VEERMATA JIJABAI TECHNOLOGICAL INSTITUTE
(VJTI)

MATUNGA, MUMBAI 400 019

(Autonomous Institute affiliated to University of Mumbai)

Curriculum
(Scheme of Instruction & Evaluation and Course contents)

(Revision 2018)
For

Second Year

Of

Four Year Undergraduate Programme Leading to
Bachelor of Technology (B. Tech.) Degree in Production Engineering

Implemented from the batch admitted in first year, 2018-19

Vision and Mission of the Institute

Vision

To establish global leadership in the field of Technology and develop competent human resources for providing service to society

Mission

To provide students with comprehensive knowledge of principles of engineering with a multi-disciplinary approach that is challenging

To create an intellectually stimulating environment for research, scholarship, creativity, innovation and professional activity.

To foster relationship with other leading institutes of learning and research, alumni and industries in order to contribute to National and International development.

Vision and Mission of the Department

Vision

To develop technically competent and disciplined production engineers with creativity, comprehension and managerial skills to serve as a preferred provider of Manufacturing and Industrial Engineering students and services that satisfy the changing needs of all customer segments .

Mission

Inculcate and develop the students who will be able to design and manufacture innovative, environment friendly, ergonomic and cost effective quality products and services.

Enhance the technical quality of the students to fulfil the challenges, competitions and opportunities in Production/ Industrial Engineering.

Prepare the students to solve community related engineering problems and other complex problems by means of inculcating technical managerial skills.

Strive continuously to pursue excellence in all the areas of Manufacturing/ Industrial enhance the department-industry/research center interaction by means of training, internship and student projects to solve industrial problems.

Programme Educational Objectives (PEO)

1. To prepare the Graduates with a sound foundation in the mathematical, scientific and engineering fundamentals and equip with modern tools so as to analyze, formulate, and solve real life manufacturing and industrial engineering problems.
2. To prepare graduates to become product and process design professionals for sustainable manufacturing.
3. To prepare the graduates for a successful career in Indian and Multinational organizations and to excel in their Postgraduate studies.
4. To encourage and motivate the graduates in the art of self-learning.
5. To inculcate a professional and ethical attitude, good leadership qualities and commitment to social responsibilities in the graduates' thought process.

Programme Outcomes (PO)

1. Graduates will demonstrate basic knowledge in mathematics, science and engineering.
2. Graduates will demonstrate the ability to design and conduct experiments, interpret and analyze data, and report results.
3. Graduates will demonstrate the ability to improve a production process or system that meets desired specifications and requirements.
4. Graduates will demonstrate the ability to develop manufacturing friendly products and software packages by working with multidisciplinary teams and applying the knowledge gained during engineering and science laboratory classes.
5. Graduates will demonstrate the ability to identify, formulate and solve manufacturing related problems.
6. Graduates will demonstrate an understanding of their professional and ethical responsibilities.
7. Graduates will be able to demonstrate effective oral and written communication.
8. Graduates will have the confidence to apply engineering solutions in global and societal contexts.
9. Graduates will be capable of self-education and clearly understand the value of lifelong learning.
10. Graduates will be broadly educated and will have an understanding of the impact of engineering on society and demonstrate awareness of contemporary issues.

Graduates will be familiar with modern engineering software tools and equipment to analyze manufacturing related problems

Programme Specific Outcomes (PSO):

1. Identify, formulate and analyze complex engineering problems to solve the real-life problems in the areas of mechanical design, tool design, advanced manufacturing methods, quality assurance and industrial Engineering.
2. Graduates would provide middle-level managerial leadership based study and practice of industrial management imparted during the programme while working in design and manufacturing industries.
3. To employ modern industrial engineering/ management techniques to improve value of the product by improving the quality and reducing the cost of manufacturing.

Scheme of Instruction and Evaluation

B. Tech. Production Engineering

Semester III

Scheme of Instruction						Scheme of Evaluation				
	Course Code	Course Title	Hr/ Week			Credits	TA	MST	ESE	Hours
			L	T	P					
1	R4MA2002S	Mathematics for Production Engineers	3	1	0	4	20	20	60	3
2	R4PE2001T	Manufacturing Technology	3	1	0	4	20	20	60	3
	R4PE2001P	MT Lab	0	0	2	1	40 % CIE + 60% ESE			
3	R4SE2002T	Strength of Material	3	0	0	3	20	20	60	3
	R4SE2002P	SOM Lab	0	0	2	1	40 % CIE + 60% ESE			
4	R4PE2002S	Basic Thermodynamics	3	0	0	3	20	20	60	3
6	R4PE2003S	Industrial Management	2	0	0	2	20	20	60	2
7	R4PE2004L	Production and Machine Drawing	1	0	2	2	40 % CIE + 60% ESE			
8	R4PE2005A	Innovation and Entrepreneurship	2	0	0	P/NP	100 % CIE			
Total			17	2	6	20				

Abbreviations:

L: Lecture, **T**: Tutorial, **P**: Practical, **TA**: Teacher Assessment, **MST**: Mid-Semester Test, **ESE**: End Semester Examination, **CIE**: Continuous In-semester Evaluation.

B. Tech. Production Engineering

Semester IV

Scheme of Instruction						Scheme of Evaluation				
	Course Code	Course Title	Hr/Week			Credits	TA	MST	ESE	ESE hours
			L	T	P					
1	R4PE2006S	Applied Probability and Statistics	3	0	0	3	20	20	60	3
2	R4PE2007T	Applied Thermodynamics	3	1	0	4	20	20	60	3
	R4PE2007P	ATD Laboratory	0	0	2	1	40 % CIE + 60% ESE			
3	R4PE2008T	Fluid Mechanics and Machinery	3	0	0	3	20	20	60	3
	R4PE2008P	FMM Laboratory	0	0	2	1	40 % CIE + 60% ESE			
4	R4EE2005T	Electrical and Electronics Engineering	3	0	0	3	20	20	60	3
	R4EE2005P	EEE Laboratory	0	0	2	1	40 % CIE + 60% ESE			
5	R4PE2009S	Managerial Economics, Finance and Costing	3	1	0	4	20	20	60	4
6	R4CH2001ST	Environmental Studies	1	0	1	P/NP	60 % CIE + 40% ESE			
Total			17	2	6	20				

Abbreviations:

L: Lecture, **T**: Tutorial, **P**: Practical, **TA**: Teacher Assessment, **MST**: Mid-Semester Test, **ESE**: End Semester Examination, **CIE**: Continuous In-semester Evaluation.

Programme	B. Tech. (Production Engineering)	**Semester -** III
Course Code	R4MA2002S	
Course Title	Mathematics for Production Engineers	
Prerequisites	Applied Mathematics – I, Applied Mathematics – II	

Course outcomes: On the completion of this course, the learner will able to

1. Define & Evaluate Laplace as well as Inverse Laplace Transform of function and Use basic knowledge of Laplace and Inverse Laplace Transform to solve ordinary differential equations and to linear time invariant system.
2. Demonstrate knowledge of matrix calculations as an elegant & powerful mathematical language in connection with the Eigen values, Eigen vectors, Cayley Hamilton Theorem, function of square matrix.
3. Develop Fourier series of periodic functions and compute Fourier Integral and use fundamental knowledge of complex variable to identify an analytic function, harmonic function, orthogonal trajectories.
4. Develop sound foundation of complex integration, Residue Theorem and demonstrate its use in evaluation of real integrals.

