

ಬಿ.ಎಂ.ಎಸ್. ತಾಂತ್ರಿಕ ಮಹಾವಿದ್ಯಾಲಯ

(ಸ್ವಾಯತ್ತ ವಿದ್ಯಾ ಸಂಸ್ಥೆ)

B.M.S. COLLEGE OF ENGINEERING, BENGALURU-19

(Autonomous College under VTU)

DEPARTMENT OF
INDUSTRIAL ENGINEERING & MANAGEMENT

SCHEME & SYLLABUS FOR
UG Programme - III & IV Semesters
2015-2016

ಬಿ.ಎಂ.ಎಸ್. ತಾಂತ್ರಿಕ ಮಹಾವಿದ್ಯಾಲಯ

ಬುಲ್ ಟೆಂಪಲ್ ರಸ್ತೆ, ಬೆಂಗಳೂರು–೫೬೦ ೦೧೯

B.M.S. COLLEGE OF ENGINEERING

Bull Temple Road, Bengaluru - 560 019

DEPARTMENT OF INDUSTRIAL ENGINEERING AND MANAGEMENT
Scheme & Syllabus for UG programme – III & IV Semesters

Department Vision

To emerge as an excellent center for imparting quality higher education and generating highly proficient technical manpower to adopt to the constantly changing global scenario with professional and ethical values.

Department Mission

- Providing excellent education in curricular, co- curricular and extra-curricular activities to students.
- Facilitating to continue their education through research activities
- Catering to the needs of the Industry and society.
- Nurturing and mentoring students to acceptance by stake holders

DEPARTMENT OF INDUSTRIAL ENGINEERING AND MANAGEMENT
Scheme & Syllabus for UG programme – III & IV Semesters

Program Outcomes (POs)

PO 1	An ability to apply knowledge of science, computing, mathematics, and industrial engineering fundamentals appropriate to the discipline.
PO 2	An ability to analyze a problem, and identify and formulate the industrial engineering principles appropriate to its solution
PO 3	An ability to design, implement, and evaluate a computer-based industrial engineering system or/and process to meet desired needs with appropriate consideration for public health and safety, cultural, societal and environmental considerations
PO 4	An ability to design and conduct experiments using IE models and IT tools , to analyze and interpret data leading to feasible solutions
PO 5	An ability to use current techniques, modern tools and skills necessary for industrial engineering practice
PO 6	An ability to analyze the local and global impact of industrial engineering solutions on individuals, organizations, and society
PO 7	Develop a Knowledge of contemporary issues and solutions
PO 8	Develop an understanding of security, professional, ethical, legal, and social issues and responsibilities of an industrial engineer
PO 9	An ability to function effectively, individually and in a team, in diverse and multi-disciplinary environments to accomplish a common goal
PO 10	Develop an ability to communicate effectively with a range of audiences in all situations
PO 11	An understanding of engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects in a multidisciplinary environment
PO 12	Recognize the need for and an ability to engage in continuing professional development

DEPARTMENT OF INDUSTRIAL ENGINEERING AND MANAGEMENT
Scheme & Syllabus for UG programme – III & IV Semesters

NOTATIONS

AY	Academic Year
AAT	Alternative Assessment Tools
BOE	Board of Examiners
BOS	Board of Studies
CBCS	Choice Based Credit System
CGPA	Cumulative Grade Point Averages
CIE	Continuous Internal Evaluation
DC	Departmental Core
GC	Group Core
HSS	Humanity and Social Science Courses
IC	Institutional Core
IE	Institutional Elective
IL	Institutional Lab.
LTPS	Lecture – Tutorial-Practical-Self Study
NFTE	Not Fit for Technical Education
PCC	Professional Core Courses
PEC	Professional Elective Courses
SEE	Semester End Examination
SGPA	Semester Grade Point Average
ST	Studio
SS	Self Study
CO	Course Outcome
PO	Program Outcome
PEO	Program Educational Objectives



DEPARTMENT OF INDUSTRIAL ENGINEERING AND MANAGEMENT
Scheme & Syllabus for UG programme – III & IV Semesters

SCHEME OF INSTRUCTIONS FOR THIRD SEMESTER

Sl No	Course Code	Course Title	Credits				
			L	T	P	S	Total
1	15MA3DCHEM	HIGHER ENGINEERING MATHEMATICS	3	1	0	0	4
2	15IE3DCPT1	PRODUCTION TECHNOLOGY-I	3	0	1	2	6
3	15IE3DCSOM	STRENGTH OF MATERIALS	3	0	0	0	3
4	15IE3DCMMM	MECHANICAL MEASUREMENTS & METROLOGY	3	0	1	0	4
5	15IE3DCEES	ELEMENTS OF ENERGY SYSTEMS	3	0	0	0	3
6	15IE3GCCMD	COMPUTER AIDED MACHINE DRAWING	1	0	2	2	5
		Total					25

SCHEME OF INSTRUCTIONS FOR FOURTH SEMESTER

Sl No	Course Code	Course Title	Credits				
			L	T	P	S	Total
1	15IE4DCIEG	INDUSTRIAL ENGINEERING	3	0	1	2	6
2	15IE4DCSFE	STATISTICS FOR ENGINEERS	3	0	0	0	3
3	15IE4DCMAE	MANAGEMENT AND ENTREPRENEURSHIP	3	0	0	0	3
4	15IE4DCPT2	PRODUCTION TECHNOLOGY-II	3	0	1	2	6
5	15IE4DCMCD	MACHINE DESIGN	3	0	0	0	3
6	15IE4DCMSM	MATERIAL SCIENCE & METALLURGY	3	0	1	0	4
		Total					25

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT
III SEMESTER: MECHANICAL ENGINEERING CLUSTER 09-10

Course	Higher Engineering Mathematics	Course Code	15MA3DCHEM
Credits	04	L -T – P-S	3-1-0-0

Prerequisites: Matrices,concepts of Trigonometry andTrigonometric formulas, methods of differentiation, methods of integration, partial derivatives, solution methods of ordinary differential equations.

Course Outcomes:

On completion of the course, the student will have the ability to:

1. Compute solution of a system of algebraic equations.
2. Demonstrate an understanding to Fourier series and Fourier transforms.
3. Formulate boundary value problems involving one dimensional heat and wave equation.
4. Employ analytical techniques to solve partial differential equations with appropriate boundary conditions.
5. Apply Z- transforms techniques to solve difference equations.
6. Obtain the extremal of a functional.

UNIT-1

MATRICES **[9 hours]**

Introduction: Elementary row transformations, Echelon form of a matrix, rank of a matrix by elementary row transformations. Consistency of system of linear equations and solution.

Solution of a system of non-homogenous equations: Gauss elimination method, LU decomposition method, Gauss-Seidel method. Eigenvalues and eigenvectors of matrices. Reduction of a matrix to diagonal form. **(7L + 2T)**

Suggested Reading: Inverse of a matrix using Gauss-Jordan method. Largest eigenvalue and corresponding eigenvector using Rayleigh power method.

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UNIT-2

FOURIER SERIES **[9 hours]**

Introduction: Periodic function, Dirichlet's condition, statement of Fourier Theorem, Fourier series of a periodic function of period 2*l*, Fourier series of functions having points of discontinuity.

Applications: Fourier series of typical waveforms -saw toothed waveform, triangular waveform, square waveform, half-wave rectifier, full wave rectifier and modified saw tooth waveform.Practical harmonic analysis. **(7L + 2T)**

Suggested Reading: Half range Fourier series, Fourier series of discrete functions, Complex Fourier series.

UNIT-3

FOURIER TRANSFORMS **[10 hours]**

Infinite Fourier transform, Fourier Sine and Cosine transforms, properties, Inverse transforms, Fourier transforms of derivatives.Solution to boundary value problems using Fourier transforms. **(7L + 3T)**

Suggested Reading: Convolution theorem, Parseval's identities and physical significance of Parseval's identities.

UNIT-4

PARTIAL DIFFERENTIAL EQUATIONS **[10 hours]**

Formation of Partial differential equations-elimination of arbitrary constants, elimination of arbitrary functions. Equations of first order- The linear equation $P\,p + Q\,q = R$ **(**Lagrange's partial differential equation).

Applications: One-dimensional heat equation and wave equation (without proof), various possible solutions of these by the method of separation of variables. **7L + 3T)**

Suggested Reading: Direct integration method, method of separation of variables, D'Alembert's solution of wave equation.

UNIT-5

Z –TRANSFORMS AND CALCULUS OF VARIATIONS **[10 hours]**

Z-transforms**:** Definition, Properties, Transforms of standard functions, Inverse transforms.

Applications:Solution of difference equations using Z- transforms.
Calculus of variations: Variation of a functional, Euler's equation, variational problems.
Applications: Hanging cable problem, Geodesics on a right circular cylinder.Brachistochrone problem. **(8L + 2T)**
Suggested Reading: Minimal surface of revolution, Geodesics of a right circular cone and sphere.

Mathematics Lab

Solution of system of algebraic equations using Gauss Seidel method
LU decomposition of matrices.
Eigenvalues and eigenvectors of matrices.
Largest and smallest eigenvalue and corresponding eigenvector of a matrix.
Diagonalisation of matrices
Z-transforms

Bibliography

Text Books

1. "Advanced Engineering Mathematics", Erwin Kreyszig, 10th edition Vol.1 and Vol.2, 2014, Wiley-India.
2. "Advanced Engineering Mathematics", Dennis G. Zill and Cullen, 4th edition, 2011, Jones and Bartlett India Pvt. Ltd.

Reference Books:

1. "Higher Engineering Mathematics", B.V. Ramana, 6th edition, 2007, Tata Mc. Graw Hill.
2. "Higher Engineering Mathematics", B.S. Grewal, 43rd edition, 2013, Khanna Publishers.
3. Advanced EngineeringMathematics,R.K. Jain,S.R.K. Iyengar, 4th edition, 2014, Narosa Publishers.

E books and online course materials

(1) Engineering Mathematics, K. A. Stroud, Dexter J. Booth, Industrial Press, 2001 http://books.google.co.in/books/about/Engineering_Mathematics.html?id=FZncL-xB8dEC&redir_esc=y.
(2) Advanced Engineering Mathematics, P. V. O'Neil, 5th Indian reprint, 2009, Cengage learning India Pvt. Ltd.

Online Courses and Video Lectures:

(1) http://ocw.mit.edu/courses/mathematics/ (online course material)

(2) http://nptel.ac.in/courses.php?disciplineId=111
(3) https://www.khanacademy.org/
(4) E-learning: www.vtu.ac.in
(5) https://www.class-central.com/subject/math (MOOCS)

On completion of the course students will be able to:

Course Code	CO#	COURSE OUTCOME (CO)	PO	Bloom's level
	CO 1	Compute solution of a system of algebraic equations.	2, 3	2, 3
	CO 2	Determine whether a given system is stable or unstable.	2, 3	2, 3
	CO 3	Express given functions to form Fourier series.	2, 3, 4	2, 3, 4
	CO 4	Demonstrate an understanding of Fourier transforms techniques	2, 3, 4	2, 3, 4
	CO 5	Employ analytical techniques to solve partial differential equations with appropriate boundary conditions	2, 3, 4	2, 3, 4
	CO 6	Apply Z- transforms techniques to solve difference equations.	2, 3	2, 3
	CO 7	Use calculus of variations to find the extremal of a functional	2, 3	2, 3

Assessment:

- Each unit consists of one full question.
- Each full question consists of three or four subdivisions.
- Five full questions to be answered.
- To set one question from Units 1, 2, 5 and two questions from Unit 3 and Unit 4

Questions for CIE and SEE will be designed to evaluate the various educational components (Blooms taxonomy) such as:

- Remembering and understanding the course contents (weightage: 40%)
- Applying the knowledge acquired from the course (weightage: 35%)
- Analyzing various engineering problems (weightage: 15%)
- Understanding of various system models (weightage: 5%)

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III SEMESTER

Course Title	PRODUCTION TECHNOLOGY - I		
Course Code	15IE3DCPT1	L -T – P-S	3 -0- 1-2

PRE-REQUISITES : NIL

Unit- 1

Theory of Metal Cutting:

Single point cutting tool nomenclature, Merchants circle diagram and analysis, Ernst Merchant's solution, shear angle relationship, problems of Merchant's analysis, tool wear and tool failure, tool life, effects of cutting parameters on tool life, tool failure criteria, Taylor's tool life equation, problems on tool life evaluation. **7Hrs.**

Cutting tool materials:

Types of cutting tool materials HSS, carbides coated carbides, ceramics **02Hrs.**

Cutting fluids:

Desired properties, types and selection, Heat generation in metal cutting, factors affecting heat generation, Heat distribution in tool and W/P, Measurement of tool tip temperature. Desired properties of Cutting tool materials **2Hrs.**

Unit-2

Production Lathe: Classification of Lathes, Capstans & Turret lathes-Constructional features. Tool and work holding devices, Tool layout. **04Hrs.**

Shaping, Slotting and planning machines:

Classification, constructional features of shaping m/c, slotting m/c, planning m/c. driving mechanisms of shaping, slotting and planning machines. Operations done on shaping machine, slotting machine and planning machine. Calculation of machining time. **04Hrs.**

Drilling machines:

Classification, constructional features of Drilling Machines. Drilling & related operations, types of drill & drill bit nomenclature, drill materials. Calculation of machining time. **3Hrs.**

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Unit- 3

Milling machines:
Classification, constructional features, milling cutters nomenclature. Milling operations, up milling and down milling concepts. Calculation of machining time. **02Hrs.**

Indexing:
Simple, compound, differential and angular indexing calculations, Simple numerical on indexing. **04Hrs.**

Unit- 4

Grinding:
Types of abrasives, bonding process, classification, constructional features (cylindrical and surface grinding, center less grinding), selection of grinding wheel. **01Hr**

Laping and Honing:
Construction, applications, Principles of operation. **01Hr**

Non-traditional machining processes:
Principle, need, equipment, operation and LBM, plasma arc machining, Electro chemical machining, ultrasonic machining, abrasive let machining, water jet machining. **04Hrs.**

Unit- 5

Rapid Prototyping:
Introduction: Need for the compression in product development, history of RP systems, Survey of applications, Growth of RP industry, and classification of RP systems.
Stereo Lithography Systems, Selective Laser Sintering and Fusion Deposition Modeling: Principle, Process parameter, Process details, Data preparation, data files and machine details, Application. **06Hrs.**

MACHINE SHOP LAB.
Preparation of three models on lathe involving: Facing, Plain turning, Taper turning, Step

turning, Thread cutting, Knurling, Drilling, Boring, Internal Thread cutting and Eccentric turning.

