KALINGA UNIVERSITY

RAIPUR | INDIA

SCHEME & SYLLABUS FOR

Bachelor of Vocational Studies (B.Voc.) Mechanical

NAAC GRADE B+ Accredited University

nirf RANKING 2025 Ranked in Top 151-200 Universities

Kalinga University, Naya Raipur, Chhattisgarh

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B.VOC IN MECHANICAL

Semester-01								
Course Code	**Course Title**	**Credits**	**L**	**T**	**P**	**Internal Marks**	**End Semester Exam Marks**	**Total Marks**
BVME101	Communication Skills	3	3	0	0	30	70	100
BVME102	Fundamentals of Information Technology	3	3	0	0	30	70	100
BVME103	Mechanical Engineering Basics	3	3	0	0	30	70	100
BVME104	Elementary Physics	3	3	0	0	30	70	100
BVME105P	**On Job Training/ Internship/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**
BVME201	Elementary Mathematics	3	3	0	0	30	70	100
BVME202	Environmental Studies	3	3	0	0	30	70	100
BVME203	Workshop Technology	3	3	0	0	30	70	100
BVME204	Elementary Chemistry	3	3	0	0	30	70	100
BVME205P	**On Job Training/ Internship/Workshop**	18	0	0	36	50	150	200
Total		**30**	**12**	**0**	**36**	**170**	**430**	**600**

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Semester-03								
Course Code	**Course Title**	**Credits**	**L**	**T**	**P**	**Internal Marks**	**End Semester Exam Marks**	**Total Marks**
BVME301	Thermodynamics	3	3	0	0	30	70	100
BVME302	Measurement & Metrology	3	3	0	0	30	70	100
BVME303	Engineering Mechanics	3	3	0	0	30	70	100
BVME304	Material Engineering	3	3	0	0	30	70	100
BVME305P	**On Job Training/ Internship/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**
BVME401	Applied Thermodynamics	3	3	0	0	30	70	100
BVME402	Fluid Mechanics & Fluid Machines	3	3	0	0	30	70	100
BVME403	Manufacturing Process	3	3	0	0	30	70	100
BVME404	Strength of Material	3	3	0	0	30	70	100
BVME405P	**On Job Training/ Internship/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**
BVME501	Heat and Mass Transfer	3	3	0	0	30	70	100
BVME502	Industrial Engineering	3	3	0	0	30	70	100
BVME503	Power Plant Engineering	3	3	0	0	30	70	100
BVME504	Automobile Technology	3	3	0	0	30	70	100
BVME505P	**On Job Training/ Internship/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**
BVME601	Refrigeration and Air Conditioning	3	3	0	0	30	70	100
BVME602	Theory of Machine	3	3	0	0	30	70	100
BVME603	Machine Design	3	3	0	0	30	70	100
BVME604	CAD/CAM	3	3	0	0	30	70	100
BVME605P	**On Job Training/ Internship/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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COMMUNICATION SKILLS
BVME101

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:

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

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FUNDAMENTALS OF INFORMATION TECHNOLOGY BVME102

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, WLL, 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:

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

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MECHANICAL ENGINEERING BASICS
BVME103

Unit 1: **06**

Introduction:

- Systems engineering fundamentals - Machine elements - Power machines - Work machine. Separable joints - Screw threads - Properties and specifications - Classification - Self-locking. Properties and specifications - Design of adhesive joints. Properties and specifications - Lateral press fit joints

Unit 2: **06**

Screws and Locking Devices:

- Standardization - Bolt - screw heads - Properties and specifications - Property classes - Nuts - screw thread - inserts - washers - Standardization - Washers Locking devices Standardization - Pins - Taper pins - Grooved and slotted pins - Shear pins

Unit 3: **06**

Shaft Hub Connections:

- Standardization - Representation & dimensioning - Keys - key connections - Properties and specifications - Preloaded form fitting joint - Force fitting joint - Clamping elements

Unit 4: **06**

Conical Tapers:

- Taper clamping elements - Standardization - Properties & specifications. Rivets - Blind rivets - Properties and specifications - Riveting techniques / types of rivets - One-sided accessibility

Unit 5: **06**

Soldered Connections:

- Standardization - Open and close joint bonding - Properties - Soldering process - Design / Solder Flux. Standardization - Properties and Classification - Welding processes in the overview - Gas welding - Arc welding - Inert gas arc welding - Microstructure and failure in metal welding

References:

- Uicker, J.J., Pennock G.R and Shigley, J.E., “Theory of Machines and Mechanisms”, Oxford University Press, 2009.
- Rattan, S.S, “Theory of Machines”, Tata McGraw-Hill, 2009.
- Thomas Bevan, “Theory of Machines”,CBS Publishers and Distributors, 2005.
- Cleghorn. W. L, “Mechanisms of Machines”, Oxford University Press, 2005

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ELEMENTARY PHYSICS
BVME104

Course Objective:

- This aim of this course is to impart knowledge in basic concepts of physics like unit, dimension, work, energy and power etc and their applications.

Course Outcomes:

Students completing this course will be able to:

- Identify different systems of units and convert units from one system to another as well as conversant with practical units.
- Represent physical quantities as scalars and vectors, applying physical laws and concept of linear and circular motion in everyday life.
- Differentiate between work, energy and power
- Express physical quantities in terms of heat and temperature in various processes on different scale.
- Understand the concept of elasticity, surface tension pressures and laws governing moment of fluid.

Unit 1: **06**

Unit and Dimensions:

- Physical quantities, Fundamental and derived units, Systems of unit (CGS, MKS and SI units), Dimensions and dimensional formulae of physical quantities (area, volume, velocity, acceleration, momentum, force, impulse, work, power, energy, surface tension, coefficient of viscosity and strain) , Dimensional equations and their uses with examples, Limitations of dimensional analysis.

Unit 2: **06**

Force and Motion:

- Scalar and vector quantities - examples, addition and multiplication of vectors, scalar product and vector product of vectors, Force, resolution and composition of forces – resultant, friction, law of friction and type of friction, Newton's Laws of motion – concept of momentum, determination of force equation from Newton's second law of motion, Newton's third law of motion Conservation of momentum, impulse and impulsive forces, simple numerical problems, Circular motion (Definition), Relation between linear and angular velocity and linear acceleration and angular acceleration , Centripetal force (derivation) and centrifugal force Banking of roads, Definition of torque ,Planetary Motion, Newton's law of gravitation, Kepler's law of planetary motion, Escape velocity (derivation)

Unit 3: **06**

Work, Power and Energy:

- **Work:** definition and its units, Work done against friction in moving an object on horizontal and inclined plane (incorporating frictional forces),
- **Power:** definitions and its units, calculation of power in simple cases,
- **Energy:** Definitions and its units: Types: Kinetic energy and Potential energy, with examples and their derivation.

Unit 4: **06**

Temperature and its measurement:

- Difference between heat and temperature on the basis of K.E. of Molecules, Principles of measurement of temperature and different scales of temperature, Transfer of Heat, Modes of transfer of heat (conduction, convection and radiation with examples), Coefficient of thermal conductivity, Properties of heat radiation. Prevost's theory of heat exchange, Laws of black body radiations: Stefan's law, Kirchhoff's law, Wien's law.

Unit 5: **06**

Properties of Matter:

- Elasticity, stress and strain, Different types of modulus of elasticity, Surface tension- its units, measurement of surface tension by capillary tube method, applications of surface tension, effect of temperature and impurity on surface tension, Fluid motion, stream line and turbulent flow, Viscosity and coefficient of viscosity.

References:

- Concept of Physics, Prof. H.C. Verma, Part-1 (Bharti Bhawan)
- Concept of Physics, Prof. H.C. Verma, Part-2 (Bharti Bhawan)
- A Text Book of Applied Physics: Eagle Prkashan, Jullandhar

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ON JOB TRAINING/INTERNSHIP/WORKSHOP
BVME105P

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SEMESTER-02

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ELEMENTARY MATHEMATICS
BVME201

Course Objective:

- To understand basics and applications of algebra, determinants, vectors, trigonometry and complex numbers. The focus of these topics in field to impart their knowledge in particular area of engineering branches and Comprehensive knowledge of basic mathematics.

Course Outcomes:

After completion of this course student will able to:

- Demonstrate basic knowledge of AP and GP; Sum of n terms, Exponential and Logarithmic series and also understand the basic concept of factorial notion in permutation, combination and binomial theorem.
- To find area of triangle to understand properties to simplify determinants to solve system of equations using matrices.
- Familiar with the basic concepts of scalar product, vector product, Triple products and multiple products.
- To understand basics and applications of trigonometry in field to impart their knowledge and comprehensive of basic mathematics.
- This course enables the students to learn the concept of imaginary numbers and gives awareness about algebra of complex numbers

Unit 1: **06**

Series:

- AP and GP; Sum of n terms, Partial fractions, Exponential and Logarithmic series, Binomial theorem for positive, Negative and fractional index (without proof) Application of Binomial theorem, Permutation & combination.

Unit 2: **06**

Determinants:

- Elementary properties of determinants of order 2 and 3, Consistency and solution of system of algebraic equation by Cramer's rule, Matrices, Type of matrix, Properties (addition, subtraction, multiplication, adjoint, inverse) of matrix.

Unit 3: **06**

Vector algebra:

- Dot and Cross product, Scalar and vector triple product, Application to work done, Moment of a force.

Unit 4: **06**

Trigonometry:

- Relation between sides and angles of a triangle, Statement of various formulae showing relationship between sides and angles of a triangle, trigonometrically equations, Inverse trigonometric function.

Unit 5: **06**

- Complex numbers, Representation, Modulus and amplitude De-moiver's theorem and its application in solving algebraic equations, Mod, Function and its properties.

References:

- R.D. Sharma: Mathematics (I& II-XI), Dhanpat Rai Publication, Delhi.
- B.S. Grewal :Engg. Mathematics by khanna Publishers, New Delhi.
- H.R. Luthra : Applied Mathematics by Bharat Bharti Prakashan & Co. Meerut
- Kailash Sinha : Applied Mathematics by Bharat Publication, Meerut
- A Text Book of Mathematics (XI& XII) NCERT

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ENVIRONMENTAL STUDIES
BVME202

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:

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

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WORKSHOP TECHNOLOGY

BVME203

Course Objective:

- The subject aims at imparting knowledge and skill components in the field of basic workshop technology. It deals with different hand and machine tools required for manufacturing simple metal components and articles. The primary objectives of this subject are to understand how different objects can be made from the given raw material by using different mechanical machines and tools.

