INDIAN INSTITUTION OF INDUSTRIAL ENGINEERING

A Course in

GRADUATESHIP EXAMINATION IN INDUSTRIAL ENGINEERING

Revised Syllabus w.e.f.
August 2026
Examination

INDIAN INSTITUTION OF INDUSTRIAL ENGINEERING

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GRADUATESHIP EXAMINATION IN INDUSTRIAL ENGINEERING

The Indian Institution of Industrial Engineering (IIIE), a National Body dedicated to the advancement of the profession of Industrial Engineering. An ISO 9001:2015 certified Institution, IIIE conducts Graduateship Examination every year through a nation-wide network of 33 Chapters and Centres. It provides an opportunity to individuals aspiring to acquire professional qualification for career advancement while contributing to the productivity of the nation. A pass in the Graduateship Examination is deemed at par with a Bachelor's Degree in Industrial Engineering, from a recognized Indian University.

The Institution also publishes a monthly "Industrial Engineering Journal" which is informative and useful to the students, Professionals and Academicians in the field of Industrial Engineering. One who wishes to qualify through the Graduateship Examination of this institution can enroll as a student member (qualifications required are given below). For detailed information about the Scheme of Examination, Syllabus and Application form, please write to the Controller of Examination (CoE) at the above address with a payment receipt of ₹ 500/- paid in ONLINE mode. Details are available on IIIE website.

ELIGIBILITY FOR GRADUATESHIP ADMISSION

- H.S.C (Std. XII with Science) with two years working experience.
- Graduate in Science with one year working experience.
- Diploma in Engg. / Technology (3 years course full time) with one year working experience.
- Has completed and passed first two years of a regular degree course in Engineering / Technology.
- Degree in Engineering / Technology of a University of India or equivalent qualification recognized by All India Council for Technology Education (AICTE)/UGC as equivalent.

SCHEME OF EXAMINATION

- Examinations are conducted twice a year, in February and in August at around 25 centers all over India. For February Examination, candidates are admitted **upto 15th October** whereas for August Examination, admission is **upto 15th March (after cut off date late fee will be applicable).**
- The written Examinations consist of three parts namely, Foundation Course, Basic Industrial Engineering, Advanced Industrial Engineering and Industrial Engineering & Management Course.
- After successful completion of Advanced Industrial Engineering, students are also required to carry out a project on a topic relating to Industrial Engineering and have the project report accepted through Viva-voce.

PAPERS FOR WRITTEN EXAMINATIONS

FOUNDATION COURSE

IE 001: Business Communication
IE 002: Elements of Industrial Engineering
IE 003: Mathematics for Engineers
IE 004: Computer & Information Technology
IE 005: Engineering Drawing & Graphics
IE 006: Material Science
IE 007: Professional Ethics in Engineering*
IE 008: Soft Skills for Engineers*

*AUDIT COURSE- ONLY assignment

BASIC INDUSTRIAL ENGINEERING COURSE

IEA 01: Probability and Statistical Techniques
IEA 02: Operation Research
IEA 03: Financial Accounting & Costing
IEA 04: Principles of Management
IEA 05: Human Factors in Engineering
IEA 06: Manufacturing Technology
IEA 07: Industrial Automation and Robotics
IEA 08: Engineering Economics

ADVANCED INDUSTRIAL ENGINEERING COURSE

IEB 01: Facilities Planning and Management
IEB 02: Supply Chain & Logistics Management
IEB 03: Production & Operations Management
IEB 04: Quality Assurance and Reliability

Electives (One subject from each Group)

GROUP I (Industrial Management)
IEE 01: Innovation & Value Engineering
IEE 02: Strategic Management
IEE 03: Project Management
IEE 04: Total Quality Management

GROUP II (Operations Management)
IEE 05: Lean Manufacturing
IEE 06: Smart Manufacturing
IEE 07: AI in Industrial Engineering
IEE 08: Industrial Safety and Maintenance

GROUP III (Business Management)
IEE 09: Managerial Finance
IEE 10: Total Productive Maintenance
IEE 11: Business Process Simulation
IEE 12: Entrepreneurship Development

GROUP IV (Integrated Resource Management)
IEE 013: Materials Management
IEE 014: Sustainability Engineering
IEE 015: Human Resource Management
IEE 016: Energy Audit & Management

Project Work-Project Report and Viva Voce

After successful attempt of mandatory 4 PAPERS OF ADVANCED IE Course, student is required to submit the project proposal on topic relating to Industrial Engineering. After successful attempt of remaining 4 PAPERS OF ELECTIVES of ADVANCED IE Course student need to submit the project report. Student's work will be evaluated once project report is accepted through Viva-voce.

A student is expected to complete Graduateship Degree Course including Project Work within a maximum period of 'NINE' Years.

Message From BoE Chairman:



The Indian Institution of Industrial Engineering (IIIE) has always been committed to advancing the discipline of Industrial Engineering in tune with the evolving needs of industry and society. In continuation of this legacy, we have undertaken a comprehensive revision of the syllabus to incorporate the emerging domains such as Artificial Intelligence, Sustainability Engineering, Industry 4.0, Robotics and Automation, Energy Audit & Management, Smart Manufacturing etc.

The revised syllabus is thoughtfully structured, providing clear and comprehensive information about the content that students need to learn. The syllabus includes recommended textbooks and reference materials where necessary, ensuring alignment with current academic standards and industry requirements. This will facilitate the students to learn each subject deeply and holistically.

The revision reflects that the modern industrial engineer must go beyond traditional industrial engineering concepts and embrace the broader responsibility for shaping efficient, intelligent and sustainable systems. The integration of these new areas will prepare the learners to understand the modern industrial concepts and prepare them to be globally competitive and socially responsible.

I am thankful to the Board of Examination Members who have contributed their time, expertise and dedication in developing this future-ready curriculum. This collective effort ensures that the institute continues to offer programs that are both academically rigorous and industry relevant.

The BOE aims at fulfilling the vision of IIIE ‘To make continuous contributions to the productivity of all branches of Economic and Social activities of our Nation’.

Best regards,
Prem Prakash Gajpal

BoE Chairman

BOE Members

Dr. Sunilkumar S Honnungar
Dr. Mariappan Nadar
Er. Pramod Kumar Singh Rathor
Dr. M Rajesh
Prof. Mahesh Bhadane
Dr. S D Dalvi

Course Code	Course Name	Marks
IE001	Business Communication	100

Learning Objectives:

1. **Learn the methods of industrial communication.**
2. **Study the presentation skills.**
3. **Communicate effectively with employers and employees.**

Course Outcomes: Learner will be able to……

1. **Develop oral and written communication skills.**
2. **Write industrial letters, reports, precis etc.**
3. **Study, analyze and conclude the cases.**
4. **Develop the presentation skills.**
5. **Communicate effectively on various online and offline platforms.**

Module	Contents	Marks
1	**Communication** - Meaning, Role, Types, Purpose, Process, Characteristics of successful communication, Importance of communication in management, Communication structure in organization, Communication in crisis. Oral communication - Principles of successful oral communication, Barriers to communication, Conversation control, Effective listening, Non–verbal communication. Written Communication - Principles of written communication, Purpose of writing, Clarity in writing, the 3X3 writing process for business communication: Prewriting – Writing – Revising, Electronic writing process.	**30**
2	**Industrial Communication -** Business letters, writing routine and persuasive letters Positive and negative messages, writing memos, Report writing of technical and general event/incidences, Report types, Report objectives, Formal report, Informal report, Analytical reports, Business reports, Precis Writing	**25**
3	**Case Method of Learning-** Understanding the case method of learning, Different types of cases, Overcoming the difficulties of the case method, Reading a case properly (previewing, skimming, reading, scanning), Case analysis approaches (Systems, Behavioral, Decision), Dos and don'ts for case preparation	**25**

4	**Presentation Skills-** Objectives of presentation, Elements of presentation, Design of a presentation**,** Advanced visual support for business presentation , Types of visual aid (earphone, laptop, smartphones, remote control, smartboards, displays, pointers), Negotiations skills- Definition of negotiation, Nature and need for negotiation, Factors affecting negotiation, Stages of negotiation process, Negotiation strategies	**30**
5	**Employment Communication -** Introduction, Writing CVs, Group discussions, Interview skills, Impact of Technological Advancement on Business Communication, Communication networks - Intranet, Internet, Modes of communication - Emails, SMS, Teleconferencing, Videoconferencing, WhatsApp, X, Facebook, Instagram platforms of companies and industries, Agenda Planning for meeting, Draft for formal invitation to participants; timing; venue of meeting, Leading meetings, Online meeting platforms like Google Meet, Zoom meetings, Microsoft teams etc., Business etiquettes and Ethics in business communication	**30**

Assessment:

Internal Assignment:

Internal assignment of 140 marks based on the entire syllabus needs to be submitted by the candidate.

End Semester Examination:

1. The question paper will comprise of a total of seven questions, each carrying 20 marks.
2. Each Question can have maximum three sub questions preferably covering from the same module.
3. Students can answer any 5 full questions of their choice amongst 7.

References:

1. R. C. Bhatia- Business Communication; Ane Books Pvt Ltd.
2. Kaul and Asha - Business Communication; Publisher: PHI, New Delhi.
3. Rai, U and Rai S. M. - Business Communication; Himalaya Publishers.

Links for Online NPTEL/SWAYAM courses:

1. https://onlinecourses.swayam2.ac.in/imb19_mg14/preview
2. https://nptel.ac.in/courses/109106129

Course Code	Course Name	Marks
IE002	Elements of Industrial Engineering	100

Learning Objectives:

1. **To learn basic industrial engineering.**
2. **To use work study techniques for productivity improvement.**
3. **To understand the advances in industrial engineering.**

Course Outcomes: Learner will be able to……

1. **Understand the concepts and evolution in industrial engineering.**
2. **Explain the concepts of productivity in industrial engineering.**
3. **Relate the concepts of work study in industrial engineering.**
4. **Describe the concepts of ergonomics in industrial engineering.**
5. **Understand and apply the advances in industrial engineering.**

Module	Contents	Marks
1	**Introduction:** Engineering, Industrial Engineering and Management definitions. Resources for Business, Goals of business. Need of optimization of resources. Evolution of Industrial Engineering; industrial Engineering Functions, Role of an Industrial Engineer.	25
2	**Productivity:** Concept of Production, Types of Production, Concept of Productivity, Production vs Productivity, Partial Productivity, Total Factor Productivity, Total Productivity, Factors influencing Productivity, Productivity cycle.	30
3	**Work Study:** Aim and Objectives of work study, Work content, Human factor in Work study, Method Study, Procedure of Method Study, Recording Technique examples: Process Charts (Process chart symbols / Process charts (Examples of Outline chart/ Two Handed Process Chart / Multiple Activity chart) Advantages and Limitations of Method study, Work Measurement, Work Measurement Techniques: Time Study (standard time calculations), Work Sampling, PMTS.	30
4	**Ergonomics:** Introduction and Overview of Ergonomics, Concept and history, Importance, Principles of ergonomics, Tools and techniques for Ergonomics, Anthropometry, Physical Ergonomics, Cognitive Ergonomics	25
5	**Operation Excellence and Advances in Industrial Engineering:** Operational Excellence, Flexible Manufacturing Systems, Supply Chain and Logistics Management, Industry 4.0, Industry 5.0	30

Assessment:

Internal Assignment:

Internal assignment of 140 marks based on the entire syllabus needs to be submitted by the candidate.

End Semester Examination:

1. The question paper will comprise of a total of seven questions, each carrying 20 marks.
2. Each Question can have maximum three sub questions preferably covering from the same module.
3. Students can answer any 5 full questions of their choice amongst 7.

References:

1. International Labour Organisation- Introduction to Work Study; National Book Foundation
2. Mahajan M. - Industrial Engineering and Production Management; Dhanpat Rai & Sons, Delhi
3. Sharma S. K. and Sharma Savitha - Work Study and Ergonomics; S.K Kataria & Sons Delhi
4. Jhamb L.C.- Work study & Ergonomics; Everest Publishing House, Pune.
5. Sheth Vijay - Industrial Engineering Methods and Practices; Penram International Publishing (India) Pvt. Ltd.
6. Khanna O. P. - Industrial Engineering and Management; Dhanpat Rai Publications
7. Telsang Martand - Industrial Engineering and Production Management; S. Chand

Links for Online NPTEL/SWAYAM courses:

1. https://archive.nptel.ac.in/courses/112/107/112107292/
2. https://onlinecourses.nptel.ac.in/noc20_me11/preview

Course Code	Course Name	Marks
IE003	Mathematics for Engineers	100

Learning Objectives:

1. **To learn differential and integral calculus.**
2. **To understand the Laplace transforms.**
3. **To apply linear algebra for engineering applications.**

Course Outcomes: Learner will be able to

1. **Apply the knowledge of calculus to solve problems related to polar curves.**
2. **Compute rate of change of multivariate functions using partial differentiation.**
3. **Apply the knowledge of multiple integrals to compute area and volume.**
4. **Understand the concept of Laplace transform, Fourier series and to solve initial value problems.**
5. **Apply the matrix theory for solving system of linear equations and compute Eigen values and Eigenvectors.**

Module	Contents	Marks
1	**Polar coordinates** - Polar curves, angle between the radius vector and the tangent, and angle between two curves. Pedal equations. Curvature and Radius of curvature- Cartesian, Polar and Pedal forms. Taylor's and Maclaurin's series expansion for one variable (Statement only)–problems. Indeterminate forms	**25**
2	**Differential Calculus -** Partial differentiation, Total derivative-differentiation of composite functions. Jacobian and problems. Maxima and Minima for a function of two variables- Problems.	**30**
3	**Multiple Integrals -** Evaluation of double and triple integrals, Evaluation of double integrals by change of order of integration, Conversion to polar coordinates. Applications to find Area and volume by double integral.	**25**
4	**Transforms -** Laplace transform, Application of Laplace Transforms, transform of elementary functions, Properties, LT of special functions- periodic functions, Heaviside Unit step function, Unit impulse function, Inverse Laplace Transforms, and its applications to solve ordinary differential equations, Fourier series: Fourier series of periodic functions	**30**
5	**Linear Algebra** - Introduction of linear algebra. Rank of a matrix. Consistency and solution of a system of linear equations-Gauss-elimination method, Gauss-Jordan method and Gauss-Seidel method. Eigenvalues and Eigenvectors, Rayleigh's power method to find the dominant Eigen value and Eigenvector.	**30**

Assessment:

Internal Assignment:

Internal assignment of 140 marks based on the entire syllabus needs to be submitted by the candidate.

End Semester Examination:

1. The question paper will comprise of a total of seven questions, each carrying 20 marks.
2. Each Question can have maximum three sub questions preferably covering from the same module.
3. Students can answer any 5 full questions of their choice amongst 7.

References:

1. B.S. Grewal - Higher Engineering Mathematics; Khanna publishers.
2. E. Kreyszig - Advanced Engineering Mathematics; JohnWiley & Sons.
3. Thomas, G.B. and Finney R.L. - Calculus and Analytic Geometry; Narosa Publ. House.
4. Srimanta Pal & SubodhC. Bhunia - Engineering Mathematics; Oxford University Press.

Links for Online NPTEL/SWAYAM courses:

1. https://archive.nptel.ac.in/courses/111/106/111106146/
2. https://archive.nptel.ac.in/courses/111/107/111107108/
3. http://www.class-central.com/subject/math(MOOCs)
4. http://academicearth.org/

Course Code	Course Name	Marks
lE004	Computers & Information Technology	100

Learning Objectives:

1. **To understand importance of software in engineering**
2. **To know the programming languages**
3. **To learn importance of IT in the industrial engineering**

Course Outcomes: Learner will be able to……

1. **Understand the concept of input and output devices of Computers**
2. **Understand an operating system and its working**
3. **Comprehend fundamental programming concepts and methodology**
4. **Compare and analyze the fundamental structures of computer networks and the Internet**
5. **Analyze the role of IT in industrial engineering.**

Module	Contents	Marks
1	**Computer System -** Introduction, Types, CPU- Memory input and Output devices, Instruction Format, Instruction Set, Instruction Cycle, Data storage devices, Microprocessors, Printing devices, Interconnecting the units of a computer, Computer memory, Input and Output devices, Data representation.	**30**
2	**Software -** User interface and operating systems, Types file management, Word processing and Desktop publishing, Spread sheet applications, Database applications.	**25**
3	**Programming languages** - Introduction to C-programming, Basic commands, data types, Introduction to C++, JavaScript, Python, PHP, SQL etc., Comparison and applications of programming languages.	**30**
4	**Functions of Modern Networks** - Local area network, wide area networks, network applications voice and information services, person to person and group communications, exchanging files, multimedia, basic elements.	**25**
5	**IT in Industrial engineering** - e- governance, Applications of IT in business. Introduction to Information technology, Internet & Worldwide Web, Applications of Artificial Intelligence in Industrial Engineering, Introduction to Data science, Introduction to Block Chain.	**20**

Assessment:

Internal Assignment:

Internal assignment of 140 marks based on the entire syllabus needs to be submitted by the candidate.

