

SEMESTER - VII

19P701 ENVIRONMENT CONSCIOUS MANUFACTURING

2 0 0 2

ENVIRONMENT CONSCIOUSNESS: The human population's effects on the earth - environmentally conscious Manufacturing - components - system effects and assessment. (6)

AIR POLLUTION IN MANUFACTURING SYSTEMS: Origin of airborne particles in manufacturing - traditional and modern particulates mitigation/elimination techniques. (6)

WATER POLLUTION IN MANUFACTURING SYSTEMS: Metalworking fluids - environmental and health impact - heavy metals in water - MWF pollution prevention through process planning, process modification and in-process recycling - water footprint analysis. (6)

SOLID POLLUTION IN MANUFACTURING SYSTEMS: Origin of solid waste in manufacturing - Industrial solid and hazardous waste management. (6)

ENVIRONMENTAL MANAGEMENT SYSTEMS: Framework and benefits - Concepts of ISO 14001 - requirements of ISO 14001. (6)

Total L: 30

TEXT BOOKS:

1. Daniel B Botkin, Edward A Keller, "Environmental Science", 8th Edition, Wiley India Pvt. Ltd., New Delhi, 2012.
2. Myer Kutz, "Environmentally Conscious Manufacturing", John Wiley and Sons, New York, 2007.

REFERENCES:

1. Paul M Swamidass, "Encyclopedia of Production and Manufacturing Management", Kluwer Academic Publisher, 2000.
2. Davim J P, "Sustainable Manufacturing", John Wiley and Sons, 2010.
3. Erach Bharucha, "Textbook of Environmental Studies for Undergraduate Courses", Orient BlackSwan, 2013.

19P702 PRODUCTION AND OPERATIONS MANAGEMENT

3 0 0 3

FORECASTING AND PLANT DESIGN: Demand forecasting - techniques of forecasting, forecast errors, forecast control. Long range capacity planning - decision tree analysis, plant location factors, location evaluation methods. Plant layout - types, characteristics, layout design techniques - SLP and CRAFT. (9)

AGGREGATE PLANNING AND MASTER PRODUCTION SCHEDULING: Approaches to aggregate planning - graphical, empirical and optimization, development of master production schedule, material requirement planning, MRP Lot sizing, introduction to MRP - II and ERP. (9)

INVENTORY MODELS AND SEQUENCING / SCHEDULING: Classification of fixed order quantity models, deterministic demand models, inventory models with probabilistic demand, price breaks, quantity discount, safety stocks. Selective inventory control techniques - ABC inventory system and vendor managed inventories. Scheduling process - n jobs through one machine, priority dispatching rules, mean flow time, tardiness. Order sequencing - Johnson's algorithm n jobs through 2 machines, extended Johnson's algorithm, n jobs through m machines. (9)

WORK SYSTEMS ENGINEERING AND LEAN TOOLS: Method study - recording tools and techniques, principles of motion economy. Work measurement - standard time, stopwatch time study, rating systems, work sampling and predetermined motion time systems. Value stream mapping - The as-is diagram, the future state map, seven wastes of lean manufacturing. 5S, kaizen, kanban and line balancing. (9)

MAINTENANCE AND PROJECT MANAGEMENT: Types of maintenance, replacement problems, bathtub curve, TPM - pillars of TPM, six big losses, OEE, OOE, TEEP. PERT/CPM - Principles, applications and time - cost / trade-off crashing. (9)

Total L: 45

TEXT BOOKS:

1. Gaither N, Frazier G, "Operations Management", 9th Edition, Cengage Learning, New Delhi, 2009.
2. Jay Heizer, Barry Render, Chuck Munson, Amit Sachan, "Operations Management", 12th Edition, Pearson Education Inc, New Delhi, 2017.

REFERENCES:

1. Hamdy A Taha, "Operations Research", 10th Edition, Pearson Education, New Delhi, 2017.
2. ILO, "Introduction to Work Study", 4th Edition, Universal Book Corporation, New Delhi, 2010.
3. Askin R G, Goldberg J B, "Design and Analysis of Lean Production Systems", 8th Edition, John Wiley and Sons Inc, New Delhi, 2007.
4. Panneerselvam R, "Production and Operations Management", 3rd Edition, PHI Learning Pvt. Ltd., New Delhi, 2010.

19P710 INDUSTRIAL ENGINEERING AND LEAN PRACTICES LABORATORY

0 0 4 2

LIST OF EXPERIMENTS:

1. Solving linear programming problem, transportation and assignment problem.
2. Project management using PERT/CPM.
3. Quality assurance using variable and attribute control charts.
4. Planning and analysis of experiments.
5. Physiological ergonomic evaluation.
6. Anthropometry exercises.
7. Exercise on Value Stream Mapping using lean simulation kit.
8. Exercise on Kanban using lean simulation kit.
9. Exercise on Single Minute Exchange of Dies using lean simulation kit.
10. Exercise on Cell layout using lean simulation kit.

Total P: 60

REFERENCES:

1. Department of Production Engineering, "Industrial Engineering and Lean Practices Laboratory Manual", PSG College of Technology, Coimbatore, 2019.
2. Gupta P K, Hira D S, "Introduction to Operations Research", S Chand and Company, New Delhi, 2012.
3. Timothy Joseph Gallwey, "Ergonomic Laboratory Exercises", CRC Press, New Delhi, 2008.
4. Wilson L, "How to Implement Lean Manufacturing", Tata McGraw Hill, New Delhi, 2015.

19P711 INNOVATION PRACTICES

0 0 4 2

INNOVATION PRACTICES LABORATORY IS TO IDENTIFY A CONSUMER PRODUCT AS NEEDED BY THE MARKET AND MAKE A PHYSICAL PROTOTYPE BY FOLLOWING THE PRODUCT DEVELOPMENT METHODOLOGY GIVEN BELOW:

1. Idea generation and concept selection: i) Market survey and concept generation. ii) Patent search for foolproof concept selection. iii) Timeline of activities.
2. Simulation and optimization of the design: i) CAD model development. ii) Simulation in CAE environment. iii) Design optimization. iv) Approximate cost estimation.
3. Model / prototype development.
4. Preparation of a detailed report.
5. In order to enrich the product innovation process this course will be provided with demonstration of the following i) Reverse engineering hardware, software and the procedure. ii) 3D scanning. iii) Rapid prototyping techniques like Fused Deposition Modelling, Selective Laser Sintering, and vacuum casting. iv) Virtual reality hardware, software and their applications in virtual prototyping. v) Failure Mode and Effect Analysis (FMEA) approach

Total P: 60

REFERENCES:

1. Kevin Otto, Kristin Wood, "Product Design", Pearson, New Delhi, 2013.
2. Karl T Ulrich, Steven D Eppinger, "Product Design and Development", Tata McGraw Hill, New Delhi, 2011.

19P720 PROJECT WORK I

0 0 4 2

- Review of fundamentals
- Identification of a problem domain
- Need for the current study
- Literature survey and patent/design registration /trademarks search
- Problem formulation based on the literature survey
- Objectives and feasibility study
- Methodology and Time Line of activities
- Progress of the work
- Conclusions
- Report and technical paper preparation

Total P: 60

SEMESTER - VIII
19P820 PROJECT WORK II

0 0 8 4

- Identification of a problem domain
- Need for the current study
- Literature survey and patent/design registration /trademarks search
- Problem formulation based on the literature survey
- Objectives and feasibility study
- Methodology and Time Line of activities
- Progress of the work
- Detailed analysis and interpretation of results
- Validation of results
- Conclusions
- Report and technical paper preparation

Total P: 120

LANGUAGE ELECTIVES
19G001 COMMUNICATION SKILLS FOR ENGINEERS

0 0 4 2

COMMUNICATION CONCEPTS :

Process of Communication
Inter and Intrapersonal Communication
Inter and Intrapersonal CommunicationActivities (9)

FOCUS ON SOFT SKILLS :

Etiquette — Work Place etiquette — Telephone etiquette
Body Language
Persuasive Communication
Public Speaking
Critical Reasoning and Conflict Management based on Case Studies
Group Communication
Meetings
Interview Techniques (14)

TECHNICAL WRITING :

Technical Writing Principles
Style and Mechanics
Technical Definitions – Physical, Functional and Process Descriptions
Technical Report Writing
Preparing Instructions and Manuals
Interpretation of Technical Data (15)

BUSINESS CORRESPONDENCE :

Writing Emails
Preparing Resumes
Memos
Technical and Business Proposals (7)

TECHNICAL COMMUNICATION :

Seminars
Process Description and Group Discussions
Use of Visual Aids (15)

Total P: 60

TEXT BOOKS:

1. Faculty Incharge "Course Material on "Communication Skills for Engineers"", PSG College of Technology., Coimbatore, 2019

REFERENCES:

1. Jeff Butterfield "Soft Skills for Everyone", Cengage Learning., New Delhi, 2013
2. Jean Naterop B and Rod Revell "Telephoning in English", Cambridge University Press., Cambridge, 2011
3. David A Mc Murrey and Joanne Buckley "Handbook for Technical Writing", Cengage Learning., New Delhi, 2011
4. Simon Sweeney "English for Business Communication", Cambridge University Press., New Delhi, 2012

19G002 GERMAN- LEVEL A1.1

0 0 4 2

GUTEN TAG! :

1. To greet, learn numbers till 20, practice telephone numbers & e mail address, learn alphabet, speak about countries & languages
2. Vocabulary: related to the topic
3. Grammar: W — Questions, Verbs & Personal pronouns I. (10)

FREUNDE, KOLLEGEN UND ICH :

1. To speak about hobbies, jobs, learn numbers from 20; build dialogues and frame simple questions & answers
2. Vocabulary: related to the topic
3. Grammar: Articles, Verbs & Personal pronouns II, sein & haben verbs, ja/nein Frage, singular/plural (10)

IN DER STADT :

1. To know places, buildings, question, know transport systems, understand international words; build dialogues and write short sentences
2. Vocabulary: related to the topic
3. Grammar: Definite & indefinite articles, Negotiation, Imperative with Sien verbs (12)

GUTEN APPETIT! :

1. To speak about food, shop, converse; Vocabulary: related to the topic; build dialogues and write short sentences
2. Grammar: Sentence position, Accusative, Accusative with verbs, personal pronouns & prepositions, Past tense of haben & sein verbs (13)