Course Outcomes:

Students completing this course will be able to:

- Practice workshop safety rules effectively.
- Acquire knowledge and use simple hand tools.
- Acquire knowledge and use of carpentry work.
- Acquire knowledge and use of the metal fabrication work.
- Acquire knowledge about different machines: Lathe, Drilling, Shaper and Planer etc.

Unit 1: **06**

General Introduction:

- Scope of subject "Workshop Technology" in engineering. Different shop activities and broad division of the shops on the basis of nature of work done such as:
  i. Wooden Fabrication (Carpentry)
  ii. Metal Fabrication (shaping and Forming, Smithy, Sheet metal and Joining-welding, Riveting, Fitting and Plumbing.

Unit 2: **06**

Carpentry:

- Timber, seasoning of timber, types of seasoning. Common Carpentry Tools-Their classification, size, specification (name of the parts and use only)., Fundamental wood working operations, Marking & Measuring, Holding & Supporting, Cutting & Sawing, Drilling & Boring, Turning, Jointing;

Unit 3: **06**

Metal Fabrication:

- **Metal Shaping-Smithy:** Operations involved (concept only. Tools and equipment used (Names, size, specification for identification only). Defects likely to occur during and after operations their Identification and Remedy. Defects due to wrong operation, wrong tool and wrong heating. Safety of Personnel, Equipment & Tools to be observed. Sheet metal working: Tools and Operations involved (Names and concept only); Sheet metal joints - Lap, seam, Locked seam, hemp, wire edge, cup or circular, Flange, angular and cap.
- **Common defects -**Their identification and remedy. Defects due to wrong operation or wrong tool. Safety of Personnel, Equipment & Tools to be observed.
- **Metal Joining During Fabrication:** Permanent Joining-Welding methods-Forge welding, gas welding (high and low pressure-oxyacetylene welding, types of flames. Electric Arc welding- D.C. & A.C., Connected tools, operation, materials and safety measures.
- **Soldering & Brazing:** Familiarity with the use of Various Tools Used in Mechanical Engineering Workshop: Marking & Measuring, Holding Tools. Cutting Tools. Hack saw (Fixed and Adjustable frame), chisels. Finishing tools Files. Drills and Allied Tools. Miscellaneous Tools.

Unit 4: **06**

Machine Shop:

- Introduction to machine tools viz lathe, drilling machine, shaper and planer simple line and block diagram of components and their functions. Brief concept of NC and CNC machines.

Unit 5: **06**

- **Foundry:** Basic idea of types of sands, patterns, moulds, furnaces and simple green sand moulding process.

References:

- Manufacturing Process by- B.S Raghuvanshi (Dhanpat Rai & Co.)
- Elementary Workshop Technology by- S.K HazraChaudhary (Media Promoters)
- Workshop Practice by- S.K Garg (University Science Press)
- Elementary Workshop Technology by J.K. Kapoor, Bharat Bharti Prakashan.

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ELEMENTARY CHEMISTRY
BVME204

Course Objectives:

- To emphasize the relevance of fundamentals and applications of chemistry for diploma holders and student will learn appropriate combinations of old and new emerging concepts. Also to bring potential applications of chemistry and practical utility in order to become good engineers and entrepreneurs.

Course Outcomes:

Students will able to understand and relate electrochemistry and corrosion.

- Describe atomic structure, concept of matter-wave chemical bonding and solid state
- Describe the periodic table as a list of elements to demonstrate trends in their physical and chemical properties.
- Understand the concept of conductance and electrochemistry as well as determine the EMF of the cells.
- Evaluate rate constant of a reaction as well as understand theories of reaction rates.
- Apply the concepts of sol, gel and emulsions to various solutions.

Unit 1: **06**

Structure of Atom:

- Basic concepts of atomic structure, Matter wave concept, Schrodinger wave equation (excluding derivation) Quantum number, Heisenberg's Uncertainty Principle, Shapes of orbitals.

Chemical Bonding:

- Basic concepts, Hydrogen bonding, Valence bond theory, Hybridization, VSEPR theory, Molecular orbital theory as applied to diatomic homo nuclear molecules of first and second period elements, Co-ordination bond.

Unit 2:

06 Periodic Classification of Elements:

- Classification of elements (s, p, d and f block elements), Modern Periodic law, Periodic properties: Ionization energy electro negativity, Electron affinity

Unit 3:

06 Electro Chemistry:

- Arrhenius Theory of electrolytic dissociation, Transport number, Electrolytic conductance, Ostwald dilution law. Concept of Acid and bases: Bronsted, Arrhenius and Lewis theory. pH. Buffer solutions, Indicators, Solubility product, Common ion effect with their applications, Redox reactions, Electrode potential (Nernst Equation), Electro-chemical cells (Galvanic and Electrolytic). EMF of a cell and free energy change. Standard electrode potential, Electro chemical series and its applications., Laclanche's or dry cell, Acid storage cell (Lead accumulator) and Alkali stroge cell (Edison accumulator), Solar cell (Photovoltaic cell), Numerical problems based on topics.

Unit 4:

06 Chemical Kinetics:

- Introduction, rate of reaction, rate constant order and molecularity of reaction. Activation energy, Zero order First order and Second order (when initial concentration of both the reacrants are same) reactions.

Catalysis:

- Definition, Characteristics of catalytic reactions, Catalytic promoters and poison, Autocatalysis and Negative catalysis, Theory of catalysis, Application.

Unit 5:

06 Solid State and Colloids:

- **Solid State:** Types of solids (Amorphous and Crystalline), Classification (Molecular, Ionic, Covalent, Metallic), Band theory of solids (Conductors, Semiconductors and Insulators), types of Crystals, FCC, BCC, Crystal imperfection

- **Colloids:** Colloids and its types, Different system of colloids, Dispersed phase and dispersion medium. Methods of preparation of colloidal solutions, Dialysis and electro-dialysis. Properties of colloidal solution with special reference to adsorption, Brownian Movement, Tyndal effect, Electrophoresis and coagulation. Gold number, Application of colloids.

References:

- Liquid Crystals and Plastic Crystals, vol.-I, edited by G.W. Gray and P.A. Winsor, Ellis Harwood Series in Physical Chemistry, New York.
- Corrosion Engineering by M.G. Fontana McGraw Hill Publications.
- Engineering Chemistry by J C Kuriacose and J. Rajaram, Tata McGraw-Hill Co, New Delhi (2004).
- Chemistry of Engineering Materials by C.P. Murthy, C.V. Agarwal and A. Naidu BS Publication Hyd.

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BVME205P

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SEMESTER-03

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THERMODYNAMICS
BVME301

Course Objectives:

- To learn about work and heat interactions, and the balance of energy between a system and its surroundings.
- To learn about the application of the I law to various energy-conversion devices.
- To evaluate the changes in properties of substances in various processes.
- To understand the difference between high-grade and low-grade energies, and the II law limitations on energy conversion.

Course Outcomes:

- Able to explain the basic concepts of thermodynamics like system, equilibrium, properties, pressure, specific volume, temperature, zeroth law of thermodynamics, temperature measurement and temperature scales. Explain the concept of thermodynamic work. Calculate work different thermodynamic processes or different thermodynamic cycles. Explain the first law of thermodynamics for closed and open systems undergoing different thermodynamic processes.
- State and prove the equivalence of two statements of second law of thermodynamics. Define reversible process and state the propositions regarding efficiency of Carnot cycle. Evaluate the feasibility of a thermodynamic cycle using the second law of thermodynamics for typical engineering problems.
- Able to explain Available and unavailable energy, Different types of Thermodynamic relations, Quantify the second law of thermodynamics for a cycle by establishing the inequality of Clausius. Apply the inequality of Clausius and establish the property entropy of a system. Derive and apply principle of increase of entropy to evaluate the feasibility of a thermodynamic process
- Illustrate the T-v, P-T diagrams and P-v-T surfaces of pure substances, Analyze the processes on T-v diagrams to solve advanced engineering problems. Explain Psychometric terms, definitions and different charts.
- To calculate efficiencies of simple power and refrigeration cycles. To know and be able to explain the difference between a Carnot and a Rankine cycle. To define the meaning of efficiencies in turbines, compressors, and pumps, and use them to solve problems.

Unit 1: **06**

Review of Fundamental Concepts and Definitions:

- **Introduction –** Basic Concepts: System, Control Volume, Surrounding, Boundaries, Universe, Types of Systems, Macroscopic and Microscopic viewpoints, Concept of Continuum, Thermodynamic Equilibrium, State, Property, Process, Exact & Inexact Differentials, Cycle, Reversibility, Quasi–static Process, Irreversible Process, Causes of Irreversibility.
- **Energy and its forms:** Work and heat (sign convention), Gas laws, Ideal gas, Real gas, Law of corresponding states, Property of mixture of gases, Electrical, magnetic, gravitational, spring and shaft work.
- **Zeroth law of thermodynamics:** Concept of temperature and its measurement; Temperature scales.

First Law of Thermodynamics:

- First Law for Flow Processes – Derivation of general energy equation for a control volume; Steady state steady flow processes including throttling; Examples of steady flow devices; Unsteady processes; Examples of steady and unsteady First Law applications for system and control volume.

- Limitations of First Law of Thermodynamics, PMM–I. Steady flow systems and their analysis, Steady flow energy equation, Boilers, Condensers, Turbine, Throttling process, Pumps, etc.

Unit 2:
06
Second Law of Thermodynamics:

- Thermal reservoirs, Energy conversion, Heat engines, Efficiency, Reversed heat engine, Heat pump, Refrigerator, Coefficient of Performance.

- Kelvin–Planck and Clausius statements of second law of thermodynamics, Equivalence of the two statements.

- Reversible and irreversible processes, Carnot cycle and Carnot engine, Carnot theorem and its corollaries, Thermodynamic Temperature Scale, PMM–II.

