KALINGA UNIVERSITY

RAIPUR | INDIA

SCHEME & SYLLABUS FOR

Bachelor of Vocational Studies (B.Voc.) Manufacturing

NAAC GRADE B+ Accredited University

nirf RANKING 2024 Ranked in Top 151-200 Universities

Kalinga University, Naya Raipur, Chhattisgarh

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B.VOC IN MANUFACTURING

Semester-01								
Course Code	**Course Title**	**Credits**	**L**	**T**	**P**	**Internal Marks**	**End Semester Exam Marks**	**Total Marks**
BVMFG101	Communication Skills	3	3	0	0	30	70	100
BVMFG102	Fundamentals of Information Technology	3	3	0	0	30	70	100
BVMFG103	Material Science	3	3	0	0	30	70	100
BVMFG104	Fuels Furnaces and Refractories	3	3	0	0	30	70	100
BVMFG105P	**Industrial Training/On Job Training/Workshop**	18	0	0	36	50	150	200
Total		**30**	**12**	**0**	**36**	**170**	**430**	**600**

Semester-02								
Course Code	**Course Title**	**Credits**	**L**	**T**	**P**	**Internal Marks**	**End Semester Exam Marks**	**Total Marks**
BVMFG201	Foundry Technology	3	3	0	0	30	70	100
BVMFG202	Environmental Studies	3	3	0	0	30	70	100
BVMFG203	Strength of Materials	3	3	0	0	30	70	100
BVMFG204	Manufacturing Process-I	3	3	0	0	30	70	100
BVMFG205P	**Industrial Training/On Job Training/Workshop**	18	0	0	36	50	150	200
Total		**30**	**12**	**0**	**36**	**170**	**430**	**600**

Semester-03								
Course Code	**Course Title**	**Credits**	**L**	**T**	**P**	**Internal Marks**	**End Semester Exam Marks**	**Total Marks**
BVMFG301	Maintenance Engineering	3	3	0	0	30	70	100
BVMFG302	Measurement and Metrology	3	3	0	0	30	70	100
BVMFG303	Basics of Plastics Engineering	3	3	0	0	30	70	100
BVMFG304	Manufacturing Process-II	3	3	0	0	30	70	100
BVMFG305P	**Industrial Training/On Job Training/Workshop**	18	0	0	36	50	150	200
Total		**30**	**12**	**0**	**36**	**170**	**430**	**600**

Semester-04								
Course Code	**Course Title**	**Credits**	**L**	**T**	**P**	**Internal Marks**	**End Semester Exam Marks**	**Total Marks**
BVMFG401	Principles of Extractive Metallurgy	3	3	0	0	30	70	100
BVMFG402	Iron and Steel Making	3	3	0	0	30	70	100
BVMFG403	Metal and Powder Forming Techniques	3	3	0	0	30	70	100
BVMFG404	Advanced Manufacturing Process	3	3	0	0	30	70	100
BVMFG405P	**Industrial Training/On Job Training/Workshop**	18	0	0	36	50	150	200
Total		**30**	**12**	**0**	**36**	**170**	**430**	**600**

Semester-05								
Course Code	**Course Title**	**Credits**	**L**	**T**	**P**	**Internal Marks**	**End Semester Exam Marks**	**Total Marks**
BVMFG501	Tool and Die Design	3	3	0	0	30	70	100
BVMFG502	Materials Joining Technology	3	3	0	0	30	70	100
BVMFG503	Theory of Machine	3	3	0	0	30	70	100
BVMFG504	Additive Manufacturing	3	3	0	0	30	70	100
BVMFG505P	**Industrial Training/On Job Training/Workshop**	18	0	0	36	50	150	200
Total		**30**	**12**	**0**	**36**	**170**	**430**	**600**

Semester-06								
Course Code	**Course Title**	**Credits**	**L**	**T**	**P**	**Internal Marks**	**End Semester Exam Marks**	**Total Marks**
BVMFG601	Machining Technology	3	3	0	0	30	70	100
BVMFG602	Quality Control	3	3	0	0	30	70	100
BVMFG603	Non-ferrous Extractive Metallurgy	3	3	0	0	30	70	100
BVMFG604	Industrial Engineering	3	3	0	0	30	70	100
BVMFG605P	**Industrial Training/On Job Training/Workshop**	18	0	0	36	50	150	200
Total		**30**	**12**	**0**	**36**	**170**	**430**	**600**

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SEMESTER-01

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BVMFG101
COMMUNICATION SKILLS

Course Objective:

- The purpose of this course is to introduce students to the theory, fundamentals and tools of communication and to develop in them vital communication skills which should be integral to personal, social and professional interactions. One of the critical links among human beings and an important thread that binds society together is the ability to share thoughts, emotions and ideas through various means of communication: both verbal and non-verbal. In the context of rapid globalization and increasing recognition of social and cultural pluralities, the significance of clear and effective communication has substantially enhanced.

Course outcomes:

- The purpose of this course is to introduce students to the theory, fundamentals and tools of communication
- To develop vital communication skills which should be integral to personal, social and professional interactions.
- One of the critical links between human beings.
- An important thread that binds society together is the ability to share thoughts, emotions and ideas through various means of communication: both verbal and non-verbal.
- In the context of rapid globalization and increasing recognition of social and cultural pluralities, the significance of clear and effective communication has substantially enhanced.

Unit - 1 **06**

- **Introduction:** Theory of communication, types and modes of communication, mediums and channels of communication, barriers to communication, English as a global language, the lingua franca, social influences on English

Unit - 2 **06**

- **Language of Communication:** Verbal and non-verbal (spoken and written) personal, social and business barriers and strategies intra-personal, inter-personal and group communication, varieties of English, language, accent, dialect, colloquialism, historical influences on English

Unit - 3 **06**

- **Speaking Skills:** Monologue dialogue group discussion effective communication/mis-communication interview public speech, regional influences on English, convergence and divergence, linguistic imperialism

Unit - 4 **06**

- **Reading and Understanding** Close reading, reading analysis of a text - audience and purpose, content and theme, tone and mood, stylistic devices, structure comprehension- analysis and interpretation translation(from Indian language to English and vice-versa) literary/knowledge texts

Unit - 5 **06**

- **Writing Skills**: Documenting report writing making notes letter writing, writing tabloids, diary entry, open letters, essays, newsletter and magazine articles, skits, short stories, impersonating characters it will enhance language of communication, various speaking skills such as personal communication, social interactions and communication in professional situations such as interviews, group discussions and office environments, important reading skills as well as writing skills such as report writing, note taking etc. while, to an extent, the art of communication is natural to all living beings, in today's world of complexities, it has also acquired some elements of science. it is hoped that after studying this course, students will find a difference in their personal and professional interactions.

References:

1. Fluency in English - Part II, Oxford University Press, 2006.
2. Business English, Pearson, 2008.
3. Language, Literature and Creativity, Orient Blackswan, 2013.
4. Language through Literature (forthcoming) ed. Dr. Gauri Mishra, Dr. Ranjana Kaul, Dr. Brati Biswas

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BVMFG102
FUNDAMENTALS OF INFORMATION TECHNOLOGY

Course objective:

- This is a basic course for commerce students to familiarize with computer and it's applications in the relevant fields and exposes them to other related courses of IT.

Course Outcomes:

- Gain a foundational understanding of key IT concepts, including hardware, software, and networks.
- Develop proficiency in using common computer applications, such as word processing and spreadsheet software.
- Explore the ethical and security considerations in IT, emphasizing responsible digital behavior.
- Acquire problem-solving skills by applying IT knowledge to real world scenarios.
- Prepare for further studies in IT or related fields by establishing a strong IT knowledge base.

Unit - 1 **06**

- **Computer characteristics:** Speed, storage, accuracy, diligence; digital signals, binary system, ASCII; historic evolution of computers;
- **Classification of computers:** microcomputer, minicomputer, mainframes, supercomputers;
- **Personal computers:** desktop, laptops, palmtop, tablet; hardware & software; von Neumann model.