TAG FÜR TAG/ZEIT MIT FREUNDEN :

1. To learn time related expressions, speak about family, about birthdays, understand & write invitations, converse in the restaurant; ask excuse, fix appointments on phone
2. Vocabulary: related to the topic
3. Grammar: Time related prepositions, Possessive articles, Modalverbs (15)

Total P: 60

TEXT BOOKS:

1. Dengler Stefanie "Netzwerk A1.1", Klett-Langenscheidt GmbH., München, 2013
2. Sandra Evans, Angela Pude "Menschen A1", Hueber Verlag., Germany, 2012

REFERENCES:

1. Stefanie Dengler "Netzwerk A1", Klett-Langenscheidt GmbH., München, 2013
2. Hermann Funk, Christina Kuhn "Studio d A1", Goyal Publishers & Distributors Pvt. Ltd., New Delhi, 2009
3. Rosa-Maria Dallapiazza "Tangram Aktuell 1 (Deutsch als Fremdsprache)", Max Hueber Verlag., Munchen, 2004
4. Christiane Lemcke und Lutz Rohrmann "Grammatik Intensivtrainer A 1", Goyal Publishers & Distributors Pvt. Ltd., New Delhi, 2012

19G003 FRENCH LANGUAGE LEVEL 1

0 0 4 2

PARTS OF SPEECH :

1. inviter et répondre à une invitation, Pronoms sujets
2. L'article définis, l'article indéfinis
3. Conjugation : présent, adjectifs possessifs
4. interrogation, décrire les personnes
5. La vie de quatre parisiens de professions différentes (12)

ELEMENTS OF GRAMMAR :

1. Exprimer l'ordre et l'obligation demander et commander
2. l'adjectif possessifs, l'article partitif, l'article démonstratif, négation ne
3. pas, l'article contracté
4. verbe pronominaux
5. prepositions (12)

SENTENCE STRUCTURE :

1. Raconter et reporter-donner son avis
2. Futur simple, pronom complètement d'objet direct, passé composé
3. Plusieurs région de France, imparfait, pronom y/en, imparfait (12)

TENSES AND NUMBERS :

1. Demander l'autorisation-passé récent, futur proche
2. La vie administrative et régionale, Pluriel des noms, moyens de transport (12)

DISCOURSE :

1. le discours rapporté, décrire un lieu, exprimer ses préférences
2. décrire la carrière, discuter d'un système éducation de France
3. parler de la technologie de l'information (12)

Total P: 60**TEXT BOOKS:**

1. Christine Andant étal "À propos (livre de l'élève", LANGER., NEW DELHI, 2012
2. Myrna Bell Rochester "Easy French Step By Step", MCGrawhill Companies., USA, 2008

REFERENCES:

1. Michael D. Oates "Entre Amis: An Interactive Approach", Houghton Mifflin., 2005 , 5th
2. Bette Hirsch, Chantal Thompson "Moments Literaries : An Anthology for intermediate French", ..
3. Simone Renaud, Dominique van Hooff "En bonne forme", ..

19G004 BASIC JAPANESE**0 0 4 2****JAPANESE PEOPLE AND CULTURE :**

1. Basic greetings and responses
2. Basic script — Method of writing hiragana and katakana — Combination sounds and simple words
3. Selfintroductions: "Hajimemashite"-Demonstratives "Kore", "Sore", "Are" — Demonstrative "Kono", "Sono", "Ano"
4. Possessive noun particle "no" — Japanese apartments: Greeting your neighbor (12)

PARTICLE "NI (AT)" FOR TIME :

1. kara (from) ~ made(until) — Particle "to (and)"
2. Time periods: Days of the week, months, time of day — Verbs (Present / future and past tense)
3. Telephone enquiry: Asking for a phone no. And business hours- Destination particle "e". (12)

LIKES AND DISLIKES :

1. Potential verbs (wakarimasu and dekimasu) — "Kara (~ because)"
2. Adverbs — Asking someone out over the phone- Verbs denoting presence
3. Introduction to Adjectives (na and ii type) -Verb groups — I, II and III — Exercises to group verbs- Please do (te kudasai)
4. Present continuous tenses (te imasu) — Shall I? (~ mashou ka) — Describing a natural phenomenon (It is raining) (12)

DIFFERENT USAGES OF ADJECTIVES :

1. Comparison — Likes and dislikes — Going to a trip- Need and desire (ga hoshii) — Wanting to . . . (Tabetai desu)- Going for a certain purpose (mi -ni ikimasu)
2. Choosing from a menu-Adjectives ("i" and "na" type) — Adjectives (Positive and negative usage) (12)

ROLE PLAYS IN JAPANESE :

1. Framing simple questions & answers
2. Writing Short paragraphs & Dialogues
3. A demonstration on usage of chopsticks and Japanese tea party (12)

Total P: 60**TEXT BOOKS:**

1. Minna no Nihongo, Honsatsu Roma "ji ban (Main Textbook Romanized Version)", . International publisher — 3A Corporation., Tokyo, 2012

REFERENCES:

1. Eri Banno et.al "Genki I: An Integrated Course in Elementary Japanese I -Workbook", .. 1999
2. Tae Kim "A Guide to Japanese Grammar: A Japanese Approach to Learning Japanese Grammar", .. 2014
3. Minna No Nihongo "Translation & Grammatical Notes In English Elementary", ..

PROFESSIONAL ELECTIVES**19P001 MECHATRONICS****3 0 0 3**

INTRODUCTION TO MECHATRONICS SYSTEM: Key elements - Mechatronics Design process - Types of Design - Traditional and Mechatronics designs – Advanced approaches in Mechatronics - Man machine interface, industrial design and ergonomics, safety. (9)

REAL-TIME INTERFACING: Introduction - Elements of data acquisition and control - Overview of I/O process, Analog signals,

discrete signals and Frequency signals – Over framing. (9)

CASE STUDIES ON DATA ACQUISITION: Introduction – Cantilever Beam Force Measurement system – Testing of Transportation bridge surface materials – Transducer calibration system for Automotive applications – Strain gauge weighing system – Solenoid Force - Displacement calibration system – Rotary optical encoder – Controlling temperature of a hot/cold reservoir – pick and place robot. (9)

CASE STUDIES ON DATA ACQUISITION AND CONTROL: Introduction – Thermal cycle fatigue of a ceramic plate – pH control system – DC - Icing Temperature Control system – Skip control of a CD Player – Autofocus Camera, exposure control. Case studies of design of mechatronic products - Motion control using D.C Motor and Solenoids - Car engine management systems. (9)

ADVANCED APPLICATIONS IN MECHATRONICS: Sensors for condition Monitoring – Mechatronic Control in Automated Manufacturing – Artificial intelligence in Mechatronics – Fuzzy Logic Applications in Mechatronics – Microsensors in Mechatronics. (9)

Total L: 45

TEXT BOOKS:

1. Devdas Shetty, Richard A Kolk, "Mechatronics System Design", 2nd Edition, Cengage Learning, 2010.
2. W Bolton, "Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering", 6th Edition, Pearson Education, 2015.

REFERENCES:

1. S Brian Morriss, "Automated Manufacturing Systems - Actuators, Controls, Sensors and Robotics", McGraw Hill International Edition, 1995.
2. D A Bradley, D Dawson, N C Burd, A J Loader, "Mechatronics: Electronics in Products and Processes", Chapman and Hall, London, 1993.
3. Richard C Dorf, Robert H Bishop, "Modern Control Systems", 12th Edition, Pearson, 2010.

19P002 MODELING AND CONTROL OF DYNAMIC SYSTEMS

3 0 0 3

INTRODUCTION TO CONTROL SYSTEMS: Introduction - need for control systems. Open-loop and closed-loop systems - Components of feedback control systems - effect of feedback control - types of feedback control systems. Transfer function: Block diagram reduction - Signal flow graphs. (8)

MATHEMATICAL MODELS OF PHYSICAL SYSTEMS: Mechanical translational and rotational systems - Fluid and Thermal systems - D.C. generator and motor; Transportation Lag Systems. (8)

TRANSIENT RESPONSE: Typical inputs - Time domain specifications - First and second order systems - steady state errors. **STABILITY:** Concept of stability - necessary and sufficient conditions of stability - Routh Hurwitz Criterion. Lead - Lag - Lag-Lead Compensation using time domain analysis. (11)

FREQUENCY RESPONSE: Bode Plot - Polar Plot - Nyquist stability criterion - Stability analysis - Control system design using Frequency domain analysis - Lead - Lag - Lag-Lead Compensation. (12)

CASE STUDIES: Servo motor - Mathematical Modelling of Servo Motor - Analysis of Servo motor system using Routh Hurwitz criterion - Root locus - Bode Plot - Polar Plot and stability analysis - Implementation of P - PI – PD and PID controllers for servo motor and analysis. (6)

Total L: 45

TEXT BOOKS:

1. Ogata K, "Modern Control Engineering", Pearson Education, 2015.
2. Benjamin C Kuo, "Automatic Control Systems", 9th Edition, Prentice Hall of India, 2014.

REFERENCES:

1. J Nagrath, M Gopal, "Control System Engineering", New Age International Publishers, 2018.
2. M Nakamura S Gata and N Kyura, "Mechatronic Servo System Control", Springer 2009, 2009.
3. Norman S Nise, "Control Systems Engineering", 6th Edition, 2018.
4. Richard C Dorf, Robert H Bishop, "Modern Control Systems", Addison – Wesley, 2015.

19P003 MAINTENANCE AND SAFETY ENGINEERING

3 0 0 3

MAINTENANCE: Types of maintenance - breakdown, preventive, predictive, condition based maintenance, total productive maintenance, maintenance prevention, reliability centered maintenance - MTBF, MTTR - elements of preventive maintenance - checklist, schedule, procedure. (9)

TOTAL PRODUCTIVE MAINTENANCE: Principles - preparatory stages of TPM implementation - TPM organization structure, TPM policies and aids, master plan - small group activities, autonomous maintenance, establishing planned maintenance, training, developing equipment management program. (11)

SAFETY SYSTEMS ANALYSIS: Introduction of safety systems, safety information system, industrial safety engineering, job safety analysis, OSHA regulations - design for safety, lock out / tag out system, work permit system - safety in power press, cranes and boiler operations - safety in foundry, forging, welding, hot working, cold working and electroplating. (10)

FIRE PROTECTION SYSTEM: Chemistry of fire - water sprinkler - fire hydrant - alarm and detection system - fire suppression system - CO₂ system, foam system, Dry Chemical Powder (DCP) system, halon system, portable extinguisher. (8)

SAFETY AND LAW: Provisions in factory act for safety - explosive act - workmen compensation act – compensation calculation - boiler act and pollution control act. (7)

Total L: 45

TEXT BOOKS:

1. John Ridley, John Channing, "Safety at Work", 7th Edition, Butterworth-Heinemann Publications, UK, 2008.
2. Charles J Robinson, Andrew P Ginder, "Implementing TPM: The North American Experience", Productivity Press, Portland, Oregon, 2007.