- **Entropy:** Clausius inequality, Concept of Entropy, Entropy change of pure substance in different thermodynamic processes, Tds equation, Principle of entropy increase, T–S diagram, Statement of the Third Law of Thermodynamics.

Unit 3:
06

- **Availability and Irreversibility:** Available and unavailable energy, Availability and irreversibility, Second law efficiency, Helmholtz & Gibbs functions.

- **Thermodynamic Relations:** Conditions for exact differentials, Maxwell relations, Clapeyron equation, Joule–Thomson coefficient and inversion curve, Coefficient of volume expansion, Adiabatic and Isothermal compressibility

Unit 4:
06
Properties of Steam and Rankine Cycle:

- Pure substance, Properties of pure substance (steam), Triple point, Critical point, Saturation states, Sub-cooled liquid state, superheated vapour state.

- Phase transformation process of water; Graphical representation of pressure, volume and temperature:P–T, P–V and P–h diagrams; T–S and H–S diagrams; Use of property diagrams, Steam tables & Mollier chart.

- Dryness factor and its measurement; Processes involving steam in closed and open systems.

- Simple Rankine cycle.

- **Air–Water Vapour Mixture and Psychrometry:** Psychrometric terms and their definitions, Psychrometric chart, Different psychrometric processes and their representation on Psychrometric chart.

Unit 5: **06**

Refrigeration Cycles:

- Reversed Carnot cycle for gas and vapour; Refrigeration capacity; Unit of refrigeration.
- **Air refrigeration cycles:** Reversed Brayton Cycle and Bell–Coleman Cycle.
- **Vapour compression refrigeration cycle:** Simple saturated cycle and actual vapour compression refrigeration cycle.
- Analysis of cycles, Effect of superheating, sub-cooling and change in evaporator and condenser pressure on performance of vapour compression refrigeration cycle.
- **Refrigerants:** Their classification and desirable properties.
- Vapour absorption refrigeration system.

References:

- Basic and Applied Thermodynamics by P. K. Nag, McGraw Hill India.
- Thermodynamics for Engineers by Kroos & Potter, Cengage Learning.
- Thermodynamics by Shavit and Gutfinger, CRC Press.
- Thermodynamics – An Engineering Approach by Çengel, McGraw Hill India.
- Basic Engineering Thermodynamics by Joel, Pearson.
- Fundamentals of Engineering Thermodynamics by Rathakrishnan, PHI.
- Engineering Thermodynamics by Dhar, Elsevier.
- Engineering Thermodynamics by Onkar Singh, New Age International.
- Engineering Thermodynamics by C. P. Arora.
- Engineering Thermodynamics by Rogers, Pearson.
- Fundamentals of Engineering Thermodynamics by Moran, Shapiro, Boettner, & Bailey, John Wiley.
- Engineering Thermodynamics by Mishra, Cengage Learning.
- Refrigeration and Air Conditioning by C. P. Arora, McGraw Hill India.

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MEASUREMENT & METROLOGY
BVME302

Course Objective:

- To enable students to understand the construction and operation of instruments for measurement of pressure; level; flow and temperature; describe a suitable calibration procedure for a particular measurement instrument; identify and quantify errors from calibration graphs and describe correction procedures for selected instruments; select a suitable measurement instrument for a given process measurement; solve numerical problems involving equations pertaining to pressure; level; temperature and flow measurements

Course Outcomes:

- To understand the concepts in measurement and metrology.
- To familiar with various standards and calibration methods used in industry.
- To be familiar with different sensors and transducers
- To build suitable measurement technique
- To have the confidence to apply automation solutions for given industrial applications.
- To demonstrate the ability to design and conduct experiments, interpret and analyze data, and report results.

Unit 1: **06**

Mechanical Measurements:

- Introduction to measurement and measuring instruments. General concepts – Generalized measurement system and its elements. Units and standards.
- Measuring instruments: Sensitivity, stability, range, accuracy and precision, static and dynamic response, repeatability.
- Systematic error, sources of error, statistical analysis of error and random errors, correction, calibration.
- Dimensional and geometric tolerance.

Sensors and Transducers:

- Types of sensors, types of transducers and their characteristics.

Unit 2: **06**

- **Time-Related Measurements:** Stroboscope, frequency measurement by direct comparison. Measurement of displacement.
- **Measurement of Pressure:** Gravitational, direct-acting, elastic and indirect type pressure transducers. Measurement of very low pressures (high vacuum).
- **Strain Measurement:** Types of strain gauges and their working; strain gauge circuits, temperature compensation. Strain rosettes, calibration.

Unit 3: **06**

- **Flow Measurement:** Hot-wire anemometry, Laser Doppler Velocimetry, Rotameter.
- **Temperature Measurement:** Thermometers, bimetallic thermocouples, thermistors, and pyrometers.
- **Measurements of Force and Torque:** Different types of load cells, elastic transducers, pneumatic and hydraulic systems. Seismic instruments.
- **Measurements of Acceleration and Vibration:** Accelerometers, vibration pickups, decibel meters, vibrometers.

Unit 4: **06**

- **Coordinate Measuring Machine (CMM):** Need, constructional features and types.
- **Metrology and Inspection:** Standards of linear measurement, line and end standards. Interchangeability and standardization.
- Linear and angular measurement devices and systems.
- **Comparators:** Sigma, Johansson's Mikrokator.
- **Limit gauges:** Classification, Taylor's Principle of Gauge Design.

Unit 5: **06**

Limits, Fits & Tolerances and Surface Roughness:

- Introduction to limits, fits, tolerances and IS standards. Limit gauges and surface roughness.
- Measurement of geometric forms like straightness, flatness, roundness.
- Toolmakers microscope, profile projector, autocollimator.

Interferometry:

- Principle and use of interferometry, optical flat.
- Measurement of screw threads and gears.

Surface Texture:

- Quantitative evaluation of surface roughness and its measurement.

References:

- Experimental Methods for Engineers by Holman, MCGRAW HILLINDIA
- Mechanical Measurements by Beckwith, Pearson
- Principles of Measurement Systems by Bentley, Pearson
- Metrology of Measurements by Bewoor and Kulkarni, MCGRAW HILLINDIA
- Measurement Systems, Application Design by Doeblein, MCGRAW HILLINDIA
- Hume KJ, "Engineering Metrology", MacDonald and Co
- Jain, RK, "Engineering Metrology" Khanna Publishers
- Jain, R.K., "Mechanical Measurement" Khanna Publishers
- Gupta SC, Engineering Metrology, Dhanpat Rai Publications

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ENGINEERING MECHANICS
BVME303

Course Objective:

- To develop the capacity to predict the effect of force and motion in the course of carrying out the design functions of engineering.

Course Outcomes:

- Determine the force systems, free-body diagrams, and equations of equilibrium of a particle in space using the laws of mechanics.
- Calculate the shear force and bending moment diagrams; analyze simple trusses using the method of joints and method of sections.
- Calculate the principal moment of inertia of plane areas.
- Solve problems using equations of motion and analyze impact of elastic bodies during collision.
- Solve problems of simple stress and strain, simple bending theory, and stresses in beams of different cross-sections.

Unit 1: **06**

Two-Dimensional Force Systems:

- Basic concepts, Laws of motion, Principle of transmissibility of forces, Transfer of a force to a parallel position, Resultant of a force system, Simplest resultant of two-dimensional concurrent and non-concurrent force systems, Distribution of force systems, Free-body diagrams, Equilibrium and equations of equilibrium.

Friction:

- Friction force, Laws of sliding friction, Equilibrium analysis of simple systems with sliding friction, Wedge friction.

Unit 2: **06**

Beams:

- Introduction, Shear force and bending moment, Differential equations of equilibrium, Shear force and bending moment diagrams for statically determined beams.

Trusses:

- Introduction, Simple truss and solution of simple truss, Methods of joints and methods of sections.

Unit 3: **06**

Centroid and Moment of Inertia:

- Centroid of plane, curve, area, volume and composite bodies. Moment of inertia of plane areas, Parallel axis theorem, Perpendicular axis theorem, Principal moment of inertia. Mass moment of inertia of circular ring, disc, cylinder, sphere, and cone about their axis of symmetry.

Unit 4: **06**

Kinematics of Rigid Body:

- Introduction, Plane motion of rigid body, Velocity and acceleration under translational and rotational motion, Relative velocity.

Kinetics of Rigid Body:

- Introduction, Force, mass and acceleration, Work and energy, Impulse and momentum, D'Alembert's principle and dynamic equilibrium.

Unit 5: **06**

Simple Stress and Strain:

- Introduction, Normal and shear stresses, Stress–strain diagrams for ductile and brittle materials, Elastic constants, One-dimensional loading of members of varying cross-sections, Strain energy.

Pure Bending of Beams:

- Introduction, Simple bending theory, Stress in beams of different cross-sections.

Torsion:

- Introduction, Torsion of shafts of circular cross-sections, Torque and twist, Shear stress due to torque.

References:

- Beer, F. P., & Johnston Jr., E. R., *Vector Mechanics for Engineers (In SI Units): Statics and Dynamics*, 8th Edition, Tata McGraw-Hill Publishing Company, New Delhi (2004).
- Vela Murali, *Engineering Mechanics*, Oxford University Press (2010).
- R. K. Bansal, *A Textbook of Engineering Mechanics*, Laxmi Publications.
- R. S. Khurmi, *Engineering Mechanics*, S. Chand Publishing.
- Meriam J. L. and Kraige L. G., *Engineering Mechanics – Statics (Vol. 1) & Dynamics (Vol. 2)*, 3rd Edition, John Wiley & Sons (1993).
- Rajasekaran S. and Sankarasubramanian G., *Engineering Mechanics: Statics and Dynamics*, 3rd Edition, Vikas Publishing House Pvt. Ltd. (2005).
- Bhavikatti S. S. & Rajashekarappa K. G., *Engineering Mechanics*, New Age International (P) Limited Publishers (1998).
- Irving H. Shames, *Engineering Mechanics*, Prentice-Hall.

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MATERIAL ENGINEERING
BVME304

Course Objectives:

- Understanding the correlation between the internal structure of materials, their mechanical properties, and various methods to quantify their mechanical integrity and failure criteria
- To provide a detailed interpretation of equilibrium phase diagrams.
- Learning about different phases and heat-treatment methods to tailor the properties of Fe–C alloys.