End Semester Examination:

1. The question paper will comprise of a total of seven questions, each carrying 20 marks.
2. Each Question can have maximum three sub questions preferably covering from the same module.
3. Students can answer any 5 full questions of their choice amongst 7.

References:

1. Gardan Davis - Computer data processing; Mcgraw Hill
2. Fl. Elamsqri, S.M Navathi - Fundamentals of data base system; Pearson
3. V. Rajaraman - Principles of computer programming; Prentice Hall
4. Dennis Curtin, Kunal Sen, Kim Foley and Cathy Morin - Information Technology- The Breaking Wave; Tata Mcgraw Hill
5. E. Alpaydin- Introduction to Machine Learning; Prentice Hall (India)
6. Saha. S.K. - Introduction to Robotics; McGraw Hill Education (India) Private Limited.

Links for Online NPTEL/SWAYAM courses:

1. https://onlinecourses.swayam2.ac.in/cec19_cs06/preview
2. https://onlinecourses.swayam2.ac.in/cec20_cs05/preview
3. https://nptel.ac.in/courses/106103068

Course Code	Course Name	Marks
lE005	Engineering Drawing & Graphics	100

Learning Objectives:

1. **To learn various projections in engineering drawing**
2. **To learn drawing and drafting methods**
3. **To understand dimensioning and tolerances in the drawing**

Course Outcomes: Learner will be able to……

1. **Understand the basic principles and conventions of engineering drawing.**
2. **Solve numerical based on Orthographic Projection of Solids.**
3. **Develop 2D and 3D drawing.**
4. **Prepare the development of surfaces.**
5. **Understand the importance of Geometrical dimensioning & tolerance.**

Module	Contents	Marks
1	**Introduction to Engineering Drawing -** Significance of Engineering drawing, BIS Conventions of Engineering Drawing, Free hand sketching of engineering drawing, Scales, Splines, circles, ellipse. **Orthographic Projections of Points, Lines and Planes** - Projections of points in 1st and 3rd quadrants. Orthographic projections of lines (Placed in First quadrant only). Orthographic projections of planes viz triangle, square, rectangle, pentagon, hexagon, and circular laminae (Placed in First quadrant only), Need to study the projections of Lines & Planes with application.	**20**
2	**Orthographic Projection of Solids** (Solids Resting on HP only) **-** Projection of Prisms & Pyramids (triangle, square, rectangle, pentagon, hexagon), Cylinders, Cones, Cubes & Tetrahedrons. Projections of Frustum of cone and pyramids	**20**
3	**Isometric Projections -** Isometric scale, Isometric projection of cube, right regular prisms, pyramids, cylinders, cones etc. Isometric projection of combination of two or more simple solids. **Orthographic Views -** Conversion of simple isometric drawings/ engineering components into orthographic views using first angle method of projection.	**30**
4	**Development of Lateral Surfaces of Solids:** Development of lateral surfaces of right regular prisms, cylinders, pyramids and cones resting with base on HP only, Development of lateral surfaces of their frustums and truncations. Problems on applications of development of lateral surfaces like funnels and trays.	**20**

5	**Drafting of Thread forms and threaded fasteners -** Sectional views of threads, ISO Metric (Internal & External), and square threads, Assembly of two plates using Hexagonal headed bolt and nut with washer.	**20**

	Flange Couplings – Drafting of Protected type flange coupling assembly on drawing sheet using drawing instruments in FV & SV. **Geometric Dimensioning and Tolerance -** Assembly drawing (2D) of screw jack (Bottle type), Assembly drawing of simple jig on drawing sheet using drawing instruments showing tolerances.	**30**

Assessment:

Internal Assignment:

Internal assignment of 140 marks based on the entire syllabus needs to be submitted by the candidate.

End Semester Examination:

1. The question paper will comprise of a total of seven questions, each carrying 20 marks.
2. Each Question can have maximum three sub questions preferably covering from the same module.
3. Students can answer any 5 full questions of their choice amongst 7.

References:

1. Bhatt, N.D., Engineering Drawing: Plane and Solid Geometry; Charotar Publishing House Pvt. Limited.
2. Bhatt, N.D., Machine Drawing: Plane and Solid Geometry; Charotar Publishing House Pvt. Limited.
3. B.K. Goel Machine Drawing; S.K. Kataria & Sons
4. David A. Madsen., Geometric Dimensioning and Tolerancing; Goodheart-Willcox Publication

Links for Online NPTEL/SWAYAM courses:

1. https://nptel.ac.in/courses/112103019
2. https://youtu.be/ANEvQyt3PnU?si=xIDpeqkrl24m-IId (NPTEL-IIT Roorkee)

Course Code	Course Name	Marks
lE006	Materials Science	100

Learning Objectives:

1. **To understand atomic structure of the materials**
2. **To learn properties and characteristics of materials**
3. **To learn materials processing methods**

Course Outcomes: Learner will be able to……

1. **Understand of the fundamental principles of materials science.**
2. **Gain exposure to different classes of engineering materials.**
3. **Apply the knowledge of materials science to analyze and solve basic engineering problems related to stress, strain and fracture of materials.**
4. **Plan the heat treatment process and types of alloys for mechanical engineering applications useful to the society.**
5. **Identify and measure the properties and characteristics of materials.**

Module	Contents	Marks
1	**Introduction to materials -** An overview on engineering materials and their origin, Role of materials in product success, Nature of materials, Classification and applications, Criteria for selection of materials, Global considerations.	**25**
2	**Atomic Structure and structure-property correlations -** Role of chemical, physical and mechanical properties in materials, The structure of crystalline solids, Interatomic bonding in crystals, Non-crystalline materials, Single crystals, Polycrystalline solids. Point, Line, surface/volume defects in crystals.	**25**
3	**Forming and shaping of materials -** Concept of plastic deformation, Dislocation theory**,** Annealing: Recovery, Recrystallization and Grain growth; Hot working & Cold working of metals. **Concept of alloy formation** - Types of alloys, Solid solutions, Factors governing solid solubility, Order-disorder transformation, Allotropic transformation. Fabrication processes of different composite materials.	**30**

4	**Special characteristics of metallic materials -** Cooling curves, Concept of super cooling, Binary Phase Diagrams, Phase Rule, Lever Rule and its applications, Iron-cementite and iron-graphite phase diagrams, Interpretation of solidification behavior and microstructures, Effect of non-equilibrium cooling, coring and homogenization, Effect of carbon and minor constituents on properties of steel and cast iron, Types of cast iron, their microstructures and typical uses, TTT Diagram. **Heat treatment -** Principle, Process and Application of various heat treatments, Diffusion coating, Defects in heat treatment. Properties and applications of alloy steels, tool steels, stainless steels, Concept of hardenability, Factors affecting hardenability, Specification of steels.	**30**
5	**Types of materials and their characteristics -** Structure and Properties of Plastic materials, Rubber, Refractories, Ceramics, Abrasives, Glass, Composites, Semi-conductors, insulating materials, nano-materials, bio- materials, Characterization and Measurements of Properties using X-ray diffraction, Non Destructive Testing techniques, Optical microscopy, Electron microscopy.	**30**

Assessment:

Internal Assignment:

Internal assignment of 140 marks based on the entire syllabus needs to be submitted by the candidate.

End Semester Examination:

1. The question paper will comprise of a total of seven questions, each carrying 20 marks.
2. Each Question can have maximum three sub questions preferably covering from the same module.
3. Students can answer any 5 full questions of their choice amongst 7.

References:

1. William D. Callister, Jr- Materials Science and Engineering: An Introduction; John Wiley and Sons
2. D.R. Askeland, P.P. Fulay- W.J. Wright, The Science and Engineering of Materials; Cengage learning india pvt. ltd
3. S.H. Avner- Introduction to Physical Metallurgy; Tata McGraw-Hill Education.
4. Budinski- Engineering Materials: Properties and Selection; Pearson
5. L.E. Murr, Charlestein- Frontiers in materials Science; Marcel Dekkar Publications.
6. Anandh Subramaniam and Kantesh Balani- E-book on Materials Science and Engineering; MHRD

Links for Online NPTEL/SWAYAM courses:

1. https://onlinecourses.nptel.ac.in/noc24_mm12/preview
2. https://onlinecourses.nptel.ac.in/noc24_mm14/preview (Non-Destructive Testing)
3. http://nptel.ac.in/courses/113106032
4. https://nptel.ac.in/courses/112108150

Course Code	Course Name	Marks
IE007	Professional Ethics in Engineering	100

Course Objectives:

1. **To develop an understanding of human values, professional ethics, and global ethical challenges in engineering, emphasizing their relevance to individual conduct, societal well-being, and sustainable development.**
2. **To cultivate the ability to apply ethical principles in engineering practice through informed decision-making, innovation, safety considerations, and responsible product development in real-world contexts.**

Course Outcomes: Learner will be able to

1. **Demonstrate an understanding of human values and their relevance to individual behavior and societal well-being.**
2. **Analyze the importance and application of ethical principles in the engineering profession.**
3. **Evaluate the integration of ethical considerations in engineering practices through the lens of experimentation and innovation.**
4. **Examine ethical responsibilities related to safety, professional conduct, and rights within engineering practice.**
5. **Discuss global ethical issues impacting engineering, including environmental, technological, and cross-cultural dimensions.**
6. **Apply professional ethics in the context of real-world engineering product development and decision-making processes.**

Module	Contents	Marks
1	**Human Values** Introduction to Morals, Values, and Ethics, Integrity and Work Ethic, Service Learning and Civic Virtue, Respect for Others and Peaceful Living Caring, Sharing, and Honesty, Courage, Valuing Time, and Commitment Cooperation, Empathy, and Self-confidence, Character and Spirituality Introduction to Yoga and Meditation for Professional Excellence and Stress Management	30
2	**Foundations of Engineering Ethics** Definition and Scope of Engineering Ethics, Moral Issues and Ethical Dilemmas, Types of Ethical Inquiry, Concepts of Moral Autonomy, Theories of Moral Development: Kohlberg and Gilligan, Consensus, Controversy, and Ethical Models, Right Action Theories: Self-interest, Customs, Religion, Application of Ethical Theories	30
3	**Engineering as a Social Experimentation** Engineering as an Experiment: Nature and Responsibilities, Engineers as Responsible Experimenters, Professional Codes of Ethics, Legal and Ethical Balance in Engineering Practice	30
4	**Safety, Responsibilities, and Rights** Safety and Risk: Concepts and Evaluation, Risk-Benefit Analysis and Mitigation Strategies, Authority and Collective Bargaining, Confidentiality and Conflict of Interest, Occupational Crimes and Professional Responsibilities, Employee Rights and Professional Rights, Intellectual Property Rights (IPR), Workplace Discrimination	25

5	**Global and Contemporary Ethical Issues (8 Hours)** Ethics in Multinational Corporations, Environmental and Computer Ethics Ethical Issues in Weapons Development, Engineers as Managers, Consultants, and Expert Witnesses, Ethical Leadership and Code of Conduct, Corporate Social Responsibility (CSR)	**25**

Assessment:

Internal Assignment:

Internal assignment of 140 marks based on the entire syllabus needs to be submitted by the candidate.

End Semester Examination:

1. The question paper will comprise of a total of seven questions, each carrying 20 marks.
2. Each Question can have maximum three sub questions preferably covering from the same module.
3. Students can answer any 5 full questions of their choice amongst 7.

Textbooks

1.Mike W. Martin and Roland Schinzinger, Ethics in Engineering, Tata McGraw Hill, 2003.
2.Govindarajan M., Natarajan S., Senthil Kumar V.S., Engineering Ethics, Prentice Hall of India, 2004.

References

1.Charles B. Fleddermann, Engineering Ethics, Pearson Prentice Hall, 2004.
2.Charles E. Harris, Michael S. Pritchard, and Michael J. Rabins, Engineering Ethics: Concepts and Cases, Cengage Learning, 2009.
3.John R. Boatright, Ethics and the Conduct of Business, Pearson Education, 2003.
4.Edmund G. Seebauer and Robert L. Barry, Fundamentals of Ethics for Scientists and Engineers, Oxford University Press, 2001.
5.Laura P. Hartman and Joe Desjardins, Business Ethics: Decision Making for Personal Integrity and Social Responsibility, McGraw Hill Education, 2013.
6.World Community Service Centre, Value Education, Vethathiri Publications, 2011.

Online Resources

1. www.onlineethics.org
2. www.nspe.org
3. www.globalethics.org
4. https://www.youtube.com/playlist?list=PLWDeKF97v9SO8vvjC1KyqteziTbTjN1So

Course Code	Course Name	Marks
IE 008	Soft Skills for Engineers	100

Course Objectives:

1. **To develop effective communication, interpersonal, and presentation skills essential for personal growth, professional success, and collaborative teamwork.**
2. **To foster self-awareness, time management, motivation, and ethical practices for building a strong foundation in personal and professional excellence.**

Course Outcomes: Learner will be able

1. **To develop effective communication skills essential for personal and professional success.**
2. **To foster self-awareness, time management, motivation, and ethical practices.**
3. **To enhance interpersonal skills and prepare students for effective presentations and teamwork.**

Module	Contents	Marks
1	**Fundamentals of Effective Communication** Principles and components of effective communication: conviction, confidence, enthusiasm, and active listening, The communication process and its management., The KISS principle (Keep It Short and Simple): Strategies for composing concise and impactful messages, Communication barriers: Internal and external barriers including intrinsic motivation, perception, language, fear, and articulation skills, Listening: Importance, characteristics of good and poor listening practices, Non-verbal communication: Role and interpretation of facial expressions, posture, gestures, eye contact, and professional appearance.	30
2	**Presentation Skills and Techniques** Four-step presentation method: Preparation, introduction, content delivery, evaluation and feedback, summarization/conclusion, TOCSE method for structured presentations	30
3	**Self-Management** Techniques for self-awareness: Identification of strengths and areas for improvement, Planning and goal-setting strategies, Emotional regulation and managing traits such as ego and pride for personal growth.	30
4	**Time Management** Importance of attendance, discipline, and punctuality in professional settings, fulfilling commitments within deadlines, Maximizing productivity through effective time utilization.	25
5	**Motivation, Interpersonal Skills and Professional Ethics** Application of motivational techniques based on individual needs and contextual demands, Role modeling and idealization for positive behavioral development, Definition, importance, and development of interpersonal skills for effective collaboration and communication, Ethics and values: Definitions, significance, and application in professional life.	25

Assessment:

End Semester Examination:

1. **The question paper will comprise of a total of seven questions, each carrying 20 marks.**
2. **Each Question can have maximum three sub questions preferably covering from the same module.**
3. **Students can answer any 5 full questions of their choice amongst 7.**

Reference Books

1. Alex, K. (2012). Soft Skills: Know Yourself & Know the World (2nd ed.). S. Chand Publishing.
2. Mitra, B. K. (2012). Personality Development and Soft Skills. Oxford University Press.
3. Salaria, R. S. (2017). Soft Skills for Engineers. Khanna Publishing House.
4. Ramesh, G., & Ramesh, M. (2010). The ACE of Soft Skills: Attitude, Communication and Etiquette for Success (2nd ed.). Pearson Education.
5. Hariharan, S., Sundararajan, N., & Shanmugapriya, S. P. (2011). Soft Skills and Life Skills: A Manual for Students. Himalaya Publishing House.
6. Raman, M., & Sharma, S. (2012). Technical Communication: Principles and Practice (2nd ed.). Oxford University Press.