REFERENCES:

1. Dhillon B S, "Maintainability, Maintenance and Reliability for Engineers", Taylor and Francis, London, 2006.
2. Heinrich H W, "Industrial Accident Prevention", National Safety Council, Chicago, 1998.
3. Gary R Krieger, John F Montgomery, "Accident Prevention Manual for Industrial Operations", 11th Edition, National Safety Council, Chicago, 1997.
4. Patrick A Michaud, "Accident Prevention and OSHA Compliance", CRC Press, USA, 1995.

19P004 FINITE ELEMENT APPLICATIONS IN MANUFACTURING

3 0 0 3

BASIC CONCEPTS: Background study on Finite Element Method (FEM) - need for application of FEM in various engineering domains - transforming physical model in to mathematical model - strong and weak form of 1D physical problems - approximation using interpolation or trial functions - solving 1D structural and thermal problem - approach to solve 2D and 3D models. (12)

DISCRETIZATION: Introduction, concept of elements - 1D, 2D and 3D elements - plane stress and plane strain models - shape functions - direct stiffness approach - stiffness matrix - element assembly - solving for unknowns - global and natural coordinate systems and Jacobian for transformations. (9)

GOVERNING EQUATIONS: Mathematical modeling of manufacturing processes - metal casting, metal cutting, metal forming, welding - heat treatment and injection molding - use of partial differential equations – interpretation of boundary conditions and initial conditions. (6)

FEA OF METAL FORMING PROCESSES: Review of theory of plasticity applied to metal forming processes - flow curve - models for friction and heat transfer - modelling of simple forging operations - plane strain upsetting - computer implementation - modelling of rolling and extrusion processes. (9)

FEA OF METAL CASTING AND WELDING PROCESSES: Overview of transport phenomena in metal casting - simple case studies on sand mould casting using CAE software - introduction to Computer-aided design and analysis of Injection moulded components using CAE software - model for manual metal arc welding - FEA analysis of welding distortion and residual stress using CAE software. (9)

Total L: 45

TEXT BOOKS:

1. J Fish, "A First Course in Finite Elements", John Wiley and Sons Ltd., England, 2007.
2. Shiro Kobayashi, Soo-ik Oh, Taylan Altan, "Metal Forming and the Finite Element Method", Oxford and IBH Publishing, New Delhi, 1989.

REFERENCES:

1. Reddy J N, "Introduction to Finite Element Method", Tata McGraw Hill, 2005.
2. Edward R Champion, "Finite Element Analysis in Manufacturing Engineering", McGraw Hill, 1992.
3. Dantzig J A, Rappez M, "Solidification", EPFL Press, Laussane, Switzerland, 2009.
4. Sindo Kou, "Transport Phenomena and Materials Processing", John Wiley and Sons Inc, New York, 1996.

19P005 DESIGN AND MANUFACTURE OF GEARS

3 0 0 3

INTRODUCTION TO GEARS: Types of gears, classification, application of gears, gearboxes, gear drawing. Review of gear

fundamentals - Law of gearing, nomenclature, interference, minimum number of teeth, gear correction - So and S, Gear tooth forces. (7)

GEAR DESIGN: Design of spur gears, design of helical gears, design of worm and worm wheel, design of bevel gears. (11)

GEAR MATERIAL SELECTION AND HARDENING METHODS: Properties of gear materials, non-metallic, non-ferrous and plastic gears, selection of material for power transmission, high-speed application, hardening by through hardening, case hardening, induction hardening, flame hardening, nitriding and tufriding, hardening defects. (8)

PRODUCTION OF CYLINDRICAL AND CONICAL GEARS: Procedure of cutting gears and obtainable quality in hobbing and gear shaping- cutter selection and work holding methods, setting calculations. Rack type gear shaping machine description and application. Internal gear cutting methods, CNC gear hobbing and gear shaping machines. Production of straight bevel gears by bevel gear generator, duplex rotary cutter method – Gleason Reva cycle method - spiral and hybrid bevel gear generation, Gleason Tri-AC, description of machine. (10)

GEAR FINISHING AND OTHER PRODUCTION METHODS: Gear finishing advantages, finishing of gears by grinding, shaving, lapping and honing methods, cold rolling of gears - description of process, machine, cutters and process parameters setting. Gear production by stamping, die casting, powder metallurgical process, injection and compression moulding of plastic gears, cold and hot rolling. Mass production methods - shear speed shaping, gear broaching. (9)

Total L: 45

TEXT BOOKS:

1. HMT, "Production Technology", Tata McGraw Hill Co., 2004.
2. Maitra G M, "Handbook of Gear Design", Tata McGraw Hill, 2001.

REFERENCES:

1. Chawathe D D, "Hand Book of Gear Technology", New Age International, 2009.
2. Darle W Dudley, "Handbook of Practical Gear Design", CRC Press, Washington D.C, 2009.
3. Dennis P Townsend, "Dudleys Gear Handbook: The Design, Manufacture and Application of Gears", 2nd Edition, Tata McGraw Hill, New Delhi, 2011.
4. Faculty of Mechanical Engineering, "Design Data Book", PSG College of Technology, M/s. DPV Printers, 2012.

19P006 PRODUCT LIFECYCLE MANAGEMENT

3 0 0 3

PRODUCT DEVELOPMENT AND PRODUCT LIFECYCLE: Product development process and functions, present market constraints, need for collaboration, collaborative product development, use of internet class technologies and data transfer, various developments on internet technology that support product development and its impact on business. Concept of product lifecycle - different phases of product lifecycle and corresponding technologies, its uses and examples. (9)

PRODUCT DATA MANAGEMENT (PDM): PDM functions, PDM system and importance, architecture of PDM systems, document management, representation of lifecycle of business objects, concepts on roles, users and project management, system administration, access control and its use in lifecycle. (9)

AUTOMATING BUSINESS PROCESSES: Product Lifecycle Management (PLM) architecture, components of PLM, lifecycle problems to resolve, Workflows - lifecycle and work flow integration, product configuration, bill of materials management, product structure, configuration management and engineering change management. Introduction to Product Manufacturing Information (PMI) and Model Based Definition (MBD). (10)

PRODUCT VISUALISATION: Use of CAD neutral approach and visualization techniques in product development, capabilities of PLM visualization software - light weight representations, markup method, representation information repository, use of visualization in different stages of lifecycle, case studies. Introduction to virtual reality, digital mock-up, virtual testing and validation. (9)

INTEGRATION OF PLM WITH OTHER SYSTEMS: Benefits of integrating PLM system with other systems, different ways to integrate PLM systems with other systems, integration with CAD and ERP - use of middleware in integrating business applications in product development. PLM software customisation. (8)

Total L: 45

TEXT BOOKS:

1. Michael Grieves, "Product Lifecycle Management", Tata McGraw Hill, 2006.
2. Faisal Hogue, "E-Enterprise Business Models Architecture and Components", Cambridge University Press, 2000.

REFERENCES:

1. Alexis Leon, "Enterprise Resource Planning", Tata McGraw Hill, 2002.
2. Danier Amor, "The E-Business Revolution", Pearson Education Asia, 2000.
3. David Ferry, Larry Whipple, "Building an Intelligent e-Business", Prima Publishing, 2000.
4. David Bedworth, Mark Hederson, Phillip Wolfe, "Computer Integrated Design and Manufacturing", McGraw Hill Inc., 1991.

19P007 SURFACE ENGINEERING AND TRIBOLOGY

3 0 0 3

SURFACE ENGINEERING: Significance of surfaces - nature of surfaces contact - surface energy - surface topography - surface texture evaluation techniques - surface integrity - Instruments and techniques for surface analysis - scanning electron microscopy and atomic forces microscopy - surface zone layers - structure of superficial layers - characteristics of superficial layer obtained by manufacturing processes - strength properties - tribological properties. (9)

SURFACE COATINGS: Structure of coatings - classification of coatings - need for technical and technological coatings - techniques for producing surface layers - thermal spraying - electron beam technology – laser based technology - ion implantation techniques - CVD methods and PVD techniques. (9)

SURFACE HARDENING: Surface hardening by flame and induction - laser and electron beam hardening - selection and applications - surface diffusion process - carbonitriding - aluminizing - siliconizing - chromizing - sursulf - selection of diffusion process. (7)

TRIBOLOGY: Scope of Tribology - Tribology in metal working - surface effects on tribology - liquid lubricants and lubrication - lubrication by solids - mechanism and effects of lubrication - film parameter - selection criteria for lubricants - basics of hydrodynamic - elasto-hydrodynamic - boundary and extreme pressure lubrication - tribological components - bearings - gears and piston rings - Introduction to Nano tribology. (11)

FRICITION AND WEAR: Laws of dry friction - mechanism of friction - sliding friction of metals and polymers - stick slips in machine tool slides - frictional heating and contact temperature - wear mechanisms - abrasive - erosive and cavitation wear - effects of adhesion between wearing surfaces - seizure and scuffing - corrosive wear and fatigue wear - wear analysis and measurement. (9)

Total L: 45

TEXT BOOKS:

1. Bharat Bhushan, "Principles and Applications of Tribology", John Wiley and Sons, 2003.
2. Tadeusz Burakowski, Tadeusz W, "Surface Engineering of Metals : Principals, Equipments and Technologies", CRC Press, 2000.

REFERENCES:

1. Sengupta S N, Ahuja D B, Basu S K, "Fundamentals of Tribology", Prentice Hall of India, 2011.
2. Bharat Bhushan, "Nano-Tribology and Nanomechanics: An Introduction", Springer, 2008.
3. Rajan, Sharma, "Heat Treatment Principals and Techniques", Prentice Hall of India, 2004.
4. Ernest Rabinowicz, "Friction and Wear of Materials", John Wiley and Sons, 1995.