Course Outcomes:

- Explain the crystal structure, mechanical properties and properties of various ferrous and non-ferrous alloys.
- Explain Ductile and brittle failure mechanisms and various mechanical testing methods of materials
- To explain the phase diagram for multi-component systems and explain the microstructures development.
- Describe various types of heat treatment process and sketch isothermal transformation.
- Discuss the properties of Alloying of steel, properties of stainless steel, and toolsteels.

Unit 1: **06**

Crystal Structure:

- Unit cells, metallic crystal structures, ceramics.

Imperfections in Solids:

- Point, line, interfacial and volume defects; dislocation strengthening mechanisms and slip systems; critically resolved shear stress.

Mechanical Property Measurement:

- Tensile, compression and torsion tests; Young's modulus; relation between true and engineering stress–strain curves; generalized Hooke's law; yielding and yield strength; ductility, resilience, toughness and elastic recovery.

Hardness:

- Rockwell, Brinell and Vickers hardness tests and their relation to strength.

Unit 2: **06**

Static Failure Theories:

- Ductile and brittle failure mechanisms, Tresca, Von Mises, Maximum Normal Stress, Mohr–Coulomb and Modified Mohr–Coulomb criteria.

Fracture Mechanics:

- Introduction to stress-intensity factor approach and Griffith criterion.

Fatigue Failure:
- High-cycle fatigue, stress–life approach, S–N curve, endurance and fatigue limits, effects of mean stress using the Modified Goodman diagram; fracture with fatigue.

Non-Destructive Testing (NDT):
- Introduction to NDT techniques.

Unit 3: **06**
Alloys and Solid Solutions:
- Substitutional and interstitial solid solutions.

Phase Diagrams:
- Interpretation of binary phase diagrams and microstructure development; eutectic, peritectic, peritectoid and monotectic reactions.

Fe–C Phase Diagram:
- Iron–iron carbide diagram and microstructural aspects of ledeburite, austenite, ferrite and cementite; cast iron.

Unit 4: **06**
Heat Treatment of Steel:
- Annealing, tempering, normalising and spheroidising.

Transformation Diagrams;
- Isothermal transformation (IT) diagrams for Fe–C alloys and microstructure development.
- Continuous cooling transformation (CCT) curves and interpretation of final microstructures and properties.

Advanced Heat-Treatment Processes:
- Austempering, martempering, case hardening, carburizing, nitriding, cyaniding, carbo-nitriding, flame and induction hardening, vacuum and plasma hardening.

Unit 5: **06**
Alloying of Steel:
- Properties of stainless steel, tool steels and maraging steels.

Cast Irons:
- Grey, white, malleable and spheroidal (ductile) cast irons.

Non-Ferrous Alloys:
- Copper and copper alloys: brass, bronze and cupro-nickel. Aluminium and Al–Cu–Mg alloys. Nickel-based super alloys and titanium alloys.

References:

- W. D. Callister (2006), Materials Science and Engineering – An Introduction, 6th Edition, Wiley India.
- Kenneth G. Budinski and Michael K. Budinski, Engineering Materials, Prentice Hall of India Private Limited, 4th Indian Reprint, 2002.
- V. Raghavan, Material Science and Engineering, Prentice Hall of India Private Limited, 1999.
- James M. Gere, Mechanics of Materials.
- B. K. Agarwal, Introduction to Engineering Materials.
- R. E. Smallman, Physical Metallurgy and Advanced Materials.
- Isaac M. Daniel, Engineering Mechanics of Composite Materials.
- U. C. Jindal, Engineering Materials and Metallurgy, Pearson, 2011.

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ON JOB TRAINING/INTERNSHIP/WORKSHOP
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SEMESTER-04

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APPLIED THERMODYNAMICS
BVME401

Course Objectives:

- To learn about the use of I law for reacting systems and the heating value of fuels.
- To learn about gas and vapor cycles and their first law and second law efficiencies.
- To understand the properties of dry and wet air and the principles of psychrometry
- To learn about gas dynamics of air flow and steam through nozzles.
- To learn about reciprocating compressors with and without intercooling.
- To analyze the performance of steam turbines.

Course Outcomes:

- To understand the applications of engineering thermodynamics in real life situations
- To perform gas power cycle analysis
- They will be able to analyze energy conversion in various thermal devices such as combustors, air coolers, nozzles, diffusers, steam turbines and reciprocating compressors.
- They will be able to understand phenomena occurring in high speed compressible flows.
- To perform vapor power cycle analysis
- To analyze thermodynamic system with compressible fluid

Unit 1: **06**

- Introduction to solid, liquid and gaseous fuels – Stoichiometry, exhaust gas analysis – First law analysis of combustion reactions – Heat calculations using enthalpy tables – Adiabatic flame temperature – Chemical equilibrium and equilibrium composition calculations using free energy. Introduction to Otto, Diesel and Dual cycles.

Unit 2: **06**

Vapour Power Cycles:

- Vapour power cycles, Rankine cycle with superheat, reheat and regeneration, exergy analysis. Rankine cycle: effect of pressure and temperature on Rankine cycle, Reheat cycle, Regenerative cycle, Feed water heaters, Binary vapour cycle, Combined cycles, Cogeneration.

Fuels and Combustion:

- Combustion analysis, heating values, air requirement, Air/Fuel ratio, standard heat of reaction and effect of temperature on standard heat of reaction, heat of formation, Adiabatic flame temperature.

Unit 3: **06**

Boilers:

- Classification and working of boilers, boiler mountings and accessories, Draught and its calculations, air pre-heater, feed water heater, superheated. Boiler efficiency, equivalent evaporation, boiler trial and heat balance.

Condenser:

- Classification of condensers, air leakage, condenser performance parameters.

Unit 4: **06**

Steam and Gas Nozzles:

- Flow through convergent and convergent-divergent nozzles, variation of velocity, area and specific volume, choked flow, throat area, nozzle efficiency, off-design operation of nozzle, shock waves, stationary normal shock waves, effect of friction on nozzle, supersaturated flow.

Steam Turbines:

- Classification of steam turbines, impulse and reaction turbines, staging, stage and overall efficiency, reheat factor, bleeding, velocity diagram of simple and compound multistage impulse and reaction turbines and related calculations, work done, efficiencies of reaction and impulse-reaction turbines, state point locus, losses in steam turbines, governing of turbines, comparison with steam engine.

Unit 5: **06**

Gas Turbine:

- Gas turbine classification, Brayton cycle, principles of gas turbines, gas turbine cycles with intercooling, reheat and regeneration and their combinations, stage efficiency, polytropic efficiency. Deviation of actual cycles from ideal cycles.

Jet Propulsion:

- Introduction to the principles of jet propulsion, turbojet and turboprop engines and their processes, principle of rocket propulsion, introduction to rocket engines.

Reciprocating Compressors:

- Staging of reciprocating compressors, optimal stage pressure ratio, effect of intercooling, minimum work for multistage reciprocating compressors.

References:

- Basic and Applied Thermodynamics – P. K. Nag, McGraw Hill India
- Applied Thermodynamics – Onkar Singh, New Age International
- Applied Thermodynamics for Engineering Technologists – Eastop, Pearson Education
- Applied Thermodynamics – Venkanna and Swati, PHI
- Sonntag, R. E., Borgnakke, C. and Van Wylen, G. J., Fundamentals of Thermodynamics, 6th Edition, 2003, John Wiley and Sons
- Jones, J. B. and Duggan, R. E., Engineering Thermodynamics, Prentice-Hall of India, 1996
- Moran, M. J. and Shapiro, H. N., Fundamentals of Engineering Thermodynamics, John Wiley and Sons, 1999
- Theory of Steam Turbine – W. J. Kearton

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FLUID MECHANICS & FLUID MACHINES
BVME402

Course Objectives:

- To learn about the application of mass and momentum conservation laws for fluid flows.
- To understand the importance of dimensional analysis.
- To obtain the velocity and pressure variations in various types of simple flows.
- To analyze the flow in water pumps and turbines.

Course Outcomes:

- Obtaining a solid understanding of the fundamentals of Fluid Mechanics
- The ability to formulate basic equations for Fluid Engineering problems
- The ability to use tables and figures to determine the friction energy loss for various pipes/ducts geometries and Fluid engineering applications
- They will be able to evaluate the performance of pumps and turbines.
- The ability to perform dimensional analysis and identify important parameters

Unit 1: **06**

- Definition of fluid, Newton's law of viscosity, units and dimensions – Properties of fluids: mass density, specific volume, specific gravity, viscosity, compressibility and surface tension. Incompressible flow, Bernoulli's equation and its applications – Pitot tube, orifice meter, venturi meter and bend meter, notches and weirs, momentum equation and its application to pipe bends.

Unit 2: **06**

- Continuum & free molecular flows. Steady and unsteady, uniform and non-uniform, laminar and turbulent flows, rotational and irrotational flows, compressible and incompressible flows, subsonic, sonic and supersonic flows, sub-critical, critical and supercritical flows. One-, two- and three-dimensional flows, streamlines, continuity equation for 3D and 1D flows, circulation, stream function and velocity potential. Buckingham's Pi theorem, important dimensionless numbers and their significance.

Unit 3: **06**

- Equation of motion for laminar flow through pipes, turbulent flow, isotropic and homogeneous turbulence, scale and intensity of turbulence, measurement of turbulence, eddy viscosity, resistance to flow, minor losses, pipes in series and parallel, power transmission through a pipe, siphon, water hammer, three-reservoir problems and pipe networks.

- Boundary layer thickness, boundary layer over a flat plate, laminar boundary layer, application of momentum equation, turbulent boundary layer, laminar sub-layer, separation and its control. Drag and lift on a sphere, a two-dimensional cylinder and an aerofoil, Magnus effect.

Unit 4: **06**

- Introduction to hydrodynamic thrust of jet on a fixed and moving surface. Classification of turbines.

Impulse Turbines:

- Constructional details, velocity triangles, power and efficiency calculations, governing of Pelton wheel.

Reaction Turbines (Francis and Kaplan):

- Constructional details, velocity triangles, power and efficiency. Principles of similarity, unit and specific speed, performance characteristics, selection of water turbines.