Cutting of "V" Groove/ Dovetail / Rectangular groove: Using Shaping Machine, Cutting of Gear Teeth Using Milling Machine. Demonstration on Grinding Machine.

REFERENCES

Text Books:

1. Workshop Technology by Hazara Choudhry, Vol -II, Media Promoters & Publishers Pvt. Ltd. 2004
2. Production Technology by R.K.Jain, Khanna Publications, 2003.
3. Stereo Lithography and other RP & M Technologies – Paul F. Jacobs – SME NY 1996.

Reference Books:

1. "Production technology "by HMT, Tata McGraw Hill, 2001.
2. "Fundamentals of Metal Machining and Machine Tools" by G. Boothroyd, McGraw Hill, 2000.
3. Fundamentals of Production Planning and Control by Stephen N. Chapman, Prentice Hall, 2005.

MOOCS

1. http://nptel.ac.in/courses/112105126/
2. http://nptel.ac.in/courses/112105127/
3) https://www.class-central.com/subject/

COURSE OUTCOMES

CO 1	To understand different types of machine tools and their mechanism, types, applications and operations
CO 2	Ability to solve machining time, tool life, indexing problems
CO 3	Ability to understand failure criteria, heat generation & distribution, selection of cutting fluids
CO 4	To understand the principles, advantages and limitations of Non-conventional machining and Rapid Prototyping

Assessment of Self Study:
Student group of 5 members to submit following assignments on Rapid Prototyping at the end of the course.

1. Creation of CAD model of component
2. Conversion of CAD model to STL format
3. Slicing the STL file into thin cross section layers
4. Construction of the model one layer at a time
5. Cleaning and finishing the model
6. Documentation and report submission

Scheme of examination: One question from each unit and choice from Unit 1 and 2.

ASSESSMENT:

Continuous Internal Evaluation (CIE) includes mid-term tests, weekly/fortnightly class test, homework assignments, problem solving, group discussions quiz, seminar, mini-project and other Alternate Assessment Tools (AAT) prescribed by the faculty handling a course prior to beginning of the classes.
Semester End Examination(SEE)-a written examination for theory courses and practical/ design examination with built-in oral part (Viva Voice).
Both CIE and SEE have equal (50:50) weightages. The student's performance in a course shall be judged individually and together based on the results of CIE and SEE.

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III SEMESTER

Course Title	STRENGTH OF MATERIALS		
Course Code	15IE3DCSOM	L -T – P-S	3-0-0-0

PRE-REQUISITES : NIL

Unit – 1

Simple stress and strain: Introduction, stress, strain, mechanical properties of materials, Linear elasticity, Hooke's Law and Poisson's ratio, Stress-Strain relation – behavior in Tension for Mild steel and nonferrous metals. Extension / Shortening of a bar, bars with cross sections varying in steps, Total elongation of tapering bars of circular cross section . Principle of super position, Elongations due to self-weight for constant cross section, simple shear stress, shear strain, elastic constants and their relations, volumetric strain.

Compound bars: General Introduction, plane stress, stresses on inclined sections, General two dimensional stress system, principal stresses and maximum shear stresses, Mohr's circle for plane stress. **12Hrs.**

Unit - 2

Bending moment and Shear force in beams: Introduction, Types of beams, loads and reactions, shear forces and bending moments, rate of loading, sign conventions, relationship between shear force and bending moments, shear force and bending moment diagrams for different beams subjected to concentrated loads, uniformly distributed load and couple for different types of beams. **06Hrs.**

Unit - 3

Bending and shear stresses in beams: Introduction, theory of simple bending, assumptions in simple bending, relationship between bending stresses, radius of curvature and bending moment, moment carrying capacity of a section, Shear stress diagram for rectangular, symmetrical I and T section (composite / fletched beams not included).Derivation of Euler Bernoulli deflection equation only. **10Hrs.**

Unit - 4

Torsion of circular shafts: Introduction, pure torsion, assumptions, derivation of torsional equations, polar modulus, torsional rigidity / stiffness of shafts, power transmitted by solid and hollow circular shafts. **06Hrs.**

Unit - 5

Thick and thin cylinders: Stresses in thin cylinders, changes in dimensions of cylinder (diameter, length and volume), Thick cylinders subjected to internal and external pressures (Lame's equation), (compound cylinders not included).

Columns and Struts: Introduction: Euler's formula for critical load of columns for different end conditions, limitations of Euler's theory, Rankine's formula. No derivation, No Numerical. **06Hrs.**

REFERENCES:

Text Books:

1. "Strength of Materials", B.C Punmia, Ashok Jain, Arun Jain, Lakshmi Publications, New Delhi. 3rd Edition, 2002
2. "Elements of Strength of Materials", Timoshenko and Young- Published by Affiliated East- West Press, 1962
3. "Strength of Materials" Ramamrutham, Dhanapath Rai Publishers, 2008.

Reference Books:

1. "Mechanics of Solids", Mubeen, Pearson Edu. India, 2002
2. "Strength of Materials", W.A. Nash, Schaum's Outline Series, Fourth Edition-2007
3. "Mechanics of materials", S.I. Units, Ferdinand Beer & Russell Johnstan, TATA McGrawHill-2003.
4. "Strength of Materials "L. S. Srinath, Prakash Desai & Ananth Ramu TMH Publishers, Chennai, 2008.
5. "Elements of Strength of Materials Timoshenko and Young" Published by Affiliated East- West Press, 1962

E-books:

1. http://engineeringebookstore.blogspot.in/2013/07/som-strength-of-materials.html
2. http://free-onlineebooks.blogspot.in/2014/11/download-bc-punmia-strength-of_29.html

MOOCS:

1. http://nptel.ac.in/courses/Webcourse-contents/IIT-ROORKEE/strength%20of%20materials/ homepage.htm
2. http://www.onesmartclick.com/engineering/strength-of-material.html
3. https://www.class-central.com/subject

Scheme of examination: One Question from Unit 2, 4, 5 & two questions from unit 1 & 3.

COURSE OUTCOMES

CO 1	Understand the concepts and principles applied to members under various loadings and the effects of these loadings
CO 2	Analyze and design structural members subjected to stresses.
CO 3	Analyze columns and pressure vessels under various loadings
CO 4	To design machine parts and structures to prevent failure

ASSESSMENT:

Continuous Internal Evaluation (CIE) includes mid-term tests, weekly/fortnightly class test, homework assignments, problem solving, group discussions quiz, seminar, mini-project and other Alternate Assessment Tools (AAT) prescribed by the faculty handling a course prior to beginning of the classes.

Semester End Examination(SEE)-a written examination for theory courses and practical/ design examination with built-in oral part (Viva Voice).

Both CIE and SEE have equal (50:50) weightages. The student's performance in a course shall be judged individually and together based on the results of CIE and SEE.

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III SEMESTER

Course Title	MECHANICAL MEASUREMENTS AND METROLOGY		
Course Code	15IE3DCMMM	L -T – P-S	3-0-1-0

PRE-REQUISITES: NIL

Unit- 1

Introduction to metrology: definition, types, need of inspection, terminologies, and methods of measurement, selection of instruments, measurement errors, units, measurement standards, calibration.

Comparators: Introduction, features, classification, Mechanical comparators, sigma comparators, electrical and electronic comparators, Solex pneumatic gauge, microscope.
Limits, fits and gauges: Limits, fits, tolerance and allowance, theory of limits and fits and their selection, hole basis and shaft basis system, Indian standard system of limits and fits, simple problems. Interchangeability, selective assembly, limit gauges, Taylor's principle of limit gauging, plug gauges, ring gauges. **10Hrs.**

Unit- 2

Measurement of screw threads and gears: Measurement of various elements of threads, major, minor and effective diameter, measurement of pitch, gear inspection, measurement of tooth thickness, gear tooth caliper, Parkinson's gear tester. **06Hrs.**

Unit-3

Measurement of surface finish: Representation of surface finish as per BIS- methods of measuring surface finish: comparison method and direct instrument measurement- surface inspection by comparison methods: touch inspection, visual inspection, scratch inspection, microscopic inspection, and comparison with standard specimen, surface photographs-Direct instrument measurement: stylus probe instruments. **06Hrs.**

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Unit- 4

Transducers: introduction, primary and secondary transducers, classifications of transducers, mechanical transducers: thermal (thermocouple, bimetallic, temp-stik) elastic members: bourdon tube, diaphragm. Electrical transducers: active and passive transducers, piezo-electric transducers (modes of operation of piezoelectric crystals and uses) **08Hrs.**

Unit- 5

Measurement and measurement system: definition, significance of measurement, generalized measurement system, definitions and concept of accuracy, precision, calibration, threshold, sensitivity, hysteresis, repeatability, linearity, loading effect, system response-times delay. Errors in measurements, classification of errors.

Pressure measurement: elastic pressure transducers viz. Bourdon tubes, diaphragm, bellows and piezoelectric pressure sensors, high pressure measurements, bridge man gauge. Vacuum measurement: vacuum gauges viz. McLeod gauge.

Temperature measurement: electrical methods of temperature measurement resistance thermometers, thermistors and thermocouples, pyrometer. **10Hrs.**

LAB EXPERIMENTS

1. Calibration of Pressure Gauge
2. Calibration of Thermocouple
3. Calibration of LVDT
4. Calibration of Load cell
5. Determination of modulus of elasticity of a mild steel specimen using strain gauges.
6. Measurements using Optical Projector / Toolmaker Microscope.
7. Measurements of angle using Sine Center / Sine bar / bevel protractor
8. Measurements of cutting tool forces using
   a) Lathe tool Dynamometer b) Drill tool Dynamometer.
9. Measurements of gear tooth profile using gear tooth Vernier /gear tooth micrometer.
10. Calibration of micrometer using slip gauges

REFERENCES :

Text Books:

1. "Mechanical measurements" by Beckwith Marangoni and Lienhard, Pearson Education, 6th Ed, 2006.
2. "Engineering Metrology" by R.K.Jain, Khanna Publishers, 1994.
3. "A course in Mechanical Measurements and Instrumentation" by A K Sawhney, J.C Kapur Publishers, 3rd Ed., 1989.

Reference Books:

1. "Engineering Metrology" by I.C.Gupta, DhanpatRai Publications, Delhi
2. "Measurements Systems, Applications & Design, by Ernen O Dobeblein, 5TH ed.
3. "Industrial Instrumentation" Alsutko, Jerry. D.Faulk, Thompson Asia Pvt. Ltd.2002.
4. "Mechanical Measurements", R.S. Shirohi & H.C. Radhakrishna, 3rd Ed., New Age Intl. Pvt Ltd.,

MOOCS :

1) www.nptel.ac.in/courses/112106138/
2) www.nptel.ac.in/courses/112106139/
3) https://www.class-central.com/subject/

COURSE OUTCOMES:

CO 1	Is able to understand the concepts of metrology, various standards that are in practice and their applications. Learns about comparators and their use in different contexts, Indian standard system of limits and fits practiced in the manufacturing of products.
CO 2	will possess the knowledge of terminology of Screw threads and Gears. Will be able to measure the different elements of screw threads and gears using different instruments.
CO 3	is able to know understand the meaning of surface finish, BIS- methods of measuring surface finish, is able to use the instruments to assess the surface finish.
CO 4	will possess the knowledge transducers and their types, advantages, and usage of transducers for different applications.
CO 5	is able to understand the concept of measurement and the measurement system, error in measurement, pressure and its measurement using different instruments, temperature and its measurement using different Instruments.

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Scheme of Examination: One question from unit 2,3 & 4 and 2 questions from unit 1 & 5.

ASSESSMENT:

Continuous Internal Evaluation (CIE) includes mid-term tests, weekly/fortnightly class test, homework assignments, problem solving, group discussions quiz, seminar, mini-project and other Alternate Assessment Tools (AAT) prescribed by the faculty handling a course prior to beginning of the classes.

Semester End Examination(SEE)-a written examination for theory courses and practical/ design examination with built-in oral part (Viva Voice).

Both CIE and SEE have equal (50:50) weightages. The student's performance in a course shall be judged individually and together based on the results of CIE and SEE.

III SEMESTER

Course Title	ELEMENTS OF ENERGY SYSTEMS		
Course Code	15IE3DCEES	L -T – P-S	3 -0- 0-0

PRE-REQUISITES: NIL

UNIT - 1

BASICS OF THERMODYNAMICS

Systems, zeroth law, first law - concept of internal energy and enthalpy- applications to closed and open systems - second law - concept of entropy - Clausius inequality. **08 Hrs.**

UNIT- 2

CYCLES AND SYSTEMS

Otto, Diesel and Brayton cycles. IC engines - 4 stroke and 2 stroke engines - brake power - efficiencies - heat balance test - simple problems only. Properties of steam - use of steam tables and Mollier diagram - Rankine cycle – simple problems. **08Hrs.**

UNIT- 3

REFRIGERATION AND AIR CONDITIONING SYSTEMS

Vapour compression refrigeration systems - COP - simple problems – basics and types of air conditioning systems. Reciprocating compressors – volumetric efficiency - power required -simple problems - rotary compressors. Heat transfer - modes of heat transfer - simple problems on conduction-composite wall, cylinder and sphere - convection - flow over flat plate-and radiation. **08Hrs.**

UNIT- 4

BASICS OF FLUID MECHANICS

Introduction - properties of fluid - density, viscosity, pressure and velocity – types of fluid flow - continuity equation - energy - head of fluid - Euler's equation - Bernoulli's equation, flow through pipes - Hagen Poiseulli's law - major and minor losses. **08Hrs.**

UNIT- 5

FLUID MEASUREMENTS

Flow measurements - orifice meter, venturimeter- Rota meter and elbow meter. Pressure measurement - total and static pressure measurements using Pitot tube, manometer, mechanical gauges. Velocity measurements – different types. **08Hrs.**

REFERENCES:

TEXT BOOKS:

1. "Fluid Mechanics", Dr.R.K.Bansal, Lakshmi Publications.
2. "Basic & Applied Thermo Dynamics", Nag P. K. Tata McGraw Hill Co. Ltd., India, 2002.