Links for Online NPTEL/SWAYAM courses:

1. https://www.youtube.com/playlist?list=PLrpK1inhO61UZI3BO1hAq5FN5zxIhJcSR
2. https://www.youtube.com/watch?v=hZSARM4VaVs
3. https://study.com/academy/lesson/video/what-are-soft-skills-definition-examples.html
4. https://www.youtube.com/watch?v=O7aCqjuziS0

Course Code	Course Name	Marks
IEA01	Probability and Statistics	100

Learning Objectives:

1. **To understand probability using standard statistical distributions**
2. **To learn hypothesis testing methods**
3. **To design the design of experiments in engineering**

Course Outcomes: Learner will be able to_ _ _ _

1. **Understand and apply concepts of probability and random variables**
2. **Estimate population parameters using various statistical techniques**
3. **Test hypotheses using standard statistical distributions**
4. **Design experiments and analyze variance**
5. **Apply time series analysis techniques for forecasting and data modeling**

Module	Contents	Marks
1	**Probability and Random Variables** Fundamentals of probability, Random variables – Discrete and Continuous Moments and moment-generating functions, Standard probability distributions, Functions of random variables, Two-dimensional random variables, Correlation and regression analysis	25
2	**Estimation Theory** Principle of least squares, Simple, multiple, and partial correlation, Parameter estimation methods, Maximum Likelihood Estimation (MLE), Method of Moments	25
3	**Hypothesis Testing** Sampling distributions, Hypothesis tests using: Normal distribution, Student's t-distribution, Chi-square distribution, F-distribution, Analysis of variance (ANOVA): One-way and two-way classifications	30
4	**Design of Experiments** Completely Randomized Design (CRD), Randomized Block Design (RBD) Latin Square Design (LSD), Two-factor factorial designs	30
5	**Time Series Analysis** Characteristics and components of time series, Methods of time series representation, Moving averages, Exponential smoothing techniques, Auto-regressive processes	30

Assessment:

Internal Assignment:

Internal assignment of 140 marks based on the entire syllabus needs to be submitted by the candidate.

End Semester Examination:

1. The question paper will comprise of a total of seven questions, each carrying 20 marks.
2. Each Question can have maximum three sub questions preferably covering from the same module.
3. Students can answer any 5 full questions of their choice amongst 7.

Reference Books

1.Freund, J.E., & Miller, I., Probability and Statistics for Engineering, 5th Edition, Prentice Hall, 1994.

2.Devore, J.L., Probability and Statistics for Engineering and the Sciences, Brooks/Cole, 1982.

3.Montgomery, D.C., & Johnson, L.A., Forecasting and Time Series, McGraw-Hill.

4.Anderson, O.D., Time Series Analysis: Theory and Practice, North-Holland, 1982.

5.Gupta, S.C., & Kapoor, V.K., Fundamentals of Mathematical Statistics, Sultan Chand & Sons, New Delhi, 1999.

Links for Online NPTEL/SWAYAM courses:

1. https://onlinecourses.nptel.ac.in/noc21_ma74/preview
2. https://www.youtube.com/watch?v=XxG2-5Fi3JU

Course Code	Course Name	Marks
IEA02	Operations Research	100

Learning Objectives:

1. **Formulate and solve optimization problems using LP, transportation, and assignment models.**
2. **Apply game, decision, and queuing theories for decision-making.**
3. **Use inventory models and simulation for effective operations management.**

Course Outcomes: Learner will be able to……

1. **Convert a real-world problem in to a Linear Programming Problem and Interpret the solution obtained using Simplex algorithm.**
2. **Express a real-world problem as Transportation problem or Assignment problem and solve it to get optimal solution using appropriate algorithms.**
3. **Understand the need for inventory control, Choose appropriate model and Calculate the economic order quantity.**
4. **Illustrate the concept of decision making in situations of competition and uncertainty and recommend the appropriate strategies.**
5. **Understand reasons of formation of queues, Classify various queuing systems and Apply parameters defined for various queuing systems for decision making in real life situations.**

Module	Contents	Marks
1	**Introduction to Operations Research (OR) -** Decision situations and decision making, O.R. for decision making. Formulation of decision problems, Concept of Optimization, Mathematical models. **Linear Programming** - Linear Programming Problem, Mathematical Formulation, Finding Optimal solution using Graphical method, Simplex method, Big-M method.	**30**
2	**Transportation problem** – Formulation, Finding Optimal solution using North-west corner method, Least cost method and Modified distribution method. Degeneracy **Assignment problem –** Formulation, Finding Optimal solution using Hungarian method	**30**
3	**Inventory Models** - Inventory, Purpose of Inventory, Inventory Costs, Inventory Control - why and how?, Inventory control systems, Economic Order Quantity Models. Inventory analysis using ABC classification.	**20**

4	**Game Theory -** Two-person Zero-Sum games; Pure and mixed strategy optima; Saddle points; Solution by linear Programming method. **Decision Theory -** Decisions under risk & uncertainty with relevant criteria in each case: Decision trees.	**30**
5	**Waiting Line Models** - Basic concepts of Queuing Theory, Structures of Queuing Models - Distribution of arrival and service times, Steady State behavior of M/M/1 and M/M/C queues with unlimited waiting space.	**30**

Assessment:

Internal Assignment:

Internal assignment of 140 marks based on the entire syllabus needs to be submitted by the candidate.

End Semester Examination:

1. The question paper will comprise of a total of seven questions, each carrying 20 marks.
2. Each Question can have maximum three sub questions preferably covering from the same module.
3. Students can answer any 5 full questions of their choice amongst 7.

References:

1. **J. K. Sharma**, *Operations Research: Theory and Applications*, Macmillan Publishers India Limited, India, 2009. ISBN: 9780230638853.
2. **P. P. Pai**, *Operations Research*, OUP India, India, 2012. ISBN: 9780198072691.
3. **H. A. Taha**, *Operations Research: An Introduction*, Pearson/Prentice Hall, India, 2006. ISBN: 9780131886570.
4. **F. S. Hillier and G. J. Lieberman**, *Introduction to Operations Research*, McGraw-Hill Higher Education, United Kingdom, 2010. ISBN: 9780071324830.
5. **Ravindran, A., Phillips, D. T., and Solberg, J. J.**, *Operations Research: Principles and Practice*, 2nd Edition, Wiley India Pvt. Limited, India, 2007. ISBN: 9788126512560.

Links for Online NPTEL/SWAYAM courses:

1. https://onlinecourses.swayam2.ac.in/cec21_ma09/preview
2. https://onlinecourses.nptel.ac.in/noc23_mg09/preview

Course Code	Course Name	Marks
IEA03	Financial Accounting & Costing	100

Learning Objectives:

1. **To Apply accounting principles (GAAP/IFRS) to prepare and analyze core financial statements**
2. **To Implement Costing Techniques in accounts function**
3. **To Evaluate Budgetary Control Systems**

Course Outcomes: Learner will be able to……

1. **Understand Financial Management Objectives and Basic concepts**
2. **Understand the process of trading account, profit and Loss account and Balance sheet**
3. **Understand the time value of money and use the different policies to determine present value, future value etc., in Financial application**
4. **Understand the process of job costing, activity-based costing, cost accounting and budgetary control**
5. **Interpret during decision making, the concepts of CVP analysis, cost control techniques including time value of money. Accepted Accounting Principles and IFRS and Green Accounting**

Module	Contents	Marks
1	Fundamentals of Financial Management - Introduction, Objectives, goals and functions of financial Management. Time value of Money, Risks and Returns, Valuation of Securities. Financial accounting - nature and functions users of financial accounting information	20
2	**Fundamental accounting concepts** - Operation of the double entry system of recording accounting transactions, Completion of the accounting cycle - the accrual convention - the asset expense controversy recognition of revenue – preparation and presentation of the basic financial statements (profit and loss account, balance sheet, cash flow statements), Analysis of financial statements – Ratio analysis using balance sheet, Profit and loss account, Financial ratio analysis	**35**
3	**Financial Accounting –** 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, 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, Capital markets; Mutual funds, Stock markets, Introduction to Industrial banks, World bank, SEBI and State finance corporations.	**35**

4	**Costing -** Cost classification, Cost ascertainment, Allocation, 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. standard cost and budgetary control, setting standards, variance analysis. Cost reduction- tools, techniques and productivity.	**20**
5	**Capital Budgeting -** Concept of Operating cycles and working of Capital Management, Capital Budgeting - Cost of capital investment decisions and Risk analysis in Capital Budgeting. Budgetary control and standard costing, Budget procedures, Functional budgets, Master budget, Variance analysis. **Concept of Generally Accepted Accounting Principles** (GAAP), Introduction to international Financial Reporting, Standards (IFRS), Green Accounting. Depreciation - Depreciation fund and its calculation and CVP analysis, Causes and significance, Methods of providing for depreciation policies, Book values, Taxes and depreciation	**30**

Assessment:

Internal Assignment:

Internal assignment of 140 marks based on the entire syllabus needs to be submitted by the candidate.

End Semester Examination:

1. The question paper will comprise of a total of seven questions, each carrying 20 marks.
2. Each Question can have maximum three sub questions preferably covering from the same module.
3. Students can answer any 5 full questions of their choice amongst 7.

References:

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).
4. Accounting for Non-Accounting Students, J R Dyson, Pitman
5. Financial Accounting Tools for Business Decision Making, Kimmel, Weygandt & Kieso's John Wiley & Sons, Inc.
6. lntroduction to Accounting for Business Studies, F. P. Langley, Butterworths.
7. L.M. Bhole and Jitendra Mahakud (2017): Financial institutions and markets, McGraw Hill Education.

Links for Online NPTEL/SWAYAM courses:

1. https://onlinecourses.nptel.ac.in/noc25_mg121/preview
2. https://nptel.ac.in/courses/110106368

Course Code	Course Name	Marks
IEA 04	Principles of Management	100

Learning Objectives:

1. **To Demonstrate the four key functions of management (planning, organizing, leading, and controlling**
2. **To Analyze Organizational Behavior & Leadership Styles**
3. **To Develop Decision-Making & Problem-Solving Skills**

Course Outcomes: Learner will be able to……

1. **Understand and Comprehend Basic Management Skills.**
2. **Compare various types of Companies and associated rules and regulations.**
3. **Understand and Apply HRM Tools and Techniques.**
4. **Exhibit skills to manage markets.**
5. **Showcase Financial Management Learnings for Resource Optimization.**

Module	Contents	Marks
1	**Principles of Management -** Evolution of scientific management, Theory of Management, Definition and concept of management, Functions of management- Planning, Organizing, Directing, Coordinating and controlling, Motivational Theories, Concept of Leadership – Line & Staff Organization, Project & Matrix Organization, System concept of management, Authority, Responsibility & span of control, Managerial ethics, Corporate social responsibility, Management of change	30
2	**Legal Aspects of Management -** The Indian Contract Act, 1872- Formation of valid contract, Discharge of contract, Quasi contract, Indemnity and Guarantee. The Indian Partnership Act, 1932- Essentials of Partnership, The Companies Act – Nature and definition of Company, Registration and Incorporation, Memorandum and Article of association, Kinds of companies - Proprietary, Partnership including LLP, and Joint stock companies- Private limited, Public limited companies, Co-operative organizations and Public sector organizations. Winding up of the Company.	30
3	**Human Resource Management -** Meaning and Scope, Principles of HRD, Job Analysis – Job description and Job specification, Recruitment, Job enrichment, Job rotation, Training and Development – Purpose and Methods, Orientation. Performance Appraisal- Purpose, Procedure and Techniques, Grievance redressal procedure, Industrial safety and Industrial Relations.	30

4	**Marketing Management -** Definition & Scope, Selling & Modern concepts of marketing, Forecasting of demand, Market research, Customer behaviours, Product launching, Sales promotion, Pricing, Channels of distribution, Advertising, Market segmentation, Marketing mix, Positioning, Targeting, Product life cycle.	**25**
5	**Financial Management -** Definition & Functions of finance department, Sources of finance, Types of capital, Profit maximization vs. Wealth maximization, Functions of finance manager in modern age, Concept of risk and return, Break even analysis, Budgets & budgetary control, Make or Buy analysis, Introduction to financial statement – profit and loss A/c and Balance sheet.	**25**

Assessment:

Internal Assignment:

Internal assignment of 140 marks based on the entire syllabus needs to be submitted by the candidate.

End Semester Examination:

1. The question paper will comprise of a total of seven questions, each carrying 20 marks.
2. Each Question can have maximum three sub questions preferably covering from the same module.
3. Students can answer any 5 full questions of their choice amongst 7.

References:

1. Koontz H & Weihrich H - Essentials of management; Tata McGraw-Hill.
2. O P Khanna - Industrial engineering and management; Dhanpat Rai Publications.
3. Hill Koontz H - Principles of Management; Tata McGraw-Hill.
4. Mamoria CB & Gankar SV - A Textbook of Human Resource Management; Himalaya Publishing House.
5. Rajan Saxena - Marketing Management; Tata McGraw Hill.
6. Lock D & Wagner R. Gower - Handbook of programme management; Abingdon: Routledge.
7. Fabozzi, Frank J. - Foundations of Financial Markets and Institutions; Prentice Hall.
8. Bare Acts – Indian Contract Act, Indian Partnership Act and Company Law

Links for Online NPTEL/SWAYAM courses:

1. https://onlinecourses.nptel.ac.in/noc22_mg104/preview
2. https://onlinecourses.nptel.ac.in/noc24_mg24/preview
3. https://onlinecourses.nptel.ac.in/noc24_mg21/preview

Course Code	Course Name	Marks
IEA05	Human Factors in Engineering	100

Learning Objectives:

1. **To understand and apply productivity concepts, measurement techniques, and improvement strategies.**
2. **To analyze and improve work systems using work study and ergonomic principles.**
3. **To utilize method and work measurement tools for enhancing operational efficiency and human performance.**

Course Outcomes: Learner will be able to……

1. **Explain the fundamental concepts of ergonomics and human factors in engineering, including their historical development and connection to engineering applications.**
2. **Analyze the components of physical loading, including posture, force, and time, and their interaction in workplace ergonomics.**
3. **Apply anthropometric data in designing workspaces and equipment to accommodate human variability.**
4. **Analyze cognitive ergonomics techniques such as standardized work, work instructions, and error-proofing strategies in industrial applications.**
5. **Apply ergonomic evaluation techniques such as posture-based and biomechanics-based analysis to assess workplace safety and efficiency.**

Module	Contents	Marks
1	**Introduction:** What is ergonomics/human factors? The purpose of production ergonomics, Historical development of ergonomics and human factors, how are ergonomics and human factors connected to engineering? Human Engineering Basics: Basic Anatomy and Physiology, Musculo-skeletal disorders, how big is the problem? The musculo-skeletal system, the muscles, the skeletal system, Joints, Injuries and healing, Movements, Musculo-skeletal complexes, the back, the neck, the shoulders, the hands.	30
2	**Physical Loading:** The components of physical loading, Posture, Force, Time, Interaction of posture, forces and time, other factors influencing physical loading, Biomechanics, Applying mechanics to the human body.	20

3	**Anthropometry:** Designing for the human, Terminology, Static (structural) measurements, Dynamic (functional) measurements, Normal distribution and percentiles, Correlations, Multivariate design, Variation, Methods for measuring body dimensions, Anthropometric datasets, Design principles, designing for the extremes, designing for adjustability, Designing work heights.	**30**
4	**Cognitive Ergonomics:** What cognitive limitations exist in the workplace? Human capabilities and limitations, the senses, Human cognitive processes, the role of expertise: The SRK model and types of mistakes, Mental workload, Designing to support human mental capabilities, Cognitive ergonomics supports used in industrial production, Design For Assembly, The use of fixtures, Kitting, Standardized work, Work instructions, Poka yoke.	**30**
5	**Ergonomics Evaluation Methods:** Heuristic evaluation (HE), Methods for evaluating physical loading, Posture-based analysis, Biomechanics-based analysis, Multi-aspect methods, Standards, legal provisions and guidelines, Example: Swedish AFS provisions.	**30**

Assessment:

Internal Assignment:

Internal assignment of 140 marks based on the entire syllabus needs to be submitted by the candidate.

End Semester Examination:

1. The question paper will comprise of a total of seven questions, each carrying 20 marks.
2. Each Question can have maximum three sub questions preferably covering from the same module.
3. Students can answer any 5 full questions of their choice amongst 7.