19P008 MANUFACTURE OF AUTOMOTIVE COMPONENTS

3 0 0 3

ENGINE AND ENGINE COMPONENTS: Casting of engine block - conventional and expendable pattern, machining of engine block - casting of cylinder heads, forging of crank shaft, connecting rod and gudgeon pin, machining and heat treatment - casting of piston by gravity casting, squeeze casting, forging of valves, heat treatment and surface improvement - cylinder liners and piston ring manufacturing. (9)

CLUTCH AND GEARBOX COMPONENTS: Principles and types - friction lining materials, requirements and its manufacturing - casting of gear box casing, guide lines - precision forging of spur and helical gears, bevel and worm gear manufacturing - orbital forming of gears, heat treatment and finishing, examples. (9)

PROPELLER SHAFT, AXLES, SPRINGS AND BODY PANELS: Casting and extrusion of propeller shaft, extrusion dies and its materials, heat treatment - forging of front axle and rear axle, casting of rear axle casing - leaf spring materials and its requirements, manufacturing of leaf spring - forming of body panels-hydro forming and press forming, welding of body panels - injection moulding of instrument panel, moulding of bumper, tooling and requirements. (10)

AUTOMOTIVE COMPONENTS USING COMPOSITES: Need for composites in automotive parts, types of composite and its characteristics - ceramic matrix piston rings - chemical vapour deposition, physical vapour deposition - composite molding of friction lining, composite propeller shaft manufacturing, composite leaf springs and process for making composite panels. (9)

MISCELLANEOUS COMPONENTS: Tyre and tube manufacturing, materials and its requirements - painting booth and coach work - safety aspects in component manufacturing, guide lines - case study examples. (8)

Total L: 45

TEXT BOOKS:

1. Heldt P M, "High Speed Combustion Engines", Oxford IBH Publishing Company, Calcutta, 1996.
2. Kirpal Singh, "Automobile Engineering, Volume I & II", Standard Publishers, New Delhi, 2014.

REFERENCES:

1. Serope Kalpakjian, Steven R Schmid, "Manufacturing Processes for Engineering Materials", Prentice Hall India Private

- Limited, New Delhi, 2007.
- Phillip F Ostwald, Jairo, Munoz, "Manufacturing Processes and Systems", Wiley India Private Limited, New Delhi, 2008.
 - Sanjay K Mazumdar, "Composites Manufacturing: Materials, Product and Process Engineering", CRC Press, LLC Publisher, New York, 2002.
 - Kalpakjian, "Manufacturing Engineering and Technology", Pearson Publishing Company, Noida, 2014.

19P009 LEAN MANUFACTURING

3 0 0 3

ORIGIN AND CHARACTERISTICS OF LEAN PRODUCTION: Craft production – mass production – Ford system – growing dysfunction – origin and history of lean production – necessity of lean production – systems and systems thinking – construction of lean production - lean image and lean activities – Muda and its types – Mura – Muri. (8)

STABILITY AND STANDARDIZED WORK: Standards in lean system – visual management – 5S – Total Productive Maintenance - key measures - six big losses - hidden losses - machine loss pyramid - small group activity - comparison of methods engineering and lean thinking – elements to be managed - necessity and prerequisites of standardized work – elements of standardized work - charts - production capacity chart - standardized combination table - standardized work analysis chart – manpower reduction – comparison of overall efficiency with individual efficiency – kaizen – common layouts. (12)

JUST IN TIME (JIT): Definition - principles of JIT - continuous flow - pull – JIT system – kanban – six kanban rules - expanded role of conveyance – production levelling – three types of pull systems – value stream mapping - symbols - current state VSM and future state VSM. (10)

JIDOKA: Development and necessity – poke yoke - common errors – inspection system and zone control – using poke jokes – jidoka implementation. (7)

LEAN INVOLVEMENT AND CULTURE: Necessity of involvement – waste of humanity – activities supporting involvement - kaizen circle activity – practical kaizen training – key factors in practical Kaizen training – lean culture - 'Five Why' analysis. (8)

Total L: 45

TEXT BOOKS:

- Devadasan S R, Mohan Sivakumar V, Murugesh R, Shalij P R, "Lean and Agile Manufacturing: Theoretical, Practical and Research Futures", Prentice Hall of India Learning Limited, 2012.
- Dennis P, "Lean Production Simplified: A Plain Language Guide to the World's Most Powerful Production System", Productivity Press, 2007.

REFERENCES:

- Gopalakrishnan N, "Simplified Lean Manufacture: Elements, Rules, Tools and Implementation", Prentice Hall of India Learning Private Limited, 2010.
- Bill Carreira, "Lean Manufacturing that Works: Powerful Tools for Dramatically Reducing Wastes and Maximizing Profits", Prentice Hall of India Learning Private Limited, 2007.
- Don Tapping, Tom Luyster, Tom Shuker, "Value Stream Management: Eight Steps to Planning, Mapping and Sustaining Lean Improvements", Productivity Press, 2002.
- James P Womack, Daniel T Jones, Daniel Roos, "The Machine That Changed the World", 1st Edition, Free Press, New York, 2007.

19P010 MATERIAL HANDLING SYSTEMS

3 0 0 3

INTRODUCTION: Definition and Scope of Material Handling - Importance of Material Handling - Basic Classification of Materials - Definition of Unit Loads - Advantages and Disadvantages - Load Utilization Processes and Handling Methods - Pallets, Skids and Containers - Alternative Method of Handling - Packaging for Materials Handling - Industrial Trucks: Classification - Hand Trucks - Power Trucks - Fork Lift Trucks - Tractors. (9)

CONVEYORS: Belt Conveyors: Definition - General Characteristics - Types - Parts - Design Aspects – Pneumatic Conveyors: Definition - Advantages and Disadvantages - Types - Parts of Pipeline Conveyors. - Hydraulic Conveyors: Definition and Uses - Advantages and Disadvantages - Design Considerations. (9)

HOIST AND WINCHES: Hoists – Definition - Characteristics and Uses - Constructional Features - Specification - Parts of Hoisting Equipments - Chain and Chain Sprockets - Steel Wire Ropes and Drums - Pulleys and Pulley Systems - Arresting Gears and Breaks - Load Handling Attachments - Winches - Definition and Uses - Constructional Features. (9)

ELEVATORS: Definition - Bucket Elevators - Definition, Specification and Uses - Types of Bucket Elevators - Selection of Elevators - Design of Buckets for Bucket Elevators - Skip Hoists - Freight Elevators - Lifts. (9)

CRANES: Definition - Basic Principles - Types of Cranes - Jib Cranes - Overhead Travelling Cranes/Bridge Cranes - Gantry Cranes - Wharf Cranes - Pillar Cranes - Tower Cranes - Truck And Wagon Cranes - Crawler Cranes - Railroad/Locomotive

Cranes - Floating Cranes - Derricks.

(9)

Total L: 45

TEXT BOOKS:

1. Siddhartha Ray, "Introduction to Materials Handling", New Age International Private Limited, New Delhi, 2010.
2. Charles D Reese, "Materials Handling Systems", Taylor and Francis, New York, 2000.

REFERENCES:

1. Rudenko N, "Materials Handling Equipment", MIR Publishers, 1969.
2. Chowdary R B, Tagore G R N, "Materials Handling Equipment", Khanna Publishers, New Delhi, 1996.
3. Spivakovsky A O, Dyachkov V K, "Conveying Machines Volume I & II", MIR Publishers, 1985.
4. Alexandrov M, "Materials Handling Equipments", MIR Publishers, 1981.

19P011 NON-TRADITIONAL MACHINING TECHNIQUES

3 0 0 3

MECHANICAL ENERGY PROCESSES: Need - types of non-traditional machining processes - hybrid processes - applications - Ultrasonic Machining (USM): Process description - equipments - mechanics of cutting - hammering and throwing model - typical problems - factors affecting material removal rate - dimensional accuracy and surface quality - applications. (9)

ABRASIVE MACHINING PROCESSES: Introduction - description - equipment - nozzles - material removal rate - typical problems - parametric analysis - process capabilities and applications of Abrasive Jet Machining (AJM) and Abrasive Water Jet Machining (AWJM) processes. (9)

THERMAL ENERGY PROCESSES: Electron Beam Machining (EBM): Principle - equipments - vacuum system - process parameters - characteristics and applications - Laser Beam Machining (LBM): Types of lasers - characteristics - material removal mechanism - process characteristics - applications - three dimensional machining and advantages - Plasma Arc Machining (PAM): Generation of plasma - elements - torch design types and its characteristics - effect of process parameters - applications. (9)

ELECTRICAL DISCHARGE MACHINING: Introduction - mechanism of material removal - description - electrodes - dielectric fluids - different types of flushing - material removal rate - process characteristics and applications – Wire - Electric Discharge Machining (Wire-EDM): Equipments - process variables - process capabilities and applications in die making. (9)

CHEMICAL ENERGY PROCESSES: Electro Chemical Machining (ECM): Principle of electrolysis - theory of ECM - description of the equipment - electrodes - modeling of material removal rate - accuracy and surface finish - advantages and limitations - various applications - Electro Chemical Grinding - Electro Chemical Deburring - Chemical etching process and its applications. (9)

Total L: 45

TEXT BOOKS:

1. Hassan Abdel, Gawad El-Hofy, "Advanced Machining Processes: Non Traditional and Hybrid Machining Process", 1st Edition, McGraw Hill, New York, 2005.
2. Jain V K, "Advanced Machining Processes", 1st Edition, Allied Publishers Pvt. Ltd., London, 2017.

REFERENCES:

1. James Brown, "Advanced Machining Technology Hand Book", 1st Edition, McGraw Hill, New Delhi, 1998.
2. Benedict G F, "Advanced Manufacturing Processes", 2nd Edition, Jain V K, New Delhi, 2016.
3. Pandey PC, "Advanced Methods of Machining", 2nd Edition, Chapman and Hill, New York, 2011.
4. Jain V K, "Modern Machining Processes", 1st Edition, Tata McGraw Hill, New Delhi, 1981.