Unit 5: **06**

Centrifugal Pumps:

- Classification of centrifugal pumps, vector diagram, work done by impeller, efficiencies of centrifugal pumps, specific speed, cavitation and separation, performance characteristics.

Reciprocating Pumps:

- Theory, slip, indicator diagram, effect of acceleration, air vessels, comparison of centrifugal and reciprocating pumps, performance characteristics.

References:

- Introduction to fluid mechanics and Fluid machines by S.K Som,Gautam Biswas, S Chakraborty.
- Fluid mechanics and machines by R.K Bansal.
- F. M. White, Fluid Mechanics, 6th Ed., Tata McGraw-Hill, 2008.
- Fluid Mechanics and Its Applications byV.K.Guptaet.al.
- Fluid Mechanics by Yunus Cengel.
- Batchelor, G. K. (1999).Introduction to fluid dynamics. New Delhi, India: Cambridge University Press.
- Acheson, D. J. (1990).Elementary fluid dynamics. New York, USA: Oxford University Press.
- R.W.Fox, A.T. McDonald and P.J. Pritchard, Introduction to Fluid Mechanics, 6th Ed.,John Wiley,2004.

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MANUFACTURING PROCESS
BVME403

Course Objective:

- To motivate and challenge students to understand and develop an appreciation of the processes in correlation with material properties which change the shape, size, and form of the raw materials into the desirable product by conventional or unconventional manufacturing methods.

Course Outcomes:

- To understand various manufacturing processes & its classifications
- To understand various Casting processes
- To understand various welding processes
- To understand various metal removal process
- To appreciate the capabilities, advantages and the limitations of the processes

Unit 1: **06**

Conventional Manufacturing Processes:

Casting and Moulding:

- Metal casting processes and equipment
- Heat transfer and solidification
- Shrinkage, riser design, casting defects and residual stresses

Bulk and Sheet Metal Forming:

- Introduction to bulk and sheet metal forming
- Plastic deformation and yield criteria
- Fundamentals of hot and cold working processes
- Load estimation for bulk forming (forging, rolling, extrusion, drawing)
- Load estimation for sheet forming (shearing, deep drawing, bending)

Powder Metallurgy:

- Basic principles of powder metallurgy

Unit 2: **06**

Metal Cutting:

- Single and multi-point cutting
- Orthogonal cutting, force components
- Chip formation
- Tool wear and tool life
- Surface finish and integrity
- Machinability
- Cutting tool materials
- Cutting fluids and coatings
- Turning, drilling, milling, and finishing processes
- Introduction to CNC machining

Additive Manufacturing:
- Rapid prototyping and rapid tooling

Joining/Fastening Processes:
- Physics of welding, brazing, and soldering
- Design considerations in welding
- Solid and liquid-state joining processes
- Adhesive bonding

Unit 3: **06**
Grinding & Superfinishing:
Grinding:
- Grinding wheels: abrasives and bonds
- Cutting action
- Grinding wheel specification
- Types of grinding wheel wear: attrition wear, fracture wear
- Dressing and truing
- Maximum chip thickness and Guest criteria
- Surface and cylindrical grinding
- Centre less grinding

Superfinishing Processes:
- Honing
- Lapping
- Polishing

Unit 4:
06
Metal Joining (Welding):
- Overview of welding and allied processes
- Gas welding and cutting: process and equipment
- Arc welding: power sources and consumables
- TIG & MIG processes and their parameters
- Resistance welding – spot, seam, projection welding
- Other processes: atomic hydrogen welding, submerged arc welding, electroslag welding, friction welding
- Soldering and brazing
- Adhesive bonding
- Weld decay in the heat-affected zone (HAZ)

Unit 5: **06**
Unconventional Machining Processes:
Mechanical Processes:
- Abrasive Jet Machining (AJM)
- Water Jet Machining (WJM)
- Abrasive Water Jet Machining (AWJM)
- Ultrasonic Machining (USM)
- Principles and process parameters

Electrical Processes:

- Electrical Discharge Machining (EDM):
    - » Principles, process parameters
    - » Material removal rate (MRR)
    - » Surface finish
    - » Tool wear
    - » Dielectric fluids
    - » Power and control circuits
    - » Wire EDM

Electrochemical Processes:

- Electrochemical Machining (ECM):
    - » Etchant and maskant
    - » Process parameters
    - » MRR and surface finish

Beam-Based Processes:

- Laser Beam Machining (LBM)
- Plasma Arc Machining (PAM)
- Electron Beam Machining (EBM)

References:

- **Kalpakjian & Schmid**, Manufacturing Processes for Engineering Materials (5th Ed.), Pearson India (2014).
- **Mikell P. Groover**, Fundamentals of Modern Manufacturing: Materials, Processes, and Systems.
- **P. N. Rao**, Manufacturing Technology, McGraw Hill India.
- **Paul Degarmo**, Materials and Manufacturing.
- **Kaushish**, Manufacturing Processes, PHI.
- **Jain**, Principles of Foundry Technology, McGraw Hill India.
- **R. K. Jain**, Production Technology.
- **Degarmo, Black & Kohser**, Materials and Processes in Manufacturing.

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STRENGTH OF MATERIAL
BVME404

Course Objectives:

- To study the identification of different types of forces, systematic evaluation of the effects of these forces, and the behavior of rigid bodies subjected to various types of forces, in the state of rest or motion of the particles.
- To understand the fundamental principles, concepts, and techniques, both theoretical and experimental, with emphasis on their application to solving Mechanics-based engineering problems.

Course Outcomes:

- Understand the concept of stress and strain under different loading conditions
- Determine the principal stresses and strains in structural members
- Determine the stresses and strains in members subjected to axial, bending, and torsional loads
- Apply concepts of stress and strain to solve problems related to springs, columns, and pressure vessels
- Calculate slope, deflection, and buckling of loaded members
- Analyze stresses developed in straight and curved beams of various cross-sections

Unit 1: **06**

Compound Stress and Strains:

- Introduction: normal stress and strain; shear stress and strain
- Stresses on inclined sections
- Strain energy and impact loads
- State of plane stress: principal stress and strain, maximum shear stress
- Mohr's circle for plane stress
- Three-dimensional states of stress and strain
- Equilibrium equations, generalized Hooke's law
- Theories of failure
- Thermal stresses

Unit 2: **06**

Stresses in Beams:

- Pure bending
- Normal stresses in beams
- Shear stresses in beams due to transverse and axial loads
- Composite beams

Deflection of Beams:

- Differential equation of the elastic curve
- Cantilever and simply supported beams
- Macaulay's method
- Area-moment method
- Fixed and continuous beams

Torsion:
- Torsion of shafts
- Combined bending and torsion of solid and hollow shafts
- Torsion of thin-walled tubes

Unit 3: **06**
Helical and Leaf Springs:
- Deflection of springs by energy method
- Helical springs under axial load and axial twist (circular and square cross-sections)
- Springs under simultaneous axial load and twisting moment (open and closed-coiled)
- Laminated springs

Columns and Struts:
- Buckling and stability
- Slenderness ratio
- Combined bending and direct stress
- Middle-third and middle-quarter rules
- Struts with different end conditions
- Euler's theory for pin-ended columns
- Effect of end conditions on buckling
- Rankine–Gordon formula
- Examples of columns in mechanical equipment and machines

Unit 4: **06**
Thin Cylinders and Spheres:
- Introduction
- Difference between thin-walled and thick-walled pressure vessels
- Thin-walled cylinders and spheres
- Hoop and axial stresses and strain
- Volumetric strain

Thick Cylinders:
- Radial, axial, and circumferential stresses in thick cylinders under internal/external pressure
- Compound cylinders
- Stresses in rotating shafts and cylinders
- Stresses due to interference fits

Unit 5: **06**
Curved Beams:
- Bending of beams with large initial curvature
- Position of neutral axis for rectangular, trapezoidal, and circular cross-sections
- Stresses in crane hooks
- Stresses in circular rings under tension or compression

Unsymmetrical Bending:
- Properties of beam cross-section
- Slope of neutral axis
- Stress and deflection in unsymmetrical bending
- Determination of shear center and flexural axis (for symmetry about one axis or both axes) for I-section and channel section

References:

- Strength of Materials — Sadhu Singh, Khanna Book Publishing Co. (P) Ltd.
- Strength of Materials — Rattan, McGraw Hill India
- Mechanics of Materials — B. C. Punmia, Laxmi Publications (P) Ltd.
- Mechanics of Materials — Hibbeler, Pearson
- Mechanics of Materials — Gere, Cengage Learning
- Mechanics of Materials — Beer, Johnston, DeWolf & Mazurek, McGraw Hill India
- Strength of Materials — Pytel and Singer, Harper Collins
- Strength of Materials — Ryder, Macmillan
- Strength of Materials — Timoshenko & Young, East-West Press
- Introduction to Solid Mechanics — Shames, Pearson
- Mechanics of Materials — Pytel, Cengage Learning
- An Introduction to Mechanics of Solids — Crandall, McGraw Hill India
- Strength of Materials — Jindal, Pearson Education
- Strength of Materials — Basavajaiah & Mahadevappa, University Press

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ON JOB TRAINING/INTERNSHIP/WORKSHOP
BVME405P

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SEMESTER-05

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HEAT AND MASS TRANSFER
BVME501

Course Objective:

- This course imparts basic knowledge of heat transfer. The knowledge imparted will enable the student to reduce or increase heat transfer in existing equipment as needed and undertake the preliminary design of heat exchangers.

Course Outcomes:

- Understand the fundamentals of heat and mass transfer.
- Apply the concept of steady and transient heat conduction.
- Apply the concept of the thermal behavior of fins.
- Apply the concept of forced and free convection.
- Apply the concept of radiation for black and non-black bodies.
- Conduct thermal analysis of heat exchangers.

Unit 1: **06**

Introduction to Heat Transfer:

- Introduction to thermodynamics and heat transfer; Modes of heat transfer: conduction, convection, and radiation; Effect of temperature on thermal conductivity of different types of materials; Introduction to combined heat transfer mechanisms; General differential heat conduction equation in rectangular, cylindrical, and spherical coordinate systems; Initial and system boundary conditions.