References:

1. Cecilia Berlin, & Caroline Adams, Production Ergonomics Designing Work Systems to Support Optimal Human Performance, Ubiquity Press Ltd., Windmill Street, London, 2017.
2. Wickens, C.D., Lee, J.D., Liu, Y., Gordon Becker, S.E. (2004). An Introduction to Human Factors in Engineering (2nd Ed.). Upper Saddle River, New Jersey:Pearson Prentice-Hall.
3. Sanders, M. S., & McCormick, E. J. (1993). Human factors in engineering and design (7th ed.). Mcgraw-Hill Book Company

Links for Online NPTEL/SWAYAM courses:

1. https://www.youtube.com/watch?v=G5PxuOEUWA8&list=PLFkR6k-V2SSr_J7OSXn_kyp6WSnyh9JP2
2. https://www.youtube.com/watch?v=lpIBwp7txhY
3. https://www.youtube.com/watch?v=MeDjaJTdX20
4. https://www.youtube.com/watch?v=mtar06a3Dh8
5. https://www.youtube.com/watch?v=k_NyvdOOsNw
6. https://www.youtube.com/watch?v=k_NyvdOOsNw

Course Code	Course Name	Marks
IEA06	Manufacturing Technology	100

Learning Objectives:

1. **To Understand and Apply Manufacturing Processes**
2. **To Operate and Program CNC Machines**
3. **To Evaluate Modern Manufacturing Systems**

Course Outcomes: Learner will be able to……

1. **Understand and analyze foundry practices like pattern making, mold making, Core making and Inspection of defects.**
2. **Understand different Welding and joining processes and its defects**
3. **Understand, Design and Analyze different sheet metal working processes**
4. **Understand need and classification of modern machining methods**
5. **Explain needs and recent trends in Metrology, CIM and factory automation.**

Module	Contents	Marks
1	**Metal Casting -** Sand Casting – Pattern and its types, material and allowances, Molding sand- types, properties and testing, Molding – types, equipment's, tools and machines, Core – types and manufacturing, Gating system and Riser – types and design , Heating and pouring, cooling and solidification- process and time estimation, Cleaning and Finishing, Defects and remedies, Inspection techniques. Die casting, Investment casting, Centrifugal Casting. Continuous Casting- Types, equipment, process parameters, material to cast.	**30**
2	**Metal Joining –** Introduction and working of Soldering, Brazing and Welding, Welding Processes-Gas, Shielded Metal Arc. TIG, MIG Submerged Arc, Electroslag, Thermit. Resistance, Pressure and Forged welding, Stud welding. Surface preparation and types of joints. Joint through Adhesive – Classification of adhesive, types of adhesive, applications. Design of welded joints, Weld inspection, Defects in various joints and their remedies.	**20**
3	**Metal Working -** Types of sheet metal operations, Types of dies and punches, Material used for dies and punches, Die design for Progressive and Drawing Die, Clearance analysis, Center of pressure, Blank size determination, Strip layout, Sheet utilization ratio , Method of reducing forces	**30**

4	**Modern Machining and Machine Tool Operations -** Tool Materials, Geometry of Cutting Tools, Mechanics of Turning, Merchant's analysis, Tools wear and Tool life- Boring, Milling, Shaping, Planning, Slotting, Sawing, Broaching, Gear Generation methods. Introduction to modern manufacturing processes, Need and classification of modern manufacturing methods. Nontraditional machining Processes- Introduction to ECM, LBM, EBM, AJM, Water Jet Machining Wire Electric Discharge Machining (W-EDM), Electrochemical discharge machining (ECDM), Nano-Machining. Selection of Type of machine, Cutting parameters, Time of machining.	**30**
5	**Metrology and Inspection -** Meaning of Metrology, Precision, Accuracy, Errors in Measurement, Calibration. Limits, Fits and Tolerance, Surface finish, Angular Measurements by Mechanical and Optical Methods. Comparators Mechanical, Electrical, Pneumatic. Gauge Design, Measurement of Screw threads and Gears, Alignment Testing. Study of Measuring Machines, Recent Trends in Engineering Metrology. Need of CIM, Evolution, Role of CIM system	**30**

Assessment:
Internal Assignment:

Internal assignment of 140 marks based on the entire syllabus needs to be submitted by the candidate.

End Semester Examination:

1. The question paper will comprise of a total of seven questions, each carrying 20 marks.
2. Each Question can have maximum three sub questions preferably covering from the same module.
3. Students can answer any 5 full questions of their choice amongst 7.

References:

1. Hajara Choudhari, Bose S.K.- Elements of workshop Technology Vol. I &II , Asian Publishing House
2. D. K. Singh – Fundamentals of Manufacturing Engineering, Ane's Books. Pvt. Ltd.
3. A. Ghosh and A. K. Mallik, Manufacturing Science, East-West Press.
4. B. Ravi – Metal Casting Computer Aided design and analysis, Prentice Hall of India.
5. Sushil Kumar Choudhary, R. S Jadoun - Computer Integrated Manufacturing & Computer Aided Manufacturing, Kindle Edition, Format: Kindle Edition
6. M.P Grover – Fundamentals of modern manufacturing Materials and systems,Wiely
7. Dr. R. S. Parmar, Welding Processes And Technology, Khanna Publishers, New Delhi.
8. R.K. Jain, Engineering Metrology, Khanna Publication.

Links for Online NPTEL/SWAYAM courses:

1. https://nptel.ac.in/courses/112/103/112103202
2. https://swayam.gov.in/nd1_noc20_me76/preview (Advanced machining Process)
3. nptel.ac.in/courses/112104195
4. https://nptel.ac.in/courses/112107219
5. https://onlinecourses.nptel.ac.in/noc19_me45/preview

Course Code	Course Name	Marks
IEA07	Industrial Automation and Robotics	100

Learning Objectives:

1. **To Design and Implement Automated Systems**
2. **To Integrate Robotics in Manufacturing by programming**
3. **To Troubleshoot and Maintain Automation Systems**

Course Outcomes: Learner will be able to……

Course Outcomes: Learner will be able to…

1. **Demonstrate understanding of fundamentals of industrial automation and AI.**
2. **Design & develop pneumatic / hydraulic circuits, electro pneumatic circuits and PLC ladder logics.**
4. **Demonstrate understanding of robotic control systems and their applications.**
5. **Demonstrate understanding of various AI and machine learning technologies**

Module	Contents	Marks
1	**1.1 Introduction to Automation** Definition and fundamentals of automation, Elements of Automated system, Automation principles and strategies, Levels of automation, types of automation, Advanced automation functions **1.2 Introduction to Artificial Intelligence** Introduction, Historical development, Intelligent Systems, Types of Intelligent Agents, Components of AI, Foundations of AI, Scope of AI, Current trends in AI, Relevance to Mechanical Engineering	30
2	**2.1 Design of Pneumatic Circuits** Design of Pneumatic sequencing circuits using Cascade method and Shift register method (up to 2 cylinders) **2.2 Design of Hydraulic Circuits** Basic Hydraulic Circuits: Meter in, meter out and Bleed off circuits; Intensifier circuits, Regenerative Circuit, Counter balance valve circuit and sequencing circuits. Electro-pneumatic circuits, PLC discrete control system	20
3	**Robots and their applications**: Introduction to Robots, Types, Classifications, Selection of Robots, Robot Degrees of freedom, Robot configuration, Accuracy and repeatability, Specification of a Robot, Robot feedback controls: Point to point	30

	control and Continuous path control, Control system for Robot joint, Adaptive control, Drives and transmission systems, End effectors, Industrial robot applications, Nex-gen robots.	
4	**4.1 Problem Solving:** Tree and Graph Search, Uninformed v/s informed search, uninformed methods: depth first search, breadth first search, Informed search: heuristic search, Best first search, branch and bound **4.2 Machine Learning:** Introduction, types of machine learning: supervised, unsupervised, reinforcement learning **4.3 Learning with Decision Trees:** Introduction to Decision Trees, Classification and Regression Trees, K means clustering algorithm, K nearest neighbor algorithm, hierarchical clustering, Concept of ensemble methods: bagging, boosting, random	**30**
5	**Learning with regression:** Linear regression, Logistic regression **Artificial Neural Networks** Concept of ANN, Basic Models of Artificial Neural Networks Important Terminologies of ANNs **Introduction to AI Technologies in the realm of Automation** •Concept of Natural Language Processing, Machine Vision, Deep learning, Expert systems, Genetic Algorithms, Industry 4.0	**30**

Assessment:

Internal Assignment:

Internal assignment of 140 marks based on the entire syllabus needs to be submitted by the candidate.

End Semester Examination:

1. The question paper will comprise of a total of seven questions, each carrying 20 marks.
2. Each Question can have maximum three sub questions preferably covering from the same module.
3. Students can answer any 5 full questions of their choice amongst 7.

References:

1. Applied Mechatronics- A. Smaili and F. Mrad, OXFORD university press
2. Mechatronics System Design , Shetty and Kolk, Cengage Learning, India Edition
3. Mechatronics - Electronic Control Systems in Mechanical Engineering , Bolton Pearson eduaction
4. Introduction to Mechatronics, Appu Kuttan K.K., OXFORD Higher Education

5. Pneumatic Circuits and Low Cost Automation by Fawcett JR
6. Electromechanical Design Handbook , Walsh, McGraw-Hill
7. Electro-mechanical Engineering - An Integrated Approach , Fraser and Milne
8. Industrial Hydraulics: Pippenger

Links for Online NPTEL/SWAYAM courses:

1. **https://nptel.ac.in/courses/112/103/112103174/**
2. **https://nptel.ac.in/courses/112/103/112103293/**
3. **https://nptel.ac.in/courses/112/102/112102011/**
4. **https://nptel.ac.in/courses/112/101/112101098/**
5. **https://nptel.ac.in/courses/112/103/112103280/**
6. **https://nptel.ac.in/courses/106/106/106106139**
7. **https://nptel.ac.in/courses/108105088**

Course Code	Course Name	Marks
IEA08	Economics and Indian Economic Environment	100

Learning Objectives:

1. **To Analyze Fundamental Economic Principles**
2. **To Evaluate India's Economic Policies & Reforms**
3. **To Assess Contemporary Challenges in Indian Economy**

Course Outcomes: Learner will be able to……

1. **Identify the emerging trends in the Indian economy.**
2. **Understand national income & its methods of measuring.**
3. **Examine microeconomics and unemployment.**
4. **Understand economic and industrial development.**
5. **Examine the contribution of the Agricultural & Transport sector.**

Module	Contents	Marks
1	**General concepts of Economics -** Need hierarchy and wants, Production & consumption, Value, Price income and wealth. Concept of utility and value, Law of diminishing marginal utility.	25
2	**National Income –** Concept and importance Methods of measuring national income: Product method, Income method, Gross national expenditure method, Difficulties in calculation of national income. Growth of national income and per capita income in various plans.	25
3	**Macro Economics -** Income determination, Consumption, Saving and investment functions. Employment: Full, Partial, Under-employment, Unemployment and their effect on economic stability, Measures to resolve unemployment issues.	30
4	**Economic and Industrial Development -** Meaning and various indicators of economic development, process of economic growth. Basic features of Indian Economy: Natural resources of India, National level planning, Five-year plans, Effect of population on economic growth. Public sector, Private sector; Large scale, Small and Medium scale industries and their characteristics, Government policy for SSE/MSMES.	30

5	**Agricultural and Co-operative Sector** - Concept of agriculture inputs and productivity, Co-operative movement and its impact on agriculture and agro-based industries. Infrastructure in India: Transport, Communication, Power etc., Government policies, Change in government policies and their impact on the economy	**30**

Assessment:

Internal Assignment:

Internal assignment of 140 marks based on the entire syllabus needs to be submitted by the candidate.

End Semester Examination:

1. The question paper will comprise of a total of seven questions, each carrying 20 marks.
2. Each Question can have maximum three sub questions preferably covering from the same module.
3. Students can answer any 5 full questions of their choice amongst 7.

References:

1. A.N.Agrawal - Indian Economy, Wishwa Publication
2. Ruddar Datt and K.P.N. Sundharan - Indian Economy, S Chand & Co.
3. S.K.Mishra and V.K.Puri - Indian Economy, Himalaya publishing house
4. K. Aswathappa - Essentials of Business Environment, Himalaya publishing house
5. Introduction to Economic Theory – NCERT
6. Paul Samuelson and W. D. Nordhaus – Economics, Tata McGraw Hill
7. Francis Cherunilam - Global Economy and Business Environment, Himalaya publishing house

Links for Online NPTEL/SWAYAM courses:

1. https://onlinecourses.nptel.ac.in/noc23_ec06/preview
2. https://nptel.ac.in/courses/109106089
3. https://nptel.ac.in/courses/110105067

Course Code	Course Name	Marks
IEB01	Facilities Planning and Management	100

Learning Objectives:

1. **To understand the fundamentals of facility location and layout planning for efficient operations.**
2. **To analyze and design various layout types using manual and computer-aided tools.**
3. **To evaluate facility systems, flow lines, and equipment replacement based on technical and economic considerations.**

Course Outcomes: Learner will be able to……

1. **Select the plant locations based on the industrial requirements.**
2. **Analyze different types of plant layouts and understand their applications and implications.**
3. **Develop alternatives of layout for facilities for particular functions**
4. **Analyze different types of assembly lines, flow lines and familiarize with the use of technology and related software tools.**
5. **Explain with current trends in multiple facilities planning.**

Module	Contents	Marks
1	**Plant Location -** Selection of site: Factors to be considered, Methods and techniques for facility location analysis, Impact of location decisions on operational efficiency and cost, Implications of globalization on facility location decisions.	30
2	**Plant Layout -** Objectives, Types of facility layouts such as process, product, cellular, and fixed-position layouts. Layout planning, Computerized planning techniques. Plant Services: Capacity estimation, Plant Safety, Elements of Safety Engineering, Material handling-systems and equipment, Production flow systems	30
3	**Location and Layout of Facilities -** Planning for production flow systems, Activity relationships, Personnel and organizational factors. Developing alternatives of layout for facilities for particular functions - Manufacturing, Receiving and shipping, Storage and warehousing systems. Principles of factory layout; Quantitative and computer aided approaches to facilities layout. Environment aspects lighting, Ventilation, Dust control, Humidity.	30
4	**Interaction of Layout and Flow system -** Design philosophies, Ergonomic considerations in layout design, Analysis of different types of assembly lines, Flexibility in assembly lines and flow lines, Material flow patterns and efficiency in warehouse and distribution environments. Automation and computer aids in warehousing operations.	20
5	**Location of Multiple Facilities and Expansion of facilities -** Current trends, Group technology, Production flow clustering, Line balancing etc. Capabilities and limitations of different facility planning software applications, Simulation software for modelling and optimizing facility processes.	30

Assessment:

Internal Assignment:

Internal assignment of 140 marks based on the entire syllabus needs to be submitted by the candidate.

End Semester Examination:

1. The question paper will comprise of a total of seven questions, each carrying 20 marks.
2. Each Question can have maximum three sub questions preferably covering from the same module.
3. Students can answer any 5 full questions of their choice amongst 7.

References:

1. **J. M. Apple**, *Plant Layout and Material Handling*, Krieger Publishing Company, United States, 1991. ISBN: 9780898747444.
2. **Reza Zanjirani Farahani and Masoud Hekmatfar**, *Facility Location: Concepts, Models, Algorithms and Case Studies*, Physica-Verlag HD, Germany, 2009. ISBN: 9783790821576.
3. **George J. Mann and Douglas M. Rouse**, *Planning and Designing Healthcare Facilities: A Lean, Innovative, and Evidence-Based Approach*, Taylor & Francis, United Kingdom, 2017. ISBN: 9781138190134.

Links for Online NPTEL/SWYAM courses:

1. https://nptel.ac.in/courses/112107238

Course Code	Course Name	Marks
IEB02	Supply Chain & Logistics Management	100

Learning Objectives:

1. **To Design Efficient Supply Chain Networks by applying strategic modeling tools**
2. **To Implement Logistics & Inventory Control Strategies**
3. **To Mitigate Risks & Leverage Digital Technologies**

Course Outcomes: Learner will be able to……

1. **Understand the basic concepts of logistics and supply chain management**
2. **Determine the material requirement and order quantities to minimize the inventory costs**
3. **Understand the Analyze of supply chain systems performance**
4. **Understand the Analyze of network design of multimodal transportation**
5. **Understand the facility utilization decision and IT role in supply chain management**

Module	Contents	Marks
1	**Introduction –** Concept of supply chain and its importance in today's competitive environment, Components and key issues of supply chain.	20
2	**Materials Management -** Scope, Importance, Classification of materials, Procurement, Purchasing policies, Vendor development and evaluation, Inventory Control, EOQ and its derivative models.	25
3	**Frame work to analyze supply chains:** Understanding the supply chain, Supply chain performance and profitability, Drivers of supply chain performance – production, inventory, transportation, facilities, and information.	30
4	**Transportation and Logistics in a Supply Chain -** Role of transportation in supply chain, Factors affecting transportation decisions, Modes of transportation and their performance characteristics, Design options for transportation network, Multimodal transportation.	30
5	**Facility Decisions** - Network design in a supply chain, Role of facility decisions, Factors influencing network design decisions, Frame work for network design decisions, Models for facility/warehouse locations and capacity allocation. **Information Technology in a Supply Chain:** Role, Importance and use of IT in a supply chain, Role and impact of e-business in supply chain.	35

Assessment:

Internal Assignment:

Internal assignment of 140 marks based on the entire syllabus needs to be submitted by the candidate.