REFERENCE BOOKS:

1. "Thermal Engineering", Sarkar B. K, Tata McGraw Hill Co. Ltd., India, 2005.
2. "Fluid Mechanics and Hydraulic Machines", Rajput R.K. S.Chand & Co., India 2008.
3. "Engineering Thermo Dynamics", Nag P.K Tata McGraw Hill Co. Ltd., India, 2005.
4. "Thermal Engineering" Rajput R.K, Laxmi Publications (P) Ltd., New Delhi, Edition. 2010.
5. "Fluid Mechanics and Fluid Power Engineering", Kumar D.S, S.K.Kataria & Sons Publishers, India, 6th Edition, 2003.

MOOCS :

1. https://www.edx.org/course/iitbombayx/iitbombayx-me209x-thermodynamics-1384#.U8aBL_mSx8E
2. https://www.coursera.org/course/introthermodynamics
3. https://www.coursera.org/course/thermodynamics
4) https://www.class-central.com/subject/

COURSE OUTCOMES

CO 1	Be able to understand the basic concepts of thermodynamics and describe energy exchange processes in terms of various forms of energies like heat and work in the systems.
CO 2	Be able to state the First Law for a closed system, open system and apply the steady flow energy equation to a system of thermodynamic components (heaters, coolers, pumps, turbines etc.) to estimate required balances of heat, work and energy flow.
CO 3	Be able understand the Second Law of Thermodynamics- Heat engines and Refrigerators, Reversible and irreversible processes, Carnot cycle and Entropy.
CO 4	Is able to acquire the knowledge of types of fluids, properties and their characteristics. Will know how to measure the pressure of a fluid at a point will have the knowledge of gauge, absolute and vacuum pressure.
CO 5	Is able to learn about the use of manometers for pressure measurement, pressure of the fluid in static condition on immersed surfaces. Will learn about the concepts of buoyancy and floatation, and the conditions for the body to be in equilibrium.
CO 6	Is able to learn about the kinematics of fluid flow, rate of discharge, and types of fluid flow.

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Scheme of Examination: One question from each unit and choice in unit-1 and unit-4

ASSESSMENT:

Continuous Internal Evaluation (CIE) includes mid-term tests, weekly/fortnightly class test, homework assignments, problem solving, group discussions quiz, seminar, mini-project and other Alternate Assessment Tools (AAT) prescribed by the faculty handling a course prior to beginning of the classes.

Semester End Examination(SEE)-a written examination for theory courses and practical/ design examination with built-in oral part (Viva Voice).

Both CIE and SEE have equal (50:50) weightages. The student's performance in a course shall be judged individually and together based on the results of CIE and SEE.

III SEMESTER

Course	COMPUTER AIDED MACHINE DRAWING	Course Code	15IE3GCCMD
Credits	05	L -T – P-S	1-0-2-2

PRE-REQUISITES: NIL

Unit- 1

Sections of Solids: Sectioning, Sectional view, Representation of section plane, Hatching, Sectioning of engineering objects like: Square, Pentagonal, Hexagonal prisms, Square, Hexagonal pyramids, Cylinder, Cone and Tetrahedron (Direct and indirect method). **08Hrs.**

Unit- 2

3D Modeling from Orthographic views: Given the 2 or 3 views of a machine component, Generation of the object in 3D environment using software. (**Assignment** - Drawing sheets from industries will be supplied to the group of students and to analyze and create the product using software) **08Hrs.**

Unit- 3

Threaded Fasteners: Thread terminology, sectional views of threads.ISO Metric (Internal & External) BSW (Internal & External) square and Acme. Sellers thread, American Standard thread. Etc.

Fasteners: Hexagonal headed bolt and nut with washer (assembly), square headed bolt and nut with washer (assembly), Proportions for square and hexagonal headed bolts & nuts, simple assembly using stud bolts with nut and lock nut. Flanged nut, slotted nut, taper and split pin for locking, counter sunk head screw, grub screw, Allen screw. **04Hrs.**

Unit- 4

Joints: Assembly of Socket and Spigot cotter joint, Pin or Knuckle joint, protected type flanged coupling, Universal coupling. **08Hrs.**

Unit- 5

Assembly Drawings: Screw jack, Machine vice, Plummer block, Tail stock, Steam stop valve, Ram's bottom safety valve, and simple eccentric. **24Hrs.**

REFERENCES :

Text books:

1. "Machine Drawing" by K.R.Gopalkrishna, 20th Edition, Subhas stores, 2007.
2. "Machine Drawing" by Sri N.D.Bhat&V.M.Panchal, 42nd Edition, Charotar Publishing House, 2007.
3. "Machine Drawing" by N. Siddeshwar, P. Kanniah, V.V.S. Sastri, published by Tata McGraw Hill, 2006.

Reference Book:

1. "Machine Drawing with Auto CAD". Goutam Pohit & Goutham Ghosh, 1st Indian print
Pearson Education, 2005.
2. "Auto CAD 2006, for Engineers and Designers". Sham Tickoo Dream tech 2005.

MOOCS :

1) http://nptel.ac.in/courses/112104172/1,
2) https://www.class-central.com/subject/

COURSE OUTCOMES

CO 1	Able to draw different sectional views of engineering objects.
CO 2	Able to draw orthographic views of objects and assemble into 3-D views using software.
CO 3	Able to differentiate between different types of threaded fasteners and joints
CO 4	Able to assemble various engineering assembly drawings.

Scheme of Examination:

Test 1 - covering the syllabus from Unit 1and 2.
Test 2 - covering syllabus from Unit 3, 4 and 5 (manual drafting).

SEE: One question from unit 1 for 20 marks
One question from unit 4 for 20 marks
One question from unit 5 for 60 marks

Assessment of Self Study:

2D Drawing sheets from Industry will be provided to the group of students to study and create the 3D solid models using software.

ASSESSMENT:

Continuous Internal Evaluation (CIE) includes mid-term tests, weekly/fortnightly class test, homework assignments, problem solving, group discussions quiz, seminar, mini-project and other Alternate Assessment Tools (AAT) prescribed by the faculty handling a course prior to beginning of the classes.

Semester End Examination(SEE)-a written examination for theory courses and practical/ design examination with built-in oral part (Viva Voice).

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IV SEMESTER SYLLABUS

Course Title	INDUSTRIAL ENGINEERING		
Course Code	15IE4DCIEG	L -T – P-S	3-0-1-2

PRE-REQUISITES : NIL

UNIT 1

INDUSTRIAL ENGINEERING: Meaning, Definition, Objective, Need, Scope, Evolution and developments.

PRODUCTIVITY: Definition of productivity, individual enterprises, task of management Productivity of materials, land, building, machine and power. Measurement of productivity, factors affecting the productivity, productivity improvement programs, wages and incentives (simple numerical problems). **06 Hrs.**

UNIT 2

WORK STUDY: Definition, objective and scope of work study. Human factors in work study. Work study and management, work study and supervision, work study and worker.

METHOD STUDY: Definition, objective and scope of method study, activity recording and exam aids. Charts to record moments in shop operation – process charts, flow process charts, travel chart and multiple activity charts. (With simple problems).

MICRO AND MEMO MOTION STUDY: Charts to record moment at work place – principles of motion economy, classification of moments two handed process chart, SIMO chart, and micro motion study. Development, definition and installation of the improved method, brief concept about synthetic motion studies. **09 Hrs.**

UNIT 3

WORK MEASUREMENT: Definition, objective and benefit of work measurement. Work measurement techniques. Work sampling: need, confidence levels, sample size determinations, random observation, conducting study with the simple problems.

TIME STUDY: Time Study, Definition, time study equipment, selection of job, steps in time study. Breaking jobs into elements, recording information. Rating & standard Rating, standard performance, scale of rating, factors of affecting rate of working, allowances and standard time determination. Predetermined motion time study – Method time measurement (MTM) **09Hrs.**

UNIT 4

ERGONOMICS: Introduction, areas of study under ergonomics, system approach to ergonomics model, man-machine system. Components of man-machine system and their functions – work capabilities of industrial worker, study of development of stress in human body and their consequences. Computer based ergonomics.

DESIGN OF MAN-MACHINE SYSTEM: Fatigue in industrial workers, Quantitative qualitative representation and alphanumeric displays, Controls and their design criteria, control types, relation between controls and displays, layouts of panels and machines. Design of work places, influence of climate on human efficiency. Influence of noise, vibration and light. **08Hrs**.

UNIT 5

CURRENT TRENDS: Introduction to Agile manufacturing, Lean and Six Sigma, Value Engineering, Just in time, Total quality management, Enterprise resource planning, Supply chain and logistics management. **08Hrs.**

INDUSTRIAL ENGNINEERING LABORATORY

I. METHOD STUDY

1) Recording Techniques using charts.
   i) Outline process chart.
   ii) Flow process chart.
   iii) Multiple Activity Chart.
2) Recording Techniques using diagrams.
   i) Flow diagram.
   ii) String diagram.

3) Application of principle of motion economy:
   i) Two handed process chart.
4) Assembling simple components.
   i) Peg board assembly.
5) Development of Plant Layout using:
   i) Black board

II. WORK MEASUREMENT

1) Rating practice using:
   i) Walking simulator.
   ii) Pin board assembly
   iii) Dealing a deck of cards.
   iv) Marble collection activity
2) Determining the standard time using:
   i) Simple operations using stopwatch time study.
   ii) Predetermined Method Time Study (PMTS).

III. ERGONOMICS

1) Measurement of heart beat rate, calorie consumption parameters using:
   i) Walking simulator.
   ii) Cycle Ergo-meter.
2) Effect of human efficiency in work environments:
   i) Noise.
   ii) Light.

REFERENCES :

Text Books :

1. "Introduction to work study" ILO, - III Revised Edition, 1981
2. "Motion and Time study "- Ralph M Barnes; John Wiley, 8th Edition, 1985.
3. "Engineered work Measurement" - Weldon, ELBS, Marvin E. Mundel- Motion and Time study, PHI, 1st edition, 1991.

References Books:

1. "Human Factors in Engineering Design" - S Sanders and E J McCormick, 6th Edition, Mc. Graw Hill
2. "Work Study and Ergonomics "- S Dalela and Sourabh, Chand Publishers, 3rd edition.
3. "Introduction to work study" by ILO.
4. "Work Study "- Ralph & Barnes.

Self Study

1. Productivity measurement a case study.
2. Work study measurement a case study.
3. Work measurement application.
4. Design of effective systems of operation.
5. Work Sampling.

MOOCS

1) https://www.class-central.com/subject/

CO 1	Industrial Engineering; to take the right decisions to optimize resources utilization by improving productivity of the Lands, Buildings, People, Materials, Machines, Money, Methods and Management effectively
CO 2	Work Study; to eliminate unproductive activities under the control of the Management, Supervisor, worker and the Design of Products and Processes
CO 3	Method Study; to use the Charts to record the Activities of the people, materials and Equipment to find alternative methods which minimize waste and to implement the best method.
CO 4	Work Measurement Techniques; to improve the processes and find the Standard Time.
CO 5	Ergonomics; to design the Man – Machine System to improve Human Efficiency and reduce the effort of the workers

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Scheme of Examination :
FIVE Questions to be set with one question from units 1 to 5 carrying 20 marks each. Questions in unit 2 & 3 units will have an internal choice.

ASSESSMENT:
Continuous Internal Evaluation (CIE) includes mid-term tests, weekly/fortnightly class test, homework assignments, problem solving, group discussions quiz, seminar, mini-project and other Alternate Assessment Tools (AAT) prescribed by the faculty handling a course prior to beginning of the classes.
Semester End Examination(SEE)-a written examination for theory courses and practical/ design examination with built-in oral part (Viva Voice).
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IV SEMESTER

Course Title	**STATISTICS FOR ENGINEERS**		
Course Code	**15IE4DCSFE**	**L -T – P-S**	**3 -0- 0-0**

PRE-REQUISITES : NIL

Unit 1

The Role of Statistics in Engineering (Data Summary and Presentation): Statistical Thinking, Collecting data, Statistical Modeling Frame work, measure of central tendency and variance, Importance of Data summary and Display, Practical problems solving through tools like Tabular and Graphical display, Pie charts, Constructions of Box Plots, S curves, Frequency polygon, Pareto Graph. **07Hrs.**

Unit 2

Discrete Random Variables and Probability Distributions: Discrete Random variables, Probability distributions and Probability mass functions, Cumulative distribution functions, Mean and Variance of a discrete random variable, discrete uniform distribution, Binominal distribution, Hyper Geometric distribution, Applications.

Continuous Random Variables and Probability Distributions: Continuous random variables, Probability distributions and probability density functions, cumulative distribution functions, Mean and Variance of a continuous random variable, uniform distribution, Normal distribution, Normal approximation to Binominal and Poisson distribution, Applications. Chi-square Distributions, Exponential distribution Weibull Distribution (Underlined Distributions - Exposure limited to theoretical concepts). **10 Hrs.**

Unit 3

Estimation Theory: Statistical Inference, Random sampling, Properties of Estimators, Sampling distribution, Sampling distribution of means, variance and proportion, Introduction to confidence intervals. **05Hrs.**

Unit 4

Statistical Inference for a Single Sample and Two Samples: Hypothesis testing, Inference on the mean of a population (variance known and unknown), Inference on the variance of a normal population, Inference on a population proportion.

