D and 3D transformation, concatenation, clipping, segmentation, 2D and 3D graphics, input and output devices, raster scan graphics systems.

Geometric modeling; wire-frame, surface and solid modeling techniques.

Computer-aided drafting; drafting packages, dimensions, text, shading, hatching, etc. of mechanical components.

Engineering analysis; design reviews and evaluation.

Element of CAM/CIM systems; CNC Machines, DNC, FMS, Machining Centres, A.C. Systems, different handling and robotic configurations employed; Computer Integrated Production Planning and Control; MRP, MRP-II, CAPP, CAI and CAQC, Application of softwares. Interfacing of CAD with CAM; manufacturing data generated from CAD data.

References:

1. "CAD/CAM - Theory and Practice", Ibrahim Zeid, Tata McGraw-Hill Publishing Co. Ltd., New Delhi.
2. "CAD/CAM" - M. P. Groover and E. W. Zimmers Jr., Prentice Hall of India
3. "Computer Aided Mechanical Design and Analysis" - V. Ramamurti, Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 3rd Edition.
4. "Mathematical Elements for Computer Graphics", D. F. Rogers and J. A. Adams, McGraw-Hill Publishing Co., Singapore, 2nd Edition.
5. "Principles of Interactive Computer Graphics", W. M. Newman and R. F. Sproull, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2nd Edition.
6. "Schaum's Outlines of Theory and Problems of Computer Graphics" - Z. Xiang and R. Plastock, McGraw Hill, Singapore, 2nd Edition.
7. "CAD/CAM/CIM" - P. Radhakrishnan, S. Subramanyan and V. Raju, New Age International Publishers.
8. "Computer Aided Manufacturing" - P.N. Rao, N.K. Tewari and T.K. Kundra, Tata McGraw-Hill Publication.
9. "Robotics Technology and Flexible Automation" - S.R. Deb, Tata McGraw-Hill Publication.
10. "Industrial Robots and Computer Integrated Manufacturing" - S. Kumar, Oxford & IBH Publishing Co. Ltd.
11. "Computer-Aided Production Management" - P.B. Mahapatra, Prentice Hall of India.
12. "Automation, Production Systems, and Computer-Integrated Manufacturing" M.P. Groover, Prentice Hall of India.

(C) : INDUSTRIAL TRIBOLOGY

Introduction to tribological systems, economic aspects, lubrication of bearings, friction control and wear prevention, properties and testing of lubricants, mechanisms of fluid flow- Reynold's equation and its limitations.

Idealized hydrodynamic bearing, plane slider bearings, journal bearings- finite and infinite, finite bearing, numerical solution, bearing design, fluid inertia and turbulence, hydrodynamic instability.

Squeeze film bearing, thrust and journal bearing, gas lubricated bearing, hydrodynamic bearings, hydrostatic bearings, porous bearings, elasto-hydrodynamic lubrication, solid lubricants.



Department of Mechanical Engineering
Jalpaiguri Govt. Engg. College
(A Govt. Autonomous College)
Jalpaiguri– 735102
Syllabus for PG Classes effective from First July,2018

Physico-mechanical interactions at interfacial contact, surfaces; Analysis and assessment of topography; tribo- models for asperity contact, frictional resistance and wear; Frictional instability and stick-slip phenomenon; Models of adhesion-diffusion wear process; Kinetics of solid state interfacial interactions.

References:

1. "Lubrication" - R.C. Gunther, Baily Brothers and Swinfen Limited.
2. "Principles of Tribology" - Halling J. (Editor), Macmillan, London.
3. "Handbook of Tribology: Materials, Coatings and Surface Treatments" - B.Bhooshan and B. K. Gupta, McGrawhill, New York.
4. "Tribology Handbook" - M.J. Neale, Butterworth Publication
5. "Basic Lubrication Theory" - A.t. Cameron, Wiley Eastern Limited
6. "Introduction to Tribology of Bearings" - B.C. Majumdar, A.H. Wheeler and Co. Pvt.Ltd. Allahabad.
7. "Tribology: Friction and Wear of Engineering Materials" - LM. Hutchings, Edward Arnold, London.
8. "Engineering Tribology" - A.H. Williams, Oxford University' Press.
9. "Theory and Practice of Lubrication for Engineers" - Dudley D. Fuller, Jihn Wiley and Sons.
10. "Principles and Applications of Tribology" - D.F. Moore, Pergamon Press.
11. "Friction and Wear of Metals" - E. Rabinowicz, John Wiley and Sons.
12. "Bearing Design and Application" - D.F. Wilcock and E.R. Booser, McGraw-Hill.
13. "Fundamentals of Fluid Film Lubrication" - B.J. Hamrock, McGraw-Hill.
14. "Friction Wear Lubrication- Tribology Handbook (Vol-I,II,III)" - LV. Kragelsky and V.B. Alisin, Mir Publication, Moscow.

OEL-301 : OPEN ELECTIVE

Structure : 3-0-0
Credit : 3

(a) BUSINESS ANALYTICS:

Unit1: Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organisation, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modeling, sampling and estimation methods overview.

Unit 2: Trendiness and Regression Analysis: Modeling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.

Unit 3: Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring, Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modeling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modeling, nonlinear Optimization.

Unit 4: Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carlo Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.

Unit 5: Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making.

Unit 6: Recent Trends in : Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.

Reference:

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.
2. Business Analytics by James Evans, persons Education.

(b) INDUSTRIAL SAFETY:

Unit-I: Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

Unit-II: Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

Unit-III: Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants- types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

Unit-IV: Fault tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, iv. Electrical motors, Types of faults in machine tools and their general causes.

Unit-V: Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

Reference:

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.
3. Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

(c) COST MANAGEMENT OF ENGINEERING PROJECTS: I

Introduction and Overview of the Strategic Cost Management Process Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity. cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Benchmarking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing. Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

References:

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

(d) COMPOSITE MATERIALS:

Unit-I: INTRODUCTION: Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

Unit – II: REINFORCEMENTS: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.

Unit – III: Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

Unit-IV: Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.

Unit – V: Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first ply failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

Text Books:

1. Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.
2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.

References:

1. Hand Book of Composite Materials-ed-Lubin.
2. Composite Materials – K.K.Chawla.
3. Composite Materials Science and Applications – Deborah D.L. Chung.
4. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W. Tasi.

(e) WASTE TO ENERGY:

Unit-I: Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

Unit-II: Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

Unit-III: Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

Unit-IV: Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

Unit-V: Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion . Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production -Urban waste to energy conversion - Biomass energy programme in India.

References:

1. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Biomass Conversion and Technology, C. Y. Were Ko-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

PTM-381 : DISSERTATION PHASE-I

Structure : 0-0-20
Credit : 10

Project work will be done by the students. At the end of the semester a seminar is to be given on the progress of the project work.

FOURTH SEMESTER

PTM-481 : DISSERTATION PHASE-II

Structure : 0-0-32
Credit : 16

Given project work is to be completed and there will be a seminar after the completion of the project work.