Unit - 2 **06**

- **Hardware:** CPU, memory, input devices, output devices.
- **Memory units:** RAM (SDRAM, DDR RAM, RDRAM etc. feature wise comparison only); ROM-different types: Flash memory;
- **Auxiliary storage:** Magnetic devices, optical devices; floppy, hard disk, memory stick, CD, DVD, CD/DVD-Writer**;**
- **Input devices -** keyboard, mouse, scanner, speech input devices, digital camera, touch screen voice input, joystick, optical readers, bar code reader;
- **Output devices:** Display device, size and resolution; CRT, LCD, LED;
- **Printers:** Dot-matrix, inkjet, laser; plotters, sound cards & speaker.

Unit - 3 **06**

- **Software:** System software, application software; concepts of files and folders, introduction to operating systems, different types of operating systems: single user, multitasking, time-sharing multi-user; booting, POST;
- **Basic features of two GUI operating systems:** Windows & Linux (Basic desk top management); Programming Languages, Compiler, Interpreter, Databases;
- **Application software:** Generic features of word processors, spread sheets and presentation software; generic introduction to latex for scientific typesetting; utilities and their use; computer viruses & protection, free software, open source.

Unit - 4 **06**

- **Computer Networks and Internet:** Connecting computers, requirements for a network: server, workstation, switch, router, network operating systems; internet: brief history, world wide web, websites, URL, browsers, search engines, search tips; internet connections: isp, dial-up, cable modem, well, dsl, leased line wireless and Wi-Fi connectivity ; email, email software features (send receive, filter, attach, forward, copy, blind copy); characteristics of web-based systems, web pages, web programming languages.

Unit - 5 **06**

- **Information Technology and Society:** Indian IT Act, intellectual property rights, issues. application of information technology in railways, airlines, banking, insurance, inventory control, financial systems, hotel management, education, video games, telephone exchanges, mobile phones, information kiosks, special effects in movies.
- **Programming Concepts & Techniques:** Program concept, characteristics of programme, stages in program development, tips for program designing, programming aids, algorithms, pseudo code, notations, design, flowcharts, symbols, rules, compiler & interpreter. introduction to programming techniques, top-down & bottom-up approach, unstructured, & modular programming, cohesion, coupling, debugging, syntax & logical errors, linking and loading, testing and debugging, documentation.

References:

1. Programming in C, R.S. Salaria, Khanna Publishing House
2. Computer Concepts and Programming in C, R.S. Salaria, Khanna Publishing House
3. Handbook of Computer Fundamentals, N.S. Gill, Khanna Publishing House

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BVMFG103
MATERIAL SCIENCE

Course Objectives:

- To understand the classification of materials, bonding and the crystal structure.
- To understand the Properties of conducting, insulating, semiconducting, dielectric and semiconductor materials.

Course Outcomes:

After the completion of this course the student will be able to:

- Describe the fundamentals of material science and concepts of unit cell & crystallography.
- Classify materials based on their conducting, insulating, semiconducting, dielectric properties.
- Know the practical uses of various materials in different electrical engineering field.

Unit - 1 **08**

- **Introduction:** Introduction and historical importance of Materials, Classification of Materials, Engineering Materials, Advanced Materials and Future Materials like ceramics, polymers, composites, Dielectric etc.
- Bravais Lattices, Crystal Structures, Crystalline, Quasi Crystalline and Non-Crystalline Materials, Miller Indices, Miller-Bravais Indices for Planes and Directions of Cubic and Non-Cubic Structures, structure of ceramics, polymers, and composites materials. Classical theory of electrical and thermal conduction in solids, temperature dependence of resistivity, skin effect, Hall Effect.

Unit - 2 **08**

- **Diffusion and Heat treatment:** Phase Diagrams: Phase Rule, Equilibrium Phase Diagrams, Phase Systems - Isomorphous, Eutectic with No and Limited Solid Solubility and Peritectic, Iron-Carbon Phase Diagram, TTT Diagram.
- **Imperfections in Solids and Strengthening Mechanisms:** Point Defects, Line Defects and Dislocations, Interfacial Defects and Bulk or Volume Defects, Recovery, Recrystallization and Grain Growth. Alteration of properties by heat treatment, Heat treatment method, Quantification of altered material properties by heat treatments.

Unit - 3 **07**

- **Mechanical behavior of Metals and Alloys:** Types of Loading, Stress-Strain Curves for Brittle and Ductile Materials, Theoretical and Observed Shear Stress, Critical Resolved Shear Stress, Deformation – Elastic, Anelastic, Plastic and Super Plastic, Yield Criteria, Macroscopic Aspects of Plastic Deformation, Toughness Measurements by S-S Curve, Impact Testing and Fracture Toughness Testing.
- **Types of Mechanical Loading and Failures**: Ductile and Brittle Fracture, Modes of Fracture Toughness, Impact Fracture, Ductile-Brittle Transition, Types of Impact Testing, Fatigue, Crack Initiation and Propagation, Fatigue Testing, Creep, Stages of Creep Curve, Stress and Temperature Effects.

Unit - 4 **07**

- **Dielectric and Magnetic Property of Materials:** Introduction, polarization of dielectric material, dielectric constant of monatomic gases, frequency dependence of permittivity, dielectric losses, frequency and temperature dependence of the dielectric constant, dielectric properties of polymeric system, ionic conductivity in insulators, insulating materials, Ferro electricity, piezoelectricity.
- Introduction, Classification of magnetic materials, diamagnetism, paramagnetism, ferromagnetism, magnetization curve, the hysteresis loop, factors affecting permeability and hysteresis loss, common magnetic materials, magnetic resonance.
- **Properties of Metals and Semiconductors:** Energy band in Metals, Semiconductors and Insulators, types of semiconductors, Intrinsic and Extrinsic semiconductors, Effect of temperature on the electrical conductivity of metals, insulator and semiconductor, thermal properties, thermal conductivity of metals and semiconductors, factors affecting the resistivity of electrical materials, electrical conductivity of doped materials, thermoelectric effects.

References:

1. C.S.Indulkar and S. Thiruvengadam, S., “An Introduction to Electrical Engineering”.
2. P L Kapoor. A Textbook of Electrical and Electronics Engineering Materials: Khanna publishers
3. Kenneth G. Budinski, “Engineering Materials: Prentice Hall of India, New Delhi

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BVMFG104
FUELS FURNACES AND REFRACTORIES

Unit - 1 **08**

- Introduction of fossil fuels and their world-wide reserves; Primary and secondary fuels, Coking and non-coking coals, Characterization of coal properties (caking and swelling indices, calorific value, proximate and ultimate analyses, etc.); Coal carbonization and effects of different parameters; Properties of coke, char and graphite. Selection of coal for sponge iron making and thermal power plants. Alternative sources of energy (viz. ferro-coke, formed coke, charcoal, solar, wind, tidal, etc.) and their suitability for metallurgical and power industries.

Unit - 2 **08**

- Classification of refractories, raw materials, manufacture, testing and properties of heavy and special refractories, silica, silicous alumino silicate, high alumina, magnetisite, chrome, chrome-magnesite, dolomite, forsterite, chemically bonded basic, carbon and insulating refractories and special purpose oxides, carbide nitride refratories. Binary phase diagrams of Al2O3-SiO2,CaO-MgO,Cr2O3-MgO and MgO - SiO2 systems. Refractory mortars and cements, Refractory castables, selection of refractories for coke oven ,ironblast furnace, copper convertor ,soaking reheating furnaces and heat treatment furnaces, electric arc furnaces.

Unit - 3 **07**

- **Classification of furnaces:** basis and uses. Mechanism of combustion, ignition temperature. Flames: Flame propagation, flame speed and inflammability limits, types of flames; premixed and diffusion flames and their characteristics.

Unit - 4 **07**

- **Combustion control; variables of control, viz.:** temperature, pressure and gas ratio control, modes or combustion control. Theoretical, adiabatic & true flame temperature. Available heat and factors affecting it.
- **Heat losses in furnaces:** Heat balance and furnace efficiency. Liquid and gaseous fuel burners: methods of atomization, types of liquid fuel burners and principle of design. Low pressure, high pressure and injection type gaseous fuel burners and principles of their design.