Statistical Inference for a Single Sample and Two Samples: Testing for Goodness of Fit, Inference for a difference in Means, Variances known, Inference for a difference in means of two normal distributions, Variances unknown, Inference on the Variances of two normal populations, Inference on two population proportions. **10Hrs.**

Unit 5

Simple Linear Regressions and Correlation: Simple Linear Regression, Properties of Least square Estimators and Estimation of variances, Common abuses of regression, Prediction of new observations, Assessing the adequacy of regression model, Transformations to a straight line, Introduction to multiple regression (will not have problems), Correlation. Design of Experiments: Strategy of experimentation, completely randomized single - factor experiment, Tests on individual treatment means, the random effects model, the randomized complete block design, one way analysis of variance and two way analysis of variance. (Exposure limited to theoretical concepts **08 Hrs.**

Statistical Software to be utilized extensively wherever possible to solve problems.

REFERENCES

Text books:

1. "Applied statistics and Probability for Engineers",- Douglas C Montgomery, George C Runger, 2nd Edn, John Wiley and Sons, ISBN-0-471-17027-5
2. "Statistics for Management", - Richard I Levin, David S Rubin, 06th Edn, Prentice Hall India, ISBN-81-203-0893-X.

Reference books:

1. "Probability and Statistics in Engineering", - William W Hines, Douglas C Montgomery, 2nd Edn, John Wiley & Sons
2. "Business Statistics for Management and Economics", - Daniel, Terrell, 06th Edn, Houghton Mifflin Company, ISBN-0-395-062835-0
3. "Probability and Statistics ", - Walpole & Mayer, MacMillan Publishing Company, 1989.

Online Reference: http://nptel.ac.in/courses.php

MOOCS

1) https://www.class-central.com/subject/

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COURSE OUTCOMES :

CO 1	Able to Identify the role that statistics in engineering problem-solving process and know methods that engineers use to collect data for making decisions
CO 2	Able to Construct and interpret visual data displays and understand how these graphical techniques are useful in uncovering and summarizing patterns in data
CO 3	Able to Determine probabilities for discrete random variables from probability mass functions and for continuous random variables
CO 4	Able to Perform hypothesis tests and construct confidence intervals on the mean, variance and population proportion of a normal distribution
CO 5	Able to Use linear or multiple linear regressions for building empirical models of engineering and scientific data and use it to estimate a mean or to make a prediction of a future observation.
CO 6	Able to Design and conduct engineering experiments involving several factors using the factorial design approach and know how ANOVA is used to analyze and interpret main effects and interactions

Scheme of Examination : One Question to be set from each unit and Two Questions will be set from the unit 2 & 4. Student will answer any 5 questions selecting at lead stone from each unit.

ASSESSMENT:

Continuous Internal Evaluation (CIE) includes mid-term tests, weekly/fortnightly class test, homework assignments, problem solving, group discussions quiz, seminar, mini-project and other Alternate Assessment Tools (AAT) prescribed by the faculty handling a course prior to beginning of the classes.

Semester End Examination(SEE)-a written examination for theory courses and practical/ design examination with built-in oral part (Viva Voice).

Both CIE and SEE have equal (50:50) weightages. The student's performance in a course shall be judged individually and together based on the results of CIE and SEE.

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IV SEMESTER

Course Title	MANAGEMENT AND ENTREPRENEURSHIP		
Course Code	15IE4DCMAE	L -T – P-S	3 -0- 0-0

PRE-REQUISITES : NIL

UNIT- 1

MANAGEMENT : Introduction- Historical evolution of management, Thought and its Development, Scope and Functional areas of management, Management as a science, art of profession Management and Administration Roles of Management, Levels of Management, functions of Management **08 Hrs.**

UNIT- 2

PLANNING AND ORGANIZING: Nature, importance and purpose of planning process Objectives Types of plans Importance of planning steps in planning and planning premises Hierarchy of plans.

Introduction of organization-Principles of organization Types of organization, centralization Vs decentralization of authority and responsibility Span of control, MBO and MBE **08 Hrs.**

UNIT- 3

STAFFING, DIRECTING & CONTROLLING: Purpose and importance of staffing-selection process and recruitment, appraisal, Meaning and purpose of Directing Leadership styles, motivation theories, communication and Coordination. Techniques of Co-ordination, Meaning and steps in controlling- essentials of a sound control system-methods of establishing control **08 Hrs.**

UNIT- 4

ENTREPRENEURSHIP: Meaning of Entrepreneur, evolution of the concept, functions of an entrepreneur, types of an entrepreneur, Concept of Entrepreneurship, stages in entrepreneurial process; role of entrepreneurs in economic development, Entrepreneurship in India, barriers for entrepreneurship. **04Hrs.**

SMALL SCALE INDUSTRIES : Definition, characteristics; scope and role of SSI in

economic development, advantages of SSI, steps to start and SSI changes in government policy towards SSI in the past 4 decades, Impact of Liberalization, Privatization, Globalization on SSI, Effect of WTO/GATT on SSI, Ancillary industry and tiny industry **04Hrs.**

UNIT- 5

INSTITUTIONAL SUPPORT : Governmental agencies supporting industrial activities, schemes; TECKSOK, KIADB, KSSIDC, KSIMC,DIC Single window agency, SISI; NSIC, SIDBI, KSFC.-Industrial Finance **04Hrs.**

PREPARATION OF PROJECT: Meaning of project; Project identification; Project selection; project report; need and significance of report; Contents: Network analysis; Errors of Project report: project appraisal, identification of business opportunities; Market Feasibility study technical feasibility study, financial feasibility study and social feasibility study. **04Hrs.**

REFERENCES

Text Books:

1. "Management and Entrepreneurship"- NVR Naidu& T. Krishna Rao, I K Publishing
2. "Dynamics of Entrepreneurial Development & Management"- Vasant Desai, Himalaya Publishing House.
3. "Entrepreneurship Development",- Poornima M. Charantimath, Small Business Enterprises Pearson Education 2006 (For Unit-2 & 4).

Reference Books:

1. "Essentials of Management",- Harold Koontz, Heinz Weihrich, Ramachandra Aryasri, Tata
   Mc Graw Hill, 2010.
2. "Principles of Management",- P.C.Tripathi, P.N.Reddy Tata McGraw Hill.
3. "Management Fundamentals Concepts, Application, Skill Development"- Roberts Lusier Thomson
4. "Entrepreneurship Development",- S. S. Khanka S. Chand & Co.
5. "Management",- Stephen Robbins Pearson Education/PHI 17th Edition, 2003.

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Online Reference: http://nptel.ac.in/courses.php

MOOCS
1) https://www.class-central.com/subject/

Scheme of Examination: There will be 7 Question to be set one question from each unit and choice from unit 4 and unit 5.

COURSE OUTCOMES :

CO 1	Able to identify the role that statistics in engineering problem-solving process and know methods that engineers use to collect data for making decisions
CO 2	Able to Construct and interpret visual data displays and understand how these graphical techniques are useful in uncovering and summarizing patterns in data.
CO 3	Able to determine probabilities for discrete random variables from probability mass functions and for continuous random variables.
CO 4	Able to perform hypothesis tests and construct confidence intervals on the mean, variance and population proportion of a normal distribution.
CO 5	Able to Use linear or multiple linear regressions for building empirical models of engineering and scientific data and use it to estimate a mean or to make a prediction of a future observation.
CO 6	Able to Design and conduct engineering experiments involving several factors using the factorial design approach and know how ANOVA is used to analyze and interpret main effects and interactions.

ASSESSMENT:
Continuous Internal Evaluation (CIE) includes mid-term tests, weekly/fortnightly class test, homework assignments, problem solving, group discussions quiz, seminar, mini-project and other Alternate Assessment Tools (AAT) prescribed by the faculty handling a course prior to beginning of the classes.
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IV SEMESTER

Course Title	PRODUCTION TECHNOLOGY-II		
Course Code	15IE4DCPT-II	L -T – P-S	3-0-1-2

PRE-REQUISITES : NIL

Unit- 1

CASTING PROCESS: Introduction to casting process & steps involved, Varieties of components produced by casting process advantages and limitations of casting process.

Patterns: Definition, functions, materials used for pattern, various pattern allowances and their importance, classification of patterns. Orientation and Parting

Binder: Definition, Types of binder used in mouldings and.

Additives: Need, type of additives used.

Casting Design: Introduction**,** design consideration on pattern the mould, the parting line, cast holes- cored holes, machined holes, identifying the possible parting line, casting requiring special sand cores, design to obviate sand cores, problems on designing castings. **07Hrs.**

Unit- 2

Sand Moulding and special moulding process: Types of base sand, requirement of base sand, Types of sand moulds.

Sand moulds: Moulding sand mixture ingredients (base sand, binder & additives) for different sand mixtures. Method used for sand moulding.

Cores: Definition, Need, Types. Method of making cores, Binders used, Concept of Gating & Risering. Principle involved and types, Fettling and cleaning of castings. Basic steps involved. Casting defects causes, features and remedies.

Moulding Machines: Jolt type, squeeze type, Jolt &Squeeze type and Sand slinger.

Special moulding Process: Study of important moulding processes Green sand, Core sand, Dry sand, Sweep mould, CO_2sand, Shell mould, Investment mould& Full mould.

Metal moulds: Gravity die-casting, centrifugal casting, Squeeze Casting, Slush Casting, Thixo-casting and continuous casting processes. **10Hrs.**

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Unit- 3

Melting Furnaces: Classification of furnaces, Constructional features & working principle of Gas fired pit furnace, Resistance furnace, Coreless Induction furnace, Electric Arc Furnace, Cupola furnace.

Solid Modeling of Casting: Casting features, Modeling Techniques, Graphical user Interphase, Model Representation, model exchange format, Model Verification. **06Hrs.**

Unit- 4

WELDING*:* Welding process: Definition, Principles, Classification, Application, Advantages & limitations of welding, Weld Joints, Welding Symbol.

Arc Welding: Principle, Metal Arc welding **(MAW)**, Flux Shielded Metal Arc Welding (**FSMAW)**, Inert Gas Welding **(TIG & MIG) Submerged** Arc Welding **(SAW)** and Atomic Hydrogen Welding processes **(AHW)**

Gas Welding: Principle, Oxy Acetylene welding, Reaction in Gas welding, Flame characteristics, Gas torch construction & working, forward and backward welding.

Special type of welding: Resistance welding - principles, Seam welding, Butt welding, Spot welding and projection welding, Friction welding, Explosive welding, Thermit welding, Laser welding Electron beam welding. **10Hrs.**

Unit- 5

Metallurgical aspect in welding and Casting: Structural analysis, Formation of different zones during Casting and welding. Heat affected zone **(HAZ).** .

Inspection methods: Welding and Casting defects, Detection causes & remedies **Methods** used for inspection of casting & welding, visual, magnetic particle, Fluorescent particle, and Ultrasonic, Radiography, Eddy Current, and Holography methods of inspection. **07Hrs.**

LAB

1. Testing of Moulding sand and Core sand Preparation of sand specimens and Conduction of the following tests:

1. Compression, Shear and Tensile tests on Universal Sand Testing Machine.
2. Permeability test
3. Core hardness & Mould hardness tests.
4. Grain fineness number test (Sieve Analysis test)
5. Clay content test.
6. Moisture Content tests.

2. Foundry Practice

- Use of foundry tools and other equipment
- Preparation of moulds using two moulding boxes using patterns or without patterns (Split pattern, Match plate pattern and Core boxes)
- Preparation of one casting (Aluminum or Cast Iron –Demonstration Only).
- Gating System, Bottom gate, Top gate, Parting Gate and Step gate.

3. Welding Process

Preparation of Welding Models using GAS, TIG and MIG Welding.

Self- Study:

Each group consists of minimum two and maximum five students.

At the end of the project students should submit the project report for final assessment.

1. Preparation of Components using Casting Techniques.
2. Flow analysis using appropriate software for Casting.
3. Testing of casted components.
4. Preparation of components using various joints in ARC Welding.
5. Preparation of components using various joints in GAS Welding.

6. Preparation of components using various joints in TIG and MIG Welding.
7. Preparation of components using Brazing techniques.
8. Testing of welded parts.

REFERENCES :

Text Books:

1. "Manufacturing Process-I" , Dr K. Radhakrishna, Sapna Book House ,5th Ed, 2006.
2. "Manufacturing & Technology : Foundry Forming and Welding ", P.N. Rao 2nd Ed., Tata Mc Graw Hill , 2003

Reference Books:

1. "Manufacturing Technology" Swaroop Kalpakjian, Steuen R Sechmid, Pearson Education Asia, 5th Ed. 2006.
2. "Process and Materials of Manufacturing", Roy A Lindberg, 4th Ed. Pearson Education, 2006.
3. "Workshop Technology", Vol-I, H.K. Hajra Choudhry& A. K. Hajra Choudhry, 12th Edition, MPP Publisher, 2001.
4. "Modern Manufacturing Methods"- M. Groover
5. "Metal casting: Computer Aided Design and Analysis", B. Ravi PHI
6. "Design for Manufacture" Harry Peck, Pitman Publishing. 1983.
7. "Product Design and Manufacturing ", by A. K. Chitale and R. C. Guptha. Fifth Edition

Online Reference:

http://nptel.ac.in/courses/112107077/ (Advanced Manufacturing Process)
http://nptel.ac.in/courses/112107089/ (Welding)
http://nptel.ac.in/courses/112107090/ (Welding)

MOOCS

1) https://www.class-central.com/subject/

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COURSE OUTCOMES :

CO 1	To have understood various processes carried out in Foundry.
CO 2	To have studied sand, its importance, it's testing and types of Sand.
CO 3	To have studied and understood various specialized casting process. The technical knowledge will help the learner to move ahead with gait
CO 4	Be able to grasp knowledge regarding various metals joining process. Problems associated with them in the industries.
CO 5	Able to make a Comparative study of all the joining processes such as welding, soldering and brazing along with metallurgical aspects and changes

Scheme of Examination:

One question from each Unit and internal choice from Units 2 & 4

ASSESSMENT:

Continuous Internal Evaluation (CIE) includes mid-term tests, weekly/fortnightly class test, homework assignments, problem solving, group discussions quiz, seminar, mini-project and other Alternate Assessment Tools (AAT) prescribed by the faculty handling a course prior to beginning of the classes.