Syllabus

1. Laplace Transforms

Laplace Transforms, Laplace transforms of standard functions such as, Linear property of Laplace transforms, First shifting theorem, Second shifting theorem

$$L\{t''f(t)\}, L\{f'(t)\}, L\left\{\frac{f(t)}{t}\right\}, L$$

Change of scale property: Unit step functions, Heaviside, Dirac delta functions, Periodic functions and their Laplace transforms, Inverse Laplace transform using linear property, theorems, partial fractions and convolution theorem, Application to solve ordinary differential equations with one dependent variable.

2. Matrices

Eigen values Eigen vectors of square matrix, Cayley Hamilton's theorem and function of square matrix, Similarity Matrices, Modal Matrix, Function of Square a Matrix, Minimal Polynomial and Minimal Equation of a Matrix, Derogatory and Non-Derogatory Matrices

3. Fourier Series and Integrals

Orthogonal orthonormal functions, Expression for a function in series of orthogonal functions, Dirichlet's conditions, Fourier series of periodic function with period 2π, $2l$. Dirichlet's theorem, even and odd functions. Half range expansions, Parseval's relations, Complex form of Fourier series, Fourier integral

4.	**Complex Variables** Functions of complex variable, Analytic function, necessary and sufficient conditions for f (z) to be analytic (without proof), Cauchy-Riemann equations in polar coordinates. Milne- Thomson method to determine analytic function f (z) when it's real or imaginary or its combination is given, Harmonic function, orthogonal trajectories
5.	**Complex Integral** Line integral of a function of a complex variable, Cauchy's theorem for analytic function, Cauchy's Goursat theorem (without proof), properties of line integral, Cauchy's integral formula and deductions. Singularities and poles, Taylor's and Laurent's series development (without proof), Residue at isolated singularity and its evaluation, Residue theorem, application to evaluate real integral of type.
	Text Books
1.	H. Dass: Advanced Engineering Mathematics, S. Chand & Co. Ltd.
2.	B. Grewal: Higher Engineering Mathematics, Khanna Publications.
3.	G. Kumbhojkar: Applied Mathematics– III, C. Jamnadas & Co.
	References
1.	Kreyszig: Advanced Engineering Mathematics, Wiley Eastern Ltd.
2.	A. Vasishtha: Matrices, Krishna Prakashan Media.
3.	Wartikar and Wartikar: Elements of Applied Mathematics, Pune Vidyarthi Griha Prakashan.
4.	T. Veerrajan: Engineering Mathematics for semester III, Tata McGraw Hill.

Programme	B. Tech. (Production Engineering)	**Semester -** III
Course Code	R4PE2001T	
Course Title	Manufacturing Technology	
Prerequisites	Applied Mechanics	

Course outcomes: On the completion of this course, the learner will able to

1. Illustrate types of machine tools, their classification, specifications and constructional features and describe different kinds of cutting tools with their significance of work-piece interface.
2. Illustrate machine tools capabilities, limitations of machining operations to generate cylindrical, circular and planar components
3. Analyze features and applications of reciprocating machine tools like shaper, planer and slotter.
4. Illustrate features and application of gear cutting and numeric control machines

Syllabus

1.	**Introduction** Overview of manufacturing processes. Machining- generating & forming processes. Types of chips and tool signature, cutting materials and cutting fluids. Classification of machine tools.
2.	**Lathe Machines** Lathe operations, Turning parameters (speed, feed, depth of cut, MMR), Lathe Components, Lathe specifications, work and tool holding devices & accessories, single point cutting tool nomenclature, Taper turning types, lathe machines types and their difference. Difference between capstan and turret lathe, Machining time (Numerical).
3.	**3.1 Drilling Machines** Drilling operations, work and tool holding devices, Drill nomenclature, Drilling machine types, Deep hole drilling (fundamentals only), Introduction to Boring & Boring machine. Machining time (Numerical) **3.2 Broaching Machine:** Broaching process, circular broach nomenclature and types of broaches, broaching machine types, Advantages and Limitations.
4.	**Reciprocating Machine Tools** Shaping machines: types of shapers, working of shaping machine, quick return mechanisms, shaper operations, machining time. Planning machines: types of planning machines, shaper vs. planer, Slotting machines.

5.	**Milling Machines** Milling operations and their difference, Milling Parameters, special attachments (Dividing head) and accessories, milling machines types, Types of Milling cutters and Machining time (Numerical).
6	**Grinding and Finishing Processes** Grinding: process, machine types and operations, grinding wheels- composition, specification, balancing, truing, dressing and shaping. Finishing processes: Reaming, Honing, Lapping, burnishing, polishing, buffing.
7	**Computer Numerical Control Machines** NC machine, Difference between NC and CNC machine tools, CNC turning centers, Machining centers- horizontal spindle, vertical spindle, universal, three axis, five axis, and seven axis. Characteristics and capabilities of machining centers. Working principles and applications only.
8	**Gear Teeth Cutting Machines** Introduction to gears, Gear milling, gear hobbing, principles of hobbing (kinematics omitted). Hobbing techniques, hob size, material (tool geometry omitted) and gear shaping process (tool geometry omitted). Gear finishing processes-gear shaving, gear lapping, gear grinding and gear burnishing.
	Text Books
1.	Hajra Choudhury: Workshop Technology: Machine Tools (Vol. II), Media Promoters and Publishers.
2.	P.N. Rao: Manufacturing Technology Vol. 2, Tata McGraw Hill.
	References
1.	Mikell Groover: Fundamentals of Modern Manufacturing, PHI.
2.	Serope Kalpakjian and Steven Schmid: Manufacturing, Engineering and Technology.
3	Chapman: Workshop Technology Part 1, 2 and 3, Taylor & Francis.
4.	DeGarmo, Black and Kosher: Materials and Process in Manufacturing, John Wiley & Sons Inc.
5.	R.K.Jain: Production Technology, Khanna Publication.

Programme	B. Tech. (Production Engineering)	**Semester -** III
Course Code	R4PE2001P	
Course Title	Manufacturing Technology Laboratory	
Prerequisites	Applied Mechanics	

	Course outcomes: On the completion of this course, the learner will able to 1. Practice safe machine shop practices with working. 2. Select the right tool, set up of the machine/ job for machining. 3. Perform operations like cylindrical turning, thread cutting etc. on lathe machine. 4. Perform operations for flat surfaces like Keyway cutting, T-slot cutting etc. on shaper/miller
S.N	List of Experiments
1.	One job on plain and taper turning.
2.	One job on turning, taper turning and screw cutting.
3.	One job on shaping machine with horizontal and inclined surfaces.
4.	One job on milling machine.
5.	One job on cylindrical grinding and surface grinding machine.
	References
1.	Gerling: All About Machine Tools, TMH.
2.	P.N. Rao: Manufacturing Technology Vol.II - Metal Cutting, Tata McGraw Hill.
3.	Hajra Choudhury: Elements of workshop Technology Vol. II, Indian Book Distribution, Kolkata.