19P012 SUPPLY CHAIN MANAGEMENT

3 0 0 3

SUPPLY CHAIN MANAGEMENT AND INVENTORY CONTROL: Meaning and definition - development chain - key issues in supply chain management (SCM) - introduction to inventory control- single stage inventory control - single period models - initial inventory - multiple order opportunities - risk pooling - centralized and decentralized systems - managing inventory in the supply chain - forecasting. (8)

VALUE OF INFORMATION: Introduction - bullwhip effect - information sharing and incentives - information for coordination of systems - information and supply chain trade-offs - supply chain integration - push, pull and push- pull system - demand driven strategies - impact of internet on supply chain strategies - benefits and risks of outsourcing. (12)

LOGISTICS AND INTERNATIONAL SUPPLY CHAIN MANAGEMENT: Logistics related business function - framework for strategic alliance - third-party logistics - retailer supplier partnerships - distributor integration - procurement and out servicing strategies - e-procurement - global market forces - managing global risks - requirements for global strategy implementation - issues in international supply chain management. (10)

COORDINATED PRODUCT AND SUPPLY CHAIN DESIGN: General framework - design for logistics – supplier integration into to new product development - mass customization - the dimensions of customer value. (7)

INFORMATION TECHNOLOGY FOR SCM: Goals of supply chain information technology - information technology standards - information technology infrastructure - Radio Frequency Identification (RFID) - point of sale data - benefits - supply chain efficiency. (8)

Total L: 45

TEXT BOOKS:

1. Simchi-Levi Davi, Kaminsky Philip, Simchi-Levi Edith, "Designing and Managing the Supply Chain: Concepts, Strategies and Case Studies", Tata McGraw Hill, 2008.
2. Chopra S, Meindl P, "Supply Chain Management: Strategy, Planning and Operation", 2nd Edition, 2005.

REFERENCES:

1. Robert Jacobs F, William Berry, Clay Whybark D, "Manufacturing Planning and Control for Supply Chain Management", Tata McGraw Hill, 2011.
2. Michael Hugos, "Essentials of Supply Chain Management", John Wiley and Sons, Inc, New Jersey, 2011.
3. David Blanchard, "Supply Chain Management Best Practices", 2nd Edition, John Wiley and Sons Inc, 2010.
4. Michael H Hugos, "Essentials of Supply Chain Management", 4th Edition, John Wiley and Sons Inc, 2018.

19P013 PLC PROGRAMMING AND APPLICATIONS

3 0 0 3

PLC HARDWARE: Introduction – Internal architecture - IEC standard – Input / Output devices – signal conditioning serial and parallel communications, standards and protocols – distributed control – network standards – industrial communication systems. (8)

LADDER AND FUNCTIONAL PROGRAMMING: Ladder diagrams – logic functions – internal relays – latching – functional blocks – application of timers and counters. (12)

SUB-ROUTINES AND DATA HANDLING: Jump and Call – sub routines – shift registers – data handling – arithmetic functions – closed loop controls – applications. (8)

DESIGNING PLC SYSTEMS: Program development – safety systems – commissioning – fault detection – documentation. (8)

APPLICATIONS OF PLC: Material handling applications - Automatic control of warehouse door - Automatic lubricating oil supplier - Conveyor belt motor control - Automatic car washing machine - Bottle label detection - Process control application – industrial case studies. (9)

Total L: 45

TEXT BOOKS:

1. W Bolton, "Programmable Logic Controllers", 6th Edition, Elsevier, 2015.
2. Frank D Petruzella, "Programmable Logic Controllers", McGraw Hill Book Company, 2017.

REFERENCES:

1. John W Webb, Ronald A Reis, "Programmable Logic Controllers: Principles and Applications", Prentice Hall India, 2003.
2. William I Fletcher, "An Engineering Approach to Digital Design", Prentice Hall of India Limited, 1999.
3. Charles H Roth Jr, "Fundamentals of Logic Design", 6th Edition, Jaico Publishing House, New Delhi, 2007.

19P014 MECHANICAL VIBRATIONS

3 0 0 3

INTRODUCTION: Relevance of and need for vibrational analysis - mathematical modelling of vibrating systems - discrete and continuous systems - single degree of freedom systems - free and forced vibrations – various damping models. (8)

TWO DEGREES OF FREEDOM SYSTEMS: Generalized co-ordinates - principal co-ordinates - derivation of equations of motion - co-ordinate coupling - Lagrange's equation - dynamic vibration absorbers. (9)

MULTI DEGREES OF FREEDOM SYSTEMS: Derivation of equations of motion - influence coefficients – orthogonality principle - calculation of natural frequencies by Matrix, Rayleigh, Stodala, Dunkerley and Holzer methods. (10)

TRANSIENT VIBRATION: Impulse and arbitrary excitations - base excitation - laplace transform formulation - response spectrum. (6)

VIBRATION MEASUREMENT AND CONTROL: Tests and measurements of vibration - modal analysis - Fast Fourier Transform (FFT) analyzer - vibration measuring sensors and exciters - methods of vibration control - excitation reduction at source - balancing of rigid, flexible and variable mass rotors - viscoelastic polymers - condition monitoring of machines (12)

Total L: 45

TEXT BOOKS:

1. Rao S S, "Mechanical Vibrations", Pearson Education, 2018.
2. Thomson W T, "Theory of Vibration with Applications", Pearson Education, 2008.

REFERENCES:

1. Raveesh Pratap, V P Singh, "Mechanical Vibrations", Dhanpat Rai Publishing Company (P) Ltd., New Delhi, 2014.
2. Ashok Kumar Mallik, "Principles of Vibration Control", Affiliated East- West Press Private Limited, 1990.
3. Seto, "Mechanical Vibrations", Schaum Outline Series, 1990.
4. Grover G K, "Mechanical Vibrations", Nem Chand and Brothers, Roorkey, 2009.

19P015 PRECISION MANUFACTURING

3 0 0 3

PRECISION ENGINEERING: Introduction - accuracy and precision - general concept of machine tool accuracy - four classes of achievable machining accuracy - examples - spindle rotation accuracy - influence of geometric accuracy of machine tools - applications - case studies. (9)

PRECISION MACHINING: Introduction - concepts of precision machining - turning - boring - drilling - milling - grinding - honing and lapping - examples - cutting tools - materials - classification - characteristics - examples. (8)

PRECISION AND ULTRA PRECISION MACHINE ELEMENTS: Introduction - guide ways - types - requirements - drive systems - classification-linear motor drive - spindle drive - rolling elements - hydrostatic and hydrodynamic bearings - pneumatic bearings - characteristics - examples. (9)

MICRO-MANUFACTURING: Bulk and surface machining - Lithographie, Galvanoformung, Abformung (LIGA) process - advances in lithography - dry and wet etching - thin film technology-sputtering - PVD-CVD - diamond turning - Electrolytic in-Process Dressing (ELID) grinding - mirror finish grinding of ceramics - micro extrusion - micro forming - laser micro welding - case studies. (10)

PRECISION MEASUREMENT TECHNIQUES: Classification of measuring system - laser based system - interference methods - surface profilers - S E M - Scanning Tunneling Microscope (STM) - AFM and on line measurement of dimensional features - examples. (9)

Total L: 45

TEXT BOOKS:

1. Murthy R L, "Precision Engineering in Manufacturing", 1st Edition, New Age International, New Delhi, 2009.
2. Venkatesh V C, Izman S, "Precision Engineering", 1st Edition, Tata McGraw Hill, New Delhi, 2007.

REFERENCES:

1. Jain V K, "Introduction to Micromachining", 2nd Edition, Varosha Publishers, New Delhi, 2010.
2. Joseph McGeough, "Micromachining of Engineering Materials", 1st Edition, CRC Press, New York, 2001.
3. Mark J M, "Fundamentals of Micro Fabrication", 1st Edition, CRC Press, New York, 2011.
4. Nakazawa H, "Principles of Precision Engineering", 1st Edition, Oxford University, 1994.

19P016 PRODUCT DEVELOPMENT STRATEGIES

3 0 0 3

CONCEPT GENERATION: Introduction - product design vs development - need - classification - product life cycle - cost - quality and servicing - customer need and analysis - concept generation - concept selection - product architecture - architecture types - product modularity and their types - examples. (9)

CONCEPT ENGINEERING: QFD - FMEA - Fault tree analysis - Design for six sigma - DFMA - design for safety, reliability and environment - product tear down approach - bench marking - Reengineering: Scanning methods - cloud points - NURBS surfaces - examples. (9)

PROTOTYPE AND TESTING: Prototype development - digital prototyping - physical prototyping - rapid prototyping - dimensional analysis and similitude - assembly and testing - Task: Types - selecting team members - collaborators and consultants - examples. (9)

MODERN TOOLS AND INDUSTRIAL DESIGN: Internet - concept of CPC - PDM/PLM - need for PLM - importance of PLM - Ergonomics: Anthropometric data - visual effects of line and form - color - Aesthetic concepts: Style - styling and design studio - examples. (9)

INTELLECTUAL PROPERTY RIGHTS: Introduction to IPR - Patent search and application - Patent ownership and transfer - Patent Infringement - new developments and International Patent Law - case studies. (9)

Total L: 45

TEXT BOOKS:

1. Karl T Ulrich, Steven D Eppinger, "Product Design and Development", 5th Edition, Tata McGraw Hill, New Delhi, 2004.
2. Kevin Otto, Kristin Woodd, "Product Design", 2nd Edition, Pearson, New Delhi, 2013.

REFERENCES:

1. Michael Grieves, "Product Life Cycle Management", 1st Edition, Tata McGraw Hill, New Delhi, 2006.
2. Chitale A K, Gupta R C, "Product Design and Manufacturing", 5th Edition, Prentice Hall of India, New Delhi, 2005.
3. George E Dieter, "Engineering Design", 1st Edition, Tata McGraw Hill, New York, 2009.