References:

1. Fuels, Furnaces and Refractories by J.D. Gilchrist.
2. Fuels,Furnaces and Refractories by O. P. Gupta.

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BVMFG105P
INDUSTRIAL TRAINING/ON JOB TRAINING/ WORKSHOP

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SEMESTER-02

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BVMFG201
FOUNDRY TECHNOLOGY

Course Objectives:
The main learning objective of this course is to prepare students for:

- To impart the basics of casting and foundry practice.
- To introduce various casting processes
- To be acquainted with design of gating system and to obtain defect free castings
- An overview of the designing of molds, casting defects, inspection and testing of castings and modernization of foundries.
- Casting of ferrous and non-ferrous materials.

Course Outcomes:
Upon the completion of this course the students will be able to

- Gain basic knowledge in casting.
- Select suitable casting process for application requirement.
- Apply gating design and mould design knowledge to overcome defects in casting.
- Selecting the type of sand, for molds and cores as well as the molding process.
- Know about the special molding processes and when their use is warranted.
- Have a broad knowledge of casting of ferrous and non-ferrous alloys and of the inspection techniques to detect casting defects.

Unit - 1 **06**

- **Introduction:** Introduction to moulding and casting processes - steps involved advantages, limitations, application of casting process. Patterns - types, applications, pattern allowances- pattern materials, colour coding as per BIS, pattern making, core and core making, core boxes, core prints, core blowers, core shooters. Sand mould making: Moulding and core sands, ingredients, properties, types of sands, sand selection - machine moulding, types of machines, applications.

Unit - 2 **06**

- **Casting Processes:** Sand preparation and sand reclamation-sand control tests. Sand casting process, types of moulding processes - plaster mould casting, die casting process - die casting methods. Centrifugal casting, continuous casting, shell moulding, CO2 moulding - investment casting, full mould process.

Unit - 3

- **Melting, Pouring And Testing:** Foundry remelting furnaces – selection of furnaces – crucible furnaces -oil fired furnace, electric furnaces – resistance, arc, induction furnaces –cupola steel melting, non-ferrous melting practices - pouring equipments – cleaning and inspection of casting –destructive and non-destructive testing - defects in sand casting and remedies.

Unit - 4 **06**

- **Gating, Feeding and Mechanization:** Elements of gating system, functions, types and design of gating systems, gating ratio, risers, functions, types and designs, methods controlling solidification, solidification time calculations, foundry mechanization

Unit - 5 **06**

- **Ferrous and Non-Ferrous Metals:** Production of iron castings - Steel foundry practice - Copper alloy foundry practice - Aluminum alloy foundry practice - Magnesium alloy foundry practice - Zinc alloy foundry practice.
- **Foundry metallurgy:** Heat treatment of castings, inspection, testing and quality control in foundries, salvage in defective castings, foundry mechanization. Foundry environment, health and safety: Dust problems in foundries, preventive maintenance in foundries, returning a sick foundry to profitability.

References:

1. O.P. Khanna, “A Text Book of Foundry Technology”, Dhanpat Rai & Sons, 15th Edition, 2011.
2. P.N. Rao, “Manufacturing Technology”, TMH, 5th Edition, 2013.
3. Campbell J., “Castings Practice: The Ten Rules of Castings”, Butterworth-Heinemann., United Kingdom, 2004, ISBN (13): 978 0750647915, (10) 9780750647915.
4. R.K. Jain, “Production Technology”, Khanna Publishers, 17th Edition, 2011.
5. Peter Beeley “foundry technogy”, Butterworth Heinemann 2nd Edition, 2001
6. P.L.Jain, ”Principle of foundry Technology “ Tata McGraw hill 4th Edition, 2006
7. T.R.Banga,”Foundry Engineering” Khanna Publishers, 5th Edition, 2014

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BVMFG202
ENVIRONMENTAL STUDIES

Course Outcomes:

- Master core concepts and methods from ecological and physical sciences and their application in environmental problem solving.
- Appreciate the ethical, cross-cultural, and historical context of environmental issues and the links between human and natural systems.
- Apply systems concepts and methodologies to analyze and understand interactions between social and environmental processes.
- Reflect critically about their roles and identities as citizens, consumers and environmental actors in a complex, interconnected world.
- Master core concepts and methods from economic, political, and social analysis as they pertain to the design and evaluation of environmental policies and institutions.

Unit - 1 **06**

Introduction to Environmental Studies:

- Multidisciplinary nature of environmental studies, Scope and importance; concept of sustainability and sustainable development.

Ecosystems:

- What is an ecosystem? Structure and function of the ecosystem;
- **Energy flow in an ecosystem:** food chains, food webs and ecological succession.
- **Case studies of the following ecosystems**: Forest ecosystem, grassland ecosystem, desert ecosystem, aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Unit - 2 **06**

Natural Resources:

- **Renewable and Non--renewable Resources:** Land resources and land use change; Land degradation, soil erosion and desertification.
- **Deforestation:** Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations.
- **Water:** Use and over--exploitation of surface and ground water, floods, droughts, conflicts over water (international & inter--state).
- **Energy resources:** Renewable and non-renewable energy sources, use of alternate energy sources, growing energy needs, case studies.

Unit - 3 **06**

Biodiversity and Conservation:

- **Levels of biological diversity:** genetic, species and ecosystem diversity; Biogeographic zones of India; Biodiversity patterns and global biodiversity hot spots, India as a mega--biodiversity nation; Endangered and endemic species of India
- **Threats to biodiversity:** Habitat loss, poaching of wildlife, man--wildlife conflicts, biological invasions;
- **Conservation of biodiversity:** In--situ and Ex--situ conservation of biodiversity.
- **Ecosystem and biodiversity services:** Ecological, economic, social, ethical, aesthetic and Informational value.

Unit - 4 **06**

Environmental Pollution:

- Types, causes, effects and controls; Air, water, soil and noise pollution, Nuclear hazards and human health risks
- **Solid waste management:** Control measures of urban and industrial waste. Pollution case studies.

Environmental Policies & Practices:

- Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture
- **Environment Laws:** Environment Protection Act; Air (Prevention & Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act. International agreements: Montreal and Kyoto protocols and Convention on Biological Diversity (CBD).
- Nature reserves, tribal populations and rights, and human wildlife conflicts in Indian context.

Unit - 5 **06**

Human Communities and the Environment:

- **Human population growth:** Impacts on environment, human health and welfare. Resettlement and rehabilitation of project affected persons; case studies.
- **Disaster management:** floods, earthquake, cyclones and landslides.
- **Environmental movements:** Chipko, Silent valley, Bishnois of Rajasthan.
- **Environmental ethics:** Role of Indian and other religions and cultures in environmental conservation. Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi).

References:

1. Carson, R. 2002. *Silent Spring*. Houghton Mifflin Harcourt.
2. Gadgil, M., & Guha, R.1993. This Fissured Land: An Ecological History of India. Univ. of California Press.
3. Gleeson, B. and Low, N. (eds.) 1999.Global Ethics and Environment, London, Routledge.
4. Gleick, P. H. 1993. Water in Crisis. Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute, Oxford Univ. Press.
5. Groom, Martha J., Gary K. Meffe, and Carl Ronald Carroll.Principles of Conservation Biology. Sunderland: Sinauer Associates, 2006.
6. Grumbine, R. Edward, and Pandit, M.K. 2013. Threats from India's Himalaya dams. Science, 339: 36--37.
7. McCully, P. 1996. Rivers no more: the environmental effects of dams(pp. 29--64). Zed Books.
8. McNeill, John R. 2000. Something New Under the Sun: An Environmental History of the Twentieth Century.
9. Odum, E.P., Odum, H.T. & Andrews, J. 1971.Fundamentals of Ecology. Philadelphia: Saunders.
10. Pepper, I.L., Gerba, C.P. & Brusseau, M.L. 2011. Environmental and Pollution Science. Academic Press.
11. Rao, M.N. & Datta, A.K. 1987. Waste Water Treatment. Oxford and IBH Publishing Co. Pvt. Ltd.
12. Raven, P.H., Hassenzahl, D.M. & Berg, L.R. 2012.Environment. 8th edition. John Wiley & Sons.
13. Rosencranz, A., Divan, S., & Noble, M. L. 2001. Environmental law and policy in India. Tripathi 1992.
14. Sengupta, R. 2003. Ecology and economics: An approach to sustainable development. OUP.
15. Singh, J.S., Singh, S.P. and Gupta, S.R. 2014. Ecology, Environmental Science and Conservation. S. Chand Publishing, New Delhi.
16. Sodhi, N.S., Gibson, L. & Raven, P.H. (eds). 2013. Conservation Biology: Voices from the Tropics. John Wiley & Sons.
17. Thapar, V. 1998. Land of the Tiger: A Natural History of the Indian Subcontinent.
18. Warren, C. E. 1971. Biology and Water Pollution Control. WB Saunders.
19. Wilson, E. O. 2006.The Creation: An appeal to save life on earth. New York: Norton.
20. World Commission on Environment and Development. 1987.Our Common Future. Oxford University Press.