Programme	B. Tech. (Production Engineering)	**Semester -** III
Course Code	R4SE2002T	
Course Title	Strength of Materials	
Prerequisites	Applied Mechanics	

Course outcomes: On the completion of this course, the learner will able to

1. Apply the principals of axial, shear and bending action for the analysis of structural elements.
2. Apply the principals of axial, shear and bending action for the design of various structures.
3. Estimate stresses and strains in shaft subjected to torsion and in thin-wall spherical and cylindrical vessel subjected to internal pressure
4. Determine analytically and graphically principal stresses, principal strains and maximum shearing stress.

Syllabus

1.	**Simple Stress and Strain** Definitions of stress, strain, modulus of elasticity, modulus of rigidity, bulk modulus, yield stress, ultimate stress, factor of safety and shear stress. Poisson ratio, bars of varying sections, stress due to self-weight. Composite sections, temperature stresses.
2.	**Shear Force and Bending Moment** Axial force, shear force and bending moment diagram for statically determinate beams and frames.
3.	**Theory of Pure Bending** Flexure formula for straight beams, moment of inertia, product of inertia and polar moment of inertia of plane areas, principal axes of inertia, moments of inertia about principal axes, transfer theorem, flitched beams. Unsymmetrical bending. Flexural stresses due to bending in two planes for symmetrical sections, bending of unsymmetrical sections.
4.	**Shear Stress in Beams** Distribution of shear stress across plane sections, shear connectors. Shear center of thin walled sections such as angle, tee, channel and I sections
5.	**Simple Theory of Torsion** Torsion of circular solid and hollow shafts, stresses in shaft when transmitting power, close-coiled helical springs under axial load.
6	**Bending Moment Combined with Axial Loads** Application to member's subjected to eccentric loads, core of a section, problems on chimneys,

	retaining walls etc., involving lateral loads
7	**Thin Cylinder and Spherical Shell** Stresses and strains in thin cylindrical and spherical shells under internal pressure.
8	**Principal Stresses and Strains** General equations for transformation of stress, principal planes and principal stresses, maximum shear stress, determination using Mohr's circle, principal stresses in beams, principal stresses in shafts subjected to torsion, bending and axial thrust, concept of equivalent torsional and bending moments.
	Text Books
1.	Ramamurtham: Strength of Materials, Dhanpat Rai Publications.
2.	Beer and Johnston: Mechanics of Materials, McGraw-Hill.
	References
1.	Bhavikatti: Strength of Materials, Vikas Publishing House.
2.	Ferdinand Singer: Mechanics of solids, Longman.
3.	Junnarkar : Mechanics of Structures Vol I, Charotar Publication house.
4.	James Gere: Mechanics of Materials, Brooks/Cole. Publishing Co.

Programme	B. Tech. (Production Engineering)	**Semester -** III
Course Code	R4SE2002P	
Course Title	Strength of Materials Lab	
Prerequisites	Applied Mechanics	

Course outcomes: On the completion of this course, the learner will able to

1. Ability to understand material behaviour under the axial, shear and bending action.
2. Ability to implement material behaviour in the analysis and design of various structural elements.

	List of Experiments/Assignments
1.	Tension test on mild steel bar
2.	Tension test on tor steel bar.
3.	Shear test on mild steel bar
4.	Tension test on steel plates
5.	Flexural test on steel plates
6.	Bend and rebend test on mild and tor steel
7.	Torsion test on mild and tor steel.
8.	Brinnel's Hardness tests on metal specimen
9.	Impact test on metal
10.	Compression test on wood
11.	Tensile test on wood specimen
12.	Flexural test on wood

Text Books

1. Junnarkar: Mechanics of Structures Vol I, Charotar Publication house.
2. E. Popov: Mechanics of Materials, Prentice Hall of India Pvt. Ltd.

References

1. S. Bhavikatti: Strength of Material, Vikas Publishing House Pvt. Ltd.

Programme	B. Tech. (Production Engineering)	**Semester -** III
Course Code	R4PE2002S	
Course Title	Basic Thermodynamics	
Prerequisites	Applied Physics	

Course outcomes: On the completion of this course, the learner will able to

1. Differentiate and explain the basic concepts of thermodynamics such as system, state etc. and heat transfer
2. Apply the laws of thermodynamics to flow and non-flow processes, heat engines, heat pumps and refrigeration system
3. Derive the heat transfer equations and Solve the heat transfer problems
4. Analyze and differentiate the various basic power cycles used in industry

Syllabus

1. **Introduction and First Law of Thermodynamics**

Application areas of thermodynamics, System, Surrounding, state, Path Property, Reversible and irreversible process, thermodynamic work, heat. Temperature, thermal equilibrium. Ideal and real gases. Properties of steam, Properties of system. Zeroth law of thermodynamics. First laws of thermodynamics: Statement, Heat and work calculations, Application of first law to flow and non-flow processes, steady flow energy equation.

2. **Second Law of Thermodynamics**

Statements and their equivalence, thermal energy reservoirs, concept of heat engine, refrigerator, heat pump and perpetual motion machines, Carnot cycle and principles. Entropy: Concept of entropy, Temperature- entropy plot, Clausius inequality and theorem, Principle of Increase of entropy. First and Second law combined.

3. **Heat Transfer**

Conduction: One dimensional, steady state, heat transfer by conduction through plane wall, radial heat transfer by conducting through hollow cylinder and hollow sphere. Conduction through a composite plane and cylindrical wall. Fourier's law of heat conduction, thermal conductivity, differential equation of heat conduction with heat generation in unsteady state in the Cartesian coordinate system, Boundary and initial conditions. Extended Surfaces: Heat transfer from finned surfaces, Types of fins, Fin equation for rectangular fin and its solution, Fin efficiency, Fin effectiveness. Convection: Heat flow by convection. Free and forced convection. Nusselt, Reynolds and Prandtl number; heat transfer between two fluids separated by composite plane and cylindrical wall. Overall heat transfer coefficient. Heat exchangers. Types of heat exchangers. Logarithmic Mean Temperature Difference (LMTD)

4. **Properties of Steam, Gas cycles and Air Cycles**

Dryness fraction, enthalpy, internal energy and entropy, steam table, polynomial form of steam equations and Mollier chart. Vapour power cycle: Carnot vapour cycle, Rankine cycle. Gas power

	cycles: Air standard assumptions, Otto cycle, Diesel cycle, dual cycle, Stirling cycle, Ericsson cycle, Atkinson cycle, Brayton cycle.
	Text Books
1.	P.K.Nag: Engineering Thermodynamics, McGraw Hill Education.
2.	D.S. Kumar: Heat and Mass Transfer, Katson Books.
	References
1.	R.S. Khurmi and Gupta: Thermal Engineering, S. Chand Publication.
2.	Mahesh Rathore: Thermal Engineering, Tata McGraw Hill Publication.
3.	R. Rajput: Thermal Engineering, Laxmi Publications-New Delhi.
4.	Domkundwar : Power Plant Engineering, Dhanpat Rai Publications.
5.	R. Yadav: Thermodynamics and Heat Engines: Vol I and II, Central Publishing House, Allahabad.
6.	Yunus Cengel: Heat transfer, McGraw-Hill Publishers.