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IV SEMESTER

Course	MACHINE DESIGN	Course Code	15IE4DCMCD
Credits	03	L -T – P-S	3-0-0-0

PRE-REQUISITES : NIL

UNIT–1

Design for Static Strength: Design considerations: Codes and Standards, Static strength; Static loads and factor of safety; Theories of failure -Maximum normal stress theory, maximum shear stress theory, Distortion energy theory; Failure of brittle materials, Failure of ductile materials. Stress concentration, Determination of Stress concentration factor. Combined Stress concentration factor. **06Hrs.**

Design for Fatigue Strength: Introduction, S -N diagram, Low cycle fatigue, High cycle fatigue, and Endurance limit. Modifying factors -size effect, surface effect, Stress concentration effects; Fluctuating stresses, Fatigue strength under fluctuating stresses, Goodman and Soderberg relationship; Stresses due to combined loading. **06Hrs.**

UNIT–2

Joints and Coupling: Design of rigid flange coupling & Bushed pin type flexible coupling. Cotter and Knuckle joints. **06Hrs.**

Design of Shafts: Torsion of shafts, design for strength & rigidity, with steady loading, ASME & BIS codes for design of transmission shafting, shafts under fluctuating loads and combined loads **05Hrs.**

UNIT- 3

Design of Gears: Introduction to Spur, Helical & Bevel gears, Design of spur gear, stresses in gear tooth, Lewis equation, form factor- dynamic and wear load. **05Hrs.**

UNIT- 4

Mechanical Joints: Riveted Joints -Types, rivet materials, Failures of Riveted joints, Efficiency, Welded Joints -Types, Strength of butt and fillet welds. **06Hrs.**

UNIT -5

Lubrication and Bearings: Mechanisms of Lubrication -Viscosity, bearing modulus, coefficient of friction, minimum oil film thickness-Heat Generated, Heat dissipated, bearing materials, lubricants and properties. Examples of journal bearing and thrust bearing design. **06Hrs.**

REFERENCES :

Text Books:

1. "Mechanical Engineering Design" -Joseph Edward Shigley, Tata McGraw Hill, New Delhi 1986.
2. "Machine Design" –V.L. Maleev and Hartman, CBS Publishers &Distribution, Delhi, 1983.
3. "Machine Design "-R.S Khurmi and J.K. Gupta, Eurasia Publishing house (p) Ltd., New Delhi.

Design Data Hand Book:

Design Data Hand Book Vol .l & Vol.2 -Dr. K. Lingaiah, Suma Publications, Bangalore.

Reference Books:

1. "Machine Design" -Robert .L , Norton -Pearson Education Asia, New Delhi, 2001
2. "Theory and Problems of Machine Design", -Hall, Holowinko, Laughlin, - Schaums Outline Series, 2002.
3. "Elements of Machine Design" -N. C. Pandey & C. S. Shah, - Chorotar Publishing House, 2002.
4. "Design of Machine Elements", V.B.Bahandri, Tata McGraw Hill Publishing Co. Ltd., New-Delhi
5. "Machine Component & Design" -William Orthwan, Jaico Publishing Co.

6. "Fundamentals of Design" -Benerad J Hamrock, Bo -Jacobson & Steven R. Schmid.
7. "Fundamentals of Machine Design Component" -Robert C. Juvinall and Kurt M. Marshek -John & sons.
8. "Machine Design "-R. K. Jain , Khanna Publications, New Delhi.
9. "Design of Machine Elements" –J B K Das and P L Srinivasa Murthy, -Sapna Book House, Bangalore.

Online References:

1. http://nptel.ac.in/courses/112105124/
2. http://nptel.ac.in/courses/Webcoursecontents/IIT%20Kharagpur/Machine%20design1/New_index1.html
3. http://nptel.ac.in/courses/IIT-MADRAS/Machine_Design_II/

E-books

1. http://www.faadooengineers.com/threads/2060687-Machine-design-by-shigley-ebook-download-pdf
2. http://www.free4ebook.com/mec.html

COURSE OUTCOMES :

CO 1	Be able to analyze the stress and strain on mechanical components and understand, identify, and quantify failure modes for mechanical components
CO 2	Demonstrate knowledge on basic machine elements used in machine design, design machine elements to withstand loads and deformations for given application while considering additional specifications
CO 3	Be able to approach a design problem successfully taking decision when there is not a unique answer.
CO 4	To develop an ability to use techniques, skills, and modern engineering tools necessary for engineering practice

MOOCS

1) https://www.class-central.com/subject/

Scheme of Examination: Two questions from units 1 & 2 and one question from units 3, 4 & 5.

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DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

ASSESSMENT:

Continuous Internal Evaluation (CIE) includes mid-term tests, weekly/fortnightly class test, homework assignments, problem solving, group discussions quiz, seminar, mini-project and other Alternate Assessment Tools (AAT) prescribed by the faculty handling a course prior to beginning of the classes.

Semester End Examination(SEE)-a written examination for theory courses and practical/ design examination with built-in oral part (Viva Voice).
Both CIE and SEE have equal (50:50) weightages. The student's performance in a course shall be judged individually and together based on the results of CIE and SEE.

IV SEMESTER

Course	MATERIAL SCIENCE AND METALLURGY	Course Code	15IE4DCMSM
Credits	04	L -T – P-S	3-0-1-0

PRE-REQUISITES : NIL

Unit – 1

Introduction to Material Science and Metallurgy: Classification of Engineering Materials, Engineering requirements of materials, Factors affecting mechanical properties, Selection of materials for Engineering application, Effect of grain size on properties of metals, Crystal imperfections: point, line, surface defects. Diffusion in solids: Diffusion Mechanism, Fick's laws of diffusion. Plastic deformation by slip& twinning **06Hrs**

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Unit - 2

Testing of Materials: Tensile properties, Engineering stress-strain, true stress &strain, Hardness testing (Brinell hardness testing, Vickers, Rockwell hardness test)

Types of Fracture: Brittle and Ductile fracture, Brittle to ductile transition, Griffith's criterion.

Creep: The creep curves, creep mechanism and factors affecting creep.

Fatigue: Fatigue cycles, Fatigue test, S.N curves, Fatigue mechanism, Factors affecting fatigue life. **08Hrs**

Unit -3

Solid solutions and phase diagrams: Types of solids solutions, Rules of governing the formation of solid solutions and intermediate phases. Cooling curves, construction of phase diagrams, Phase diagrams of Eutectic systems Phase rules: Gibbs phase rule and Lever rule. Interpretation of phase diagrams. Iron carbon equilibrium Diagram; Equilibrium phases, Invariant reactions, critical temperatures, Solidification of steels. **10Hrs**

Unit - 4

Heat treatment of Ferrous and Non-ferrous materials: TTT diagram, Construction of TTT diagram, TTT diagram for hypo and hyper eutectoid steels cooling curves, Non equilibrium phases, Effect of alloying elements on steels.

Heat treatment processes- Annealing, and its types, normalizing, hardening and hardenability, tempering, surface heat treatment methods. Heat treatment of Non-ferrous materials.

Ferrous, Non-ferrous and Advanced materials.

Ferrous - Types, Composition, Properties and applications of plain carbon steels and cast irons. Designation of steels.

Non-ferrous: Aluminum and its alloys, Magnesium alloys, Copper and its alloys **10Hrs**

Unit 5

Composite Materials-Definition, Classifications, Production methods, properties and applications of MMC and FRP composites.

Nano material: Nano powders, and nanomaterial, methods of preparation- plasma arcing, chemical vapor deposition electro deposition, sol-gel synthesis, ball milling, and comparative studies of the advantages and disadvantages of Nano powder production technologies. **06Hrs.**

LAB. EXPERIMENTS

Tensile, shear and compression tests of metallic and nonmetallic specimens using a Universal Testing Machine,

Torsion tests, Bending Test on metallic and nonmetallic specimens. Fatigue Test Izod and Charpy tests on M.S. Specimen Brinell, Rockwell and Vickers's Hardness test.

1. Examination of different engineering materials. Identification of microstructures of plain carbon steel, tool steel, Grey C.I, SG iron, Brass, Bronze & composites. (Preparation of specimen demo)
2. Heat treatment: Annealing, normalizing, hardening and tempering of steel Hardness studies of heat-treated Samples (Demo).
3. To study the wear characteristics of one ferrous, and one non-ferrous and composite materials for different parameters
4. Demo on Non-destructive test experiments like,
   (a). Magnetic crack detection
   (b). Dye penetration testing, to study the defects of Casted and Welded specimens

Text Books:

1. "Materials Science & Engineering-An Introduction", William D. Callister Jr. Wiley India Pvt. Ltd. 6th Edition, New Delhi 2006.
2. "Foundation of Material Science and Engineering", Smith, 3rd Edition McGraw Hill, 1997.

Reference Books:

1. "Introduction to Material Science for Engineering", 6th edition James F. Shackel ford, Pearson, Prentice Hall, New Jersey, 2006.
2. "Mechanical Metallurgy" 3rd Edn. George. E. Dieter, McGraw Hill, 2001.
3. "Basic Science and Emerging technique", -Mick Wilson , Kamali Kannangara, First Indian edition ,2005.

COURSE OUTCOMES :

CO 1	Understand all class of materials and their structure, properties, processing, applications and performance.
CO 2	Understand the process of testing materials and to study the behavior of material.
CO 3	Know the importance and construction of Iron-carbon diagram time temperature transformation curve, heat treatment processes
CO 4	Understand ferrous, nonferrous and advanced composition, properties and application
CO 5	Understand how the Nano materials are useful in production technologies

MOOCS

1) https://www.class-central.com/subject/

Online References:

1. http://nptel.ac.in/courses/113106032/ (Structures of materials)
2. http://nptel.ac.in/courses/113101003/ (Phase transformation and Heat Treatment)
3. http://nptel.ac.in/courses/113108052/ (Defects in solids)

Scheme of Examination: Each Question from each unit and internal choice from Unit 3 & 4.

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DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

ASSESSMENT:

Continuous Internal Evaluation (CIE) includes mid-term tests, weekly/fortnightly class test, homework assignments, problem solving, group discussions quiz, seminar, mini-project and other Alternate Assessment Tools (AAT) prescribed by the faculty handling a course prior to beginning of the classes.

Semester End Examination(SEE) -a written examination for theory courses and practical/ design examination with built-in oral part (Viva Voice).
Both CIE and SEE have equal (50:50) weightages. The student's performance in a course shall be judged individually and together based on the results of CIE and SEE.

Lateral Entry : Mathematics for Diploma students

THIRD SEMESTER B.E COURSE (All Branches)

Course Name	Mathematics -I	Course Code	15MA3IMMAT
Credits	00	L – T –P-S	0 – 0 – 0 - 0
Contact Hours	48 hours (36L+12T)	III semester Lateral Entry students	

Prerequisites: Basic concepts of Trigonometry, Trigonometric formulas, concept of differentiation, concept of integration.

Course Objectives : To provide students with a solid foundation in mathematical fundamentals such as differentiation, differential equations, vectors and orthogonal curvilinear coordinates for different branches of engineering.

UNIT 1

DIFFERENTIAL AND INTEGRAL CALCULUS [9 Hours]

List of standard derivatives including hyperbolic functions, rules of differentiation. Differentiation of product of two functions using Leibnitz rule (direct problems).Taylor's and Maclaurin's series expansion for functions of single variable. List of standard integrals, integration by parts.Definite integrals – problems. **(7L+2T)**

UNIT 2

POLAR COORDINATES AND PARTIAL DERIVATIVES [10 Hours]

Polar curves: Polar coordinates, angle between radius vector and tangent, angle between two polar curves. Partial differentiation. Total differentiation-Composite and Implicit functions. Taylor's and Maclaurin's series expansion for functions of two variables. Jacobians and their properties (without proof) – Problems. **(7L+3T)**

UNIT 3

FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS [8 Hours]

Introduction to first order differential equations. Linear equation and its solution. Bernoulli's equation and its solution. Exact differential equation and its solution. Orthogonal Trajectories. **(6L+2T)**

UNIT 4

SECOND AND HIGHER ORDER ORDINARY DIFFERENTIAL EQUATIONS [9 Hours]

Ordinary differential equations with constant coefficients: Homogeneous differential equations, non-homogeneous differential equations – Particular integral for functions of the type f (x) = e^{ax}, sin(ax), cos(ax), x^n, e^{ax}sin(bx), e^{ax}cos(bx). Method of variation of parameters. Cauchy's and Legendre differential equation **(7L+2T)**

UNIT 5

VECTOR CALCULUS AND ORTHOGONAL CURVILINEAR COORDINATES (OCC) [8 Hours]

Recapitulation of scalars, vectors and operation on scalars and vectors. Scalar and vector point functions. Del operator, gradient-directional derivative, divergence, curl and Laplacian operator. Vector identities (without proof).Cylindrical and Spherical polar coordinate systems. Expressing a vector point function in cylindrical and spherical systems. Expressions for gradient, divergence, curl and Laplacian in OCC. **(6L+2T)**

Bibliography

Text Books:

- Advanced Engineering Mathematics, Erwin Kreyszig, Wiley Precise Textbook series, Vol. 1 and Vol. 2, 10th edition, 2014, Wiley- India.

- Higher Engineering Mathematics, B.V. Ramana, 7th reprint, 2009, Tata Mc. Graw Hill.

Reference Books:

- Higher Engineering Mathematics, B.S. Grewal, 43rd edition, 2014, Khanna Publishers
- Advanced Engineering Mathematics, 4th edition, 2011, by Dennis G. Zill and Cullen, Jones and Bartlett India Pvt. Ltd.