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BVMFG203
STRENGTH OF MATERIALS

Course Objectives:

- Understand the fundamentals of solid mechanics.
- Acquire elementary knowledge of stresses, strains & material properties.
- Understand & analyse the basic principles involved in the behaviour of machine parts under load in the context of designing it.
- Understand & analyse the mechanical properties of the various materials.

Unit - 1 **06**

- **Basic Concepts:** Definition, elastic & plastic properties of material, stress & strain diagram for ductile & brittle materials, introductory remarks on fatigue, creep & fracture. Simple stresses and strains: Stress & strain, Simple stress and strain in composite sections, Thermal stresses, relation between elastic constants.

Unit - 2 **06**

- **Principal Planes and Stresses:** Principal stresses and principal planes, Mohr's circle for biaxial stresses.

Unit - 3 **06**

- **Bending Moment and shearing forces:** Types of beams, types of support, shear force and bending moment diagram for simply supported, and cantilever subjected to point and uniformly distributed loads, relation between intensity of loading shear force and bending moment.

Unit - 4 **06**

- **Bending, slope and deflection of beams:** Definitions, theory of simple bending, relation between slope and deflection calculations for cantilever & simply supported beams.

Unit - 5 **06**

- **Torsion & Vibration:** Concept of Pure Torsion, Torsion equation for solid and hollow circular shafts, power Transmitted and stiffness of shaft. Assumptions in theory of pure Torsion, Comparison between Solid and Hollow Shafts, Theory of Failure for Brittle and Ductile material. Types of vibrations, free vibrations.

References:

1. Strength of materials – Ryder
2. Strength of materials – Sadhu Singh
3. Strength of materials – Rajput
4. Strength of materials – Bansal

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BVMFG204
MANUFACTURING PROCESS - I

Course Objectives:
Students will be able to
- Learn basic ideas about foundry, pattern and its kinds.
- Understand various sands, their properties, gating system.
- Basic idea about different melting furnaces like cupola, electric arc furnace.
- Will be able to know about special casting processes other than conventional methods.
- Know the safety practices while working in workshop.

Unit - 1 **06**
- **Foundry:** Introduction to foundry, advantages and disadvantages, Pattern: pattern making, Type of patterns, pattern materials, pattern allowances, pattern making tools, materials and colour codes.

Unit - 2 **06**
- **Sand Moulding & Core making:** Introduction, mould material, sand grains, types of sand, sand properties, sand preparation, testing of moulding sand, types of mould, sand moulding techniques, conventional sand moulding, CO2 moulding and Shell moulding, Machine moulding, Pit Moulding, Moulding materials, Cores: Core making materials, types of cores, Core prints. Gating System – Parts of the gating system – pouring basin, sprue, runner, riser

Unit - 3 **06**
- **Melting furnaces:** Arc furnace: types, operational features, advantages and disadvantages, Cupola: construction, different zones, working principle, advantages and disadvantages and efficiency of cupola.

Unit - 4 **06**
- **Special Casting processes:** Introduction, Permanent mould casting: mould construction, stages in casting, advantages and limitations, Die casting: types of die casting machines, advantages and disadvantages, Centrifugal casting: true centrifugal casting, semi centrifugal casting, centrifuging, Investment casting: die making, making wax pattern, assembling wax pattern, investing or pour method, removal of wax pattern, advantages and disadvantages. Cleaning of casting, Casting defects & Remedies, Casting of complicated shapes: automotive components, casting of light alloys

Unit - 5 **06**
- **Welding processes:** Concepts, principle, application, advantages and disadvantage of Oxy-acetylene gas welding, Shielded metal arc welding, submerged arc welding, MIG and TIG welding processes. Electric resistance welding, Spot, Seam, Projection and Butt welding. Thermit welding, defects in welding. Concept of Brazing and Soldering.

References:

1. Elements of Workshop Technology, Vol. I & II - Hazra S. K. and Chaudhary
2. Workshop Technology by Raghuwanshi B. S.

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SEMESTER-03

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BVMFG301
MAINTENANCE ENGINEERING

Course Objectives:
Students will be able to
- Understand the concept of maintainability and failure.
- Understand different types of maintenance and their application.
- Work with safety provisions.
- Learn different types of hazards and their prevention.
- Fire protection and prevention.

Unit - 1 **06**
- Definition, Importance, Purpose and results of maintainability efforts, maintainability in product life cycle, maintainability tools; failure mode, effect and critical analysis, fault tree analysis, cause and effect diagram, total quality management.

Unit - 2 **06**
- Principle, relative advantage, limitation and application of various maintenance strategies like, preventive maintenance, predictive maintenance, total productive maintenance, reliability based maintenance, computer integrated maintenance etc.

Unit - 3 **06**
- Concept and strategies for tero-technology, maintenance planning and condition based maintenance.

Unit - 4 **06**
- **Industrial safety-**concept and relevance, Importance, Fundamental Concepts and Terms, occupational diseases, hazards and their control, electrical and mechanical hazards, radiation and biohazards, personal protective equipment and clothing.

Unit - 5 **06**
- Safety responsibility and function of various functionaries and departments, Fire protection and prevention, explosion and explosives, safety & profitably employee training and safety, workers compensation

References:

1. B.S. Dhillon “Engineering Maintainability”, Eastern Economy Edition PHI
2. A.K. Gupta “Reliability Engineering and Technology”, Macmillan India Limited
3. S.K. Srivastav, “Industrial Maintenance Management” S. Chand & Company
4. E.T. Newbrough “Effective Maintenance Management”, Mc Graw Hill
5. K. Tarafadar, K. J. Tarfdar “Industrial Safety Management”, Dhanpat Rai

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BVMFG302
MEASUREMENT AND METROLOGY

Course Objectives:
Students will be able to

- Understand the principle of operation of an instrument.
- Use measuring device for a particular application
- Differentiate between different types of errors.
- Define accuracy, precision, calibration, sensitivity etc. in metrology.
- Select appropriate instruments for specific measurement.

Unit - 1 **06**

- **Introduction:** Principles of dimensional and form measurements. Basic standards of length and angle. Industrial standards. Errors in measurement. Classification & Types of measuring instruments, limits, fits & tolerances.
- **Vernier Caliper & Gauges:** Construction and parts of Vernier, Principle of Vernier. Classification & Description of gauges, Micrometer: Working principle, Construction and parts of micrometer, Straightness and Taper Measurement: Sinebar, autocollimators

Unit - 2 **06**

- **Measurement:** General measurement system, Sensor, Signal conditioner, Data display and data output block, Calibration, traceability and standards, Common terms encountered in measurement techniques, Transducer, Range and span, Response: time lag, linear, Response time constant, Resolution, sensitivity, Precision and repeatability, Significant figures, Average value or mean, root mean square value, Accuracy and Errors.

Unit - 3 **06**

- **Measurement of Temperature & Pressure:** Glass thermometers, Thermocouples, Temperature compensation, Calibration, Advantages and disadvantages, uses of thermocouples. Bimetals Resistance thermometer, Thermistors, their advantages and disadvantages and field of use, Pyrometers.