Programme	B. Tech. (Production Engineering)	**Semester -** III
Course Code	R4PE2003S	
Course Title	Industrial Management	
Prerequisites	None	

Course outcomes: On the completion of this course, the learner will able to

1. Analyze different principles of management
2. Understand different concept and characteristics of strategic management
3. Apply various quality management practices in industrial environment
4. Assess decision making models under the management information system

Syllabus

1. **Basics of Management**

Introduction, Definition of management, characteristics of management, functions of management - Planning, Organising, Staffing, Directing, Co-ordination, Controlling, Motivating, Communication, Decision Making, Principles of management – F.W. Taylor, Henry Fayol, Elton Mayo, Administration and management, Nature of management, levels of management, managerial skills, managerial roles, Forms of Organization- Line , Line –staff etc. Forms of ownerships – Partnership, Proprietorship, Joint stock, Co-operative society, Govt. Sector etc., concept of Globalisation

2. **Strategic Management**

Military origins of strategy – Evolution - Concept and Characteristics of strategic management – Defining strategy – Mintzberg's 5P's of strategy – Corporate, Business and Functional Levels of strategy - Strategic Management Process. Preparing an Environmental Threat and Opportunity Profile (ETOP) – Industry Analysis - Porter's Five Forces Model of competition. BCG Matrix – GE 9 Cell Model -Balanced Scorecard, Generic Competitive Strategies: Low cost, Differentiation, Focus.

3. **Human Resource Development**

Strategic importance HRM; objectives of HRM; challenges to HR professionals; role, Responsibilities and competencies of HR professionals; HR department operations; Human Resource Planning - objectives and process; human resource information system. Talent acquisition; recruitment and selection strategies, career planning and management, training and development, investment in training programme; executive development. Labour laws. Trade union and conflict resolution.

4 **Intellectual Property Rights**

Introduction to IPRs, Basic concepts and need for Intellectual Property - Patents, Copyrights,

	Geographical Indications, IPR in India and Abroad – Genesis and Development – the way from WTO to WIPO – TRIPS, Nature of Intellectual Property, Industrial Property, technological Research, Inventions and Innovations – Important examples of IPR, Copyrights, Trademark, Industrial Design. International Treaties and Conventions on IPRs, TRIPS Agreement, PCT Agreement, Patent Act of India, Patent Amendment Act, Design Act, Trademark Act, Geographical Indication Act. Meaning and practical aspects of registration of Copy Rights, Trademarks, Patents, Geographical Indications, Trade Secrets and Industrial Design registration in India and Abroad.
5.	**Business Ethics and CSR** Business Ethics – Concept, Characteristics, Importance and Need. Indian Ethos, Ethics and Values, Work Ethos. Ethics in Marketing and Advertising, HR, Finance and Accounting, Production, IT. Corporate Governance: Concept, Importance, Evolution. Principles of Corporate Governance, Regulatory Framework of Corporate Governance in India, SEBI Guidelines, Role of Independent Directors, Protection of Stake Holders, Changing roles of corporate Boards. Elements of Good Corporate Governance, Failure of Corporate Governance and its consequences. Corporate Social Responsibility: Concept, Scope & Relevance and Importance. Corporate philanthropy, Models and drivers CSR. CSR and Indian Corporations. Role of NGO's and International Agencies in CSR, Integrating CSR into Business
	Text Books
1.	Tripathi and Reddy: Principles of Management, Tata McGraw Hill, New Delhi.
2.	L.C. Jhamb and Savitri Jhamb: Industrial Management – I, Everest Publishing House.
	References
1.	Ashwathppa: Human Resource Management, Tata McGraw Hill, New Delhi
2.	Kenneth Laudon and Jane Laudon: Management Information Systems, Pearson Education.
3.	Ravi Kishore: Project Management, Tata McGraw Hill, New Delhi.
4.	M. Khan and P. Jain: Financial Management, Tata McGraw Hill, New Delhi.
5.	Dinesh Seth and Subhash Rastogi: Global Management Solutions, Cengage Learning, USA.

Programme	B. Tech. (Production Engineering)	**Semester -** III
Course Code	R4PE2004L	
Course Title	Production and Machine Drawing	
Prerequisites	Engineering Drawing	

Course outcomes: On the completion of this course, the learner will able to

1. An ability to use the techniques, skills and modern engineering tools necessary for engineering practice with the concept of virtual work.
2. Comprehend to understand and apply the knowledge of machine drawing as a system of communication in which ideas are expressed clearly and all information fully conveyed.
3. Familiarity with the use of graphical techniques in problem formulation and solution and an ability to effectively use graphical methods in communication and draw details and assembly drawing of mechanical systems.
4. Create 2-D and 3-D models using any standard CAD software with manufacturing considerations.

Syllabus

1.	**Fundamentals of Production Drawing** Principles of Dimensioning, Specification of Materials, Standard Mechanical Components Specifications, Limit, Surface Roughness, Production Drawings and Process Sheets Production Drawings of Mating Parts, Production Drawing of Assemblies Tool Drawings, Jigs and Fixtures Drawings, Inspection and Gauging Tool Drawings
2.	**Production Machine Elements** Screwed fasteners: Thread nomenclature, forms of screw threads, V threads, Square thread, ACME, Buttress, and Whitworth. Representation of threads, Hexagonal headed bolts and nuts, square headed bolts & nuts, locking devices for nuts. Keys, cotters and pin joints : Keys such as saddle keys, sunk keys, round keys, Cotter joints such as Socket and Spigot joint, Gib and Cotter joint, Cotter and Sleeve Joint. Pin joint (Knuckle joint). Couplings: Rigid couplings, Split, Muff, and Flanged protected type, Flexible bush pin type.
3.	**Assembly and Details Drawings** Machine tools parts: Machine swivel vice, pipe vice, screw jack, tailstock, tool head of shaper, Simple drill jig & milling fixture, simple press tool assembly. Bearings: Plummer block, foot step bearing, bracket with pedestal bearing. IC Engine parts: I.C. Engine connecting rod, stuffing box joints: Classification of Pulleys, pipe joints, Pulleys: Flat belt, V-belt, rope belt, Fast and loose pulleys. Pipe joints (any two): Flanged joints, Socket and spigot joint, Gland and stuffing box, expansion joint, and eccentric. Conventional representation of ball and roller bearing. Pedestal bearing, footstep bearing, and Clapper block.