End Semester Examination:

1. The question paper will comprise of a total of seven questions, each carrying 20 marks.
2. Each Question can have maximum three sub questions preferably covering from the same module.
3. Students can answer any 5 full questions of their choice amongst 7.

References:

1. David Simchi-Levi, Philip Kaminsky, Edith Simchi-Levi, Ravi Shankar - Designing and Managing the Supply Chain: Concepts, Strategies, and Case Studies, McGraw-Hill.
2. Christopher, M. - Logistics and Supply Chain Management: Strategies for Reducing Costs and Improving Services, Pitman
3. Croucher Phil, Rushton Alan and Oxley John - The handbook of Logistics and distribution Management
4. Douglas M. Lambert - Fundamental of logistics management, McGraw Hill.
5. Sahay B. S. - Supply Chain Management for Global competitiveness, Macmillan
6. Chopra Sunil and Meindl P - Supply Chain Management: Strategy, Planning, and Operation, Prentice Hall
7. Forrester J. W. - Industrial dynamics, Cambridge, Massachusetts, The MIT press
8. Waters Donald - Logistics: An Introduction to SCM, Palgrave McMillan

Links for Online NPTEL/SWAYAM courses:

1. https://onlinecourses.nptel.ac.in/noc22_mg74/preview
2. https://elearn.nptel.ac.in/shop/iit-workshops/completed/supply-chain-management/
3. https://onlinecourses.swayam2.ac.in/ugc19_hs51/preview

Course Code	Course Name	Marks
IEB03	Production & Operations Management	100

Learning Objectives:

1. **To Optimize Production Processes by applying Industrial Engineering Tools**
2. **To Manage Supply Chain and Inventory Systems**
3. **To Solve Operational Problems Using Quantitative Tools**

Course Outcomes: Learner will be able to……

1. **Understand and apply concepts of operations management.**
2. **Estimate the demand for a product and carry out aggregate and capacity planning.**
3. **Analyze the sequence in which jobs are to be made so that all the jobs are done in minimum time.**
4. **Sketch the network of various activities constituting a project as per their dependencies and Calculate project duration and critical activities.**
5. **Apply principles of lean manufacturing, Understand the concept of FMS.**

Module	Contents	Marks
1	**Introduction to Operations Management -** Concept, importance and functions. Introduction to product design and development, Process selection, Continuous and intermittent manufacturing: Project, Job, Batch, Mass and Process types of Production Systems. Operations in VUCA world.	**30**
2	**Demand Forecasting -** Importance of forecasting**,** qualitative and quantitative methods of forecasting **Aggregate Planning:** Concept of aggregate planning, decision rules, strategies and methods **Master Production Scheduling:** Need for MPS, components of MPS	**20**
3	**Capacity Requirement Planning -** Measurement of capacity, Effective capacity, Short-range, medium-range and long-range capacity planning. Scheduling: Theory of scheduling, Use of Gantt charts in scheduling, Sequencing in job shop - processing of n Jobs through Two Machines and m Machines, Graphical Method for processing of n Jobs through Two Machines.	**30**
4	**Project Management -** Necessity for project management, Steps in project management, Network models for project management – CPM, PERT, Project crashing.	**30**
5	**Just-in-time-systems -** Concept, Characteristics and advantages Lean Manufacturing: Introduction, Evolution, Principles and advantages of lean manufacturing. Cellular Manufacturing: Characteristics, Advantages and applications FMS: Types, components, advantages, application	**30**

Assessment:

Internal Assignment:

Internal assignment of 140 marks based on the entire syllabus needs to be submitted by the candidate.

End Semester Examination:

1. The question paper will comprise of a total of seven questions, each carrying 20 marks.
2. Each Question can have maximum three sub questions preferably covering from the same module.
3. Students can answer any 5 full questions of their choice amongst 7.

References:

1. B. Mahadevan - Operation Management; Pearson
2. Nair N.G. - Production and Operations Management; Tata McGraw Hill
3. Krajewski L. and Ritzman L. P. - Operations Management Process and value Chains; Prentice Hall (India)
4. Chary S.N. - Operations Management: Concepts, Methods and Strategy, Prentice Hall (India)
5. Buffa. E.S. - Modern Production Management, John Willey, New York
6. Garg Atul - Production and Operations Management, Tata McGraw Hill
7. Chase Richard B, Ravi Shankar, Jacobs F.R., Aquilano N.J. - Operations and Supply Management, Tata McGraw Hill
8. R. Panneerselvam - Production and Operations Management, Prentice Hall (India)
9. William J Stevenson - Operation Management, Tata McGraw Hill

Links for Online NPTEL/SWAYAM courses:

1. https://onlinecourses.nptel.ac.in/noc21_me18/preview
2. https://onlinecourses.swayam2.ac.in/imb20_mg15/preview
3. https://onlinecourses.nptel.ac.in/noc23_mg89/preview

Course Code	Course Name	Marks
IEB04	Quality Assurance and Reliability	100

Learning Objectives:

1. **To understand core concepts of quality, assurance, and quality costs.**
2. **To apply statistical tools and sampling methods for quality control.**
3. **To evaluate product and system reliability using failure models.**

Course Outcomes: Learner will be able to...

1. **Define and differentiate key quality concepts, such as quality dimensions, quality costs, and quality assurance systems.**
2. **Apply 7QC tools and control charts to identify process variations and monitor product/process quality.**
3. **Develop and interpret control charts for variables and attributes, and understand their statistical basis.**
4. **Apply acceptance sampling techniques using single, double, and multiple sampling plans with performance metrics like AOQ, LTPD, ASN, and AOQL.**
5. **Evaluate system reliability and failure models, and compute reliability measures for series, parallel, and mixed configurations.**

Module	Contents	Marks
1	**Introduction:** Definition of Quality, Dimensions of Quality, The Juran's Spiral of quality, Quality costs – four categories of costs and hidden costs. Brief discussion on sporadic and chronic quality problems. **Quality Assurance:** Definition and concept of quality assurance, Quality audit concept, audit approach, ingredients of a quality program.	20
2	**Statistical Process Control:** Introduction to statistical process control. SPC tools and techniques 7QC tools, Process capability – Basic definition, standardized formula and Six sigma concept of process capability. **Introduction to control charts:** Classification, chance and assignable causes of variation. Basic principles of control charts, Analysis of patterns of control charts. **Control Charts for Variables:** Controls charts for X bar and Range, statistical basis of the charts, development and use of X bar and R charts, interpretation of charts. Control charts for X bar and standard deviation (S), development and use of X bar and S chart.	30

3	**Control Charts for Attributes:** Development and operation of control chart for constant sample size and variable sample size. Choice between variables and attributes control charts. Advanced quality concepts. **Design of experiments** – Quality Loss function, Step function, Quadratic loss function, Types of loss functions, problems.	**30**
4	**Sampling Inspection:** Concept of accepting sampling, economics of inspection, Acceptance plans – single, double and multiple sampling. Operating characteristic curves – construction and use. Producer risk and Consumer risk. Determinations of AOQ, LTPD, ASN, AOQL, ATI	**30**
5	**Reliability and Life Testing:** Failure models of components, definition of reliability, MTBF, Failure rate, common failure rate curve, types of failure, reliability evaluation in simple cases of exponential failures in series, paralleled and series-parallel device configurations, Redundancy and improvement factors evaluations.	**30**

Assessment:

Internal Assignment:

Internal assignment of 140 marks based on the entire syllabus needs to be submitted by the candidate.

End Semester Examination:

1. The question paper will comprise of a total of seven questions, each carrying 20 marks.
2. Each Question can have maximum three sub questions preferably covering from the same module.
3. Students can answer any 5 full questions of their choice amongst 7.

References:

1. **Hans-Joachim Lenz and Peter-William Wilrich (Eds.)**, *Frontiers in Statistical Quality Control 9*, Physica-Verlag HD, Germany, 2010. ISBN: 9783790823730.
2. **Gryna, F. M.** (2001). *Quality Planning and Analysis: From Product Development Through Use*. Boston: McGraw-Hill. ISBN: 9780071165433.
3. **Bicheno, J., & Gopalan, M. R.** *A Management Guide to Quality and Productivity*. Wiley-Dreamtech India. ISBN: 9788177226109.

Links for Online NPTEL/SWAYAM courses:

1. https://www.youtube.com/watch?v=0hzqHwu1i_I
2. https://www.youtube.com/watch?v=ztlbEP30s-k
3. https://www.youtube.com/watch?v=tDrV_070InY

Course Code	Course Name	Marks
IEE01	Innovation & Value Engineering	100

Learning Objectives:

1. **To develop a strong foundation in innovation, value engineering, and design thinking for enhancing cost-effectiveness, performance, and quality in engineering and product development.**
2. **To equip students with structured problem-solving skills and creativity tools for analyzing functions, eliminating unnecessary costs, and fostering innovative solutions in real-world engineering scenarios.**

Course Outcomes: Learner will be able to……

1. **Understand the fundamentals of innovation and its role in engineering and product development.**
2. **Apply value engineering concepts to improve cost-effectiveness and performance.**
3. **Identify and analyze functions to eliminate unnecessary costs without sacrificing quality.**
4. **Use structured problem-solving techniques and innovation tools in engineering scenarios.**
5. **Promote creativity and design thinking in decision-making and product development.**

Module	Contents	Marks
1	**Introduction to Innovation and Value Engineering** Concepts of Innovation and Creativity, Types and sources of innovation (disruptive, incremental, open), Definition and scope of Value Engineering (VE) and Value, Analysis (VA), History, principles, and benefits of VE, Relationship between innovation and value creation	30
2	**Function-Oriented Thinking and Analysis** Functional Analysis: Concepts and applications, Function classification (Basic vs. Secondary functions), Function-cost-worth analysis, Tools for function analysis: FAST Diagrams, Mind Maps, Examples from industry (case studies)	25
3	**Value Engineering Job Plan and Methodology** VE Job Plan: Phases and procedures, Information Phase, Function Analysis Phase, Creative Phase, Evaluation Phase, Development Phase, Implementation Phase, SMART goal setting and team-based problem solving, Innovation tools: TRIZ, Brainstorming, SCAMPER	30
4	**Cost Reduction, Decision Making, and Innovation Strategy** Identifying cost drivers in products and services, Cost-benefit analysis, Decision-making tools for engineers (SWOT, AHP, Pareto analysis), Role	25

	of innovation strategy in product design and development, Introduction to Design Thinking methodology	
5	**Applications, Case Studies, and Future Trends** Application of VE in manufacturing, service sectors, infrastructure, IT, etc. Innovation in digital era: AI, IoT, and sustainable engineering, Value engineering in the public sector and procurement Case studies: Toyota, Tata Motors, Samsung, GE, Emerging trends: Circular economy, frugal innovation, green engineering	**30**

Assessment:

Internal Assignment:

Internal assignment of 140 marks based on the entire syllabus needs to be submitted by the candidate.

End Semester Examination:

1. The question paper will comprise of a total of seven questions, each carrying 20 marks.
2. Each Question can have maximum three sub questions preferably covering from the same module.
3. Students can answer any 5 full questions of their choice amongst 7.

Textbooks

1.Mudge, Arthur E., Value Engineering – A Systematic Approach, McGraw-Hill
2.Lawrence D. Miles, Techniques of Value Analysis and Engineering, McGraw-Hill
3.Tidd, Joe & Bessant, John, Managing Innovation: Integrating Technological, Market and Organizational Change, Wiley
4.Altschuller, Genrich, TRIZ: The Innovation Algorithm,
5. Technical Innovation Center

Links for Online NPTEL/SWAYAM courses:

1. https://nptel.ac.in/courses/112107282
2. **https://onlinecourses.nptel.ac.in/noc26_me57/preview**

Course Code	Course Name	Marks
IEE02	Strategic Management	100

Learning Objectives:

1. **To Analyze Competitive Business Environments**
2. **To Formulate and Execute Business Strategies**
3. **To Evaluate Ethical and Global Strategic Challenges**

Course Outcomes: Learner will be able to……

1. **Apply the SWOT analysis for different businesses**
2. **Distinguish between the different nature of businesses**
3. **Understand strategy formulation the different nature of businesses**
4. **Understand and formulate corporate level strategy**
5. **Evaluate different strategies for effective functioning of businesses**

Module	Contents	Marks
1	**Nature of Business:** types of businesses, corporate objectives, goals, stages of corporate planning, SWOT analysis, Gap analysis, Investment analysis. Capital Budgeting, risk analysis. Management information systems.	25
2	**Concept of Strategy** –benefits of strategy, process of Strategic Management and levels. Strategic Decision Making. Strategic Intent – Vision, Mission, Goals and Objectives of organization. Strategy and Corporate Governance.	30
3	**Strategy Formulation** – environment analysis, environmental sectors, scanning of environment. Organizational appraisal – competence vs. capability, techniques. Industry and Competition Analysis.	30
4	**Corporate Level Strategies**- Stability Strategy – BCG portfolio model, Generic strategies, Expansion strategies – Ansoff Matrix, Integration Strategies, Diversification Strategies, Cooperative Strategies; Retrenchment Strategies.	20
5	**Strategy Implementation** – Nature, barriers and inter relationship; Structural Implementation; Functional and Operational Implementation; Behavioural Implementation; Strategy Evaluation and Control **Trends in Strategic Management –** Disruptive forces for changes in business. Strategies for green economies. Effect of AI (Artificial Intelligence) on strategies Management	35

Assessment:

Internal Assignment:

Internal assignment of 140 marks based on the entire syllabus needs to be submitted by the candidate.

End Semester Examination:

1. The question paper will comprise of a total of seven questions, each carrying 20 marks.
2. Each Question can have maximum three sub questions preferably covering from the same module.
3. Students can answer any 5 full questions of their choice amongst 7.

References:

1. Kazmi, A.- Strategic Management and Business Policy, McGraw Hill Companies
2. Nag, A. - Strategic Management – Analysis, Implementation and Control, VikasPublishing House.
3. Lorange, P - Implementation of Strategic Planning, Prentice Hall Publications.

Links for Online NPTEL/SWAYAM courses:

1. https://nptel.ac.in/courses/122105024
2. https://onlinecourses.swayam2.ac.in/imb19_mg08/preview

Course Code	Course Name	Marks
IEE03	Project Management	100

Learning Objectives:

1. **To understand project management principles**
2. **To develop the ability to apply project management tools and techniques**

Course Outcomes: Learner will be able to……

1. **Discuss the complete structure of project management and analyze the scope of project planning.**
2. **Identify and apply various project selection methods.**
3. **Explain the importance of procurement and evaluate key procurement techniques.**
4. **Define guidelines for effective project control and apply controlling techniques.**
5. **Outline the fundamentals of project initiation and early-stage management practices.**

Module	Contents	Marks
1	**Project Basics** Introduction to Project Management, Characteristics of Projects, Types of Projects, Project Management Body of Knowledge (PMBOK),Role and Qualities of a Project Manager, Project Organization and Benefits, Idea Generation and Needs of Society, Import Substitution, Project Lifecycle, Project Charter and Project Sponsor, Customer Needs and Stakeholder Concepts, Project Scope and Feasibility Study, Baseline Plan and SWOT Analysis, Organizational Structure and Hierarchy, Project Teams: Formation, Attitude, and Aptitude	30
2	**Project Planning & Selection** Project Identification and Selection, Feasibility Analysis (Technical, Financial, Market), Project Charter Preparation, Scope Definition, Work Breakdown Structure (WBS), Organizational Breakdown Structure, Milestone Planning, Scheduling Techniques: Gantt Charts, Bar Charts, Activity-on-Node (AON), Activity-on-Arrow (AOA), Critical Path, Method (CPM), PERT, Time-Cost Trade-Off, Budgeting and Cost Estimation	30
3	**Procurement** Vendor Selection Methods, Just-in-Time (JIT), Supply Chains and Logistics, Quality Concepts: Quality Circles, Control & Assurance, Cause and Effect Analysis, ISO Standards, Total Quality Management (TQM), Six Sigma, Resource Planning and Allocation, Constraints in Resource Availability, Resource Leveling and Crashing	30
4	**Project Control** Project Scope Control, Change Requests and Change Management, Schedule, Resource, Cost, and Quality Control, Project Communication: Channels and Tools, Meetings and Progress Reviews, Project Reporting and Documentation, Audits and Evaluation, Project Close-Out Reports and Guidelines, Maintenance and Shutdown Projects, Plant Turnaround and Introduction to Replacement Analysis	25

5	**Project Closure & Performance Evaluation** Project Closure Process, Final Audit and Evaluation Reports, Performance Indicators and Feedback Mechanisms, Lessons Learned Documentation, Handover and Knowledge Transfer Stakeholder Communication During Closure, Success Metrics and Criteria, Post-Project Reviews, Continuous Improvement Recommendations	25

Assessment:

Internal Assignment:

Internal assignment of 140 marks based on the entire syllabus needs to be submitted by the candidate.