Unit - 4 **06**

- **Measurement of Level, Vibration & Humidity:** Method of measurement, float indicator, displacement type, pressure dependent, capacitance, ultrasonic transducer, piezoelectric transducer. Different types of pickups and transducers, their principle of operation & field of use.

Unit - 5 **06**

- **Measurement of Torque, Velocity & Acceleration:** Different types of dynamometers, Principle of operation and field of use. Transducers used and method of measurement, Introduction to Coordinate Measuring Machines.

References:

1. Measurements – Harsh Vardhan
2. Electrical & Electronics and Instrument – A. K. Sawhney
3. Mechanical Measurement and Control – R. V. Jalgaonkar
4. Production Technology – O.P. Khanna & M. Lal

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BVMFG303
BASICS OF PLASTICS ENGINEERING

Course Objectives:

- To learn about the various plastics materials
- To study about the general properties, processing behavior and applications of different class of plastics materials
- To understand the various processing techniques of plastic materials.
- To develop the knowledge of National & International standards for testing methods.
- To enable the students to identify and compare the properties of different plastics materials.

Course Outcomes:

Upon completion of this course the student will be able to

- familiarize in natural polymer properties and its applications
- acquire skills in selecting additives for plastic materials for specific applications
- acquire the knowledge of processing of plastic materials by various mouding techniques
- Identify the plastic materials for some specified applications based on its property.
- Understand the basic principle of polymer testing machines.

Unit - 1 **06**

- **Plastic Materials:** Basic chemistry of polymers-nomenclature of polymers sources for raw materials. Methods of manufacturing –properties and applications of Natural Polymers - Shellac resin and natural rubber - Cellulosics - Cellulose nitrate, cellulose acetate, cellulose acetate butyrate, Ethyl cellulose and others.

Unit - 2 **06**

- **Types of Plastic Materials:** Thermoplastics- Thermosets - Composites - Bio Degradable Polymers - Classification - Properties – Applications – selection of material- Introduction to fillers – additives- its applications.

Unit - 3 **06**

- **Plastics Processing:** Basic principles of processing - shape and size – Effect of polymer property on processing – Newtonian and Non-Newtonian fluids - Rheology of polymer melts.

Unit - 4 **06**

- **Processing Techniques:** Introduction to Injection Moulding- Blow Moulding- Compression Moulding – Transfer Moulding-extrusion - Tooling - Process variables- trouble shooting-Applications – Selection of moulding process.

Unit - 5 **06**

- **Testing Of Plastics:** Importance of testing, Standard and specifications- National and International standards-BIS, ASTM, ISO,BS,DIN,JIS- Laboratory accreditations – NABL, NABCB, APLAC -Indentation techniques – evaluation of properties – Introduction to basic testing equipment.

References:

1. J.A. Brydson, “Plastics Materials”, Butterworth-Heinemann - Oxford, 7th Ed., 2001.
2. Allen; W. S. and Baker; P. N., Hand Book of Plastic Technology, Volume-1 & 2, CBS Publishers and Distributors, New Delhi (2009).

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BVMFG304
MANUFACTURING PROCESS-II

Course Objectives:

- Know different traditional machining processes.
- Understanding the working of different machines.
- Work as maintenance engineer
- Produce jobs as per given requirements by selecting specific machining process.
- Adopt safety practices while working on various machines.

Unit - 1 **06**

- **Introduction and classification of machine tool:** Basic concept of machining, different type of tool material, Cutting fluid (Classification and purpose), Types of chip, Orthogonal and Oblique cutting.
- **Lathe Machine**: Type of Lathe machine, Specification of lathe machine, Type of accessories and attachment used, Types of operation which can be performed, Work holding methods, different method of cantering the job, taper turning methods, principle of thread cutting operation. Concept of semiautomatic, automatic and CNC lathe, difference between Capstan and Turret lathe.

Unit - 2 **06**

- **Shaper, Slotter and Planer:** Difference between shaper, slotter and planer machine, Classification and specification of shaper, slotter and planer machine. Quick return mechanism, Type of operation performed, type of work holding and tool holding mechanism.

Unit - 3 **06**

- **Drilling, Rimming and Boring:** Classification and specification of drilling, rimming and boring machine, different type of work holding mechanism, Type of operation performed, drilling, boring and rimming tool.

Unit - 4 **06**

- **Milling Machine:** Classification and specification of milling machine, up milling and down milling, types of milling cutter, different type of work holding and tool holding methods, Different type of milling operation.

Unit - 5 **06**

- **Grinding Machine:** Classification and specification of grinding machine, specification of grinding wheel, lapping, honing, super finishing, polishing, buffing, and operation.

References:

1. Hajra Choudhary SK, Bose HK and Hajra Choudhary AK ”Elements of Workshop Technology, Vol II”, 12th Edition , Media Promoters and Publishers Pvt. Ltd
2. Workshop Practice II - Hajara Choudhary
3. Workshop practice - Chap man and Hall
4. Khanna, O.P and Lal, M, “A Text book of Production Technology, Vol II” Dhanpat Rai Publications Pvt Ltd.

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BVMFG401
PRINCIPLES OF EXTRACTIVE METALLURGY

Unit - 1 **08**

- Overview of Extractive Metallurgy processes; Pyro-metallurgy, Hydrometallurgy and Electrometallurgy; Thermodynamic and Kinetic Principles of metal extraction; Ellingham diagrams, Calcinations; Roasting; Predominance Area Diagram, Roasting Practices, Smelting, Formation and function of slag and their calculations, Metallo-thremic reduction of oxides, Smelting Furnaces, Matte Smelting, Pyro metallurgical processes using vacuum

Unit - 2 **08**

- **Hydrometallurgy:** Leaching; Theory of Leaching; Role of oxygen in leaching operation; Bacterial and microbial leaching; Contact reduction of metals in aqueous solutions; Gaseous reduction of metals in aqueous solutions; Ion exchange, Solvent Extraction and Electrolysis

Unit - 3 **07**

- **Electrometallurgy:** laws of electrolysis, electrolyte Structure of solvent media; Electrolysis of aqueous solution; Electrolysis of fused salts; Cell design; Electro-plating.

Unit - 4 **07**

- Halide Metallurgy and Halogenisation, Basic approaches of refining, preparation of pure compounds; Purification of crude metals produced in bulk; Numerical problems relevant to Pyro, Hydro and Electrometallurgical processes

References:

1. Principles of Extractive Metallurgy: A. Ghosh & H.S. Ray, IIN Publications, Kolkata 1984.
2. Principles of Extractive Metallurgy: Rosenquist, T., McGrawhill-Kogakusha International – 1983

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BVMFG402
IRON AND STEEL MAKING

Unit - 1 **08**

- History of Iron making in India, Indian and other resources of raw materials required for iron making. coke making. Blast furnace plant and -Modern blast furnace, plant layout, Details of construction of blast furnace and its main accessories; gas cleaning system, hot blast generation. Blast furnace refractories and blast furnace cooling system

Unit - 2 **08**

- Agglomeration of iron ore fines, sintering and pelletision, evaluation of properties of blast furnace, burden materials and application to blast furnace performance. Blast furnace plant operation, blowing in, blowing out and banking of blast furnace, role of burden charging and distribution in iron extraction, irregularities in Blast furnace operation and their remedies. Blast furnace products their quality control and disposal, coke rate and fuel efficiency of B.F. operations.

Unit - 3 **07**

- **Modern trends in Blast furnace practice-**Production of super flux sinter, pellets, super flux and cold bonded pellets. Auxiliary fuel injection in the blast furnace. High temp.blast, humidified and oxy generated blast, high top pressure, Desulphurization of hot metal. Chemical processes in Blast Furnace, Reactions in Tuyere, hearth and bosh zone. Reduction and coke gasification, Reactions in stack and exit gases. Thermodynamics of Blast furnace process requirement in Blast furnace, temp. profile in the furnace. Free energy and equilibrium consideration in Blast furnace a brief discussion on blast furnace stoichiometry and enthalpy balance

Unit - 4 **07**

- Alternate route for iron making charcoal blast furnace, low shaft furnace and electro thermal processes of iron making. Direct reduction processes, their classification, choice of DR process. Introduction to Production of Ferro-alloys. Production of various ferro-alloys Fe-Mn, Fe-V, Fe-Cr etc. uses of ferro-alloys in iron and steel industry

References:

1. Modern Iron Making - Dr. R.H. Tupkary
2. Principles of Blast Furnace iron making - Dr. A K Biswas

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BVMFG403
METAL AND POWDER FORMING TECHNIQUES

Course Objectives:

- Describing types of deformations and classification of forming processes.
- Classifying and explain bulk forming processes.
- Describing sheet metal forming processes
- Distinguishing differences between conventional forming and special forming processes.
- Elaborating various stages involved in the powder forming processes.