4.	**Tolerances and Fits** Tolerances and Fits: Limits, fits, allowances and tolerances: Selection of tolerances, methods of placing limit dimensions, fits .Calculation of tolerances, limits, allowances and fit.
5.	**CAD** Computer Aided Design and Drafting: Auto-CAD commands, Editing commands, Basic Dimensioning, Creating 2-D and 3-D objects of simple machine parts.
	Text Books
1.	Narayana, Kannaiah and Venketa Reddy: Machine Drawing, New Age International Publishers.
2.	Siddheshwara Sastry: Machine Drawing, Tata McGraw Hill Publishing House.
	References
1.	M.B. Shah and B. C. Rana : Machine Drawing, Pearson Publications.
2.	N.D. Bhatt and V. Panchal: Machine Drawing, Charotar Publishing House.
3.	T. Jeyapoovan: Engineering Drawing with AUTO CAD, Vikas Publications.

Programme	B. Tech. (Production Engineering)	**Semester -** III
Course Code	R4PE2005A	
Course Title	Innovation and Entrepreneurship	
Prerequisites	None	

	Course outcomes: On the completion of this course, the learner will able to 1.appreciate and apply the innovation and process of innovation 2.Relate innovation and problem solving 3.demonstrate application of innovation to techno-entrepreneurship
	Syllabus
1.	**Introduction** Innovation, definition and classification. The relationship of innovation and entrepreneurship, creation of competitive advantage based on innovation. Innovative models. Product, process, organizational and marketing innovation and their role in business development.
2.	**Innovation Sources** Sources of innovation (push, pull, analogies), transfer of technology. Creative methods and approaches used in innovation management. Approaches to management of the innovation process (agile management, Six Thinking Hats, NUF test).
3.	**Systematic Approaches** Project approach to innovation management, method Stage Gate, its essence, adaptation of access to selected business models. In-house business development of the innovation process in the company. Open Innovation as a modern concept, the limits of this method and its benefits for business development. Innovations aimed at humans, role of co-creation in the innovation process
4.	**Innovation Strategy** The strategy of innovation process, types and selection of appropriate strategies. * Measurement and evaluation of the benefits of innovation for business (financial and non-financial metrics, their combination and choice). Barriers to innovation in business, innovation failure and its causes, post-audits of innovative projects. * Organization and facilitation of an innovation workshop.
5.	**Entrepreneurship** Concept, Functions, Need and Importance. Myths about Entrepreneurship. Process of Entrepreneurship. Types of Entrepreneurs. Competencies and Characteristics; Entrepreneurial

	Value: Values, Attitudes and Motivation. Mindset .Intrapreneur Entrepreneurship- Innovation and Problem Solving. Market understanding/
	Textbooks
1.	T. H. Byers, R. C. Dorf, A. Nelson, Technology Ventures: From Idea to Enterprise, McGraw Hill (2013)
2.	Blank Steve: The Startup Owner's Manual: The Step by Step Guide for Building a Great Company, K&S Ranch.
	References
1.	Bansal, Rashmi: Stay Hungry Stay Foolish, CIIE, IIM Ahmedabad
2.	Kachru Upendra: India Land of a Billion Entrepreneurs, Pearson.
3.	Bagchi, Subroto, (2012). MBA At 16: a Teenager's Guide to Business, Penguin Books

Semester - IV

Programme	B. Tech. (Production Engineering)	**Semester -** IV
Course Code	R4PE2006S	
Course Title	Applied Probability and Statistics	
Prerequisites	Mathematics for Production Engineers	

Course outcomes: On the completion of this course, the learner will able to

1. Create and interpret numerical summary statistics and interpret the relations between two quantitative variables, regression.
2. Compute simple probabilities of events. Use basic counting techniques (multiplication rule, combinations, and permutations) to compute probability and odds.
3. Compute the covariance and correlation between jointly distributed variables
4. Compute expectation and variance for different distributions and solve the problems using discrete distributions
5. Infer properties of a population from a sample and analyze the variance and set design of experiment

Syllabus

1. **Basic Statistics**

Review of Measures of central tendency and dispersion. Moments, skewness and Kurtosis. Describing the Relation between variables- Correlation, Co-variance, Karl Pearson Coefficient of Correlation Spearman's Rank Correlation Coefficient (non-repeated & repeated ranks).Regression Coefficients & lines of regression.

2. **Probability Theory**

Review of probability: Marginal, joint and conditional probability- Bayes' theorem and Bayesian inference with known priors, probability intervals. Central limit theorem.

Random variables- Discrete and Continuous random variables, – Probability distribution of finite function – Probability mass and density function, Probability distribution for random variables. Moments – Moment generating functions and their properties (Expected value, variance)- Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions – Functions of a Random Variable.

Two dimensional random variables -Joint distributions – Marginal and Conditional distributions – Functions of two dimensional random variables – Regression Curve – Correlation.

3. **Estimation Theory**

Unbiased Estimation. Efficient estimation. Point estimates and interval estimates, reliability confidence interval – Method of Moments – Maximum Likelihood Estimation - Curve fitting by Principle of least squares – Regression Lines.

4. **Statistical Decision Theory [Testing of Hypotheses]**

Sampling distributions - Test of Hypothesis. Level of significance, critical region. One tailed and

	two tailed tests. Type I and Type II errors -. Interval Estimation of population parameters. Large and small samples. Tests based on Normal, t, Chi-Square and F distributions for testing of mean, variance and proportions – Tests for Independence of attributes and Goodness of fit. Sampling Distribution. Test of significance for Large samples: Test for significance of the difference between sample mean and population means, Test for significance of the difference between the means of two samples. Student's t-distribution and its properties. Test of significance of small samples: Test for significance of the difference between sample mean and population means, Test for significance of the difference between the means of two Samples, paired t-test.
5.	**Correlation and Regression** Correlation and regression. Linear and nonlinear relations. Measures of correlation. Least squares regression lines. Estimation of error with explained + unexplained variation. Regression coefficient. Multiple and partial correlation.
6.	**Analysis of Variance** Purpose. One factor experiment-total variation, model for analysis, expected value of the variations, distribution .Two factor experiment, Experimental design.
7.	**Application of Statistics and Probability** Application to management of inventory, Queuing theory, Statistical process control and process capability, Acceptance Sampling, Forecasting, decision making under uncertainty, reliability, maintenance and replacement of equipment. Statistical Software's: Learning of problem solving in statistical software's such as Excel, Matlab, SPSS, etc.
	Text Books
1.	Richard Levin and David Rubin: Statistics for Management, Pearson India.
2.	S. Gupta and V. Kapoor: Fundamentals of Mathematical Statistics, S. Chand and Co.
3.	Sheldon Ross: Introduction to Probability and Statistics for Engineers and Scientists, Elsevier.
4.	Ronald Walpole, Raymond Myers, Myers and Keying: Probability and Statistics for Engineers and Scientists.
5.	Montgomery and George Runger: Applied statistics & probability for engineers, Wiley publisher.
	References
1.	Murray Spiegel and Larry Stephens: Statistics, Schaum's Series, TMH Publishing.
2.	Murray Spiegel: Probability and Statistics, Schaum's Series, TMH Publishing.
3.	Jay Devore: Probability and Statistics for Engineering and the Sciences, Thomson and Duxbury Publications.