19P017 COMPOSITE MATERIALS PROCESSING

3 0 0 3

POLYMER MATRIX COMPOSITES: Need for composite development, classification of composite materials and advantages. Types and role of reinforcement. Characteristics of polymer matrix composites, matrix materials, rule of mixtures. Processing methods - manual lay-up, automated lay-up using tape laying machines, fibre placement machines, vacuum bag moulding, spray - up, filament winding, pultrusion and resin transfer moulding. (9)

MICROMECHANICS OF POLYMER MATRIX COMPOSITES: Evaluation of elastic moduli - strength of unidirectional and angle composite lamina. (9)

MACROMECHANICS OF POLYMER MATRIX COMPOSITES: Macro mechanical analysis of unidirectional and angle polymer matrix composite lamina - evaluation of stiffness matrices of polymer matrix composite laminates. (10)

METAL MATRIX COMPOSITES: Characteristics of metal matrix composites, matrix materials, processing methods solid state, liquid state and vapour deposition methods - applications. (8)

CERAMIC MATRIX COMPOSITES AND SECONDARY OPERATIONS ON COMPOSITES: Characteristics of ceramic matrix composites, matrix materials, processing methods - conventional mixing and pressing, slurry techniques, matrix transfer molding, sol-gel processing and deposition methods - applications. Secondary operations - cutting, machining and drilling to fabricate composite parts - adhesive bonding and mechanical fastening methods - challenges involved in secondary processing of composites. (9)

Total L: 45

TEXT BOOKS:

1. Autar K Kaw, "Mechanics of Composite Materials", 2nd Edition, CRC Press, New York, 2018.
2. Sanjay K Mazumdar, "Composites Manufacturing: Materials, Product and Process Engineering", CRC Press, New York, 2010.

REFERENCES:

1. Deborah D L Chung, "Composite Materials: Science and Applications Functional Materials for Modern Technologies", Springer, Verlag, London, 2009.
2. F L Matthews, R D Rawlings, "Composite Materials : Engineering and Science", CRC Press, New York, 2007.
3. Kishan K Chawla, "Composite Materials Science and Engineering", Springer, New Delhi, 2015.
4. Robert M Jones, "Mechanics of Composite Materials", Taylor and Francis, 2014.

19P018 INDUSTRIAL ERGONOMICS

3 0 0 3

INPUT MODALITIES: Ergonomics for productivity, safety, health and comfort, history of ergonomics, multi- disciplinary engineering, human-machine system - characteristics, information theory, coding, compatibility, memory, decision making, attention, text, graphics, symbols, selection of display modality - visual and auditory display, representational display, tactual and olfactory display, design of controls. (10)

ANTHROPOMETRY: Need for anthropometry, sources of human variability, data collection methodology, measuring procedures and tools, statistical analysis of measured data - percentile calculation, principles of applied anthropometry, ergonomic design guidelines for products, equipment and accessories, applications of anthropometry. (8)

WORK ERGONOMICS: Work station design for standing and seated workers, manual material handling, design of hand tools, muscles, structure, function and capacity, physical work capacity, measurement of physiological work, stress and fatigue, work-related musculoskeletal disorders, ergonomic interventions to prevent injuries, human thermoregulation, measurement, protection and thermal comfort. (10)

ILLUMINATION, NOISE AND VIBRATION: Vision and the eye, measurement of light, lighting design, visual fatigue, eyestrain, psychological aspects of indoor lighting, the ear, measurement of sound, ear protection, design of acoustic environment, industrial noise control, auditory environment outdoors, effects of noise on task performance and health, vibration, human error, safety and equipment design. (9)

VIRTUAL ERGONOMICS: Digital Human Modeling (DHM), anthropometric models, models for production design, biomechanical and anatomical models, DHM packages – selection strategies and functionalities, virtual ergonomics evaluation techniques – Rapid Upper Limb Assessment (RULA), field of vision, reach envelopes, accessibility and clearance analysis, discomfort analysis, applications of DHM. (8)

Total L: 45

TEXT BOOKS:

1. Bridger R S, "Introduction to Human Factors and Ergonomics", CRC Press, Taylor and Francis Group, 2017.
2. Martin Helander, "A Guide to Human Factors and Ergonomics", CRC Press, Taylor and Francis Group, 2005.

REFERENCES:

1. Christopher Nemeth, "Human Factors Methods for Design", CRC Press, Taylor and Francis Group, 2004.
2. Chakrabarthi D, "Indian Anthropometric Dimensions for Ergonomic Design Practice", National Institute of Design, Ahmedabad, 1997.
3. Duffy V G, "Hand Book of Digital Human Modelling: Research for Applied Ergonomics and Human Factor Engineering", CRC Press, Taylor and Francis Group, 2009.
4. Mark S Sanders, "Human Factors in Engineering and Design", McGraw Hill Education, 2013.

19P019 COMPUTATIONAL FLUID DYNAMICS

3 0 0 3

BASICS OF FLUID FLOW: Derivation of fluid flow governing equations - conservation of mass, momentum and energy - relationship between mathematical terms and characteristics of fluid flow, mathematical classification of flow, hyperbolic, parabolic, elliptic and mixed flow types. (9)

DISCRETISATION: Choice of grid - finite difference method – finite volume method- forward, backward and central difference schemes, explicit and implicit methods - properties of numerical solution methods, stability analysis, error estimation. (9)

NEED FOR CFD TECHNIQUES: Impact of non-conservation terms over the solution, artificial viscosity, upwind schemes, Cell Reynolds number, Courant number- Lax - Wendroff technique, MacCormack's technique, relaxation technique, ADI technique. (9)

CFD TECHNIQUE FOR INCOMPRESSIBLE FLUID FLOW: Checker board distribution, staggered grid – pressure correction technique, SIMPLE algorithm. (9)

APPLICATIONS: In heat transfer and fluid flow problems (9)

Total L: 45

TEXT BOOKS:

1. John D Anderson, "Computational Fluid Dynamics — The Basics with Applications", 1st Edition, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2012.
2. Versteeg H K, Malalasekara W, "An Introduction to Computational Fluid Dynamics - The Finite Volume Method", 2nd Edition, Pearson Education India, 2007.

REFERENCES:

1. Muralidhar K, Sundararajan T, "Computational Fluid Flow and Heat Transfer", 2nd Edition, Narosa Publications, 2003.
2. Chung T J, "Computational Fluid Dynamics", 2nd Edition, Cambridge University Press, 2010.
3. Joel H Freziger, Milovan Peric, "Computational Methods for Fluid Dynamics", 3rd Edition, Springer Science and Business Media, 12.

19P020 SIX SIGMA

3 0 0 3

INTRODUCTION: Six sigma definition – DMAIC and DMADV deployment models – project reporting - project budgets - project records - six sigma teams – team membership - stages in group development - member roles and responsibilities - facilitation technique. (8)

DEFINE PHASE: Project charter - project decomposition – work breakdown structure - pareto analysis - deliverables – critical to quality metrics - critical to schedule metrics - critical to cost metrics - project scheduling – gantt charts - PERT - CPM. (8)

MEASURE AND ANALSE PHASES: Process definition – flowcharts - SIPOC - metric definition - capability analysis - SPC techniques - control chart selection - control chart interpretation - distributions - measurement system evaluation – Gage R & R - analyzing the source of variation – cause and effect diagram - box plots – statistical interference - regression - correlation - Design of Experiments (DOE). (11)

IMPROVE AND CONTROL PHASES: Improvement decisions – category importance weights - optimization using

simulation - risk assessment tools - design review - fault - tree analysis - safety analysis - FMEA. Control phase - business process control planning - maintaining gains - tools and techniques useful for control planning - preparing the process control plan - process control planning for short and small runs - process audits - selecting process control elements. (11)

DESIGN FOR SIX SIGMA (DFSS): Design for six sigma quality - Quality Function Deployment (QFD) - TRIZ. (7)

Total L: 45

TEXT BOOKS:

1. Thomas Pyzdek, Paul Keller, "Six Sigma Handbook: Complete Guide for Greenbelts, Blackbelts and Managers at All Levels", Tata McGraw Hill Companies Inc, 2014.
2. Jay Arthur, "Lean Six Sigma - Demystified", Tata McGraw Hill Companies Inc, 2010.

REFERENCES:

1. Joseph De Feo, William Barnard, Juran Institute, "Juran Institute's Six Sigma Breakthrough and Beyond", The McGraw Hill Companies, 2004.
2. Michael L George, David T Rowlands, Bill Kastle, "What is Lean Six Sigma", McGraw Hill, New York, 2004.
3. Kai Yang, Basem El-Haik, "Design for Six Sigma", McGraw Hill, New York, 2004.
4. Donald W Benbow, Kubiak T M, "Certified Six Sigma Black Belt Handbook", Pearson Education, 2007.

19P021 ADDITIVE MANUFACTURING

3 0 0 3

BASICS AND CLASSIFICATION OF ADDITIVE MANUFACTURING: Fundamentals of Additive Manufacturing (AM) - historical development of AM - classifications of AM systems - information workflow in AM - impact of AM on product development - reverse engineering - digitization techniques - model construction. (9)

DATA PROCESSING FOR ADDITIVE MANUFACTURING: Additive Manufacturing data formats - STL Format - STL file problems - consequences of building a valid and invalid tessellated model - STL file repair - other translators - newly proposed formats standard for representing layered manufacturing objects. (9)

SOLID AND LIQUID BASED ADDITIVE MANUFACTURING SYSTEMS: Fused Deposition Modeling (FDM) - Laminated Object Manufacturing (LOM) - Stereolithography (SLA) - Solid Ground Curing (SGC) - Shape Deposition Manufacturing (SDM) - JP-System 5 - polyjet printing - principle, details of processes, process variables, types, products, materials, advantages and applications. (9)

POWDER BASED AND OTHER ADDITIVE MANUFACTURING SYSTEMS: Selective Laser Sintering (SLS) - Selective Laser Melting (SLM) - Electron Beam Melting (EBM) - powder based beam deposition processes - printing processes - Three Dimensional Printing (3DP) - droplet formation technology - printing process modeling - principle, details of processes, process variables, types, products, materials, advantages and applications. (9)

ADDITIVE MANUFACTURING APPLICATIONS AND RAPID TOOLING: Applications of AM in aerospace industry, automotive manufacturing industry, biomedical field - magics software - rapid tooling - direct and indirect tooling - soft tooling vs hard tooling - process optimization - factors influencing accuracy - data preparation errors - part building errors - errors in finishing - influence of part build orientation. (9)

Total L: 45

TEXT BOOKS:

1. Gibson I, Rosen D W, Stucker B, "Additive Manufacturing Methodologies: Rapid Prototyping to Direct Digital Manufacturing", Springer, 2015.
2. Frank W Liou, "Rapid Prototyping and Engineering Applications: A Tool Box for Prototype Development", CRC Press, 2019.

REFERENCES:

1. Chua C K, Leong K F, Lim C S, "Rapid Prototyping: Principles and Applications", 2nd Edition, World Scientific Publishers, 2010.
2. Hilton P D, Jacobs P F, "Rapid Tooling: Technologies and Industrial Applications", CRC press, 2011.
3. Pham D T, Dimov S S, "Rapid Manufacturing", Verlag, 2011.