Course Outcomes:

Upon completion of this course, the students will be able to:

- Illustrate deformation types and classification of forming processes.
- Describe bulk forming processes and their applications.
- Elaborate different sheet metal forming processes and their applications.
- Compare and distinguish conventional and special forming processes.
- Discuss powder forming processes and its applications

Unit - 1 **06**

- **Introduction:** Mechanical behavior of materials- Elastic and plastic deformations - Classification of forming processes - Temperature in metal working: Cold, Warm and hot working - Introduction to the theory of plastic deformation.

Unit - 2 **06**

- **Bulk Forming:** Introduction - Plastic deformation in forging, rolling, extrusion, rod/wire, tube drawing and swaging processes and their applications - Effect of friction, calculation of forces, work done, process parameters, equipment's and defects - Design for manufacturing - Economics of bulk forming.

Unit - 3 **06**

- **Sheet Metal Forming:** Introduction - Sheet metal characteristics - Conventional sheet metal forming processes like shearing, bending and miscellaneous forming processes - High energy rate forming processes - Super plastic forming processes - Deep drawing process - Principles, process parameters, advantages, limitations and applications of the above - Formability of sheet metals - Equipment's - Defects - Design for manufacturing - Economics of sheet metal forming.

Unit - 4 **06**

- **Special Forming:** Orbital forging - Isothermal forging - Hot and cold Isostatic pressing - High speed extrusion - High speed forming machines - Rubber pad forming - Water hammer forming - Fine blanking - Incremental forming and comparing the above with conventional forming.

Unit - 5 **06**

- **Powder Forming:** Introduction - Powder production methods - Particle size characterization – Blending – Compacting - Sintering - Secondary and finishing operations - Advantages and applications of powder metallurgy - Design for manufacturing - Powder forging, rolling, extrusion, drawing - Economics of powder forging.

References:

1. Kalpakjian S. and Schmid S.R., "Manufacturing Engineering and Technology", Pearson., New Delhi, India, 2018.
2. Sadhu Singh, "Theory of plasticity and metal forming processes", Khanna Publishers, 2008
3. Heinz Tschätsch, "Metal Forming Practise: Processes - Machines – Tools", Springer-Verlag Berlin Heidelberg., Germany, 2006.
4. Juneja B.L., "Fundamentals of Metal forming Processes", New Age International Publishers Ltd., Chennai, India, 2018.
5. Kumar Surender, "Technology of Metal Forming Processes", PHI learning Pvt. Ltd., New Delhi, India, 2008.
6. Nagpal G.R.,"Metal Forming Processes", Khanna Publishers., New Delhi, India, 2000.
7. Mikell P. Groover, "Fundamental of Modern Manufacturing: Materials, Processes and Systems", John Wiley and Sons Ltd., United States, 2013.

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BVMFG404
ADVANCED MANUFACTURING PROCESS

Course Objectives:

- Know different non-traditional machining process.
- Know the working of Special Purpose Machine.
- Use of specific machine as per specific requirement.
- Develop the mindset towards modern trends in manufacturing.
- Work as maintenance engineer.

Unit - 1 **06**

- Introduction to modern manufacturing processes, classification of unconventional machining method, operating principles, applications, limitations, process parameters of abrasive jet machining, water jet machining, abrasive flow machining.

Unit - 2 **06**

- Fundamental principles, operational characteristics, applications. Advantages and limitations of ultrasonic machining and ultrasonic welding, electrical discharge machining.

Unit - 3 **06**

- Fundamental principles, process parameters, applications advantages and limitations of chemical machining, electro chemical machining and grinding.

Unit - 4 **06**

- Principles, process parameters, applications, advantages and limitations of LASER beam, electron beam machining and plasma arc machining.

Unit - 5 **06**

- Concept, general elements of special purpose machine (SPM), productivity improvement by special purpose machine, introduction to total productivity maintenance (TPM)

References:

1. New Technology by Amitava Bhattacharya (IEI)
2. Non-Conventional Manufacturing by V K Jain.
3. Production Technology by R. K. Jain
4. Non-Conventional manufacturing by P K Mishra
5. Manufacturing Science by Amitabh Ghosh

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BVMFG501
TOOL AND DIE DESIGN

Course Objectives:

- Understand tool angles of cutting tools and their importance.
- To understand different types of dies and their working principle.
- Study different types of dies and die design fundamentals.
- Study of forging die.
- How to design jigs and fixtures?

Unit - 1 **06**

- **Tool Design Consideration & Cutting Tools:** Basic metal cutting process, requirements of cutting tool, mechanism of chip formation, forces on cutting tool, power required, machinability of various materials, selection of cutting speed and feed, chatter-and vibration, cutting fluid. Cutting Tools: Design of Single Point Cutting Tool. Form tools – Introduction, types, design of form tools. Drills – Introduction, Types, Design of drill. Milling cutters – Introduction, Types, Geometry. Design of milling cutters.

Unit - 2 **06**

- **Bending methods:** Bending Terminology, V – Bending, Air bending, bottoming Dies, spring back & its prevention. Design Principles- Bend radius, Bend allowance, width of die opening, Bending pressure.

Unit - 3 **06**

- **Forming and Drawing Dies:** Forming Dies – Introduction, Types – solid form dies, pad type form dies, , Embossing dies, coiningdies, Bulgingdies, Assemblydies. Drawing Dies – Introduction, Difference between blending, forming & drawing, Metal flow during drawing, Design, Design consideration – Radius of draw die, Punch Radius, Draw clearance, Drawing speed, Calculating blank size, , Drawing pressure, Blank holding pressure.

Unit - 4 **06**

- **Forging Die Design:** Introduction, Classification of forging dies, Single impression dies, Forging design factors – Draft, fillet & Corner radius, parting line, shrinkage & die wear, mismatch, finish allowances, webs , forging operation- fullering, edging, bending, drawing, flattering, blacking finishing ,Die design for machine forging – determination of stock size in closed & open die forging.

Unit - 5 **06**

Design of Jigs & Fixtures:

- **Introduction, locating & clamping –** principle of location, principle of pin location, locating devices, radial or angular location, V –location, bush location design principle for location purpose, principle for clamping purposes, clamping devices, design principles common to jigs & fixtures.
- **Drilling Jigs:** Design principles, drill bushes, design principles for drill bushings, Types of drilling jigs – Template jig, plate type jig, open type jig, swinging leaf jig, Box type jig, channel type jig. Jig feet.
- **Milling Fixtures:** Essential features of milling fixtures, milling machine vice, Design principles for milling fixtures, Indexing jig & fixtures, Automatic clamping devices

References:

1. Production Engineering Design (Tool Design), Umesh Chandra & Surender Kumar, Satya Prakashan, New Delhi
2. Tool Design, C.Donaldso, G.H.Lecain and V.C.Goold, Tata McGraw Hill

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BVMFG502
MATERIALS JOINING TECHNOLOGY

Course Objectives:

- To study SMAW, GMAW, GTAW, Oxy-acetylene welding and resistance spot welding processes.
- To study the various types of resistance welding process.
- To study the various solid state welding process.
- To study advanced welding process.
- To study the various welding design and testing methods.

Course Outcomes:

Upon successful completion of the course, students should be able to:

- To understand the basic working principles SMAW, GMAW, GTAW, Oxy-acetylene welding and resistance spot welding processes
- To know the various types of the resistance welding process
- To familiarize about the various solid state welding process
- To know the advanced welding process
- To apply the various welding design and testing methods

Unit - 1 **06**

- **Gas and Arc Welding Processes:** Fundamental principles – Air Acetylene welding, Oxyacetylene welding, Carbon arc welding, shielded metal arc welding, Submerged arc welding, TIG and MIG welding, Plasma arc welding and Electro slag welding processes - advantages, limitations and applications.