Programme	B. Tech. (Production Engineering)	**Semester -** IV
Course Code	R4PE2007T	
Course Title	Applied Thermodynamics	
Prerequisites	Basic Thermodynamics	

Course outcomes: On the completion of this course, the learner will able to

1. Discuss fundamental refrigeration and air conditioning principles
2. Identify and locate various important components of the refrigeration and air conditioning system
3. Illustrate various refrigeration and air conditioning processes using psychometric chart
4. Design and analyse complete air conditioning system

Syllabus

1. **Introduction**

Methods of refrigeration vapour compression refrigeration system, vapour absorption refrigeration system, applications of refrigeration & air conditioning, Automobile air conditioning, air conditioning for passengers, isolated vehicles, transport vehicles, applications related with very low temperatures, cryogenics, air liquefaction cycle

Refrigerant: Classification, properties, selection criteria, commonly used refrigerants, alternative refrigerants, eco-friendly refrigerants, applications of refrigerants, refrigerants used in automobile air conditioning

2. **Air Conditioning Systems and Components**

Classification, layouts, central / unitary air conditioning systems, components like compressors, evaporators, condensers, expansion devices, fan blowers, heating systems, Automotive heaters, Types, Heater Systems, Air conditioning Protection, Engine protection.

Load Analysis: Outside & inside design consideration, factors forming the load on refrigeration & air conditioning systems, cooling & heating load calculations, load calculations for automobiles, effect of air conditioning load on engine performance.

3. **Compressor and IC Engines**

Uses of compressed air, classification, single stage reciprocating compressor with and without clearance, work and power calculations, two stage air compressor with & without perfect inter cooling, FAD and volumetric efficiency. Four and two stroke cycle I.C. engines. S.I. and C.I. engines. Systems requirements of I.C. engines. Ignition system of S.I. engines. Governing of I.C. engines. Valve timing diagrams. Calculation of I.P, F.P. and B.P., determination of indicated and brake thermal efficiency and specific fuel consumption. Testing of I.C. engines. Heat balance sheet.

4. **Boiler**

Fire tube and Water tube boiler, Low pressure and high pressure boilers, once through oiler,

	examples, and important features of HP boilers, Mountings and accessories. Layout of a modern HP boiler. Equivalent evaporation of boilers. Boiler performance. Boiler efficiency
5.	**Steam and Gas Turbines** Flow through nozzle: Introduction, steam flow through nozzles, nozzle efficiency, and general relationship between area, velocity and pressure in nozzle flow. Steam turbine: Classification, compounding of turbine, Impulse turbine velocity diagram. Condition for max efficiency. Reaction turbine - velocity diagram, degree of reaction, Parson's turbine. Condition for maximum efficiency. Applications of gas turbine, Actual Brayton cycle, open and closed cycle gas turbine, methods to improve efficiency and specific output, open cycle with intercooling, reheat, and regeneration. Effect of operating variable on thermal efficiency and work ratio.
6.	**Power Plant Engineering** Steam Power Plants: Flow sheet and working of modern-thermal power plants, super critical pressure steam stations, site selection, coal storage, preparation, coal handling systems, feeding and burning of pulverized fuel, ash handling systems, dust collection-mechanical dust collector and electrostatic precipitator. Nuclear Power Plants: Principles of nuclear energy, basic nuclear reactions, nuclear reactors-PWR, BWR, CANDU, Sodium graphite, fast breeder, homogeneous; gas cooled. Advantages and limitations, nuclear power station, waste disposal.
	Text Books
1.	Mahesh Rathore:Thermal Engineering, Tata McGraw Hill Publication.
2.	Patel and Karamchandani: Elements of Heat Engines, Vol.3, Acharya Book Depot.
3.	R. Khurmi and J. Gupta: Thermal Engineering, S. Chand and Company Limited.
4.	R. Rajput: Engineering Thermodynamics, Laxmi Publication.
5.	P. K. Nag: Power Plant Engineering, McGraw Hill Education.
	References
1.	C.P. Arora: Refrigeration and Air Conditioning, Tata McGraw Hill Publications.
2.	Ganeshan: Internal Combustion Engines, Tata McGraw Hill Publications.
3.	Kothandraman and Domkundwar: A course in thermal engineering, Dhanpat Rai & Sons.
4.	Ballaney: Thermal Engineering, Khanna Publishers.
5.	Domkundwar: Power Plant Engineering, Dhanpat Rai Publications.

Programme	B. Tech. (Production Engineering)	**Semester -** IV
Course Code	R4PE2007P	
Course Title	Applied Thermodynamics Laboratory	
Prerequisites	Basic Thermodynamics	

	Course outcomes: On the completion of this course, the learner will able to 1. Conduct the load tests on various mechanical systems 2. Study effects of parameters on efficiency of system 3. Study the diesel engine and its functioning
	List of Experiments/Assignments
1.	Load Test on compressor
2.	To find the thermal conductivity of a metal rod
3.	Trial on Parallel flow Heat exchanger
4.	Trial on Counter flow Heat exchanger
5.	Study of domestic refrigerators
6.	Load test on a Diesel Engine
7.	Study of a Gas Turbine Plant
8.	Assignments based on the topics covered in the theory course.
	Text Books
1.	J.P. Hollman : Heat Transfer, McGraw Hill International Publications.
2.	Patel and Karmachandani: Heat Engines Vol.III, Acharaya Publications.
3.	Ganeshan: Internal Combustion Engines, Tata McGraw Hill Publications.

Programme	B. Tech. (Production Engineering)	**Semester -** IV
Course Code	R4PE2008T	
Course Title	Fluid Mechanics and Machinery	
Prerequisites	Applied Mechanics	

Course outcomes: On the completion of this course, the learner will able to

1. Apply mathematical knowledge to predict the properties and characteristics of a fluid.
2. Apply conservation laws to fluid flow problems in engineering applications.
3. Critically analyses the performance of pumps and turbines.
4. Design and create circuits related to fluid power

Syllabus

1. **Introduction**

Definition of fluids and its properties, Newtonian and non-Newtonian, their stress strain relationship (general description only), Newton's law of viscosity.

Fluid Static: pressure at a point in fluid, variation of pressure with depth, fluid application to manometer, transmission of pressure in a fluid, thrust on plane surface, Centre of pressure horizontal and vertical plane surfaces, forces on immersed bodies.

2. **Buoyancy and Flotation**

Buoyancy, center of buoyancy, meta Centre and meta centric height, conditions of equilibrium of floating and submerged bodies, determination of Metacentric height experimentally and theoretically.

3. **Fluid Kinematics and Dynamics**

Eulerian and Lagrangian description of fluid flow; stream, streak and path lines; types of flows, flow rate and continuity equation. Various types of flow, continuity equation, energy equation, momentum equation. Application of energy and continuity equation for fluid flow measurement in closed conduit (No derivations, only applications are to be imparted).

Euler's and Bernoulli's equations, Application of Bernoulli's equation; Pitot tube, Venturimeter and Orifice meter, momentum equation and its application on force on pipe bend.

4. **Flow in Pipes**

Laminar and turbulent flow in pipes (elementary treatment only), Darcy's equation, and laminar flow between flat parallel stationary plates. Laminar flow between parallel plates one of which is moving, losses in bends, couplings and valves.