E books and online course materials

- (1) Engineering Mathematics, K. A. Stroud, Dexter J. Booth, Industrial Press, 2001 http://books.google.co.in/books/about/Engineering_Mathematics.html?id=FZncL-xB8dEC&redir_esc=y.
- (2) Advanced Engineering Mathematics, P. V. O'Neil, 5th Indian reprint, 2009, Cengage learning India Pvt. Ltd.
- (3)http://ocw.mit.edu/courses/mathematics/ (online course material)

Online Courses

1. https:// www.khanacademy.org/Math
2. https:// www.class-central.com/subject/math (MOOCS)
3. E-learning: www.vtu.ac.in .

On completion of the course the student will have the ability to

Course Code	CO	PO	Bloom's level
15MA3IMMAT	**CO-1:** Understand the basic concepts of differentiation and integration.	1	2
	CO-2: Apply the concepts of polar curves and multivariate calculus.	1	2
	CO-3: Apply analytical techniques to compute solutions of first and higher order ordinary differential equations.	1	3
	CO-4: Apply techniques of vector calculus to engineering problems.	1	3
	CO-5: Comprehend the generalization of vector calculus in curvilinear coordinate system.	1	3

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Program Outcome:

1. Graduates will apply knowledge of Mathematics, Science and Engineering concepts to solve problems pertinent to relevant engineering field.

FOURTH SEMESTER B.E COURSE

IV SEMESTER

Course Name	Mathematics -II	Course Code	15MA4IMMAT
Credits	00	L – T –P-S	0 – 0 – 0 - 0
Contact Hours	48 hours (36L+12T)	IV semester Lateral Entry Students	

Prerequisites: Basic concepts of Trigonometry, Trigonometric formulas, concept of differentiation, concept of integration.

Course Objectives: To provide students with a solid foundation in mathematical fundamentals such as Laplace Transforms, Solution of ordinary differential equations using Laplace Transforms, vector integration, computation of area and volume using double integrals and triple integrals respectively.

UNIT 1

LAPLACE TRANSFORMS **[8 Hours]**

Laplace transforms of standard functions. Properties and problems. Laplace Transform of Periodic functions with plotting. Unit step function. **(6L+2T)**

UNIT 2

INVERSE LAPLACE TRANSFORMS **[9 Hours]**

Inverse Laplace transforms of standard functions. Properties and problems. Solution of ODE-Initial and Boundary value Problems. **(7L+2T)**

UNIT 3

DOUBLE INTEGRAL **[11 Hours]**

Evaluation of double integral. Change of order of integration. Change of variables to polar coordinates. Application: Area. **(8L+3T)**

UNIT 4

TRIPLE INTEGRALS AND IMPROPER INTEGRALS **[8 Hours]**

Evaluation of triple integral. Application: Volume. Gamma and Beta functions-definition Relation between Gamma and Beta functions. Properties and Problems. **(6L+2T)**

UNIT 5

VECTOR INTEGRATION **[8 Hours]**

Line integral. Green's theorem. Stokes' theorem. Gauss divergence theorem. **(6L+2T)**

Bibliography

Text Book:

- Advanced Engineering Mathematics, Erwin Kreyszig, Wiley Precise Textbook series, Vol. 1 and Vol. 2, 10th edition, 2014, Wiley- India.
- Advanced Engineering Mathematics, 4th edition, 2011, by Dennis G. Zill and Cullen, Jones and Bartlett India Pvt. Ltd

Reference Book:

- Higher Engineering Mathematics, B.S. Grewal, 43rd edition, 2014, Khanna Publishers.
- Higher Engineering Mathematics, B.V. Ramana, 7th reprint, 2009, Tata Mc. Graw Hill.

E books and online course materials

(1) Engineering Mathematics, K. A. Stroud, Dexter J. Booth, Industrial Press, 2001
http://books.google.co.in/books/about/Engineering_Mathematics.html?id=FZncL-xB8dEC&redir_esc=y.

(2) Advanced Engineering Mathematics, P. V. O'Neil, 5th Indian reprint, 2009, Cengage learning India Pvt. Ltd.

(3) http://ocw.mit.edu/courses/mathematics/ (online course material)

Online Courses

1. https:// www.khanacademy.org/Math
2. https:// www.class-central.com/subject/math (MOOCS)
   E-learning: www.vtu.ac.in

On completion of the course the student will have the ability to

Course Code	CO	PO	Bloom's level
15MA4IMMAT	**CO-1:** Obtain solution of ordinary differential equations using Laplace Transform techniques.	1	3
	CO-2: Apply double integrals to compute areas and triple integrals in computing volumes.	1	3
	CO-3: Use Gamma and Beta functions to evaluate integrals.	1	2
	CO-4: Use of integral calculus in scalar and vector fields.	1	3

Program Outcome:

1. Graduates will apply knowledge of Mathematics, Science and Engineering concepts to solve problems pertinent to relevant engineering field.



ಬಿ.ಎಂ.ಎಸ್. ತಾಂತ್ರಿಕ ಮಹಾವಿದ್ಯಾಲಯ

(ಸ್ವಾಯತ್ತ ವಿದ್ಯಾ ಸಂಸ್ಥೆ)

B.M.S. COLLEGE OF ENGINEERING, BENGALURU-19

(Autonomous College under VTU)

DEPARTMENT OF
INDUSTRIAL ENGINEERING & MANAGEMENT

SCHEME & SYLLABUS FOR
UG Programme - V & VI Semesters
2016-2017

ಬಿ.ಎಂ.ಎಸ್. ತಾಂತ್ರಿಕ ಮಹಾವಿದ್ಯಾಲಯ

ಬುಲ್ ಟೆಂಪಲ್ ರಸ್ತೆ, ಬೆಂಗಳೂರು–೫೬೦ ೦೧೯

B.M.S. COLLEGE OF ENGINEERING

Bull Temple Road, Bengaluru - 560 019

B.M.S. COLLEGE OF ENGINEERING (AUTONOMOUS) BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING AND MANAGEMENT

SCHEME FOR THE ACADEMIC YEAR 2016-17
V SEMESTER B.E. INDUSTRIAL ENGINEERING AND MANAGEMENT

Course Code	Course Title	Teaching Department	Credits hour/week					Contact Hr/Wk
			L	T	P	S	Total	
16IE5DCCIM	COMPUTERS IN MANUFACTURING	IEM	3	0	1	2	6	5
16IE5DCOPR	OPERATIONS RESEARCH	IEM	3	1	0	0	4	5
16IE5DCQAR	QUALITY ASSURANCE & RELIABILITY	IEM	3	0	1	2	6	5
16IE5DCENE	ENGINEERING ECONOMY	IEM	2	1	0	0	3	4
16IE5DCFPD	FACILITIES PLANNING AND DESIGN	IEM	3	0	0	0	3	3
16IE5DE	ELECTIVE- I	IEM	3	0	0	0	3	3
	TOTAL							25

L-Lecture Hours/Week,1 Credit=1hour, P-Practical Hours/Week, 1 Credit=2Hours,
T-Tutorial Lecture Hours/Week, 1 Credit =2 hours, S-Self-Study to be added to contact Hrs. /Week
CIE-Continuous Internal Evaluation, SEE-Semester End Examination (of 3 hours duration)

ELECTIVE-I

16IE5DEAPT	Applied Thermodynamics
16IE5DEPDD	Product Design & Development
16IE5DEOBE	Organizational Behavior
16IE5DETOM	Theory of Machines
16IE5DETEG	Theory of Machines

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DEPARTMENT OF INDUSTRIAL ENGINEERING AND MANAGEMENT
SCHEME FOR THE ACADEMIC YEAR 2016-17
VI SEMESTER B.E. INDUSTRIAL ENGINEERING AND MANAGEMENT

Course Code	Course Title	Teaching Department	Credits hour/week					Contact Hr/Wk
			L	T	P	S	Total	
16IE6DCSMA	SIMULATION MODELING & ANALYSIS	IEM	3	0	1	2	6	5
16IE6DCFAC	FINANCIAL ACCOUNTS AND COSTING	IEM	3	1	0	0	4	5
16IE6DCPOM	PRODUCTION & OPERATIONS MANAGEMENT	IEM	2	1	0	0	3	4
16IE6DCSCL	SUPPLY CHAIN & LOGISTIC MANAGEMENT	IEM	3	0	0	2	5	3
16IE6DE	ELECTIVE- II	IEM	3	0	0	0	3	3
16IE6DE	ELECTIVE- III	IEM	3	0	0	0	3	3
16IE6DCDML	DECISION MODELING LAB	IEM	0	0	1	0	1	2
	TOTAL							25

L-Lecture Hours/Week, 1 Credit=1hour, P-Practical Hours/Week, 1 Credit=2Hours,
T- Tutorial Lecture Hours/Week, 1 Credit =2 hours, S-Self-Study to be added to contact Hrs. /Week
CIE-Continuous Internal Evaluation, SEE-Semester End examination (of 3 hours duration)

ELECTIVE-II

16IE6DEFM	Fluid Mechanics
16IE6DESEM	Software Engineering &Management
16IE6DEDBM	Data Base Management System
16IE6DEWCM	World Class Manufacturing
16IE6DEIPC	Industrial Pollution Control

ELECTIVE-III

16IE6DEAOR	Advanced Operations Research
16IE6DEAIM	Automation In Manufacturing
16IE6DEMKM	Marketing Management
16IE6DEHP	Hydraulics & Pneumatics

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DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

Course	COMPUTERS IN MANUFACTURING	Course Code	16IE5DCCIM
Credits	06	L-T–P-S	3-0-1-2

Prerequisites: Nil

UNIT-1

Introduction: Role of computers in design and manufacturing. Influence of computers in manufacturing environment. Product cycle in conventional and computerized manufacturing environment, Introduction to CAD and CAM, Advantages and disadvantages of CAD and CAM.Application of computers in design process. **06Hrs**

UNIT-2

Computer Graphics: Software configuration of a graphic system, functions of a graphics package, construction of geometry, wire frame and solid modeling, geometric 2D homogeneous transformation with simple problems. **06Hrs**

UNIT-3

Introduction to Computer Numerical Control: Fundamental concepts of Numerical control, Numerical control modes, Numerical control elements, open and closed loop systems, advantages and limitations.

Drives of CNC system: Hydraulic drives, DC Motors, Stepper motors. Adaptive control systems: ACO and ACC systems.

Turning tool geometry, modular tooling system, milling tooling systems, tool presetting, automatic tool changers (ATC), Tool magazines. **10Hrs**

UNIT-4

Programming of CNC Machine Tools: Introduction to part programming, coordinate systems, dimensioning, axes and motion nomenclature, structure of a part program, tool radius and length compensation, subroutines, canned cycles. Manual part programming, APT programming, writing programs using G& M codes, and by APT Language. **12Hrs**

Suggested Reading: Direct integration method, method of separation of variables, D'Alembert's solution of wave equation.

UNIT-5

Introduction to Robotics: Introduction, robot configuration, robot motions, Programming the robots, Robot programming methods, End effectors, work cell control and interlocks Robot sensors, Robot applications. **06Hrs**

UNIT-6

Laboratory Experiments:

1) CNC Turning: Writing and simulation of manual part program using G & M codes for Simple parts including turning, taper turning, and shoulder turning and cutting. Use of radiuscompensation, canned cycles. (4 programs) Demonstration of one CNC program

2) CNC Milling- Writing and simulation of manual part program using G & M codes forsimple parts including Surface milling, Edge milling, Contour milling, Drilling, and pocket milling. Tool length compensation, use of canned cycles.(4 programs) Demonstration of one CNC program

3) Programming of Robots by lead through and off line methods. Use of robot to pick and place, stacking of objects in increasing or decreasing order. (4 programs)

Assessment of Self Study:

Student group of 5 members to submit following assignments in CNC &Robotics lab at the end of the course.

1. Writing a CNC program for a part drawing.
2. Simulating the CNC program using G & M codes manual part programming software.
3. Loading of CNC program on to the machine.
4. Executing the program on CNC Machine to prepare the part.

5. Checking the model with respect to dimensions and accuracy of the contours, surface finish etc.
6. Documentation, presentation and report submission.

Text Books:

1) **Computer Control of Manufacturing Systems**, YoremKoren ,McGraw Hill, 1983 ISBN-0-07-Y66379-3,

2) **CAD/CAM**, Mikell P. Grover, Emory, W. Zimmers Pearson Education Inc.,2003 ISBN-81-203-0402-0,

3) **CAD/CAM Principle and Applications**, PN Rao, Tata McGraw Hill, 7th Reprint, 2007 ISBN-0-07-058373-0,

References:

1) **Principle of interactive Computer Graphics,** Newman and Sproull, TMH,2nd Edition, 1978, ISBN13-978-0070463-387

2) **CAD/CAM**, IbhrahimZeid, THM, 1991, ISBN-00707-28577,

3) **Numerical control and CAM,**Kundra, Rao and Tiwary, Tata McGraw Hill PublishingCo., NewDelhi, 1987, ISBN 13-978 00 745 17 406,

4) **Mechatronics**HMT – Tata McGraw Hill publishing company,ISBN 0-07-462127-5

5) **CAD/CAM/CIM** – P. Radhakrishnan, S. Subramanyan and Raju – New Age International Publishers, 2009 Edition, ISBN-13-978-8122422368

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

Course Outcomes

CO 1	Is able to understand the role of computers in design and manufacturing, computerized manufacturing environment, CAD and CAM, their advantages and will acquire the knowledge of hardware of computer systems used in CAD/CAM
CO 2	Is able to understand, the various functions of graphic packages and will be in a position to use the computers for the engineering design applications. Students will be knowing the concepts of geometrical modeling, study the various types of geometrical models and their possible applications and limitations
CO 3	Able to ascertain about the development and principles of numerical control technology, understand the basics of CNC hardware, Control systems, CNC toolingand work holding devices.
CO 4	Is able to understand the different types of CNC programming, requirements of programming, structure of a program and other related topics. The students will have practical experience in writing CNC programs and alsooperating of CNC machines
CO 5	Is able to empathize a Robot – types of robots, configuration, robot motions, end effectors, robot programming methods, and their applications.