End Semester Examination:

1. The question paper will comprise of a total of seven questions, each carrying 20 marks.
2. Each Question can have maximum three sub questions preferably covering from the same module.
3. Students can answer any 5 full questions of their choice amongst 7.

Text Books:

1. Project Management: A Systems Approach to Planning, Scheduling, and Controlling – Harold Kerzner
2. Project Management – S. Choudhury, Tata McGraw Hill

Reference Books:

1. Project Management – K. Nagarajan, New Age International Publishers
2. Project Management – Gopala Krishnan and V.E. Rama Moorthy, Macmillan India Ltd

Links for Online NPTEL/SWAYAM courses:

1. https://onlinecourses.nptel.ac.in/noc24_mg01/preview
2. https://onlinecourses.nptel.ac.in/noc25_mg78/preview
3. https://onlinecourses.swayam2.ac.in/cec25_mg15/preview

Course Code	Course Name	Marks
IEE04	Total Quality Management	100

Learning Objectives:

1. **To understand the importance of Quality Management and principles of TQM**
2. **To understand seven basic QC tools and advanced QM tools**
3. **To understand the concept of Statistical Quality Control**

Outcomes: The students will be able to use the tools and techniques of TQM in the manufacturing and service sectors.

1. **To apply QM and principles of TQM in organizational development process.**
2. **To apply the QC & QM tools in process improvement.**
3. **To apply SQC techniques to improve process quality.**
4. **To apply Six Sigma project in TQM Implementation**
5. **To apply QMS and Certification for Quality Accreditation & Quality Sustainability.**

Module	Contents	Marks
1	**Introduction to Quality Management :** **A)** Definitions of Quality, product quality and service quality; the evolution of quality; need for Quality Management, Quality statements and Policy, Customer orientation & satisfaction, Customer complaints, customer retention; Supplier partnership, Supplier rating & selection, CSI, Costs of Quality, Prevention , appraisal and failure aspects , Use of COQ for improving quality and performance, Designing for quality, Quality of design, Quality of conformance. B) Basic concepts of TQM, TQM framework, Contributions of Deming, Juran and Crosby, Juran Triology , PDCA Cycle, Barriers to TQM; TQM principles; Strategic Quality Planning; Quality councils; employee involvement, motivation; Empowerment; Team and Teamwork; recognition and reward, performance appraisal.	35
2	**QC Tools :** A) **Seven QC Tools:** Check Sheet, Histogram, Pareto Chart, Fishbone Diagram, Run Charts, Scatter Diagram, Process Flow Chart. B) **Seven QM Tools:** Program Decision Process Chart, Tree Diagram, Affinity Diagram, Prioritization Matrix, etc. Bench Marking Types – Process, Product, Quality Improvement Tools: Why-Why Analysis, Root Cause Analysis, Poka Yoke (Mistake Proofing)	30

3	**Statistical Quality Control:** 100% Inspection versus Sampling Inspection, Reasons for SQC. A) **Acceptance Sampling:** Concept of Producer Risk and Consumers Risk. Operating Characteristics Curve. Sampling Plan – Single Sampling Plan versus Double Sampling Plan. Design Sampling Plan on the basis of MIL, ASQ Standards. B) **Statistical Process Control:** Variations – Concept, Causes – Random & Assignable, Difference – Process in Control versus Process is Capable, Control Charts, X-Bar, R, P and C Charts, Process Capability (Cp) & Process Capability Index (Cpk), Sigma Limits. Applications of Control Charts in Mass Production, Process Production.	**35**
4	A) **Continuous Improvement:** Quality Circles, Quality Function Development (QFD), Taguchi quality loss function, Parameter Design, Robust Design; TPM- concepts, 5S, Kaizen, FMEA- stages, Zero Defect. B) **TQM Implementation:** Manufacturing and Service sectors, Introduction to Six Sigma: Definition, Concept, Methodology. Six Sigma Approaches – Design for Six Sigma (DFSS) Approach & DMAIC Approach, Six Sigma Tools: Applications to manufacturing and service sector including IT, ITeS, and E Com.	**20**
5	**Quality Management System & Certification:** A) **QMS:** Elements and documentation, Quality auditing, Necessity for Certification & Certification Process, Benefits of Certification. Certifying Bodies & Accreditation Agencies, ISO 9000-2015 (5th Edition), Introduction to TS16949: Technical Specifications, QS9000, ISO14000- concepts, requirements and benefits. Case studies of TQM implementation in manufacturing and service sectors including IT and Environmental management systems- ISO 14000 Series Standards, Integration of ISO 14000 with ISO 9000. B) **Quality Awards:** Malcom Baldrige National Quality Award and Rajiv Gandhi National Quality award.	**20**

Text Books:

1. Besterfield D.H. et al.: Total quality Management, 3rd Edition, Pearson Education Asia, 2006.
2. Janakiraman B. and Gopal R.K.: Total Quality Management, Prentice Hall India, 2006.
3. Poornima M. Charantimath: Total Quality Management, 2nd Edition, Pearson Education Asia, 2006.
4. N. Logothetis: Managing for Total Quality, 6th Edition, Prentice Hall of India Pvt. Ltd. 2003.
5. Suganthi L. and Samuel A.: Total Quality Management, Prentice Hall India, 2006.
6. Evans J.R. and Lindsay W.M.: The Management and Control of Quality, 8th Edition, 1st Indian Edition, Cengage Learning, 2012.

Reference Books:

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 6th Edition, South-Western (Thomson Learning), 2005.
2. Oakland, J.S. "TQM – Text with Cases", Butterworth – Heinemann Ltd., Oxford, 3rd Edition, 2003.

Links for Online NPTEL/SWAYAM courses:

1. Quality Engineering & Management - Course
2. Quality Assurance Through NAAC Accreditation Process - Course

Course Code	Course Name	Marks
IEE05	Lean Manufacturing	100

Learning Objectives:

1. **To understand and apply lean principles for waste reduction and productivity improvement.**
2. **To select and analyze material handling systems based on force, speed, and load criteria.**
3. **To use lean tools like 5S, Kaizen, TPM, and VSM for efficient manufacturing system design.**

Course Outcomes: Learner will be able to…..

1. **Identify and apply lean manufacturing principles such as Just-in-Time (JIT), 5S, Kaizen, and waste elimination to improve productivity.**
2. **Analyze and implement lean tools like small-lot production, setup-time reduction, and pull production systems for process efficiency.**
3. **Apply Total Productive Maintenance (TPM) principles to enhance equipment effectiveness and reliability.**
4. **Design focused factories and work cells using concepts of group technology and cellular manufacturing.**
5. **Develop and interpret Value Stream Maps (VSM) to assess current systems and plan for future lean implementations.**

Module	Contents	Marks
1	**Race without a Finish Line:** Competitive Advantage, Just-in-Time and Total Quality Management, Evolution of Manufacturing, the Quality Movement, the Imperative. **Value – Added and Waste Elimination:** Value – added focus, sources of waste, JIT Principles, The meaning of JIT. 5S housekeeping Concepts, 5S auditing, Kaizen activities, Kaizen workshop, Benefits of kaizen. Case studies.	30
2	**Elements of Lean Production:** Small-Lot Production, Lot-Size Basics, Lot Sizing, Lot- Size Reduction, Facilitating small Lot Sizes. Case studies. **Setup-Time Reduction:** Improve Setups. Setup-Reduction Methodology, Techniques for Setup Reduction, setup-Reduction Projects. Case studies. (Problems to be discussed)	30

3	**Maintaining and Improving Equipment:** Equipment Maintenance, Equipment Effectiveness, Preventive Maintenance Program, Total Productive Maintenance, Implementing TPM. **Pull Production Systems:** Production Control Systems, Process Improvement, How to Achieve Pull Production, Other Mechanisms for Signal and Control, To Pull or Not to Pull.	**30**
4	**Focused Factories and Group Technology:** Ways of Doing Work, Facilities Layout, Group Technology, Focused Factory, Establishing Product, Chapter Supplement. **Work cells and Cellular Manufacturing:** Work cell Concepts, Work cell Applications, Work Design, and Workers in Cells, Equipment Issues, Implementing, and Getting Started. Case studies. (Problems to be discussed)	**30**
5	Lean Systems: Introduction to value stream mapping, VSM Principles, VSM TOOLS, and Current Value stream mapping, Future State Mapping. Case studies.	**20**

Assessment:

Internal Assignment:

Internal assignment of 140 marks based on the entire syllabus needs to be submitted by the candidate.

End Semester Examination:

1. The question paper will comprise of a total of seven questions, each carrying 20 marks.
2. Each Question can have maximum three sub questions preferably covering from the same module.
3. Students can answer any 5 full questions of their choice amongst 7.

References:

1. **Dennis, P.** (2007). *Lean Production Simplified, Second Edition: A Plain-Language Guide to the World's Most Powerful Production System*. United Kingdom: Taylor & Francis. ISBN: 9781563273568.
2. **Miltenburg, J.** (2005). *Manufacturing Strategy: How to Formulate and Implement a Winning Plan, Second Edition*. United Kingdom: Taylor & Francis. ISBN: 9781563273179.
3. **Luyster, T., & Tapping, D.** (2017). *Creating Your Lean Future State: How to Move from Seeing to Doing*. United Kingdom: Taylor & Francis. ISBN: 9781138438724.

Links for Online NPTEL/SWAYAM courses:

1. Links: https://www.youtube.com/watch?v=HQEkn-mJnas
2. Links: https://www.youtube.com/watch?v=0yhlpFdC8cI

Course Code	Course Name	Marks
IEE 06	Smart Manufacturing	100

Learning Objectives:

1. **To Understand Industry 4.0 and 5.0 Technologies**
2. **To Implement Data-Driven Manufacturing Systems**
3. **To Design and Evaluate Smart Factory Solutions**

Course Outcomes: Learner will be able to……

1. **Explain the benefits and limitations of industrial automation**
2. **Identify the key components of an industrial automation system**
3. **Analyze different types of industrial robots and their applications**
4. **Develop basic PLC programs for simple industrial control applications**
5. **Identify common industrial automation safety considerations and Troubleshoot**

Module	Contents	Marks
1	**Introduction to Industrial Automation and Components -** Fundamentals of automation, Benefits and challenges of industrial automation, Levels of automation, Applications of industrial automation in various industries, Sensors and transducers (types, applications), Actuators (pneumatic, hydraulic, electric), Industrial robots (configurations, end-of-arm tooling) , Industrial controllers (Programmable Logic Controllers).	**30**
2	**PLC Fundamentals and Programming** - Introduction to PLCs, PLC hardware and architecture, Ladder logic programming basics, Programming instructions (timers, counters, data manipulation),, Hands-on labs for developing simple PLC programs.	**20**
3	**SCADA Systems and Industrial Control Systems - :**Introduction to SCADA systems, Functions and functionalities of SCADA, HMI (Human-Machine Interface, Industrial communication protocols (Modbus, Profibus **),** Process control fundamentals (feedback loop, PID control), Control system design and implementation, Advanced control strategies (cascade control, feed forward control)	**30**
4	**Industrial Robotics and Industrial Automation Case Studies** - Robot anatomy and types (SCARA, articulated, etc.), Robot programming and applications in automation, Robot safety considerations, Real-world applications of industrial automation in various industries (manufacturing, process control, etc.) System design and integration challenges, Case study analysis and discussion.	**30**

5	**Industrial Automation Safety and Troubleshooting-**Importance of safety in industrial automation, Risk assessment and mitigation strategies, Safety standards and regulations, Common troubleshooting techniques for automation systems, Fault identification and rectification. The Future of Industrial Automation:Industrial Internet of Things(IIOT), Industry 4.0, Industry 5.0, smart factories	**30**

Assessment:

Internal Assignment:

Internal assignment of 140 marks based on the entire syllabus needs to be submitted by the candidate.

End Semester Examination:

1. The question paper will comprise of a total of seven questions, each carrying 20 marks.
2. Each Question can have maximum three sub questions preferably covering from the same module.
3. Students can answer any 5 full questions of their choice amongst 7.

References:

1. Groover, M. P. - Automation, production systems, and computer-integrated manufacturing, Pearson Education..
2. Webb, J. W. - Principles of programmable logic controllers , Industrial Press
3. Skidmore, D.- SCADA: Supervisory control and data acquisition , Institution of Engineering and Technology

Links for Online NPTEL/SWAYAM courses:

1. https://onlinecourses.nptel.ac.in/noc21_me67/preview
2. https://nptel.ac.in/courses/108105063
3. https://nptel.ac.in/courses/106105195
4. https://onlinecourses.nptel.ac.in/noc21_mg83/preview
5. https://onlinecourses.nptel.ac.in/noc25_me154/preview

Course Code	Course Name	Marks
IEE07	AI in Industrial Engineering	100

Learning Objectives:

1. **To Apply AI Techniques to Industrial Systems**
2. **To Develop AI-Driven Automation Solutions**
3. **To Evaluate Ethical and Operational Risks of AI in Industry**

Course Outcomes: Learner will be able to……

1. **Understand the importance of AI in industry process operations.**
2. **Understand concept of Machine learning, Algorithms and Neural networks**
3. **Describe various AI applications in industry operations**
4. **Explain about the basic of Data science and analytics**
5. **Understand AI tools in industries with applications and case studies**

Module	Contents	Marks
1	Core AI Concepts: Introduction to AI: Defining AI, its history, and its potential impact, Intelligent Agents and Systems: Understanding how AI systems operate and interact with their environment, Knowledge Representation: Techniques for representing knowledge in a way that machines can understand and use, Search Algorithms: Methods for finding optimal solutions in complex problem spaces, Logic and Reasoning: Using logical reasoning to make inferences and draw conclusions.	30
2	Machine Learning: Fundamentals of Machine Learning: Supervised, unsupervised, and reinforcement learning, Data Preprocessing and Feature Engineering: Preparing data for machine learning models, Machine Learning Algorithms: Classification, regression, clustering, and dimensionality reduction, Neural Networks and Deep Learning: Understanding and applying neural networks for complex tasks.	20
3	AI in Industrial Applications: AI for Manufacturing: Predictive maintenance, quality control, process optimization, and automation, Supply Chain Optimization: Demand forecasting, inventory management, and logistics optimization, Robotics and Automation: Integrating robots with AI for enhanced efficiency and precision, Digital Twins: Creating digital representations of physical systems for simulation and analysis, Industry 4.0 and AI: Understanding the convergence of AI with other Industry 4.0 technologies.	30

4	Data Science and Analytics: Data Mining and Big Data: Extracting valuable insights from large datasets, Statistical Analysis and Modeling: Using statistical techniques to analyze data and build predictive models, Data Visualization: Presenting data in a clear and understandable way.	30
5	Specific AI Techniques and Tools: Optimization Techniques: Metaheuristics, genetic algorithms, and other optimization methods, Natural Language Processing (NLP): Enabling machines to understand and process human language, Reinforcement Learning: Training agents to make optimal decisions through trial and error, Generative Adversarial Networks (GANs): Using GANs for generating synthetic data and other applications. AI Ethics: Addressing ethical issues related to the development and deployment of AI, Responsible AI: Ensuring that AI systems are used responsibly and ethically.	30

Assessment:

Internal Assignment:

Internal assignment of 140 marks based on the entire syllabus needs to be submitted by the candidate.

End Semester Examination:

1. The question paper will comprise of a total of seven questions, each carrying 20 marks.
2. Each Question can have maximum three sub questions preferably covering from the same module.
3. Students can answer any 5 full questions of their choice amongst 7.