Unit - 2 **06**

- **Resistance Welding Processes:** Spot welding, Seam welding, Projection welding, Resistance Butt welding, Flash Butt welding, Percussion welding and High frequency resistance welding processes - advantages, limitations and applications.

Unit - 3 **06**

- **Solid State Welding Processes:** Cold welding, Diffusion bonding, Explosive welding, Ultrasonic welding, Friction welding, Forge welding, Roll welding and Hot pressure welding processes - advantages, limitations and applications.

Unit - 4 **06**

- **Other Welding Processes:** Thermite welding, atomic hydrogen welding, Electron beam welding, Laser Beam welding, Friction Stir welding, Under Water welding, Welding automation in aerospace, nuclear and surface transport vehicles.

Unit - 5 **06**

- **Design of Weld Joints, Weldability and Testing of Weldments:** Various weld joint designs – Welding defects – causes and remedies - Weldability of Aluminum, Copper, and Stainless steels. Destructive and nondestructive testing of Weldments.

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BVMFG503
THEORY OF MACHINE

Course Objectives:

- To focus on understanding the concept of machines, mechanisms and their elements.
- To form foundation for kinematics synthesis, analysis and design of mechanism.
- To know different machine elements and mechanisms.
- Understand Kinematics and dynamics of different machines and mechanisms.
- Select Suitable drives and mechanisms for a particular application,
- Appreciate concept of balancing.
- Develop ability to come up with innovative ideas.

Unit - 1 **06**

- **Mechanisms:** Kinematic concept of Link, Kinematic chain, Mechanism, degree of freedom, Inversions of four bar mechanism, single slider crank mechanism and double slider crank mechanisms.

Unit - 2 **06**

- **Motion Analysis:** Types of motion: Kinematic and Dynamic quantities; Vector diagrams, Velocity and acceleration diagram of plane mechanism.

Unit - 3 **06**

- **Flywheel & Belt:** Concept, function and application of flywheel with the help of Turning Moment diagram; Fluctuation of energy and speed. Types of belt, ration of tension in belt, Centrifugal tension in belt & Power transmission

Unit - 4 **06**

- **Gears:** Fundamental laws of gearing: classification and basic terminology, involute tooth profile and its kinematic consideration, spur gears, other types of gears, standards in tooth forms.
- **Gear trains:** Simple and, compound gear trains.

Unit - 5 **06**

- **CAM & Balancing:** Balancing of Rotating masses by a single mass in same plane, balancing of a single rotating mass by two masses rotating in different planes, balancing of several masses rotating in same plane. Various types of cams, Displacement, velocity and acceleration of followers, Graphical determination of CAM profiles with simple followers.

References:

1. Theory of Machines and Mechanism by Ghosh and Malik
2. Mechanism and Machine Theory by J.S. Rao and R.V. Dukkibati
3. Theory of Machine by S.S. Rattan, Tata McGrow Hill.
4. Theory of Machine by Thomas Beven

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BVMFG504
ADDITIVE MANUFACTURING

Course Objectives:

- To introduce the development of Additive Manufacturing (AM), various business opportunities and applications
- To familiarize various software tools, processes and techniques to create physical objects that satisfy product development / prototyping requirements, using AM.
- To be acquainted with vat polymerization and material extrusion processes.
- To be familiar with powder bed fusion and direct energy deposition.
- To gain knowledge on applications of binder jetting, material jetting and laminated object manufacturing processes.

Course Outcomes:

At the end of this course students shall be able to:

- Recognize the development of AM technology and how AM technology propagated into various businesses and developing opportunities.
- Acquire knowledge on process of transforming a concept into the final product in AM technology.
- Elaborate the vat polymerization and material extrusion processes and its applications.
- Acquire knowledge on process and applications of powder bed fusion and direct energy deposition.
- Evaluate the advantages, limitations, applications of binder jetting, material jetting and laminated object manufacturing processes.

Unit - 1 **06**

- **Introduction:** AM evolution, Distinction between AM & CNC machining, Advantages of AM; AM process chain: Conceptualization, CAD, conversion to STL, Transfer to AM, STL file manipulation, Machine setup, build, removal and clean up, post processing; Classification of AM processes: Liquid polymer system, molten material systems, discrete particle system, solid sheet system..

Unit - 2 **06**

- **Liquid and Solid Based AM Process:** Stereo lithography Apparatus (SLA): Principle, pre-build process, part-building and post-build processes, photo polymerization of SL resins, Advantages, limitations and applications; Solid Ground Curing (SGC): Principle, process, Advantages, limitation, and applications; Fused deposition Modeling (FDM): Principle, details of processes Advantages, limitation, and applications; Laminated Object Manufacturing (LOM): Principles, details of processes, products, materials, advantages, limitations and applications

Unit - 3 **06**

- **Powder Based Am Process:** Selective Laser Sintering (SLS): Principle, process, Indirect and direct SLS- powder structures, materials, post processing, surface deviation and accuracy, Applications; Laser Engineered Net Shaping (LENS): Processes, materials, products, advantages, limitations and applications.
- **Other Additive Manufacturing Systems:** Shape Deposition Manufacturing (SDM), Ballastic Particle Manufacturing (BPM), Selective Laser Melting, Electron Beam Melting.

Unit - 4 **06**

- **AM Applications:** Functional models, Pattern for investment and vacuum casting, Medical models, art models, Engineering analysis models, Rapid tooling (Direct and Indirect method), new materials development, Bi-metallic parts, Re-manufacturing. Application examples for Aerospace, defense, automobile, Bio-medical and general engineering industries; Post processing of AM parts: Support material removal, surface texture improvement, accuracy improvement, aesthetic improvement, preparation for use as a pattern, property enhancements using non- thermal and thermal techniques.

Unit - 5 **06**

- **Design for AM:** Motivation, DFMA concepts and objectives, AM unique capabilities, exploring design freedoms, Design tools for AM, Part Orientation, Removal of Supports, Hollowing out parts, Inclusion of Undercuts and Other Manufacturing Constraining Features, Interlocking Features, Reduction of Part Count in an Assembly, Identification of markings/ numbers etc;

References:

1. Amit Bandyopadhyay and Susmita Bose, “Additive Manufacturing”, 1st Edition, CRC Press.,United States, 2015, ISBN-13: 978-1482223590.
2. Andreas Gebhardt, “Understanding Additive Manufacturing: Rapid Prototyping, Rapid Manufacturing”, Hanser Gardner Publication, Cincinnati., Ohio, 2011, ISBN:9783446425521.
3. Kamrani A.K. and Nasr E.A., “Rapid Prototyping: Theory and practice”, Springer., United States ,2006, ISBN: 978-1-4614-9842-1.
4. Liou, L.W. and Liou, F.W., “Rapid Prototyping and Engineering applications: A tool box for prototype development”, CRC Press., United States, 2011, ISBN: 9780849334092.
5. Milan Brandt, “Laser Additive Manufacturing: Materials, Design, Technologies, and Applications”, Woodhead Publishing., United Kingdom, 2016, ISBN: 9780081004333.

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SEMESTER-06

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BVMFG601
MACHINING TECHNOLOGY

Course Objectives:
The main learning objective of this course is to prepare the students:
- To impart knowledge on basics of metal cutting.
- To solve problems on cutting forces, tool life and analytical methods of estimating cutting temperature.
- To describe the basic principles of machine tools and processes
- To elaborate abrasive and finishing operations.
- To outline basics of automation and structure of machine tools.

Course Outcomes:
Upon the completion of this course the students will be able to
- Apply the knowledge in the basics of metal cutting.
- Apply suitable machining processes based on requirements.
- Distinguish different finishing operations.
- Test the machine tool structure and differentiate various automation.