Steady-State One-Dimensional Heat Conduction:

- Simple and composite systems in rectangular, cylindrical, and spherical coordinates with and without energy generation; Concept of thermal resistance; Analogy between heat and electricity flow; Thermal contact resistance and overall heat transfer coefficient; Critical radius of insulation for cylindrical and spherical bodies.

Unit 2: **06**

Fins:

- Heat transfer through extended surfaces and its classification; Fins of uniform cross-sectional area; Error in measurement of temperature in thermometer wells.

Transient Conduction:

- Transient heat conduction; Lumped capacitance method; Time constant; Unsteady-state heat conduction in one dimension only; Heisler charts and their applications.

Unit 3: **06**

Forced Convection:

- Basic concepts: hydrodynamic boundary layer, thermal boundary layer; Approximate integral boundary layer analysis; Analogy between momentum and heat transfer in turbulent flow over a flat surface; Mixed boundary layer; Flow over a flat plate; Flow across a single cylinder and a sphere; Flow inside ducts; Thermal entrance region; Empirical heat transfer relations; Relation between fluid friction and heat transfer; Liquid metal heat transfer.

Natural Convection:

- Physical mechanism of natural convection; Buoyant force; Empirical heat transfer relations for natural convection over vertical planes and cylinders, horizontal plates, cylinders, and spheres; Combined free and forced convection; Effect of turbulence.

Unit 4: **06**

Thermal Radiation:

- Basic concepts of radiation; Radiation properties of surfaces; Black body radiation: Planck's law, Wien's displacement law, Stefan–Boltzmann law, Kirchhoff's law; Gray body; Shape factor; Black-body radiation; Radiation exchange between diffuse non-black bodies in an enclosure; Radiation shields; Radiation combined with conduction and convection; Absorption and emission in gaseous media; Solar radiation; Greenhouse effect; Radiation network analysis.

Unit 5: **06**

Heat Exchanger:

- Different types of heat exchangers; Fouling factors; Overall heat transfer coefficient; Logarithmic mean temperature difference (LMTD) method; Effectiveness–Number of Transfer Units (NTU) method; Compact heat exchangers.

Condensation and Boiling:

- Introduction to condensation phenomena; Heat transfer relations for laminar film condensation on vertical surfaces and on the outside and inside of a horizontal tube; Effect of non-condensable gases; Dropwise condensation; Heat pipes; Boiling modes; Pool boiling; Hysteresis in boiling curve; Forced convection boiling.

Introduction to Mass Transfer:

- Introduction to Fick's law of diffusion; Steady-state equimolar counter-diffusion; Steady-state diffusion through a stagnant gas film; Heat and mass transfer analogy; Convective mass transfer correlations.

References:

- Fundamentals of Heat and Mass Transfer by Incropera & DeWitt, John Wiley & Sons.
- Heat and Mass Transfer by Cengel, McGraw-Hill.
- Heat Transfer by J. P. Holman, McGraw-Hill.
- Heat and Mass Transfer by Rudramoorthy and Mayilsamy, Pearson Education.
- Heat Transfer by Ghoshdastidar, Oxford University Press.
- A Textbook on Heat Transfer by Sukhatme, University Press.
- Heat Transfer by Venkateshan, Ane Books Pvt. Ltd.
- Schaum's Outline of Heat Transfer by Pitts & Sisson, McGraw-Hill.
- Heat and Mass Transfer by R. Yadav, Central Publishing House.

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INDUSTRIAL ENGINEERING
BVME502

Course Objective:

- The course provides knowledge of work study; work force management; cost analysis; PPC; MIS and product design. After going through the course; the student will be able to manage factory activities in a proper and efficient manner

Course Outcomes:

- Understand the concept of production system, productivity, facility and process planning in various industries
- Apply the various forecasting and project management techniques
- Apply the concept of break-even analysis, inventory control utilization using queuing theory
- Apply principles of work study and ergonomics for design of work systems
- Formulate mathematical models for optimal solution of industrial problems using linear programming approach

Unit 1: **06**

- **Overview of Industrial Engineering:** Types of production systems, concept of productivity, productivity measurement in manufacturing and service organizations, operations strategies, liability and process design.

- **Facility location and layout:** Factors affecting facility location; principle of plant layout design, types of plant layout; computer aided layout design techniques; assembly line balancing; materials handling principles, types of material handling systems, methods of process planning, steps in process selection, production equipment and tooling selection, group technology, and flexible manufacturing.

Unit 2: **06**

- **Production Planning and control:** Forecasting techniques – causal and time series models, moving average, exponential smoothing, trend and seasonality; aggregate production planning; master production scheduling; materials requirement planning (MRP) and MRP-II; routing, scheduling and priority dispatching, concept of JIT manufacturing system

- **Project Management:** Project network analysis, CPM, PERT and Project crashing.

Unit 3: **06**

- **Engineering economy and Inventory control:** Methods of depreciation; break-even analysis, techniques for evaluation of capital investments, financial statements, time-cost trade-off, resource levelling; Inventory functions, costs, classifications, deterministic inventory models, perpetual and periodic inventory control systems, ABC analysis, and VED analysis.

- **Queuing Theory:** Basis of Queuing theory, elements of queuing theory, Operating characteristics of aqueuing system, Classification of Queuing models.

Unit 4: **06**

- **Work System Design:** Taylor's scientific management, Gilbreths's contributions; work study: method study, micro-motion study, principles of motion economy; work measurement –time study, work sampling, standard data, Predetermined motion time system (PMTS); ergonomics; job evaluation, merit rating, incentive schemes, and wage administration.

- **Product Design and Development:** Principles of product design, tolerance design; quality and cost considerations; product life cycle; standardization, simplification, diversification, value engineering and analysis, and concurrent engineering.

Unit 5: **06**

- **Operational Analysis:** Formulation of LPP, Graphical solution of LPP, Simplex Method,SensitivityAnalysis, degeneracy and unbound solutions. transportation and assignment models; Optimality test: the stepping stone method and MODI method, simulation.

References:

- Industrial Engineering and Production Management by Martand T Telsang S. Chand Publishing
- Industrial Engineering and Production Management by M. Mahajan Dhanpat Rai & Co. (P) Limited
- Industrial Engineering and Management by Ravi Shankar, Galgotia Publications Pvt Ltd
- Production and Operations Management by Adam, B.E. & Ebert, R.J., PHI
- Product Design and Manufacturing by Chitale A.V. and Gupta R.C., PHI
- Operations Research Theory & Applications by J K Sharma, Macmillan India Ltd,
- Production Systems Analysis and Control by J.L.Riggs, John Wiley & Sons
- Automation, Production Systems & Computer Integrated Manufacturing by Groover, M.P. PHI
- Operations Research, by A.M. Natarajan, P. Balasubramani, A. Tamilarasi, Pearson Education
- Operations Research by P. K. Gupta and D. S. Hira, S. Chand & Co.

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POWER PLANT ENGINEERING
BVME503

Course Objective:

- To introduce students to different aspects of power plant engineering. To familiarize the students to the working of power plants based on different fuels. To expose the students to the principles of safety and environmental issues.

Course Outcomes:

- Describe and analyze different types of sources and mathematical expressions related to thermodynamics and various terms and factors involved with power plant operation.
- Analyze the working and layout of steam power plants and the different systems comprising the plant and discuss about its economic and safety impacts.
- Combine concepts of previously learnt courses to define the working principle of diesel power plant, its layout, safety principles and compare it with plants of other types.
- Describe the working principle and basic components of the nuclear power plant and the economic and safety principles involved with it.
- Discuss the working principle and basic components of the hydroelectric plants and the economic principles and safety precautions involved with it.

Unit 1: **06**

- **Introduction:** Power and energy, sources of energy, review of thermodynamic cycles related to power plants, fuels and combustion calculations. Load estimation, load curves, various terms and factors involved in power plant calculations. Effect of variable load on power plant operation, Selection of power plant units. Power plant economics and selection Effect of plant type on costs, rates, fixed elements, energy elements, customer elements and investor's profit; depreciation and replacement, theory of rates. Economics of plant selection, other considerations in plant selection.

Unit 2: **06**

- **Steam power plant:** General layout of steam power plant, Power plant boilers including critical and super critical boilers. Fluidized bed boilers, boilers mountings and accessories, Different systems such as coal handling system, pulverisers and coal burners, combustion system, draft, ash handling system, Dust collection system, Feed water treatment and condenser and cooling towers and cooling ponds, Turbine auxiliary systems such as governing, feed heating, reheating, flange heating and gland leakage. Operation and maintenance of steam power plant, heat balance and efficiency, Site selection of a steam power plant.

Unit 3: **06**

- **Diesel power plant:** General layout, Components of Diesel power plant, Performance of diesel power plant, fuel system, lubrication system, air intake and admission system, supercharging system, exhaust system, diesel plant operation and efficiency, heat balance, Site selection of diesel power plant, Comparative study of diesel power plant with steam power plant. Gas turbine power plant: Layout of gas turbine power plant, Elements of gas turbine power plants, Gas turbine fuels, cogeneration, auxiliary systems such as fuel, controls and lubrication, operation and maintenance, Combined cycle power plants, Site selection of gas turbine power plant, Integrated Gasifier based Combined Cycle (IGCC) systems.

Unit 4: **06**

- **Nuclear power plant:** Layout and subsystems of nuclear power plants, Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANDU Reactor, Pressurized Heavy Water Reactor (PHWR), Fast Breeder Reactors (FBR), gas cooled and liquid metal cooled reactors, safety measures for nuclear power plants. Hydroelectric and Non-Conventional Power Plant: Hydroelectric power plants, classification, typical layout and components, principles of wind, tidal, solar PV and solar thermal, geothermal, biogas and fuel cell power systems.

Unit 5: **06**

- **Electrical system:** Generators and generator cooling, transformers and their cooling, bus bar, etc. Energy Saving and Control: Energy, economic and environmental issues, power tariffs, load distribution parameters, load curve, capital and operating cost of different power plants, pollution control technologies including waste disposal options for coal and nuclear plants.