ASSESSMENT:

Continuous Internal Evaluation (CIE) includes periodic class tests, quizzes or Alternative Assessment Tools (AAT) prescribed by the faculty handling a course prior to beginning of the classes like assignments, problem solving, case studies, group discussion, seminar, mini-project etc.

Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

Both CIE and SEE have equal (50:50) weightages. The student's performance in a course shall be judged individually and together based on the results of CIE and SEE.

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DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

Course	OPERATIONS RESEARCH	Course Code	16IE5DCOPR
Credits	04	L-T-P-S	3-1-0-0

Prerequisites: Nil

UNIT-1

Introduction:OR definition, scope, phases, limitations, models, applications and advantages of OR **02Hrs**

Linear programming: Definition, mathematical formulation, standard form, graphical method: feasible, infeasible, multiple solution, unbounded solution and simplex method: feasible, infeasible, multiple solution, unbounded solution, introduction to duality in LPP with simple problems **13 Hrs**

UNIT-2

Transportation problem: Formulation of transportation model, basic feasible solution using different methods, optimal solutions, degeneracy in transportation problems, unbalanced transportation problem **07Hrs**

Assignment problem: Formulation, balanced, unbalanced and maximization assignment problem, travelling salesman problem using Hungarian method **07Hrs**

UNIT-3

Queuing theory: Queuing system and their characteristics, analysis of markovian queues, M/M/1, M/M/K queuing system **07Hrs**

UNIT-4

Project management using network analysis: Network construction, determination of critical path and duration, floats using CPM. PERT-Estimation of project duration, Variance and crashing of projects **09Hrs**

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DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

UNIT-5

Game theory: Two persons - zero sum game, games with and without saddle point, graphical solution, dominance property **07Hrs**

Text Books:

1. **Operations Research and Introduction**, Taha H A, Pearson Education, 9th Edition, 2014
2. **Introduction to Operation Research**, F K Hiller and Liberman, McGraw hill Education PvtLtd, 9th Edition, 2011
3. **Operations Research –Principles and practice**, Philips Ravindaran and Soleberg, WileyPublication, 2nd Edition, 2007

Reference Books:

1. **Operations Research**, S D Sharma,KedarNath, RamNathPublication, 2014
2. **Operations Research**, Kanthiswarup and others,SultanChand and sons, 2014.
3. **Operations Research Problems and Solutions**, J K Sharma, McMillan Publishers, 3rd Edition, 2009.
4. **Operations Research**,P K Gupta and Hira, S Chand Publications, 2007.

Online Reference:www.nptel.ac.in

COURSE OUTCOMES

CO 1	To be able to understand the fundamental concept and approach of linear programming appropriate to the further study of operations research and identify problems in real life
CO 2	To be able to recognize and optimize the transportation and assignment problems
CO 3	To be able to recognize and solve Queuing theory problems
CO 4	To be able to use network planning procedures for solving logistics problems
CO 5	To be able to recognize and solve Game theory problems

ASSESSMENT

Continuous Internal Evaluation (CIE) includes periodic class tests, quizzes or Alternative Assessment Tools (AAT) prescribed by the faculty handling a course prior to beginning of the classes like assignments, problem solving, case studies, group discussion, seminar, mini-project etc.

Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

Both CIE and SEE have equal (50:50) weightages. The student's performance in a course shall be judged individually and together based on the results of CIE and SEE.

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

Course	QUALITY ASSURANCE AND RELIABILITY	Course Code	16IE5DCQAR
Credits	06	L-T–P-S	3-0-1-2

PRE-REQUISITES : NIL

UNIT –1

Introduction to Quality: Definition of Quality, Quality function, Dimensions of Quality, Quality Engineering terminology, Brief history of quality methodology, statistical methods for quality improvement, Quality costs – four categories costs and hidden costs. Brief discussion on sporadic and chronic quality problems, Introduction to Quality function deployment. **06Hrs**

UNIT - 2

Quality Assurance: Definition and concept of quality assurance, departmental assurance activities .Quality aud it concept, aud it approach etc. structuring the audit program, planning and performing audit activities, audit reporting, ingredient sofa quality program. **04Hrs**

Statistical Process Control: Introduction to statistical process control–chance and assignable causes variation. Basic principles of control charts, choice of control limits, sample size and sampling frequency, rational subgroups. Analysis of patterns of control charts. Case Studies on application of SPC, Process capability–Basicdefinition and six sigma concept of process capability, Seven QC tools. **07 Hrs**

UNIT - 3

Control Charts For Variables: Controls charts for X bar and Rangestatistical 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 Schart.Control charts for individual measurements**.** Gauge R and R and MSA. **06Hrs**

Control chartfornon - conformities (defects) – Development and operation of control chart for constant sample size and variable sample size. Choice between variables and attributes control charts.Guidelines for implementing control charts. **06Hrs**

UNIT-4

Sampling Inspection: Concept of accepting sampling, economics of inspection, Acceptance plans–single, double sampling. Operating characteristic curves–constructionanduse. Determinations of average outgoing quality, average out going quality level, average total inspection, producer risk and consumer risk, published sampling plans. **06Hrs**

UNIT-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 **05Hrs**

UNIT-6

1. To test the Goodness of fit for the given quality characteristic using Uniform distribution
2. To test the Goodness of fit for the given quality characteristic using Binomial distribution
3. To test the Goodness of fit for the given quality characteristic using Poisson distribution
4. To test the Goodness of fit for the given quality characteristic using Normal distribution
5. Conduction of Repeatability and Reproducibility studies for appraiser and instrument using R&R Software
6. Assessing Process Capability of the given manufacturing process using Normal Probability

   Paper method and process capability indices
7. Experiments on Application of 7QC Tools as applied to Manufacturing and Service Operations.
8. Construction of control chart for attribute equality characteristic
9. Construction of control charts using Sy stat Software/Minitab

9. Construction of control charts using Sy stat Software/Minitab
10. Attribute sampling Plans–Single,Doubleandmultiplesamplingplans.
11. Experiment son correlation and Simple linear regressions
12. Experiment son multiple linear regressions
13. Conduction of Design of Experiments Full Factorial approach for the given quality characteristic for machining operations/ catapult/Golf experiment
14. Exercises to demonstrate Taguchi's Orthogonal Array technique through DOE software.

REFERENCES:

Text Books:

1. **Introduction to statistical Quality Control-**DC Montgomery,JohnWileyandSons, 7th EditionISBN : 978-1-118-32416-5
2. **Quality Planning & Analysis** - J M Juran, Frank M Gryna; Tata Mc GrawHill, \ 4th edition,ISBN-13: 978-0070393684

Reference Books:

1. **Statistical Quality Control** - Grant and Leaven worth, Mc Graw Hill,7th Edition

   ISBN-13: 978-0078443541
2. **Total Quality Management** – NVR Naidu, KM Babu and G. Rajendra –New Age International Pvt.Ltd–2006
3. **1) Total Quality Management**-KesavanR, I.K International, New Delhi –2007

   ISBN-13: 978-8189866860

Online Reference: www.nptel.com

E-books:http://bookboon.com/en/quality-management-ebook

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COURSE OUTCOMES

CO 1	To understand the underlying reasons for modern quality philosophies & methodologies, as compared with the earlier practices
CO 2	To develop abilities to construct control charts and analyze process data generated overtime
CO 3	To understand the statistical basis of control charts, process capability analysis and acceptance sampling
CO 4	To understand various issues regarding reliability engineering

Scheme for Examination: Five questions choosing one each from each unit and **Unit2** and **3** with choice questions

ASSESSMENT

Continuous Internal Evaluation (CIE) includes periodic class tests, quizzes or Alternative Assessment Tools (AAT) prescribed by the faculty handling a course prior to beginning of the classes like assignments, problem solving, case studies, group discussion, seminar, mini-project etc.

Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

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B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

Course	ENGINEERING ECONOMY	Course Code	16IE5DCENE
Credits	03	L-T–P-S	2-1-0-0

PRE-REQUISITES: NIL

UNIT- 1

Introduction to metrology: definition, types, need of inspection, terminologies, and **Introduction:** Engineering Decision- Makers, Engineering and Economics, Problem solving and Decision making, Intuition and Analysis, Tactics and Strategy, Decision maze. Practical oriented decision making. **05Hrs**

Interest and Interest Factors: Interest rate, simple interest Compound interest, Cash-flow diagrams, Exercises and Discussion on time value of money. **05Hrs**

UNIT- 2

Present Worth Comparison: Conditions for present worth comparisons, Basic Present worth comparisons, Present worth equivalence, Net Present worth, Assets with unequal lives, infinite lives, Future worth comparison, Pay – back comparison, Exercises, Discussions and problems. **06 Hrs**

UNIT-3

Equivalent Annual Worth Comparisons: Equivalent Annual Worth Comparison methods, Situations for Equivalent Annual Worth Comparison Consideration of asset life, Comparison of assets with equal and unequal lives, Use of sinking fund method, Annuity contract for guaranteed income, Exercises, Problems. **06 Hrs**

Rate of Return Calculations: Rate of return, Minimum acceptable rate of return, IRR, IRR misconceptions, Cost of capital concepts. **03 Hrs**

Depreciation: Causes of Depreciation, Basic methods of computing depreciation charges **03 Hrs**

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UNIT- 4

Replacement Analysis: Deterioration, obsolescence, inadequacy, Economic life for cycle replacements **03 Hrs**

Structural Analysis of Alternatives: Identifying and Defining alternatives, IRR analysis of mutually exclusive alternatives, Capital Budget view point, Rankine criteria. **04 Hrs**

UNIT- 5

Estimating & Costing: Components of costs such as Direct Material Cost, Direct Labour Cost, Fixed, Over – Heads, Factory Costs, Administrative – Over Heads, First Cost, Marginal Cost, Selling price, Estimation for simple components

Effects of Inflation: Causes, consequences and control of inflation. After tax actual cash flow comparisons, Lease/ Buy decisions **05 Hrs**

Text Books:

1. **Engineering Economy**- Riggs J.L. McGraw Hill, 2002, ISBN 0-07912248-5.
2. **Engineering Economy** - Paul Degarmo, Macmillan Pub, Co. 2001, ISBN-00-232 86008.
3. **Engineering Economy** - Naidu, Babu and Rajendra –, New Age International Pvt. Ltd – 2008, ISBN-13:4788122419092
4. **Engineering Economics- R Panner Selvam – PHI Publishing Pvt Ltd, 2nd Edition, ISBN; 978-81-203-4837-0 2008**

REFERENCES :

1. **Industrial Engineering and Management**–O. P.Khanna, Dhanpat Rai & Sons 2000,ISBN-818992835X
2. **Financial Management** - I M Pandey, Vikas Publishing House 11th Edition, 2002, ISBN- 978932598229.
3. **Engineering Economy -**Thuesenh.G. PHI, 9th Edition, 2002, ISBN-10:01 30281289

Online reference:www.ntpel.com
EBooks :http://bookboon.com/en/search?q=enginnering%20economics&p=1

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
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COURSE OUTCOMES:

CO 1	Able to learn Problem solving and Decision making using Intuition and Analysis,
CO 2	Know Decision maze, Interest and Interest Factors: time value of money
CO 3	Able to use Present Worth Comparison: Future worth comparison, Pay –back comparison, Equivalent Annual Worth Comparison methods, sinking fund method, Rate of Return Calculations to solve complete engineering problems
CO 4	To calculate Depreciation charges, Replacement Analysis, Structural Analysis of Alternatives
CO 5	Know Estimating & Costing, Effects of Inflation: Lease/ Buy decisions

Scheme of Examination: One Question to be set from each unit and Two Questions will be set from the unit 1 & 3.Student will answer any 5 questions selecting at least one from each unit.

ASSESSMENT

Continuous Internal Evaluation (CIE) includes periodic class tests, quizzes or Alternative Assessment Tools (AAT) prescribed by the faculty handling a course prior to beginning of the classes like assignments, problem solving, case studies, group discussion, seminar, mini-project etc.

Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

Both CIE and SEE have equal (50:50) weightages. The student's performance in a course shall be judged individually and together based on the results of CIE and SEE.

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

Course	FACILITIES PLANNING AND DESIGN	Course Code	16IE5DCFPD
Credits	03	L-T–P-S	3-0-0-0

PRE-REQUISITES: NIL

UNIT - 1

Plant Location: Factors influencing plant location, Theories of plant location and Locational Economics.

Capitals- Objectives of plant layout, Principles of plant layout, types of plant layout, their merits and demerits. **05 Hrs**

Material Handling: Objectives and principles of Material handling, Unit load concept, classification of material handling equipment. **03 Hrs**

UNIT- 2

Plant Layout Design: Traditional Layout procedures: Immer's Basic Steps, Nadler's ideal systems approach, Muther's SLP, Apple's Plant Layout Procedure and Reed's procedure, Activity relationship chart, relationship Diagram, Space relationship diagram. **04 Hrs**

Computerized Layout Planning: Classification of Layout Algorithms – distance based Vs. Adjacency based approaches, Pairwise Exchange Method, Graph based method. CRAFT, CORELAP, ALDEP – Input requirements and procedure Introduction to Simulated Annealing and Genetic Algorithm in Layout design. **06 Hrs**

UNIT- 3

Space Determination & Area Allocation: Factors for consideration in space planning, receiving, storage, production, shipping, tool room and tool crib, other auxiliary service actions. Establishing total space requirement. The area allocation procedure, the plot plan.