Unit - 1 **06**
- **Fundamentals of Metal Cutting:** Tool geometry- Mechanics of orthogonal and oblique cutting - mechanism of chip formation- Types of chips produced in cutting -Cutting forces - Merchant's circle diagram – simple problems -Cutting temperature causes, effects, measurement, estimation and Control-Tool failure modes-wear mechanisms – tool life - simple problems- Machinability -Surface finish and integrity of machined surfaces- Machining economics- cutting tool materials- Cutting tool Reconditioning-Cutting fluids.

Unit - 2 **06**
- **Basic Machining Processes: Lathe:** Kinematic arrangement -Specification - Types - Mechanisms - work holding devices- Operations - Drilling: Specification - Types - Mechanism - Operations - Drill tool nomenclature –- Boring: Specification - Types - Operations - Boring tool - Jig Boring machine – Reamer and tap Milling: Specification – Types - Cutter nomenclature - Types of cutters - mounting of cutters- Operations - Indexing - Cam and thread milling- Shaper: Specification - Types – Mechanism- Planer: Specification - Types - Mechanism - Broaching: Specification - Types – Tool nomenclature- Broaching process

Unit - 3 **06**
- **Grinding and Finishing Operations:** Grinding: Types of grinding machine - Designation and selection of grinding wheel - Abrasives- Bonds -bonded abrasives - Reconditioning of grinding wheel - grinding operations and machines wheel grinding -Design Considerations for grinding- economics of grinding- finishing operation. - deburring - lapping, honing, burnishing.

Unit - 4 **06**

- **Gear Cutting:** Gear cutting Methods-Kinematics of gear shaping and gear hobbing – template gear cutting Methods-Gear generation principles specifications - Bevel gear generator - Gear finishing methods-gear grinding –lapping

Unit - 5 **06**

- **Machine Tool Structure and Automation:** Classification Machine Tool Structures-Vibration and chatters in machining-erecting and testing of machine Tools-Automation: Cam controlled automats, single spindle and multi spindle automats - Swiss type, automatic screw mechanism - Feeding mechanism – Transfer mechanism, Tracer controller mechanism.

References:

1. Sharma P.C., "A Textbook of Production Technology (Manufacturing Processes)", 8th Edition, S. Chand Publishing., India 2014 ISBN:9788121911146.
2. Jain R.K., "Production Technology: Manufacturing Processes, Technology and Automation", 17th Edition, Khanna publication, India, 2014, ISBN-10: 9788174090997, ISBN-3: 978-8174090997
3. John R. Walker and Bob Dixon, "Machining Fundamentals", 9th Edition, The Goodheart-Willcox Co. United States, 2014, ISBN: 978-1-61960-209-0.
4. Krar S.F., "Technology of Machine Tools", 7th Edition, McGraw-Hill, New York, 2011, ISBN-13: 9780073510835, ISBN-10: 0073510831.
5. Roy A. Lindberg, "Processes and Materials of Manufacture", 4th Edition, PHI Learning, United States, 1994, Reprint 2008, ISBN: 9788120306639, 8120306635
6. Serope Kalpakjian, Steven Schmid, "Manufacturing Engineering & Technology",7thEdtion, Pearson, United States, 2013, ISBN: 0131489658.
7. Winston A. Knight, Geoffrey Boothroyd, "Fundamentals of Metal Machining and Machine Tools (Mechanical Engineering)", 3rd Edition, United States, 2005, ISBN 0070850577, 9780070850576.

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BVMFG602
QUALITY CONTROL

Course Objectives:

- Understand the terms like quality, quality control, inspection, value of quality, and cost of quality.
- Know about reliability and statistical quality control.
- Construct and draw control charts.
- Understand different sampling methods and draw OC curve.
- Understand ISO certification procedure and quality system.

Unit - 1 **06**

- **Concept of Quality:** Definition of quality cost of quality, value of quality. Quality control, objectives of quality control, quality control and inspection.

Unit - 2 **06**

- **Statistical concepts and Reliability:** Definition of probability, laws of probability. Normal and Binomial probability distributions. Statistical Quality Control, Definition of reliability, basic concept. Failure patterns for complex product, designing for reliability, System reliability.

Unit - 3 **06**

- **Control Charts for Variables and Attributes:** Introduction, objectives, theories of control charts for averages, ranges, standard deviations. Process capability study, Fraction defectives and number of defects. Interpretation of control charts.

Unit - 4 **06**

- **Acceptance Sampling by attributes:** Concepts of acceptance sampling, advantages and limitations, sampling methods, single, double and- multiple sampling plants .operating characteristic curves.

Unit - 5 **06**

- **Total Quality Management and ISO 9000 Quality System:** Concept of Total Quality management, Principle objectives of TQM, History of ISO: 9000, ISO: 9000 series in general, benefits by becoming an ISO: 9000 company, steps to registration, India and ISO: 9000.

References:

1. Statistical Quality Control
2. Quality Planning and Analysis
3. M.Mahahjan - J.M .Juran & Frank M Gryna
4. 1.Statistical Quality Control by Eugune L.Grant & Richard S Leaven worth
5. 2.Total Quality Management by John M Kelly
6. 3.TQM by R.P. Mohanty & R.R. Lakhe.

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BVMFG603
NON-FERROUS EXTRACTIVE METALLURGY

Unit - 1 **08**

- General principles of extraction of metals from oxides and sulphides; Mineral resources of non – ferrous metals in India; their production, consumption and demand; Future of non – ferrous metal industries in India; Thermodynamic considerations and process selection in pyro-metallurgical extraction of metals. Aluminium: ayer's process and factors affecting its operation; Hall – Heroult process: principle & practices, use of electrodes, anode effect; Refining of Aluminium; Alternative methods of Alumina and Aluminium production.

Unit - 2 **08**

- Extraction of metals from Sulphide ores (Cu, Ni, Pb and Zn) Matte smelting; Converting; Refining; by products recovery; recent developments; Continues copper production processes, hydrometallurgy of copper.

Unit - 3 **07**

- Extraction of metals from oxide ores (Sn, Mg), and extraction of metals through halide route (Ti and Zr). Extraction of metals like (U,Nb, etc)

Unit - 4 **07**

- **Electro winning and Electro refining of metals:**
- From aqueous salts (Cu, Ni, Au, and Ag)
- From fused salts (Al and Mg)
- Environmental pollution and its address related to various metal extraction processes in general.

References:

- Extraction of Non Ferrous Metals by H.S.Ray, R.Sridhar & K.P. Abraham, Affiliated EastWest Press, New Delhi
- Principles of Extractive Metallurgy, by T. Rosenquist, McGraw hill, 1974

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BVMFG604
INDUSTRIAL ENGINEERING

Course Objectives:

- Understand importance of productivity, factors affecting productivity and forecasting.
- Find the breakeven point for manufacturing a product.
- Prepare or modify layout of production system.
- Find the economic order quantity for given situation.
- Using techniques of work measurement and method study should be able to improve the existing manufacturing method.

Unit - 1 **06**

Production Functions and Forecasting: Concept, Types and Management of production systems, Predicting markets for products, components of demands, time series forecasting methods (moving average, exponentially weighted moving average, Delphi, market survey and historical and life cycle analysis.

Unit - 2 **06**

Facility Layout and Engineering Economy: Process charts, line and product layout, functional process lay out, group layout, balancing technique, Concept of replacement and depreciation, Break even analysis, overhead, fixed and variable cost.

Unit - 3 **06**

Inventory Control: System inventories, EOQ, buffer stock, reorder point, fixed reorder quantity system, periodic reorder system, ABC analysis, Material requirement planning.

Unit - 4 **06**

Concept of JIT, Lean Manufacturing & Group Technology: Production wastages and its control, Concept, classification and coding of parts, coding system, OPTIZ coding system and its application.

Unit - 5 **06**

Work study: Conceptual frame work of Method Study, Micro motion study and work measurement, Principle of Motion Economy, Work sampling.

References:

1. Industrial Engg. & Management – O. P. Khanna
2. Production & Operation Management – S. N. Chary
3. Production & Operation Management – Ronald, S. Ebert
4. Production & Operation Management – S. K Sharma

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BVMFG605P
INDUSTRIAL TRAINING/ON JOB TRAINING/ WORKSHOP

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