19P022 MEASUREMENT SYSTEMS

3 0 0 3

PRINCIPLES OF MEASUREMENT: Measurement systems, generalized configuration and functional descriptions of measuring instruments - examples - Static and Dynamic performance characteristics - Sources of error, Classification and elimination of error - Resistive potentiometers - Resistance strain gauge - Linear variable differential transformer - Variable inductance and variable reluctance pickups - Capacitive pickups - Eddy current non contacting transducers - Piezoelectric transducers - Ultrasonic transducers (10)

MOTION MEASUREMENT: Linear and rotary encoders - Linear and angular velocity measurements - Seismic motion transducers - Seismic instrument for vibrational displacement and velocity - Seismic accelerometer - Piezo electric accelerometers (8)

FORCE AND TORQUE MEASUREMENT: Measuring methods - Elastic transducers - Strain gauge load cells - Piezoelectric load cells - Hydraulic and pneumatic systems - Torque measurement by mechanical, hydraulic and electric dynamometers - Transmission dynamometers. (9)

TEMPERATURE MEASUREMENT: Liquid-in-glass thermometers - Bi-metal temperature sensing elements - thermistors - Thermocouples - RTD and thermopiles - Pyrometry - Optical and total radiation pyrometer - Infrared thermography - Calibration of temperature measuring devices (8)

FLOW AND PRESSURE MEASUREMENT: Variable area meter - Turbine type meter - Magnetic flow meter - Pulse producing methods - Pressure probes - Anemometry - Static and dynamic pressures - Elastic transducers - Secondary transducers used with elastic transducers - Strain gauge pressure cells - High pressure measurement gauges - Low pressure measurement (10)

Total L: 45

TEXT BOOKS:

1. Ernest O Doebelin, "Measurement Systems: Applications and Design", Tata McGraw Hill, New Delhi, 2006.
2. Beckwith T G, Marangoni and Lienhard, "Mechanical Measurements", Pearson Education, New Delhi, 2004.

REFERENCES:

1. Nakra B C, Choudhry K K, "Instrumentation, Measurements and Analysis", Tata McGraw Hill, New Delhi, 2005.
2. Richard S Figliola, Donald E Beasley, "Theory and Design of Mechanical Measurements", Wiley India, New Delhi, 2004.
3. Holmen J P, "Experimental Methods for Engineers", Tata McGraw Hill Publications Company Limited, New Delhi, 2004.
4. John G Webster, "Mechanical Variables Measurements", CRC Press, New York, 2000.

19P023 STATISTICAL QUALITY CONTROL

3 0 0 3

BASIC STATISTICS FOR QUALITY CONTROL: Introduction to quality - definition of quality - basic and modern quality tools - measures of location and dispersion - statistics and parameters - causes of variation and their characteristics - constant and variable system of chance causes - patterns of variation. (9)

CONTROL CHART FUNDAMENTALS AND APPLICATIONS: Variables and attributes - defects and defectives - statistical basis of the control chart - purpose of control charting - anatomy of a control chart - two types of errors - rational subgrouping - sensitizing rules - guidelines for implementing control charts - control chart for variables and attributes. (9)

ACCEPTANCE SAMPLING: Importance of sampling - weakness of certain traditional practices in acceptance sampling - single sampling - Operating Characteristic (OC) curve of an ideal sampling plan - Average Outgoing Quality (AOQ) and Average Outgoing Quality Limit (AOQL) - double sampling, multiple sampling, and sequential sampling - use of Dodge-Romig Tables in sampling inspection. (9)

REGRESSION: Definition - need for regression - simple linear probabilistic model for regression - assumptions - method of least squares - estimation of constants - ANOVA for linear regression - testing the usefulness of the model - coefficient of determination - checking the assumptions - multiple regression - general linear model and assumptions - ANOVA for multiple regression - interpretation of results - polynomial regression - limitations of regression. (9)

DESIGN AND ANALYSIS OF EXPERIMENTS: Classical design of experiments - single factor experiments - multiple factor experiments - randomized block design - latin square design - analysis of experimental results - Taguchi design of experiments - planning, analysis and conducting phases, analysis and interpretation of experimental results. (9)

Total L: 45

TEXT BOOKS:

1. Grant E M, Leavenworth R L, "Statistical Quality Control", Tata McGraw Hill, New Delhi, 2017.
2. Montgomery D C, "Design and Analysis of Experiments", Wiley India, New Delhi, 2012.

REFERENCES:

1. Ross P J, "Taguchi Techniques for Quality Engineering", Tata McGraw Hill, New Delhi, 2005.
2. Montgomery D C, "Statistical Quality Control: A Modern Introduction", Wiley India, New Delhi, 2010.
3. Mahajan M, "Statistical Quality Control", Dhanpat Rai and Co Pvt. Ltd., New Delhi, 2018.
4. Krishnaiah K, "Applied Statistical Quality Control and Improvement", PHI Learning Pvt. Ltd., New Delhi, 2014.

19P024 AUTOMATED ASSEMBLY SYSTEM DESIGN

3 0 0 3

AUTOMATED ASSEMBLY: Assembly process - historical perspective - why and when automated assembly -

parts of automated assembly system (5)

PART FEEDING AND ORIENTING: Vibratory and mechanical feeder - mechanics - design parameters - feed rate considerations - Design of orientor - performance analysis of orienting system (12)

FEED TRACK, ESCAPEMENT AND PLACEMENT: selection and design of feed tracks - analysis - Types of escapements - placing mechanisms - robots in assembly (8)

QUANTITATIVE ANALYSIS OF ASSEMBLY SYSTEMS: Analysis of assembly systems with synchronous transfer - free transfer - Economics of automated assembly (10)

DESIGN FOR ASSEMBLY: Manual assembly design guidelines - handling time considerations - Automated assembly feeding orienting - insertion. Design rules for automated assembly - design for robot assembly - Feasibility study (10)

Total L: 45

TEXT BOOKS:

1. Geoffrey Boothroyd, "Assembly Automation and Product Design", CRC Press, 2005.
2. Mikell P Groover, "Automation, Production Systems and Computer - Integrated Manufacturing", Prentice Hall, New Delhi, 2007.

REFERENCES:

1. Geoffrey Boothroyd, Peter Dewhurst, Winston A Knight, "Product Design for Manufacture and Assembly", CRC Press, 2011.
2. Edwin H Zimmerman, "Getting Factory Automation Right (the First Time)", Manufacturing Engineers, 2001.
3. James A Rehg, "Introduction to Robotics in CIM Systems", Prentice Hall of India, 2002.

19P025 SUSTAINABLE MOBILITY AND LOGISTICS

3 0 0 3

EVOLUTION OF MOBILITY AND LOGISTICS: Need for sustainability in mobility and logistics - Multidisciplinary approach - Traffic and transport system - Accessibility - Travel behavior and travel resistance - Evolution of Indian road and rail network - Significance of Metro and Mono rails in mobility - role of ship, rail and air cargo in logistics - loading and unloading of goods - E-commerce: Authenticity and related policies. (12)

MOBILITY DETERMINANTS: Travel needs and demands - Demographical - Spatial and economic factors - Brever law - Growth rate of sustainable mobility - Calibration of Green Technologies - ECO score - Model choice determinants - Traffic simulation models. (9)

LOGISTICS AND TRENDS: Requirement - General framework - Trends, Determinants, Indicators - Pre and post liberalization in India - Globalization and interdependency of economy - Centralization and rationalization of production and distribution - Changes in consumption patterns - Technological innovations (9)

INDICATORS: Link between GDP and transport - Competition between Traffic modes - Growth rate of sustainable logistics - Transported weight - Transport performance - Vehicle kilometer (6)

ENVIRONMENTAL ASSESSMENT: Environmental impacts - Contribution of vehicles to environmental stresses – External costs - Importance of vehicle emission norms - Alternate vehicle technologies - Life Cycle assessment of vehicles. (9)

Total L: 45

TEXT BOOKS:

1. Cathy Macharis, Joeri Van Mierlo, "Sustainable Mobility and Logistics", VUB Press, Brussels, 2013.
2. Anbalagan P, "Urban Development and Sustainable Transport", Bookwell publications, 2012.

REFERENCES:

1. Jo van Nunen, Paul Huijbregts, Piet Rietveld, "Transition towards Sustainable Mobility: New solutions and Approaches for Sustainable Transport systems", Springer, Berlin, 2014.
2. Ian J Kerr, "27 Down: New departures in Indian Railway Studies", Orient Blackswan Publications, 2007.
3. Erling Holden, "Achieving Sustainable Mobility - Everyday and Leisure-Time Travel in the EU", Ashgate Publishing, United Kingdom, 2007.
4. Werner Brilon, Felix Huber, Micheal Schreckenberg, "Traffic and Mobility: Simulation - Economics - Environment", Springer, New York, 1999.

ONE-CREDIT COURSES
19PF01 PRECISION MACHINING

1 0 0 1

CNC TURNING: Principles, types, machines, tools.	(2)
CNC MILLING: Basic principles of milling, concepts of 3/4/5 axes, high speed milling, machine and controller types.	(2)
ELECTRIC DISCHARGE MACHING (EDM): Wire and sinking EDM, principles, application.	(1)
WORK AND TOOL HOLDING: Types, applications.	(1)
COMPUTER-AIDED MANUFACTURING (CAM): Principles, softwares, examples.	(2)
METROLOGY: Principles, measurements, examples.	(1)
GEOMETRIC DIMENSIONING AND TOLERANCING (GD&T): Principles, examples.	(1)
QUALITY MANAGEMENT: Principles, purpose, ISO, process orientation, non-quality dispositions.	(1)
CONVENTIONAL PRECISION MANUFACTURING METHODS: For jig boring, jig milling, jig surface and cylindrical grinding.	(2)
PRODUCTIVITY IMPROVEMENT: Types, measurement, overall equipment effectiveness /total effective equipment performance OEE/TEEP measurements, machine utilisation. Shop visit.	(2)

Total L: 15

TEXT BOOKS:

1. Material Provided by "M/s. L&T", Coimbatore.
2. David A Dornfeld and Dae-Eun Lee, "Precision Manufacturing", Springer, 2007.
3. Murty R L, "Precision Engineering in Manufacturing", New Age International, 2005.