5. **Dimensional Analysis**

Need for dimensional analysis, methods of dimensional analysis, Dimensionless parameters, application of dimensionless parameters, Model analysis.

6	**Turbines and Pumps** Selection of site for Hydroelectric Power Plant, Essential Features of Water power plant, Turbine, types, specific speed of Pelton, Francis and Kaplan turbines, Calculation of power output efficiencies. Centrifugal pump – types, specific speed, Equations for energy transfer, efficiencies. Reciprocating pump, gear pump, screw pump.
7	**Power Hydraulic Pumps and Motors** Valves: Introduction, types of valves viz. check valve, relief valve, speed control valves, pressure compensating valves, pressure compensated flow control valves, unloading valves, direction control valves, sequence valves, and counter balance valves. Oil hydraulic circuits: Introduction, basic circuit, Sequencing circuit.
8	**Computational Fluid Dynamics** Introduction - Scope and Application of CFD: Methods of Predictions: Working of Commercial CFD Softwares: Solution Methodology - Preprocessing, Solver, Post processing.
	Text Books
1.	Modi and Seth: .Fluid Mechanics and Hydraulic Machines, Standard Publications.
2.	Jagdish Lal: Fluid Mechanics and Hydraulics, Media Promoters and Publishers.
	References
1.	Frank White: Fluid Mechanics, Tata McGraw Hill Publication.
2.	S. Ramamurtham: Fluid Mechanics and Hydraulic Machines, Dhanpat Rai Publications.
3.	R. Bansal: Fluid Mechanics and Hydraulics, Laxmi Publications.
4.	Robert Fox, Alan McDonald and Philip Pritchard: Fluid Mechanics and Machinery, Wiley India.

Programme	B. Tech. (Production Engineering)		**Semester -** IV
Course Code	R4PE2008P		
Course Title	Fluid Mechanics and Machinery Laboratory		
Prerequisites	Applied Mechanics		
	Course outcomes: On the completion of this course, the learner will able to 1. Calibrate various instruments. 2. Verify principle studied in theory. 3. Understand characteristics of various component or machinery. 4. Develop various circuits		
	Experiments / Assignments		
1.	Calibration of Pressure gauge/ Vacuum gauge.		
2.	Determination of Centre of Pressure.		
3.	Verification of Bernoulli's Theorem.		
4.	Flow through Venturimeter / Orifice meter.		
5.	Determination of friction in pipes.		
6.	Impact of Jets.		
7.	Characteristics of Gear Pump.		
8.	Characteristics of Pelton turbine, Francis turbine and Kaplan turbine.		
9.	Hydraulic Circuits- Basic Hydraulic Circuits, Regenerative circuit, sequencing circuit, Counter Balance circuit, Flow control circuits.		
	Text Books		
1.	Modi and Seth: .Fluid Mechanics and Hydraulic Machines, Standard Publications.		
2.	Ramamurtham: Fluid Mechanics and Hydraulic Machines, Danpat Rai Publications.		
3.	Jagdish Lal: Fluid Mechanics and Hydraulics, Media Promoters and Publishers.		
	References		
1.	Frank White: Fluid Mechanics, Tata McGraw Hill Publication.		
2.	R. Bansal: Fluid Mechanics and Hydraulics, Laxmi Publications Pvt (L).		

Programme	B. Tech. (Production Engineering)	**Semester -** IV
Course Code	R4EE2005T	
Course Title	Electrical and Electronics Engineering	
Prerequisites	Basic Electrical and Electronics Engineering	

Course outcomes: On the completion of this course, the learner will able to

1. Understand construction, principle of operation of electrical machines.
2. Carry out various tests on electrical machines.
3. Analyse and optimize the performance of electrical machines.
4. Understand the basics of electronics for controls.

Syllabus

1.	**Single-Phase Induction Motors** Double field revolving theory, analysis of motor equivalent circuit. Split phase, capacitor start and capacitor start run I. M, testing of single phase I. M. Applications of different single phase I.M.
2.	**Three-Phase Induction Motors** Construction, principle operation, equivalent circuit, torque equation, torque -slip characteristics, different losses and calculation of efficiency. No load test and blocked rotor test, Load test on 3 phase I. M. Different methods of Speed control of 3 phase I. M., Starter use for 3 phases I. M. Applications of 3 phase I.M.
3.	**Synchronous Machines** Alternator: Construction, EMF equation, winding factor, armature reaction, synchronous impedance, load characteristics voltage regulation. Use of alternators in power plants. Synchronous Motors: Principle operation, method of starting, V and inverted V curves, applications of Synchronous motors.
4.	**Stepper and Servo Motors & Drives** Stepper motor- construction and working principle and applications Servo motor – types: brushless servo motor, permanent magnet servo motor construction and applications. Industrial drives- types, group drive, individual drive, multi motor drive, Stepper motor drive- single stepping and half stepping. Servo drives Electrical safety - importance of earthing - electric shock
5.	**Variable Frequency Drives** Introduction to Variable Frequency Drives, block diagram of Variable Frequency Drives, principle of operation and working of Variable Frequency Drives.

6.	**Basics of Electronics** Operational Amplifiers: Basics-ideal OP-AMP, OP-AMP applications (elementary configurations), CMRR, PSRR, Slew Rate Introduction to Boolean Algebra, Basic Logic Gates and Truth Tables, digital IC's, registers, timers, counters, multiplexers, de-multiplexers, encoder, decoders (internal architecture not necessary, only functions) Introduction to PLC and applications Timers and Data Converters: IC 555 Timer – Block Diagram, Data Converters – Basic Principle of Analogue-to-Digital (ADC) and Digital-to-Analogue (DAC) Conversion.
	Text Books
1.	P. Bimbhra: Electrical Machinery, Khanna Publishers.
2.	Rashid: Power Electronics, Prentice-Hall of India.
3.	B.L. Theraja and A. Theraja: Electrical Technology Vol. I & II, S. Chand & Co. Ltd.
	References
1.	M. Say: Electrical Machine, A Pitman international text.
2.	Vukosavic and Slobodan: Electrical Machine, Springer New York Heidelberg Dordrecht London.
3.	P. Aearnley: Stepping Motors – A Guide to Motor Theory and Practice, Peter Perengrinus, London.
4.	Botkar : Operational Amplifiers, Khanna Publishers.

Programme	B. Tech. (Production Engineering)	**Semester -** IV
Course Code	R4EE2005P	
Course Title	Electrical and Electronics Engineering Laboratory	
Prerequisites	Basic Electrical and Electronics Engineering	

	Course outcomes: On the completion of this course, the learner will able to 1. Understand the working of different motors. 2. Analyze the parametric effects on performance of different motors. 3. Select a particular motor depending on the specified purpose.
	List of Experiments
1.	Load test on 3 phase Induction Motor.
2.	O.C. / S.C. test on 3 Phase Induction Motor.
3.	Speed control of 3 phase Induction Motor.
4.	Performance Test and working of Stepper Motor
5.	Performance Test and working of Servo Motor (using Variable Frequency Drive)
6.	Implementing study of gates and logic operations like NOT, AND, OR 555 timer as a stable multi vibrator
7.	Operational Amplifier (Adder, Subtracter, Differentiator, Integrator, Inverting and non-Inverting)
	Text Books
1.	P. Bimbhra: Electrical Machinery, Khanna Publishers.
2.	B. Theraja and A. Theraja: Electrical Technology Vol. I & II, S. Chand & Co. Ltd.
	References
1.	M. Say: Electrical Machine, A Pitman international text Publishers.