References:

1. Artificial Intelligence: A Modern Approach: by Stuart Russell and Peter Norvig.
2. Deep Learning: by Ian Goodfellow, Yoshua Bengio, and Aaron Courville.
3. A First Course in Artificial Intelligence: by Deepak Khemani.
4. Heuristics: Intelligent Search Strategies for Computer Problem Solving: by Judea Pearl.
5. Artificial Intelligence: by Elaine Rich and Kevin Knight.

Links for Online NPTEL/SWAYAM courses:

1. **https://onlinecourses.nptel.ac.in/noc21_me67/preview**
2. **https://nptel.ac.in/courses/108105063**
3. **https://onlinecourses.nptel.ac.in/noc25_ge44/preview**
4. **https://onlinecourses.nptel.ac.in/noc25_ge44/preview**

Course Code	Course Name	Marks
IEE08	Industrial Safety and Maintenance	100

Learning Objectives:

1. **To Understand and Apply Safety Regulations**
2. **To Perform Risk Assessment and Hazard Control**
3. **To Maintain Industrial Equipment for peak performance**

Course Outcomes: Learner will be able to……

1. **Understand the importance of industrial safety and its relevance with accidents**
2. **Develop awareness about safety programs and personal protective equipment.**
3. **Understand types and importance of maintenance in the industries.**
4. **Establish maintenance strategies for maximizing the profit by effective budgeting.**
5. **Understand manpower and material planning in maintenance engineering.**

Module	Contents	Marks
1	**Evolution of Modern Safety Concept -** Safety management functions, Safety policy, Safety organization, Safety Committee, Budgeting for safety, Behavior based safety. **Accidents –** Concept of an accident, Reportable and non-reportable accidents, Reporting to statutory authorities, Accident investigation and analysis, Records for accidents, Departmental accident reports, Documentation of accidents, Cost of accident	**30**
2	**Safety Training –** Creating awareness, Safety awards and celebrations, safety posters, Safety displays, Safety pledge, Safety incentive scheme, Safety campaign. **Personal protection in the work environment -** Types of PPEs (Personal protective equipment); respiratory and non-respiratory equipment. Standards related to PPEs, Monitoring safety	**30**
3	**Maintenance Concepts -** Introduction, Challenges in maintenance operations, Maintenance objectives, Maintenance Levels, Types of Maintenance Systems, Benefits of maintenance, Effects of Maintenance, Principles of Maintenance, Role of overhauling in maintenance	**25**
4	**Maintenance Management –** Maintainability, Maintainability analysis, Functional analysis, Concept of failure analysis, Maintainability prediction, Design for maintainability, Cost Effectiveness, Production maintenance integration Decision making in Maintenance: Problems identification and solving, Limitation of failure statistics, Behavioural concepts in decision making	**25**

5	**Maintenance Planning** - Objectives of Manpower Planning, Stages of Manpower Planning, Timescale of Manpower Planning. Use of AI in Maintenance Planning **Maintenance Material Planning and Control** - Present material policies, Information System, Classification of spares, Inventory cost, Spare parts management: slow moving spares, spares with and without salvage value	**30**

Assessment:

Internal Assignment:

Internal assignment of 140 marks based on the entire syllabus needs to be submitted by the candidate.

End Semester Examination:

1. The question paper will comprise of a total of seven questions, each carrying 20 marks.
2. Each Question can have maximum three sub questions preferably covering from the same module.
3. Students can answer any 5 full questions of their choice amongst 7.

References:

1. Mishra, R.C., Pathak K - Maintenance Engineering and Management, Prentice Hall of India
2. Andrew K.S. Jardine, Albert H.C. Tsan - Maintenance, Replacement and Reliability, CRS Press
3. Carder, A.S, - Maintenance Management, McGraw Hill
4. Blanchard, B.S. - Maintainability Principles and Practices, McGraw Hill
5. Tina Agustiady, Elizabeth A. Cudney - Total Productive Maintenance, CRS Press
6. Nakajima, S. - Introduction to Total Productive Maintenance. Productivity Press, Cambridge

Links for Online NPTEL/SWAYAM courses:

1. https://nptel.ac.in/courses/110105094
2. https://onlinecourses.swayam2.ac.in/nou25_me11/preview
3. https://onlinecourses.swayam2.ac.in/nou25_ge74/preview

Course Code	Course Name	Marks
IEE09	Managerial Finance	100

Learning Objectives:

1. **To determine the time value of money**
2. **To learn working capital management and its importance**
3. **To learn project financing tools and instruments**

Course Outcomes: Learner will be able to……

1. **Demonstrate knowledge of the concepts, principles, and rules of Business organizations.**
2. **Understand in depth the objectives of financial management and enable the students to access the proper sources of finance for the business.**
3. **Understand the students to construct an optimal capital structure through the conceptual knowledge on capital structure theories and enable them to take better dividend decisions.**
4. **Impart deeper understanding in working capital management to avail the adequate working capital for business functions.**
5. **Enable the students to evaluate the capital budgets through capital budgeting techniques & Demonstrate knowledge of the concepts, principles, and rules of taxation of individuals.**

Module	Contents	Marks
1	**Forms of Business Organizations -** Proprietary, Partnership, Private Ltd. And Public Limited companies; their regulatory framework.	**20**
2	**Time Value of Money** - Future and present values of single cash flow and annuity, Interest rate: nominal versus effective, Various types of borrowing and interest rates, cost of capital and its effect on Investment decisions, Economic comparisons of alternative investments. Analysis of Balance sheet and profit and loss account, Cash flow and fund flow statements and their interpretation. Types of Financial Ratios: Liquidity ratio, Turnover ratio, Profitability ratio, Leverage ratio etc.	**35**

3	**Working Capital Management -** Concepts and constituents of current assets and current liabilities; Operating cycle of Business and its effect on inventory; receivables and cash flow. Financing of business: short term & long term, Assessment of requirements and means of financing; various types of short-term financing; types of securities and their assessment; Long term financing of business; Sources of long-term finance Equity. Preferential shares, Debentures, Deposits, Long term loan from financial institutions, Lease financing.	**35**
4	**Tax framework and its effect on business policies –** Direct and indirect taxes, Effect of sales tax, Excise duty, Goods Service tax (GST), Value added tax (VAT), cess and Customs duty on pricing in investment decisions.	**20**
5	**Project Financing -** Preparations of project feasibility report, Techno financial appraisal risk analysis of the project, Sources of project, Sources of project financing, Project alternatives Calculations criteria NPV, Future Value of Project, Present value of annuity, Internal rate of return (IRR) with case studies **Money and Capital Market** - Features, Liberalization and its effect on India's capital market.	**30**

Assessment:

Internal Assignment:

Internal assignment of 140 marks based on the entire syllabus needs to be submitted by the candidate.

End Semester Examination:

1. The question paper will comprise of a total of seven questions, each carrying 20 marks.
2. Each Question can have maximum three sub questions preferably covering from the same module.
3. Students can answer any 5 full questions of their choice amongst 7.

References:

1. A Khan and P. K. Jain - Financial Management: Text and problems, Tata McGraw Hill
2. Prasanna Chandra - Financial Management: Theory and Practice, Tata McGraw Hill
3. A Khan and P. K. Jain - Financial Management: Text and problems, Tata McGraw Hill
4. Prasanna Chandra - Financial Management: Theory and Practice, Tata McGraw Hill

Links for Online NPTEL/SWAYAM courses:

1. https://onlinecourses.nptel.ac.in/noc24_ec01/preview
2. https://onlinecourses.nptel.ac.in/noc24_mg20/preview

Course Code	Course Name	Marks
IEE10	Total Productive Maintenance	100

Learning Objectives:

1. **To develop an understanding of Total Productive Maintenance (TPM) principles.**
2. **To learn applications of TPM tools and techniques**

Course Outcomes: Learner will be able to……

1. **Understand how TPM improves operations by preventing equipment breakdowns, reducing defects, and improving equipment effectiveness.**
2. **Apply TPM tools to identify and eliminate various forms of operational losses.**
3. **Describe the organizational structure and key responsibilities involved in TPM implementation.**
4. **Analyze the economic impact and long-term benefits of TPM on organizational performance.**

Module	Contents	Marks
1	**Introduction to TPM** Fundamentals and concepts of Total Productive Maintenance (TPM), Objectives and functions of TPM, Overview of Reliability-Centered Maintenance (RCM), Maintainability prediction techniques, System effectiveness and equipment availability, Maintenance cost analysis and evaluation methods	30
2	**TPM Implementation and Planning** TPM implementation strategies and phases, Preventive maintenance and minimal repair techniques, Types and classification of maintenance, Balancing preventive and breakdown maintenance, Preventive maintenance (PM) scheduling methods, Functional characteristics and reliability aspects, Replacement models and decision-making tools	30
3	**Zero Defects and Autonomous Maintenance** Concept of zero defects and zero breakdowns, Maximizing equipment effectiveness through TPM practices, Autonomous maintenance: principles and execution, Eight pillars of TPM, Role of small group activities and team engagement, Organizational structure and policy formulation, Master planning and systematic implementation, Inventory control for maintenance and efficiency measurement	30

4	**Human Factors and Advanced Monitoring Techniques** Development and use of maintenance manuals, Staffing models and workforce planning, Application of queuing models and simulations in maintenance, Spare parts management and optimization, Maintenance planning and scheduling frameworks, Condition monitoring, techniques: vibration analysis, wear debris analysis, corrosion monitoring, Use of expert systems in predictive maintenance	**25**
5	**Advanced Maintenance Strategies** Maintenance Management Information Systems (MMIS), Roles of Capacity Assurance Technicians, Principles of Total Economic Maintenance, Team-based maintenance approaches and TPM culture, Long-term strategies for sustaining TPM vision and continuous improvement	**25**

Assessment:

Internal Assignment:

Internal assignment of 140 marks based on the entire syllabus needs to be submitted by the candidate.

End Semester Examination:

1. The question paper will comprise of a total of seven questions, each carrying 20 marks.
2. Each Question can have maximum three sub questions preferably covering from the same module.
3. Students can answer any 5 full questions of their choice amongst 7.

Reference Books

1. Tina Kanti Agustiady & Elizabeth A. Cudney – *Total Productive Maintenance: Strategies and Implementation Guide*, Productivity Press, 2015.
2. Kern Peng – *Equipment Management in the Post-Maintenance Era*, Productivity Press, 2012.
3. David J. Sumanth – *Total Productivity Management (TPmgt)*, Productivity Press, 1997.
4. Fumio Gotoh & Masaji Tajiri – *Autonomous Maintenance in Seven Steps*, Productivity Press, 1999.
5. Japan Institute of Plant Maintenance – *Autonomous Maintenance for Operators*, Productivity Press, 1997.
6. R.C. Mishra & K. Pathak – *Maintenance Engineering and Management*, 2nd Ed., PHI.
7. K. Venkatraman – *Maintenance Engineering and Management*, 2nd Ed., PHI.
8. P. Gopalakrishnan & A.K. Banerji – *Maintenance and Spare Parts Management*, PHI.
9. F. Goto – *Equipment Planning for TPM Maintenance Prevention Design*, Productivity Press.
10. K. Shirose – *Total Productive Maintenance for Workshop Leaders*, Productivity Press.

Links for Online NPTEL/SWAYAM courses:

1. https://www.youtube.com/watch?v=UOuTBCrW2kY
2. https://onlinecourses.swayam2.ac.in/imb22_mg01/preview

Course Code	Course Name	Marks
IEE11	Business Process Simulation	100

Learning Objectives:

1. **To know the need of Basic Simulation Modeling**
2. **To use the modeling tools for growth of business**
3. **To learn the software for Basic Simulation Modeling**

Course Outcomes: Learner will be able to……

1. **Understand of integrating business management principles and practice the theory in an interdisciplinary environment.**
2. **Develop skills that are necessary to solidify a business situation using what-if scenarios.**
3. **Obtain the knowledge and skill to analyze a business process not just at high-level.**
4. **Work as a member of a team in completing everyday business tasks and making decisions relating to the overall operation of the business and growth of the business.**
5. **Apply critical thinking and problem-solving skills in a rapidly evolving environment.**

Module	Contents	Marks
1	**Basic Simulation Modeling -** Introduction, Role of simulation, Models and simulation, Scope and phases involved in simulation process, Steps in simulation study, Other types of simulation, Case studies.	25
2	**Simulation modeling** – Modeling process, Modeling complex systems, List processing in Simulation,	25
3	**Probability and Statistics -** Random Variables, Simulation Output Data and Stochastic process, Case studies, Input Probability distributions, Useful distributions	30
4	**Simulation Applications -** Application to inventory, Queuing model, Corporate planning, Marketing, Scheduling, Factory layout design, Quality control, Supply chain optimization **Simulation software -** Introduction, Classification, Simulation with Extend Sim, Desirable Software features, Business games, Simulation Programming logic	30
5	**Random number Generators -** Introduction, Generators; methods and applications process generators, Random Variates- Continuous and Discrete Random variates. **Business Intelligence Tools- Dashboard making,** Looker, Tableau, and Power BI, Comparison	30

Assessment:

Internal Assignment:

Internal assignment of 140 marks based on the entire syllabus needs to be submitted by the candidate.

End Semester Examination:

1. The question paper will comprise of a total of seven questions, each carrying 20 marks.
2. Each Question can have maximum three sub questions preferably covering from the same module.
3. Students can answer any 5 full questions of their choice amongst 7.

References:

1. Law A.M. and Kelton W.D - Simulation Modeling and Analysis, Tata McGraw
2. Bank J and Carson J. S. - Discrete event simulation, Prentice Hall
3. G Gordon - System simulation, Prentice Hall
4. James R.E. and Sisson R.L. - Design and use Computer simulation models; Macmillan
5. Manuel Laguna, Johan Marklund - Business Process Modeling, Simulation and Design, Prentice Hall.
6. Griffin Cook - Numerical Analysis, Modelling and Simulation, Larsen and Keller Education
7. Watson & Blackstone - Computer Simulation, John Wiley and Sons
8. Pegden, C. D., Shannon, R. E. and Sadowski, R. P. - Introduction to Simulation Using SIMAN, McGraw- Hill
9. Robinson, S. - Successful Simulation: A Practical Approach to Simulation Projects, McGraw Hill

Links for Online NPTEL/SWAYAM courses:

1. https://onlinecourses.nptel.ac.in/noc24_mg54/preview
2. https://onlinecourses.nptel.ac.in/noc24_me14/preview
3. https://onlinecourses.nptel.ac.in/noc24_ch04/preview

Course Code	Course Name	Marks
IEE12	Entrepreneurship Development	100

Learning Objectives:

1. **Knowing the need of entrepreneurship**
2. **Using the Government support for entrepreneurship development**
3. **Working for growth of an organization**

Course Outcomes: Learner will be able to……

1. **Recognize the introductory concepts to entrepreneurship and its key aspects.**
2. **State the vital concepts for mathematical models and computations related to finances and accounting.**
3. **Develop a sound perception of key entrepreneurship capabilities and traits based on creativity, decision-making, technicality, marketability, and problem-solving.**
4. **Explain vital insights into entrepreneurship development in accordance with organizational assistance.**
5. **Understand the legal aspects, rules and regulations concerned with the diverse entrepreneurial activity.**

Module	Contents	Marks
1	**Introduction -** Meaning, importance and evolution of term 'Entrepreneurship', Types of entrepreneur, Factors influencing entrepreneurship, Psychological factors, Social factors, Economic factors, Environmental factors, Characteristics of an entrepreneur, Entrepreneur and Intrapreneur, Barriers to entrepreneurship, Business Model Canvas (BMC) and its key components, **Indian Business history**	**25**
2	**Finance and Accounting in relation to Entrepreneurship -** Need for finance, Sources of finance, Term loans, Capital structure, Financial institutions, Management of working Capital, Elements and types of Costs, Break even analysis, Taxation- Income Tax, GST, Estimation of financial requirements.	**30**

3	**Creativity and Business Opportunity -** Creativity; innovation and inventions, Skills of an entrepreneur, Decision making and problem solving (steps in decision making). Opportunity identification and product/service selection- Generation and screening the project ideas, Market analysis, Technical analysis, Cost benefit analysis and Network analysis. Project Formulation – Assessment of project feasibility, Dealing with basic and initial problems of setting up of Enterprises. Role of Shark tank India in the Entrepreneurship Development	**30**
4	**Entrepreneurship Growth -** Assistance to an entrepreneur, New Ventures. Industrial Parks: Meaning, features, and examples, Special Economic Zone, IT Parks: Meaning, features and examples, Types of Start-ups, Government of India initiatives/schemes (Make-in-India, Startup India, Outlook Skill-India, Viksit Bharat Sampark, Aatmnirbhar Bharat)	**25**
5	**Rules And Legislation -** Applicability of Legislation, Industries Development (Regulations) Act, 1951, Factories Act, 1948, The Industrial Employment (Standing Orders) Act, 1946, Suspension, Stoppage of work, Termination of employment, Environment (Protection) Act, 1986, The sale of Goods Act, 1950; Industrial Dispute Act 1947 and latest amendments in all the acts, OSHA standards in India	**30**

Assessment:

Internal Assignment:

Internal assignment of 140 marks based on the entire syllabus needs to be submitted by the candidate.