References:

- Power Plant Engineering, by F.T. Morse, Affiliated East-West Press Pvt. Ltd.
- Power Plant Engineering by Hedge, Pearson India.
- Power Plant Technology, by Wakil, McGraw Hill.
- Power Plant Engineering by P.K. Nag, Tata McGraw Hill.
- Steam & Gas Turbines & Power Plant Engineering by R.Yadav, Central Pub.House.
- Power Plant Engineering by Gupta, PHI India.
- El Wakil M.M., Power Plant Technology, Tata McGraw Hill, 2010.
- Power Plant Engineering. Mahesh Verma, Metropolitan Book Company Pvt. Ltd.

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AUTOMOBILE TECHNOLOGY
BVME504

Course Objective:

- The purpose of this course is to impart adequate knowledge in both practical and theoretical, covering the various types of power-driven vehicles and to familiarize the students with the fundamentals of Automotive Engine System, Chassis and suspension system, braking and transmission system, and cooling system. The students are acquainted with the operation, maintenance and repairs of all components of the various transportation vehicles.

Course Outcomes:

Students completing this course will be able to:

- It gives the information about the transmission system used in automobile like clutch, gear box and wheels with tyres
- It provide the idea about steering and braking system
- It provides the details about system and its work, shock absorbers and the storage batteries with its its different uses.
- It gives information about the voltage and current generation in automobile and types of motors and its Behavior at the time of starting.
- It provide the idea about the automobile wiring system like parking, brake, speedometer, pressure gauge and temperature gauge etc.

Unit 1: **06**

Auto Transmission System:

- **Clutch:** Function of clutch in an auto mobile, Construction detail of single plate and multi plate friction clutches, Centrifugal and semi centrifugal clutch. Construction and working of fluid flywheel.

- **Gear Box:** Its function, Assembly detail and working of sliding Mesh, constant mesh, Synchromesh and epicycle gear boxes. Simple concept of over drive, overrunning clutch, transfer case and torque converter.

- **Wheels and Tyres:** Sizes of tyres used in Indian vehicles, over inflation, under inflation and their effect. Causes of tyre wear, Tyre retreading, idea of Toe in, Toe out, Camber, Caster, King pin inclination. Advantages of tube less tyres over tyres with tubes. Wheel alignment and balancing, Tyre rotation, Difference between radial and cross ply.

Unit 2: **06**

- **Steering System:** Its function, Principle of steering. Ackerman and Devis steering gears, Steering gear types, Worm and nut, Worm and wheel, Worm and roller, Rack and pinion type. Concept of steering system commonly used in Indian Vehicles. Concept of steering locking assembly, introduction to power steering.

- **Braking System:** Construction details and working of mechanical, Hydraulic and Vacuum brakes, disc brake, air brake, Introduction to power brake. Details of master cylinder, Wheel cylinders, Concept of brake drum and brake linings and brake adjustment.

Unit 3: **06**

- **Suspension System:** Function of suspension system. Types of suspension systems, Working of leaf springs, Coil springs. Shock absorbers, Torsion bar suspension and stabilizers. Mac phersion system.

- **Storage Battery:** Storage Battery constructional detail of lead acid cell battery. Battery charging from D.C. mains, A.C. mains, Battery charger-Charging circuit, care and maintenance of batteries. Checking of cells for voltage and specific gravity of electrolyte.

Unit 4: **06**

Dynamo and Alternator:

- Introduction to Dynamo and its details, Regulators-Voltage, current and compensated types. Charging of battery from alternator. Use of battery, dynamo/alternator in an automobile.

Engine Starting:

- Engine starting circuit, Drive motor and its characteristics, Conditions of starting and behavior of motor at starting. Turbo charging and inter-cooling.

Unit 5: **06**

Automobile Wiring & Lighting System:

- Earth returns and insulated return systems-6 volts, 12 volts and 24 volts systems, Positive and negative earthing, Fuse in circuit, Automobile cables Specifications and color code. Diagram of typical wiring systems. Principle of auto illumination, Lighting requirement-Head lamp mounting and construction, sealed beam lamp, Parking brake, Direction indicators. Electric horns, Revolution counter, Speedometer, Fuel gauge, Pressure gauge, and Temperature gauge, Wind screen wipers, and stereo system and speaker, introduction to remote sensing devices. Microprocessor control of automobile.

Study of Specification for Different Units:

- Clutch, Gear Box, Propeller Shaft, Final Drive, Wheel and tyre manufactured in India.

References:

- I.C Engine Analysis & Practice by E.F Obert.
- Internal Combustion Engine Fundamentals, by John B. Heywood, Tata Mcgraw Hill Publishers.
- Engine Emission, by B. B. Pundir, Narosa Publication.
- Engineering Fundamentals of Internal Combustion Engines by W.W. Pulkrabek, Pearson Education.
- Fundamentals of Internal Combustion Engine by Gill, Smith, Ziurs, Oxford & IBH Publishing CO.
- Fundamentals of Internal Combustion Engines by H.N. Gupta, Prentice Hall of India.

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ON JOB TRAINING/INTERNSHIP/WORKSHOP
BVME505P

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SEMESTER-06

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REFRIGERATION AND AIR CONDITIONING
BVME601

Course Objectives:

- It helps the students to understand the concepts and uses of various types of refrigeration systems and equipments.
- The student will be able to estimate the heating/cooling load and design air conditioning system and equipments.

Course Outcomes:

- Understand the basics concepts of Refrigeration & Air-Conditioning and its future prospects.
- Explain the construction and working of various components in Refrigeration & Air-Conditioning systems.
- Understand the different types of RAC systems with their respective applications.
- Apply the basic laws to the thermodynamic analysis of different processes involved in Refrigeration and Air-Conditioning.
- Apply the basic concepts to calculate the COP and other performance parameters for different RAC systems
- Analyze the effects of performance parameters on COP.

Unit 1: **06**

Refrigeration:

- Introduction to refrigeration system, Methods of refrigeration, Unit of refrigeration, Refrigeration effect, Carnot refrigeration cycle, Refrigerator and Heat Pump, C.O.P.

Air Refrigeration cycle:

- Open and closed air refrigeration cycles, Reversed air Carnot cycle, Bell Coleman or Reversed Joule air refrigeration cycle, Need of Aircraft refrigeration, Classification of aircraft refrigeration system. Boot strap refrigeration, Regenerative, Reduced ambient, Dry air rated temperature (DART).

Unit 2: **06**

Vapour Compression System:

- Reversed vapour Carnot cycle, limitation of Reversed vapour Carnot cycle, Simple vapour compression cycle, Analysis of vapour compression cycle, Use of T-S and P-H charts, Effect of change in suction and discharge pressures on C.O.P, Effect of sub cooling of condensate & superheating of refrigerant vapour on C.O.P of the cycle, Actual vapour compression refrigeration cycle,

Multistage System:

- Multistage vapour compression system requirement, Different configuration of multi pressure system, Removal of flash gas, Intercooling, Multi evaporator system, Cascade system.

Unit 3: **06**

Vapour Absorption system:

- Working Principal of vapour absorption refrigeration system, Comparison between absorption & compression systems, Elementary idea of refrigerant absorbent mixtures, Temperature – concentration diagram & Enthalpy – concentration diagram , Adiabatic mixing of two streams, Ammonia – Water vapour absorption system, Lithium- Bromide water vapour absorption system, Comparison Three fluid system

Refrigerants:

- Classification of refrigerants, Nomenclature, Desirable properties of refrigerants, Common refrigerants, Secondary refrigerants, and Environment friendly refrigerants, Anti-freeze solution, Phase changing materials, Ozone layer depletion and global warming considerations of refrigerants, Selection of refrigerants, Future Refrigerants like Hydrofluoro-Olefines

Unit 4: **06**

Air Conditioning:

- Introduction to air conditioning, Psychrometric properties and their definitions, Psychrometric chart, Different Psychrometric processes, Air Washers, Cooling towers & humidifying efficiency, Thermal analysis of human body, Effective temperature and comfort chart, Cooling and heating load calculations, Selection of inside & outside design conditions, Heat transfer through walls & roofs, Infiltration & ventilation, Internal heat gain, Sensible heat factor (SHF), By pass factor, Grand Sensible heat factor (GSHF), Apparatus dew point (ADP). Window air Conditioner, Simple air conditioning system, Air conditioning system with ventilation.

Unit 5: **06**

Refrigeration System Equipment:

- Compressors, Condensers, Expansion Devices and Evaporators, Elementary knowledge of transmission and distribution of air through ducts and fans,

Application:

- Food preservation, Transport refrigeration, Cold storage, Refrigerates Freezers, Ice plant, Water coolers, Comfort and Industrial air conditioning Refrigeration.

Other systems:

- Cryogenic liquefaction and refrigeration systems, Brief introduction of Thermo-electric refrigeration system, Steam jet refrigeration system, Vortex tube refrigeration system, Magnetic refrigeration system.

References:

- Refrigeration and Air conditioning by C.P Arora, McGraw-Hill
- Refrigeration and Air conditioning, by Manohar Prasad, New Age International (P) Ltd. Pub.
- Refrigeration and Air conditioning by R.C. Arora, PHI
- Principles of Refrigeration by Roy J. Dossat. Pearson Education
- Refrigeration and Air conditioning by Stoecker & Jones. McGraw-Hill
- Refrigeration and Air conditioning by Arora & Domkundwar. DhanpatRai
- Thermal Environment Engineering. By Kuhen, Ramsey &Thelked

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THEORY OF MACHINE
BVME602

Course objectives:

- To identify and enumerate different link based mechanisms with basic understanding of motion
- To interpret and analyze various velocity and acceleration diagrams for various mechanisms
- To understand and illustrate various power transmission mechanisms using suitable method

Course Outcomes:

The students will be able to:

- Understand the principles of kinematics and dynamics of machines.
- Calculate the velocity and acceleration for 4-bar and slider crank mechanism
- Develop cam profile for followers executing various types of motions
- Apply the concept of gear, gear train and flywheel for power transmission
- Apply dynamic force analysis for slider crank mechanism and balance rotating & reciprocating masses in machines.
- Apply the concepts of gyroscope, governors in fluctuation of load and brake & dynamometer in power transmission.

Unit 1: **06**

- Introduction, mechanisms and machines, kinematics and kinetics, types of links, kinematic pairs and their classification, types of constraint, degrees of freedom of planar mechanism, Grubler's equation, mechanisms, inversion of four bar chain, slider crank chain and double slider crank chain.