Programme	B. Tech. (Production Engineering)	**Semester -** IV
Course Code	R4PE2009S	
Course Title	Managerial Economics, Finance and Costing	
Prerequisites	Industrial Management	

Course outcomes: On the completion of this course, the learner will able to

1. Correlate various micro and macro-economic variables and solve numerical problems
2. Analyze, interpret the financial statements and decide upon the health of a firm.
3. Appreciate and illustrate Economic/Industrial/Trade policies and their implications and role played by various financial institutions/banks.
4. Apply costing and accounting and costing practices in solving real life problems.

Syllabus

1. **Managerial Economics**

Introduction- Economics, basic concepts - utility, wealth, welfare, price, markets, and opportunity cost. Micro - and macro- economics, economics of growth and development.

Demand and supply analysis: Law and elasticity of demand and supply. Demand function. Market structure - competition, monopoly, oligopoly and imperfect competition. Market imperfections and state interventions. Role of government; monetary, fiscal and trade policies, BOP, industrial policy; instruments of government policy; taxation, incentives, budget. National income measures – GDP, NDP, GNP, NNP; Inflation and its indices. Globalization of market and production-multinational corporation.

Theory of firm: Production and Cost analysis for short run and long run. Cost-Output Relationship: Cost Function, Cost-Output relationships in Short Run and Long Run. Revenue Analysis and Pricing Policies.

2. **Finance**

Introduction – Basic business function, sources of finance and their relative importance. Long and short term finance. Fund allocation, alternative uses of finance. Time value of money. Analysis of financial statements –Ratio analysis using balance sheet, profit and loss account. Capital budgeting decisions- type, nature and evaluation criteria: NPV, IRR, Payback. Working capital management. Financial markets; money markets, bill market, discount houses, call loan market, etc., Capital markets; mutual funds, stock markets, industrial banks, world bank, UTI, IDBI, ICICI, SEBI and state finance corporations.

3.	**Costing** Cost classification: Cost ascertainment; allocation, apportionment, absorption of overheads and non-production cost; overhead analysis, absorption methods, general considerations. Job costing; factory job costing, contract cost. Unit costing; output and operating cost, simple process costing, normal and abnormal losses in process, waste, scrap, bye-and joint products. Marginal costs and breakdown charges. Cost planning and control, standard cost and budgetary control, setting standards, variance analysis. Cost reduction; tools, techniques and productivity. Depreciation; causes and significance, methods of providing for depreciation, book values, taxes and depreciation.
	Textbooks
1.	Paul Samuelson and William Nordhaus: Economics, Tata McGraw Hill.
2.	Prasanna Chandra: Financial Management, McGraw Hill.
3.	Jawaharlal: Cost Accounting, Tata McGraw Hill (TMH).
	References
1.	Prasanna Chandra: Finance Sense - Text and Cases, Tata McGraw Hill.
2.	Varshney and Maheshwari: Managerial Economics, Sultan Chand and Sons, New Delhi.
3.	Ruddar Datt and Sundaram: Indian Economy, S.Chand Publication.
4.	L.M. Bhole and Jitendra Mahakud (2017): Financial institutions and markets, McGraw Hill Education.
5.	Paul Keat, Philip Young and Sreejata Banerjee: Managerial Economics, Pearson Publication.
6.	Dominick Salvatore: Principles of Economics, Schaum's Outline Series.
7.	Dominick Salvatore: Microeconomics, Schaum’s Outline Series.
8.	Eugene Diulio: Macroeconomics, Schaum's Outline Series.

Programme	B. Tech. (Production Engineering)	**Semester -** IV
Course Code	R4CH2001ST	
Course Title	Environmental Studies	
Prerequisites	None	

Course outcomes: After completing this course, students will be able to

1. Imply the basic knowledge of environmental protection, sustainable development and improvement.
2. Categorize and scrutinize impact of human development on natural resources. Provide the student with an understanding of radioactive waste.
3. Interpret the impact of environmental problems on socio economic growth and human health.
4. Imply various strategies, technological improvement, and methods for sustainable management of environmental systems and for the remediation of degraded environment.
5. Apply different Science and Technology (S&T) based sustainability solutions and limitations as well as to identify impact of human population on the natural environment and human health.

Syllabus

1. **Significance of Environment Science**

Definition, basic principles and scope of environment science. Earth Man and Environment inter-relationship. Need for awareness Industrialization & Urbanization; Modern Human Life, Basic Ecological Concepts Ecosystems, nature of environmental threats Current environmental problems, Importance of clean air.

2. **Ecosystems and Its conservation:**

Introduction, definition: genetic, species and ecosystem diversity.
Concept of an ecosystem: Structure and function of an ecosystem, Producers, consumers and decomposers.
Conservation of ecosystem: Natural Resources, Renewable and Non-renewable Resources, Natural resources and associated problems.

Forest resources, Water resources, Mineral resources, Food resources, Energy resources, Land resources.

Role of an individual in conservation of natural resources. Biodiversity and its significance, and conservation. Global, National and effects of biodiversity.

3.	**Fundamentals of Environmental Chemistry:** Definition, Causes, effects and control measures of (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards (h) Radioactive Waste (I) E-waste. Importance of Environmental Chemistry to access and manage environmental pollution.
4.	**Pollution Monitoring and Control Methods:** Methods of controlling air pollution: Pollution controlling methods, Principle, construction, working and application of Equipment for gaseous pollutants control: Method to control water pollution: Principle, construction, working. Concept of Sustainability and Green Chemistry as a tool for sustainable development.
5.	**Environmental Assessment, Management and Legislation:** Aims And Objectives Of Environmental Impact Assessment (EIA). Environmental Impact Statement (EIS) And Environmental Management Plan (EMP) Environmental Ethics: Issues And Possible Solutions: Environment Audit :Principle, Procedure And Benefits Case study can be submit by the students. ***Projects and activities by students on Current Environmental Issues in India*** *Global Environmental Issues:* Biodiversity loss ,Climate change, Ozone layer depletion, Sea level rise Global Warming ***International efforts for environmental protection and contribution of India for same, National Action Plan on Climate Change***
	Textbooks
1.	De.: Environmental Chemistry, 6th Edition, New Age International
2.	P.K.Goel, Water Pollution, Causes, Effects and Control, New Age International
3.	Erach Bharucha, Text Book of Environmental Studies for Undergraduate Courses, Universities Press, Second Edition
	References
1.	Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad,
2.	Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T., Environmental Encyclopedia, Jaico Publ. House, Mumbai,.
3.	Jadhav, H &Bhosale, V.M., Environmental Protection and Laws. Himalaya Pub. House, Delhi.