End Semester Examination:

1. The question paper will comprise of a total of seven questions, each carrying 20 marks.
2. Each Question can have maximum three sub questions preferably covering from the same module.
3. Students can answer any 5 full questions of their choice amongst 7.

References:

1. Robert Hisrich and Michael Peters - Entrepreneurship, Tata McGraw Hill
2. Marc J Dollinger - Entrepreneurship – Strategies and Resources, Pearson
3. Khanka S.S. - Entrepreneurial Development, S. Chand & Co. Ltd.
4. Donald F Kuratko - Entrepreneurship – Theory, Process and Practice, Cengage Learning
5. Dr. Gupta and Dr. Srinivasan - Entrepreneurship development in India, Sultan Chand and Sons
6. Vasant Desai - Dynamics of Entrepreneurial Development and Management, Himalaya Publishing House

7. M.W. Deshpande - Entrepreneurship of Small-Scale Industries, Deep & Deep
8. Pandey G W. - A complete Guide To Successful Entrepreneurship, Vikas Publishing.
9. Rao C R - Finance for Small Scale Industries
10. Khan & Jain - Financial Management, Tata McGraw Hill
11. Sangeeta Sharma - Entrepreneurship Development, Prentice Hall.
12. Rao T.V., Deshpande M.V., Prayag Metha & Nadakarni M.S. - Developing Entrepreneurship A Hand Book, Learning Systems.
13. Venkateshwara Rao and Udai Pareek (Eds) - Developing Entrepreneurship - A Handbook
14. Ravi J. Mathai - Rural Entrepreneurship A Frame Work in Development Entrepreneurship –A Handbook
15. Rajeev Roy – Entrepreneurship, Oxford University Press

Links for Online NPTEL/SWAYAM courses:

1. https://onlinecourses.swayam2.ac.in/cec20_mg19/preview
2. https://onlinecourses.nptel.ac.in/noc25_mg81/preview
3. https://nptel.ac.in/courses/109103171

Course Code	Course Name	Marks
IEE13	Materials Management	100

Learning Objectives:

1. **To learn cost minimization techniques by managing the inventory**
2. **To Design Efficient Procurement Strategies**
3. **To Implement Warehouse and Logistics Solutions**

Course Outcomes: Learner will be able to……

1. **Analyze the conceptual framework of Material Management**
2. **Understand the importance of materials and spare parts management in an organization.**
3. **Apply the policies of Inventory Management and Develop overall materials requirement plan**
4. **Develop an understanding of the functions of different areas of management and their linkages with material management.**
5. **Prepare cost sheets by applying concepts of purchasing and cost system by analyzing specific costs and Analyze the role of supply chain management system in an organization**

Module	Contents	Marks
1	**Introduction to materials management -** Need, Scope, Functions, Objectives and importance of Materials Management, role of materials management in industries, The need for the integrated approach in material management.	20
2	**Demand forecasting -** Various quantitative methods of demand forecasting, Different type of averaging, Exponentially weighed smoothening, Correction for fluctuations, Time series analysis, Delphi and other group techniques.	30
3	**Inventory Management -** Basic methods in Inventory control Assumptions used in deriving models. Inventory costs and EOQ model. Price breaks and quantities, Effects of variations in lead-time and demand, Effects of shortage cost on EOQ. Systems of Inventory control, Design of Inventory control systems. Classification of systems and selective Inventory control ABC, VED, FSN, HML, SDE, XYZ Analysis, Coverage analysis in material management, Procedure for Setting up an Efficient Inventory Control System, Logistics Management and Its Link with Inventory Control and other Areas.	35

4	**Vendor rating and source selection -** Techniques and materials, Strategic sourcing Use of Indian Standards for vendor rating, Make or buy decisions – Materials Requirements, Planning Concept, methods and illustration examples. Introduction to JIT Philosophy features and impact in materials management.	**20**
5	**Purchasing Management -** Objectives and Functions of Purchasing Department, Purchase Policy and legal aspects of buying, purchase procedure, Negotiations, Purchase of High Capital Equipment and their Feasibilities, Store and Material control - Receipts and issues - Stores Record, Cost classification and preparation of cost sheet. Specific cost associated with material management. Application of Computers in Materials Management Information Systems for Procurement, storage and Material Planning **Introduction to Supply Chain Management -** Understanding the supply chain concept, objectives of supply, production and distribution system, Supply chain Drivers and Obstacles, Supplier selection and Supplier evaluation	**35**

Assessment:

Internal Assignment:

Internal assignment of 140 marks based on the entire syllabus needs to be submitted by the candidate.

End Semester Examination:

1. The question paper will comprise of a total of seven questions, each carrying 20 marks.
2. Each Question can have maximum three sub questions preferably covering from the same module.
3. Students can answer any 5 full questions of their choice amongst 7.

References

1. Datta A K,-Materials Management, Procedures, Text and Cases, Prentice-Hall of India Pvt. Ltd.
2. J.R. Tony Arnold; Stephen N. Chapman; Lloyd M. Clive- Introduction to Material Management,Prentice Hall
3. Gopalakrishanan,-Materials Management An Integrated Approach, PHI
4. Buchan & Kbenigsberg- Scientific Inventory Management, Prentice Hall
5. Tersine - Principles of Inventory Management, Elsevier Science Ltd

Links for Online NPTEL/SWAYAM courses

1. https://nptel.ac.in/courses/110105095
2. https://nptel.ac.in/courses/110106045
3. https://onlinecourses.nptel.ac.in/noc20_mg17/preview

Course Code	Course Name	Marks
IEE14	Sustainability Engineering	100

Learning Objectives:

1. **Understanding the need of sustainability engineering**
2. **Knowing the environment legislations**
3. **Implementing the impact of sustainability engineering on the environment**

Course Outcomes: Learner will be able to……

1. **Understand environmental acts for Sustainable Development.**
2. **Impart knowledge on the policies, legislations, and institutional framework and enforcement mechanisms for environmental management in India.**
3. **Learn tools and systems for Sustainability practices.**
4. **Understand economics for environment management.**
5. **Learn ESG and BRSR standards in India.**

Module	Contents	Marks
1	**Introduction to Sustainable Engineering**- Sustainable development, concepts of sustainable development: three pillar model, Atkisson's pyramid model, prism model, principles of sustainable development, sustainable engineering, threats for sustainability, MDGs, SDGs, CDM **Environmental Ethics and Legislations** – Life cycle Analysis (LCA), Environmental ethics, Environmental agreements and protocols, Environmental laws in India – The Water Act, The Air Act, The Environment Act.	**30**
2	**Environmental management standards:** Environmental conscious- quality function deployment-R3 and R6 cycles-Environmental impact assessment methods- CML, EI 95 and 99, ISO 14001, EMS and PAS 2050 standards, environmental impact parameters. Sustainability assessment-concept models and various approaches, product sustainability and risk assessment-corporate social responsibility	**30**
3	**Sustainability practices:** Basic concept of sustainable habitat, Methods for increasing energy efficiency in buildings, Green Engineering, Sustainable Urbanisation, Sustainable cities, Sustainable transport.	**30**
4	**Environment Economics-** Standard Market Model, External Costs Public Goods, impact Analysis; Cost-effectiveness analysis; Benefit cost analysis; Risk Analysis; Cost estimation techniques; Current policy.	**25**

5	**ESG -** Environmental, social, and corporate governance, **BRSR -** Evolution of BRSR, Objectives, Principles, BRSR Core Framework for ESG Disclosures, ESG reporting software, Circular Economy and Business Models	**25**

Assessment:

Internal Assignment:

Internal assignment of 140 marks based on the entire syllabus needs to be submitted by the candidate.

End Semester Examination:

1. The question paper will comprise of a total of seven questions, each carrying 20 marks.
2. Each Question can have maximum three sub questions preferably covering from the same module.
3. Students can answer any 5 full questions of their choice amongst 7.

References

1. Shyam Divan and Armin Roseneranz -Environmental law and policy in India, Oxford University Press, New Delhi.
2. Sulphey, M.M., Safeer M.M - Introduction to Environment Management, PHI Learning.
3. W.P. and B.W. and B.W. Saigo - Environmental Science- A Global Concern", Cunningham, McGraw- Hill lntl.Ed.
4. Davis. M.L. and D.A. Cornwell -Environmental Engineering, McGraw- Hill Intl.Ed.
5. Enger E.D. and B.F. Smith; W.C- Environmental Science- A Study of Interrelationships, Brown Publishers 1992.

Links for Online NPTEL/SWAYAM courses:

1. Environment Management: https://archive.nptel.ac.in/courses/120/108/120108004/
2. https://jawaharlalcolleges.com/downloads/dpt/cse/course/semester3/MCN%20201%20SUSTAINABLE%20ENGINEERING.pdf
3. https://www.sebi.gov.in/sebi_data/commondocs/may-2021/Business%20responsibility%20and%20sustainability%20reporting%20by%20listed%20entitiesAnnexure1_p.PDF

Course Code	Course Name	Marks
IEE15	Human Resource Management	100

Learning Objectives:

1. **Knowing the need of human resource management.**
2. **Understanding the employment process.**
3. **Preparing for self growth through the training and development**

Course Outcomes: Learner will be able to……

1. **Justify the need of human resource management.**
2. **Analyze the process of recruitment and selection.**
3. **Identify opportunities of Promotion through motivation.**
4. **Understand Evaluation of the process of Performance Appraisal and Development.**
5. **Know the importance of Training, development and stress management.**

Module	Contents	Marks
1	**Human Resource Management and Development** - Need of Human Resource Management (HRM) and Development (HRD), Search for Competitive Advantage, Models of Excellence, Failure of Personnel Management, Decline in Trade Union Pressure, Changes in Workforce and the Nature of Work, HRM vs. Personnel Management, HRD Concepts , Training, Education, development, Objectives of HRD, Role and Significance of HRD, Management of HRD Unit, Focus of the HRD System, Structure of HRD System, Role of HRD Manager.	**30**
2	**Recruitment And Selection -** Introduction, Recruitment, Functions, Internal Recruitment, Recruitment Policy, Recruitment Process, Preliminary Screening of Applicants, Review of Application Blanks, Reference Checking, Psychological Testing, Interview, Induction, Objectives, Steps in Induction Programme, Employees Socialization, Placement	**25**
3	**Promotion And Motivation-** Introduction, Promotion from Within, Forms of Promotion, Informal and Formal, Other Forms, Elements of Promotion, Upward Advancement, Enhanced Responsibilities, Status and Prestige, Better Pay and Wages, Other Elements, Purpose of Promotion, Promotion Policy, Requirements of Promotion Policy, Basis of Promotion, Seniority, Merit Rating, Quota-system, Trade Tests, Promotion by Examinations, Age-group Preference, Personal Attributes, Performance Appraisal, Promotion Alternatives, Lateral Transfer and Horizontal Transfer, Job Rotation	**30**

4	**Performance Appraisal And Development-** Introduction, Performance Appraisal – Definitions, Importance, Functions, Objectives, Role of Appraisals in Performance Management, Process and Methods of Performance Appraisal, Types and Methods of Performance Appraisal, Traditional Methods, Modern Methods, Potential Appraisal, Steps to Performance Appraisal, Performance Counseling, Conditions for Effective Performance Counseling, Different Phases of Performance Counseling, Performance Counseling Process, Counseling Interview.	**25**
5	**Training, Development & Stress Management –** Introduction, Definition and Purposes, Need for Manpower Training, Classification of Training Programes, Induction and Orientation, Supervisory Training Programes, Training for Top and Middle Management, Steps for Designing the Training Programmes, Identification of Training Needs, Sequence of a Training Programmes, Need for a Training Policy, Training Methods, Off-the-job Methods. **Stress Management -** Categories of Stressors, Internal Source of Stress, External Stressors, Personality Traits, Negative Affectivity, Self-reliance, Counter Dependence, Identification of Stress at Various Levels, Stress and Human Resource Management	**30**

Assessment:

Internal Assignment:

Internal assignment of 140 marks based on the entire syllabus needs to be submitted by the candidate.

End Semester Examination:

1. The question paper will comprise of a total of seven questions, each carrying 20 marks.
2. Each Question can have maximum three sub questions preferably covering from the same module.
3. Students can answer any 5 full questions of their choice amongst 7.

References:

1. Bhattacharyya, D.K. Human Resource Management, Excel Books, New Delhi.
2. Bhattacharyya, D.K, Human Resource Planning, Excel Books, New Delhi.
3. Lamholtz, E.C. - Human Resource Accounting, Dickenson Publishing Company, California.

Links for Online NPTEL/SWAYAM courses:

1. https://onlinecourses.swayam2.ac.in/nou25_mg14/preview
2. https://nptel.ac.in/courses/110105069

Course Code	Course Name	Marks
IEE16	Energy Audit & Management	100

Learning Objectives:

1. **To study the principles of energy management**
2. **To study energy economics and auditing**
3. **To study thermal and electrical energy management**

Course Outcomes: Learner will be able to……

1. **Summarize and explain need for energy management**
2. **Perform energy audit in the industry**
3. **Understand the importance of energy and utility costing**
4. **Describe importance of and analyze efficiency in thermal utilities**
5. **Describe importance of and analyze efficiency in electrical utilities**

Module	Contents	Marks
1	**General Aspects of Energy Management -** Current energy scenario in India, Current energy consumption pattern in global and Indian industry, Principles of Energy management, Energy policy, Energy action planning, Energy security and reliability, Need of Renewable energy. Carbon footprints, Carbon Credits.	30
2	**Energy Auditing** - Need of Energy Audit, Types of energy audit, Components of energy audit, Energy audit methodology, Instruments, equipment used in energy audit, Analysis and recommendations of energy audit - examples for different applications, Energy audit reporting, Energy audit software, how to become Energy Manager and Energy Auditor?	30
3	**Energy Economics** - Costing of Utilities - Determination of cost of steam, natural gas, compressed air and electricity, Financial Analysis Techniques - Simple payback, Time value of money, Net Present Value (NPV), Return on Investment (ROI), Internal Rate of Return (IRR), Risk and Sensitivity analysis.	30
4	**Energy Efficiency in Thermal Utilities** - Energy performance assessment and efficiency improvement of Boilers, Furnaces, Heat exchangers, Fans and blowers, pumps, Compressors and HVAC systems. Assessment of steam distribution losses, Steam leakages, Steam trapping, Condensate and flash steam recovery system	25
5	**Electrical Energy Management**: Distribution and transformer losses. Electrical motors - types, efficiency and selection. Speed control, Energy efficient motors. Electricity Act 2003.Lighting - Lamp types and their features, recommended illumination levels, lighting system energy efficiency.	25

Assessment:

Internal Assignment:

Internal assignment of 140 marks based on the entire syllabus needs to be submitted by the candidate.

End Semester Examination:

1. The question paper will comprise of a total of seven questions, each carrying 20 marks.
2. Each Question can have maximum three sub questions preferably covering from the same module.
3. Students can answer any 5 full questions of their choice amongst 7.

References:

1. Energy engineering and management, Amlan Chakrabarti, PHI Learning, New Delhi, 2012
2. Handbook of Energy Audit, Albert Thumann P.E. CEM, William J. Younger CEM, The Fairmont Press Inc., 7th Edition.
3. Energy management Handbook, 5th Edition, Wayne C. Turner, The Fairmont Press Inc., Georgia.
4. Handbook on Energy Audit and Environment management, Abbi Y. A., Jain Shashank, TERI, New Delhi, 2006
5. Energy Performance assessment for equipment and Utility Systems Vol. 1 to 4, Bureau of Energy Efficiency, Govt. of India.
6. www.bee-india.nic.in
7. https://aipnpc.org/Guidebooks.aspx (Guidebooks for energy audit and management)

Links for Online NPTEL/SWAYAM courses:

1. https://onlinecourses.swayam2.ac.in/nou23_es05/preview
2. https://onlinecourses.nptel.ac.in/noc25_ar10/preview
3. https://nptel.ac.in/courses/108106022