- **Velocity analysis:** Introduction, velocity of point in mechanism, relative velocity method, velocities in four bar mechanism, instantaneous center

- **Acceleration analysis:** Introduction, acceleration of a point on a link, acceleration diagram, Corioli's component of acceleration, crank and slotted lever mechanism

Unit 2: **06**

- **Cams:** Introduction, classification of cams and followers, cam profiles for knife edge, roller and flat faced followers for uniform velocity, uniform acceleration

- **Gears and gear trains:** Introduction, classification of gears, law of gearing, tooth forms and their comparisons, systems of gear teeth, length of path of contact, contact ratio, minimum number of teeth on gear and pinion to avoid interference, simple, compound, reverted and planetary gear trains, sun and planet gear train.

Unit 3: **06**

- **Force analysis:** Static force analysis of mechanisms, D'Alembert's Principle, dynamics of rigid link inplane motion, dynamic force analysis of planar mechanisms, piston force and crank effort. Turning moment on crankshaft due to force on piston, Turning moment diagrams for single cylinder double acting steam engine, four stroke IC engine and multi-cylinder engines, Fluctuation of speed, Flywheel.

Unit 4: **06**

- **Balancing:** Introduction, static balance, dynamic balance, balancing of rotating masses, two plane balancing, graphical and analytical methods, balancing of reciprocating masses, balancing of single cylinder engine.

- **Governors:** Introduction, types of governors, characteristics of centrifugal governors, gravity controlled and spring controlled centrifugal governors, hunting of centrifugal governors, inertia governors. Effort and Power of governor

Unit 5: **06**

- **Brakes and dynamometers:** Introduction, Law of friction and types of lubrication, types of brakes, effect of braking on rear and front wheels of a four wheeler, dynamometers, belt transmission dynamometer, torsion dynamometer, hydraulic dynamometer

- **Gyroscope:** Space motion of rigid bodies, angular momentum, gyroscopic couples, gyroscopic stabilization, ship stabilization, stability of four wheel and two wheel vehicles moving on curved paths.

References:

- Kinematics and dynamics of machinery: Wilson and Sadler, Third edition, Pearson.
- Theory of Mechanisms and Machines: Amitabh Ghosh and Ashok Kumar Mallik, Third Edition Affiliated East-West Press.
- Theory of Machines and Mechanisms: Joseph Edward Shigley and John Joseph Uicker, Jr. Oxford University Press
- Kinematics and dynamics of machinery: R L Norton, McGraw Hill
- Theory of Machines: S.S. Rattan, McGraw Hill
- Theory of Machines: Thomas Bevan, CBS Publishers.

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MACHINE DESIGN
BVME603

Course Objective:

- The objectives of this course are to cover basics of design process; engineering materials; failure prevention under static loadings and characteristics of a few types of mechanical elements like joints – temporary / permanent etc.

Course Outcomes:

The student will be able to:

- Recall the basic concepts of Solid Mechanics to understand the subject.
- Classify various machine elements based on their functions and applications.
- Apply the principles of solid mechanics to machine elements subjected to static and fluctuating loads.
- Analyze forces, bending moments, twisting moments and failure causes in various machine elements to be designed.
- Design the machine elements to meet the required specification.

Unit 1: **06**

- **Introduction:** Definition, Design requirements of machine elements, Design procedure, Standards in design, Standards designation of carbon & alloy steels, Selection of preferred sizes, Selection of materials for static and fatigue loads, Design against Static Load

- **Design against Fluctuating Loads:** Cyclic stresses, Fatigue and endurance limit, Stress concentration factor, Stress concentration factor for various machine parts, Design for finite & infinite life, Soderberg, Goodman, Gerber criteria

Unit 2: **06**

- **Riveted Joints:** Riveting methods, materials, Types of rivet heads, Types of riveted joints, Caulking and Fullering, Failure of riveted joint, Efficiency of riveted joint, Design of boiler joints, Eccentric loaded riveted joint

- **Welded Joints:** Stress relieving of welded joints, Butt Joints, Fillet Joints, Strength of Butt Welds, Strength of parallel fillet welds,

- Strength of transverse fillet welds

- **Shafts:** Cause of failure in shafts, Materials for shaft, Stresses in shafts, Design of shafts subjected to twisting moment, bending moment and combined twisting and bending moments, Shafts subjected to fatigue loads, Design for rigidity, Keys, Types of keys, Selection of square and flat keys, Strength of sunk key

Unit 3: **06**

- **Spur Gears:** Tooth forms, System of gear teeth, contact ratio, Standard proportions of gear systems, Interference in involute gears, Backlash, Selection of gear materials, Gear manufacturing methods, Design considerations, Beam strength of gear tooth, Dynamic tooth load, Wear strength of gear tooth, Failure of gear tooth, Design of spur gears, AGMA and Indian standards.

- **Helical Gears:** Terminology, Proportions for helical gears, Force components on a tooth of helical gear, Virtual number of teeth, Beam strength and wear strength of helical gears, Dynamic load on helical gears, Design of helical gears. Introduction, Classification and Applications of Bevel & Worm Gears

Unit 4: **06**

- **Sliding Contact Bearing:** Types, Selection of bearing, Plain journal bearing, Hydrodynamic lubrication, Properties and materials, Lubricants and lubrication, Hydrodynamic journal bearing, Heat generation, Design of journal bearing.

- **Rolling Contact Bearing:** Advantages and disadvantages, Types of ball bearing, Thrust ball bearing, Types of roller bearing, Selection of radial ball bearing, Bearing life, Selection of roller bearings, Dynamic equivalent load for roller contact bearing under constant and variable loading, Reliability of Bearing.

Unit 5: **06**

- **IC Engine Parts:** Selection of type of IC engine, General design considerations, Design of Cylinder and cylinder head; Design of piston, piston ring and gudgeon pin;

- **Friction Clutches:** Clutches, Difference between coupling and clutch, Single plate friction clutch, Torque transmitting capacity, Multi-Disk Clutches, Friction Material

References:

- Design of Machine Elements-V.B. Bhandari, Tata McGraw Hill Co.
- Design of Machine Elements, Sharma and Purohit, PHI.
- Mechanical Engineering Design, 9e – Joseph E. Shigely, McGraw Hill Education.
- Machine Design-Maleev and Hartman, CBS Publishers.
- Design of Machine Design-M.F. Spott, Pearson Education.
- Elements of Machine Component Design, Juvinal & Marshek, John Wiley & Sons.
- Machine design, Robert L. Norton, Pearson Education
- Theory & Problem of Machine Design (Schaum's Outline Series) Hall, Holowenko, Laughlin, Tata McGraw Hill Co.

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CAD/CAM
BVME604

Course Objective:

- The course is aimed at giving exposure to and enhancing the knowledge and skills of fresh graduate engineers and engineers involved in the operation use of CNC machines, CAD/CAM packages and for those who want to provide training to others in this area.

Course Outcomes:

- The student will be able to describe basic geometric modelling.
- The student will be able to use finite element modeling technique for solving problem.
- The student will be able to understand the working and programming for CNC.
- The student will be able to understand how the robot function.
- Students learn the concepts of rapid tool processing.

Unit 1: **06**

Principles of Computer Graphics:

- Point plotting, drawing of lines, Bresenham's circle algorithm. Transformation in Graphics: Co-ordinate system used in Graphics and windowing, view port, views.2D transformations – rotation, scaling, translation, mirror, reflection, shear – homogeneous transformations – concatenation.3D Transformation – Perspective Projection – Technique (Description of techniques only).Geometric Modelling: Classification of Geometric Modelling – Wire frame, Surface and Solid Modelling, applications –representation of curves and surfaces – Parametric form. Design of curved shapes-Cubic spline – Bezier curve – B-spline – Design of Surfaces - features of Surface Modelling Package – Solid Primitives, CSG.B-rep and description of other modelling techniques like Pure primitive instancing, cell decomposition, spatial occupancy enumeration, Boolean Operations (join, cut, intersection), Creating 3D objects from2D profiles (extrusion, revolving etc).

Unit 2: **06**

Graphics standard & Data storage:

- Standards for computer graphics GKS, PHIGS. Data exchange standards – IGES, STEP – Manipulation of the model - Model storage. Finite Element Modelling: Introduction, Mesh Generation – mesh requirements. Semi-Automatic Methods- Node-based approach, Region based approach, Solid-modelling-based methods. Fully Automatic Methods- Element-based approach, Application, Mesh Refinements using Isoperimetric Finite Elements, Meshing in high gradient areas, Transition Regions. Sub modeling Concept. An overview of modelling software's like PRO-E, CATIA, IDEAS, SOLID EDGE etc.

Unit 3:06
CAM:

- **Scope and applications –** NC in CAM – Principal types of CNC machine tools and their construction features – tooling for CNC – ISO designation for tooling – CNC operating system – FANUC,SINUMERIK – LINUMERIK.

- **Programming for CNC machining –** coordinate systems – manual part programming – computer assisted part programming – CNC part programming with CAD system.

- **Material handling in CAM environment:** Types – AGVS – AS/RS – Swarf handling and disposal of wastes – single and mixed mode assembly lines – quantitative analysis of assembly systems.

Unit 4: **06**
Robotics:

- **Classification and specification –** drive and controls – sensors - end effectors - grippers- tool handling and work handling – machine vision – robot programming concepts – case studies in assembly.

- **Quality Function Deployment:** Process Planning – CAPP – Variant and Generative systems- Concurrent Engineering and Design for Manufacturing. Advanced manufacturing Planning Computer Aided Production Planning and Control – Aggregate production planning and master production schedule – MRP – MRP II – ERP - Capacity planning.

Unit 5: **06**
Rapid prototyping:

- Need for rapid prototyping, Basic principles and advantages of RP, General features and classifications of different RP techniques with examples.

- **Introduction to three representative RP techniques:** Fusion Deposition Modelling, Laminated Object Manufacturing and Stereo-lithography.
-
- **Flexible manufacturing cells:** Systems – characteristics – economics and technological justification – planning, installation, operation and evaluation issues – role of group technology and JIT in FMS – typical case studies future prospects.

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