19PF02 NON DESTRUCTIVE TESTING OF AIRCRAFT STRUCTURES

1 0 0 1

INTRODUCTION TO NON DESTRUCTIVE TESTING: Liquid penetrant testing, magnetic particles testing, ultrasonic testing, eddy current testing, radiography, thermography, working principle, procedure of testing and analysis.	(6)
RECENT TRENDS IN NDT: Vibration monitoring, holography and speckle methods, acoustic emission technique, other emerging methods, working principle and procedure of testing.	(4)
NDT OF COMPOSITES: Various methods of testing, procedure and results, case studies.	(2)
NDT IN MANUFACTURING AND MAINTENANCE: Importance of aircraft maintenance, procedure, critical issues and case studies.	(2)
NDT AND DAMAGE TOLERANCE PHILOSOPHY: Importance of damage tolerant design and case studies.	(1)

Total L: 15

REFERENCES:

1. Grandt Jr A F, "Fundamentals of Structural Integrity: Damage Tolerant Design and Nondestructive Evaluation", Wileys, October 2003.
2. Dowling N E, "Mechanical Behaviour of Materials", Pearson Education, 2014.
3. Halmshaw R, "Non-destructive Testing", Edward Arnold, London, 1987. Published in nine volumes by the American Society for Non-Destructive Testing.

19PF03 INTRODUCTION TO DESIGN AND MANUFACTURE OF ARMOUR SYSTEMS

1 0 0 1

INTRODUCTION: Historical perspective, basic concepts of armour systems	(3)
MECHANICAL BEHAVIOUR: Dynamic behaviour of materials, dynamic impact testing, projectile characteristics.	(3)
MECHANICS: Penetration mechanics, stress waves and shock behaviour.	(3)

ARMOUR MATERIALS: Metallic armour, ceramic armour, composite armour, hybrid systems, personnel armour - design and testing. (3)

ARMOUR FOR VEHICLES: Design and testing, reactive armour systems, blast and ballistic testing (3)

Total L: 15

REFERENCES:

1. Paul J. Hazell, Armour: Materials, Theory and Design; 1st Edition, CRC Press, 2015, ISBN 978-1482238297.
2. Ian Crouch (Eds.), The Science of Armour Materials; 1st Edition, Woodhead Publishing, 2016, ISBN 978-0081010020.
3. T. Balakrishna Bhat and Vemuri Madhu, Composite Armour Materials and Modules, DRDO Monographs/Special Publications Series, 2017, ISBN: 978-8186514900.

19PF04 ADVANCED MATERIALS FOR ARMOUR APPLICATIONS

1 0 0 1

INTRODUCTION: Basic concepts, early applications of armour, fundamentals of materials and structures. (3)

MECHANICAL BEHAVIOUR: Static and Dynamic Behaviour of Materials, Projectile Materials and Behaviour. (3)

METALLIC ARMOUR MATERIALS: Processing and Properties of Steel, Aluminium, Mg and Ti. (3)

CERAMIC ARMOUR MATERIALS: Processing and Properties. (3)

COMPOSITES ARMOUR MATERIALS: Processing and Properties, Hybrid Armour Materials. (3)

Total L: 15

REFERENCES:

1. Paul J Hazell, "Armour: Materials, Theory, and Design", 1st Edition, CRC Press, 2015.
2. T Balakrishna Bhat, Vemuri Madhu, "Composite Armour Materials and Modules", DRDO Monographs/Special Publications Series, 2017.
3. Ian Crouch, "The Science of Armour Materials", 1st Edition, Woodhead Publishing, 2016.
4. Autar K Kaw, "Mechanics of Composite Materials", 2nd Edition, CRC Press, 2005.

HUMANITIES

19OFA1 EXPORT – IMPORT PRACTICES

1 0 0 1

INTRODUCTION : Export – Import Business – Preliminaries for starting Export – Import Business Registration. (3)

EXPORT PROCEDURES: : Obtaining an Export License – Export Credit Insurance – Procedures and Documentation (4)

FOREIGN EXCHANGE : Finance for Exports – Pricing - Understanding Foreign Exchange Rates. (3)

IMPORT PROCEDURES : Import Policy – License - Procedure and Documentation. (3)

EXPORT INCENTIVES : Incentives - Institutional support (2)

Total L: 15

REFERENCES:

1. Ramagopal C , "Export Import Procedures - Documentation and Logistics", New Age International, 2014.
2. Cherian and Parab , "Export Marketing", Himalaya Publishing House, New Delhi, 2008.
3. Parul Gupta , "Export Import Management", MC-Graw Hill, 2017.
4. Justin Paul, Rajiv Aserkar , "Export Import Management", Oxford, 2013.

19OFA2 INSURANCE - CONCEPTS AND PRACTICES

1 0 0 1

INTRODUCTION TO INSURANCE AND RISK MANAGEMENT : Origin, History, Nature and Scope of insurance – Meaning, types and significance of risk. (3)

INSURANCE LAWS AND REGULATIONS : Insurance Act, IRDA Act, Consumer Protection Act, Ombudsman Scheme. (2)

INSURANCE UNDERWRITING AND RISK MANAGEMENT : Meaning of underwriting and underwriter, guidelines and steps in

the process of underwriting – characteristics, significance and principles of risk management. (4)

FINANCIAL ASPECTS OF INSURANCE MANAGEMENT : Role and functions of financial institutions, determination of premium for various insurance products. (3)

SETTLEMENT OF INSURANCE CLAIMS : Documents needed during various claims, Factors affecting insurance claims (3)

Total L: 15

REFERENCES:

1. Scott Harrington, Gregory Niehaus , "Risk Management and Insurance", McGraw Hill Education, 2017.
2. George E Rejda , "Principles of Risk Management & Insurance", Pearson Education, 2017.
3. John Hull , "Risk Management & Financial Institution", John Wiley and Sons, 2018.
4. Arjun Mittal, D D Chaturvedi , "Insurance and Risk Management", Scholar Tech Press, 2017.

190FA3 PUBLIC FINANCE

1 0 0 1

INTRODUCTION: Nature and Scope of public finance – Principles of taxation. (2)

PUBLIC REVENUE AND TAXATION: Sources of Revenue – Tax and non-tax revenue – Classification of Taxes, GST. (4)

PUBLIC EXPENDITURE: Importance – Types – Causes of increase in public expenditure – Effects of public expenditure in India. (3)

DEFICIT FINANCING AND BUDGET: Sources of public debt – Debt redemption – Budget – Types – Preparation of Budget in India. (3)

FEDERAL FINANCE: Centre-State financial relations – Finance commissions. (3)

TOTAL: 15

REFERENCE BOOKS:

1. Richard A Musgrave and Peggy B Musgrave, "Public Finance in Theory and Practice" – Tata McGraw Hill Education, New Delhi, 2004.
2. Bhatia H.L, "Public Finance" – Vikas Publishing House, 29th Edition, New Delhi, 2012.
3. David N Hyman, "Public Finance: A contemporary application of theory and policy", Cengage Publication, 11th Edition, Noida, 2014.
4. Santhosh Dalvi and Krishnan Venkatasubramanian, "An introduction to Goods and Service Tax: The biggest tax reform in India", CCH Publisher, New Delhi, 2015.

190FA4 SECURITY ANALYSIS AND PORTFOLIO MANAGEMENT

1 0 0 1

INVESTMENT ENVIRONMENT : Financial Markets - Classification - Financial Instruments – Security Trading. (2)

TYPES OF SECURITIES : Trading – Orders, Margin Trading – Clearing and Settlement Procedures. (5)

SECURITY ANALYSIS I : Industry Analysis –Estimation of Rates of Return. (2)

SECURITY ANALYSIS II : Company Analysis — Estimation of Rates of Return. (2)

PORTFOLIO MANAGEMENT : Measuring Risk and Returns and Treatment in Portfolio Management. (4)

Total L: 15

REFERENCES:

1. William F Sharpe, Gordon J. Alexander, Jeffery V Bailey , "Investments", Prentice Hall, 2012.
2. Prasanna Chandra , "Investment Analysis and Portfolio Management", TATA McGraw Hill Publishing, 2011.
3. Ranganathan , "Investment Analysis and Portfolio Management", Pearson, 2004.
4. Bhalla V K , "Investment Management", TATA McGraw Hill Publishing, 2011

ENGLISH

19GF01 INTERPERSONAL AND ORGANIZATIONAL COMMUNICATION

1 0 0 1

INTRA ORGANIZATIONAL COMMUNICATION : Communication Networks in an Organization; Intra- organizational communication (2)

INTER ORGANIZATIONAL COMMUNICATION : Flow Nomenclature; Workplace diversity and intercultural aspects of communication (2)

COMMUNICATION FUNCTIONS IN ORGANIZATIONS : Teamwork and team dynamics; Conflict resolution strategies and styles; Leading and influencing others-facilitation skills (3)

WRITTEN COMMUNICATION : Email Writing, Professional Reports, and Memos (4)

INTERPERSONAL SKILLS : Nature and Dimensions of Interpersonal Communication; Personality and Communication styles; Active listening and intentional responding; Working with emotional intelligence (4)

Total L: 15

REFERENCES:

1. Bagchi Subroto , "The Professional", Penguin Publications, UK, 2011.
2. PMBOK guide , "A Guide to the Project Management Body of Knowledge", Project Management Institute Inc, USA, 2013.

19GF02 HUMAN VALUES THROUGH LITERATURE

1 0 0 1

PROSE : Kalam's vision of college education in Wings of fire - Emerson's advocacy of independence of Human will in Self-reliance - Harmony in Education-views of Betrand Russel (4)

POETRY : Maintaining Human relations in Robert Frost's Mending Wall - Quest for identity and freedom in Kamala Das's An Introduction (2)

DRAMA : Statesmanship and friendship in Girish Karnad's Tughlaq (3)

ONE-ACT PLAY : The theme of love in Chekhov's The Bear (3)

SHORT STORY : Empathy in Somerset maugham's Mr. Know-all - Family bond in Anita Desai's Devoted son (3)

Total L: 15

TEXT BOOKS:

1. Faculty - Department of English , "Course materials", PSG College of Technology, Coimbatore, 2019.

REFERENCES:

1. Abrams M .H, Harpham , "A Glossary of Literary Terms", Cengage, Boston, 2015.
2. Scholes R, et.al. , "Elements of Literature", IV, Indian Rpt. OUP, New Delhi, 2013.