Constructing The Layout: Methods of constructing the layout, Evaluation of layout, efficiency indices, presenting layout to management. **08 Hrs**

UNIT-4

Quantitative Approaches To Location Models: Facility location models - Single and Multi-facility, Location allocation Models and numerical problems. **04 Hrs**

Other Facilities Layout Models: – Quadratic Assignment Problem, Warehouse layout models. Machine Layout Models and Simple Problems **04 Hrs**

UNIT-5

Layout Models And Decision Making: Conventional Storage models, AS & RS, Simulation Models–simple problems, Introduction to MCDM, MADM approaches-AHP **06 Hrs**

REFERENCES:

TEXT BOOKS:

1. **Facilities Planning** – James A.Tomkins, John A.White, YavuzA.Bozer, J M.A.Tanchoco, John Wiley and Sons, 2010, ISBN 978-0-470-44404-7
2. **Plant Layout and Material handling -** James M Apple,, John, Wiely and Sons, 2nd Edition,1977
3. **Facility layout and Location** - Francies,R.L. and White,J.A., McGraw Hill 2nd edition 1992.

REFERENCE BOOKS:

1. **Practical layout** - Muther Richard, McGraw Hill-1955.
2. **Facilities Design** – SundereshHeragu, PWS Publishing Company, ISBN-0-534-95183..
3. **Plant Layout Design -** James M Moore, McMilan Co.1962 LCCCN61- 5204.

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COURSE OUTCOMES

CO 1	Be able to learn various factors influencing the decision regarding locations of industrial plants, plant layouts and material handling.
CO 2	Be able to get an insight into traditional layout procedures, and the how the earlier layout designers used to address the problem. A comparative study is possible after gaining the knowledge regarding computerized layout planning procedures
CO 3	Understand the functions that demand space in a layout, services that are to beprovided, building constraints, area allocation procedures etc.that in turn helphim/her to visit the layout problem in a new light and construct a layout in a step bystep manner
CO 4	Learn to address the problems in an quantitative manner for problem solving, either taking a single facility or multiple facilities for analysis at any given time and gather ahuge data involving a large number of people.
CO 5	Be able to understand various layout models developed over a long period of time mathematically. This exposure is important from the point of view of layout.

SScheme of Examination:

Five Questions to be set with one question from each unit carrying 20 marks each. Unit-2&Unit-3 units will have an internal choice.

ASSESSMENT

Continuous Internal Evaluation (CIE) includes periodic class tests, quizzes or Alternative Assessment Tools (AAT) prescribed by the faculty handling a course prior to beginning of the classes like assignments, problem solving, case studies, group discussion, seminar, mini-project etc.

Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

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B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

Course	APPLIED THERMODYNAMICS	Course Code	16IE5DEAPT
Credits	03	L-T–P-S	3-0-0-0

PRE-REQUISITES: NIL

UNIT-1

Gas Power Cycles: Air standard cycles; Carnot, Otto, Diesel, Dual and Stirling cycles, P-V and T-S diagrams, description, efficiencies. Comparison of Otto, Diesel and Dual cycle and numerical problems **06Hrs**

UNIT-2

Gas turbines: Classification of Gas Turbines, Analysis of open cycle gas turbine cycle. Advantages and disadvantages of closed cycle.Methods to improve thermal efficiency and numerical problems. **06Hrs**

UNIT-3

Vapour Power Cycles: -Carnot vapour power cycle, drawbacks as a reference cycle. Simple Rankine cycle; description, T – S diagram, analysis for performance. Comparison of Carnot and Rankine cycles. Effects of pressure and temperature on Rankine cycle performance. Actual vapour power cycles. Ideal and practical regenerative Rankine cycles, open and closed feed water heaters. Reheat Rankine cycle and numerical problems. **11Hrs**

UNIT-4

Reciprocating Compressors: - Operation of a single stage reciprocating compressors. Work input through P – S diagram and steady state steady flow analysis. Effects of clearance, volumetric efficiency. Adiabatic, isothermal and mechanical efficiencies. Multi-stage compressor, optimum intermediate pressure, inter-cooling, minimum work for compression and numerical problems. **11Hrs**

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UNIT- 5

I.C. Engines: Testing I C engineperformance, related numerical problems, heat balance sheet, Morse test and numerical problems. **06 Hrs**

Text books:

1. **Basic and Applied The rmodynamics,** P.K. Nag, TataMcGrawHill,3rdEdition, 2009.
2. **The rmodynamics an Engineering approach,** YunusA. Cengeland MichaelA. Boles,Tata Mc. GrawhillPublication, 2008.

Reference Book:

1. **Engineering Thermodynamics,**Rajput, LaxmiPublicationspvtltd., 3rdEdition, 2007.
2. **Fundamentals of Thermodynamics,** G.J. Van Wylen and R.E. Sonntag, Wiley Eastern
3. **I C Engines,** M.L. Mathur and R.P. Sharma, 2014

Online course: www.nptel.ac.in

Scheme of Examination: One question from**units 1, 2 & 5** and two questions from **units 3 & 4**
Course Outcomes

CO 1	Be able to understand the basic concepts of thermodynamics and describe energy exchange processes in terms of various forms of energies like heat and work in the systems
CO 2	Be able to state the First Law for a closed system, open system and apply the steady flow energy equation to a system of thermodynamic components (heaters, coolers,pumps, turbines etc.) to estimate required balances of heat, work and energy flow
CO 3	Be able understand the Second Law of Thermodynamics - Heat engines and Refrigerators, Reversible and irreversible processes, Carnot cycle and Entropy
CO 4	Be able to apply ideal cycle analysis to simple Heat Engine and Gas Turbine cycles toestimate thermal efficiency and work as a function of pressures and temperatures atvarious points in the cycle.
CO 5	Be able to conduct experiments on Petrol and Diesel engines. Be able to calculate the efficiencies of the Petrol and Diesel engines

ASSESSMENT

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B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

Course	PRODUCT DESIGN & DEVELOPMENT	Course Code	16IE5DEPDD
Credits	03	L-T–P-S	3-0-0-0

PRE-REQUISITES : NIL

UNIT-1

Introduction: Characteristics of successful product development, Design and development of products, duration and cost of product development, the challenges of product development.

Development Processes and Organizations: A generic development process, concept development: the front-end process, adopting the generic product development process, the AMF development process, product development organizations, the AMF organization.

Product Planning: The product planning process, identify opportunities. Evaluate and prioritize projects, allocate resources and plan timing, complete pre project planning, reflect all the results and the process. **10Hrs**

UNIT-2

Identifying Customer Needs: Gather raw data from customers, interpret raw data in terms of customer needs, organize the needs into a hierarchy, establish the relative importance of the needs and reflect on the results and the process.

Product Specifications: What are specifications, when are specifications established, establishing target specifications, setting the final specifications. **06 Hrs**

UNIT-3

Concept Generation: The activity of concept generation clarify the problem, search externally, search internally, explore systematically, reflect on the results and the process.

Concept Selection: Overview of methodology, concept screening, and concept scoring,

Concept Testing: Define the purpose of concept test, choose a survey population, choose a survey format, communicate the concept, measure customer response, interpret the result, and reflect on the results and the process. **10 Hrs**

UNIT-4

Product Architecture: What is product architecture, implications of the architecture, establishing the architecture, variety and supply chain considerations, platform planning, related system level design issues.

INDUSTRIAL DESIGN: Assessing the need for industrial design, the impact of industrial design, industrial design process, managing the industrial design process, assesses the quality of industrial design. **06 Hrs**

UNIT-5

Intellectual Property Rights: Basic principles of IP laws: Introduction, Concept of property, Need for a holistic approach, Basis for protection, Invention, Criteria for patentability, Non – patentable inventions. Patents: Introduction, principles underlying the patent law in India, patentable invention. Procedure forobtaining patent. **04Hrs**

Product Development Economics: Elements of economic analysis, base case financial mode,. Sensitive analysis, project trade-offs, influence of qualitative factors on project success, qualitative analysis.

Managing Projects: Understanding and representing task, baseline project planning, accelerating projects, project execution, postmortem project evaluation. **04 Hrs**

Text Books:

1) Product Design & Development - Karl T. Ulrich & Steven D., Tata McGraw Hill, 5th Edition, 2006
2) Product Design and Manufacturing by A.K. Chitale and R.C. Gupta, PHI.
3) Basic principles and acquisition of Intellectual Property Rights", Dr. T Ramakrishna, CIPRA, NSLIU -2005.
4) Intellectual Property Law Handbook, Dr.B.L.Wadehhra, Universal Law Publishing Co. Ltd., 2002.

Reference Books:

1) **New Product Development** by Tim Jones, Butterworth Heinr1ann, Oxford, UIC 1997.
2) **New Product Development:** Design & 'Analysis by Roland Enene, Kinetovicz, John Wiley and Sons Inc., N. Y. 1990.

3) **Product Design for Manufacture and Assembly** by Gefferry Boothroyd, Peter ` Dewhurst and Winston Knight, Taylor &Fransis group, 3rd Edition, 2011
4) Successful Product Design by Jill Hollins, Stwout Pugh, Butterworth, London 1 990.

Online Links:
http://nptel.ac.in/courses.php
Scheme for examination: Five questions choosing one each from each unit and Unit 1 and 3 with choice questions

Course Outcomes

CO 1	Understand the basic concepts of product design
CO 2	Understand the product design process in industry
CO 3	Understand the economic factors involved in PD
CO 4	Understand the basic concepts of IPR
CO 5	Understand modern approaches helpful in product design

ASSESSMENT

Continuous Internal Evaluation (CIE) includes periodic class tests, quizzes or Alternative Assessment Tools (AAT) prescribed by the faculty handling a course prior to beginning of the classes like assignments, problem solving, case studies, group discussion, seminar, mini-project etc.

Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

Both CIE and SEE have equal (50:50) weightages. The student's performance in a course shall be judged individually and together based on the results of CIE and SEE.

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

Course	ORGANIZATIONAL BEHAVIOR	Course Code	16IE5DE0BE
Credits	03	L-T-P-S	3-0-0-0

PRE-REQUISITES : NIL

UNIT-1

Introduction: Definition of Organization Behavior and Historical development, Environmental context (Information Technology and Globalization, Diversity and Ethics, Design and Cultural, Reward Systems.

The Individual: Foundation of individual behavior, Ability.

Learning: Definition, Theories of Learning, Individual Decision Making, classical conditioning, operant conditioning, social Making, learning theory, continuous and intermittent reinforcement. **06 Hrs**

UNIT-2

Perception: Definition, Factors influencing perception, attribution theory, selective perception, projection, stereotyping, Halo effect.

Values And Attitudes: Definitions, values, Attitudes: Types of values, job satisfaction, job involvement, professional Ethics, Organizational commitment, cognitive dissonance. **10 Hrs.**

UNIT-3

Motivation: Maslow's Hierarchy of Needs, Mc. Gregor's theory X and Y, Herzberg's motivation Hygiene theory, David Mc Cleland three needs theory, Victor vroom's expectancy theory of motivation.

The Group: Definition and classification of groups, Factors affecting group formation, stages of group development, Norms, Hawthorne studies, group processes, group tasks, group decision making.

Conflict Management: Definition of conflict, functional and dysfunctional conflict, stages of conflict process. **10 Hrs**



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UNIT-4

Leader Ship: Definition, Behavioral theories – Blake and Mounton managerial grid, Contingency theories, Hersey - Blanchard's situational theory, Leadership styles, characteristics, Transactional, transformation leaders. **08 Hrs**

UNIT-5

The Organization: Mechanistic and Organic structures, Minitberg's basic elements of organization, Organizational Designing and Employee behaviour, organization development, quality of work life (QWL), Team building. **06 Hrs**

Text books:

1. **Organizational Behavior**, Stephen P Robbins, 9th Edn, Pearson Education Publications, ISBN–81–7808–561-5, 2002
2. **Organizational Behavior** – Fred Luthans, 9th Edn, McGraw Hill International Edition, ISBN–0–07– 20412–1, 2011

Reference books:

1. **OrganizationBehavior** – Hellriegel, Srocum and woodman, Thompson Learning, 9th Edition, PHI, 2001
2. **Organizational Behavior** – Aswathappa – Himalaya Publishers. 2001.
3. **Organizational Behavior** – VSP Rao and others, Konark Publishers 2002.
4. **Organizational Behavior** (Human behaviour at work) 9th Edition John Newstron / Keith Davis. 2002.
5. **Management of Organizational Behavior**, Paul Henry and Kenneth H. Blanchard, Prentice Hall of India, 1996.

Course Outcomes

CO 1 **CO 3** **CO 4**	About the individual and learning: In the context of Environment,Information Technology, Globalization, Diversity and Ethics. To design Organizations in various Cultural and reward systems including individual behavior. Learning process to Modify behavior to meet organizations goals, to condition and reinforce positive attitudes and values.
CO 2	About Perception: to be satisfied, to involve professionally, ethically and commitment to the job with High moral values and attitudes
CO 3	About Motivation: to motivate people to work efficiently in groups to increase the effectiveness of the Organization using group dynamics, decisions, tasks and manage conflicts
CO 4	About Leadership; to lead, acquire leadership characteristics, to become transactional and Transformational leaders.
CO 5	About organization:To Design Conducive Behavior to Develop Quality of Work life Balance and to Work in Teams

Scheme Of Examination:

FIVE Questions to be set with one question from units 1 to 5 carrying 20 marks each. Questions in unit 2 & 3 units will have an internal choice.

ASSESSMENT

Continuous Internal Evaluation (CIE) includes periodic class tests, quizzes or Alternative Assessment Tools (AAT) prescribed by the faculty handling a course prior to beginning of the classes like assignments, problem solving, case studies, group discussion, seminar, mini-project etc.

Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

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B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

Course	THEORY OF MACHINES	Course Code	16IE5DETOM
Credits	03	L-T-P-S	3-0-0-0

PRE-REQUISITES : NIL

UNIT-1

Introduction: Definitions: Link or element, kinematic pairs, degrees of freedom, Grubler's criterion (without derivation), Kinematic chain, Mechanism, structure, Mobility of Mechanism, Inversion.
Kinematic Chains and Inversions: Inversions of Four bar chain; Single slider crank chain and Double slider crank chain. **05Hrs**

Mechanisms: Quick return motion mechanisms-Drag link mechanism, Whitworth mechanism and Crank and slotted lever Mechanism. Straight line motion mechanisms –Peaucellier's mechanism and Robert's mechanism, Intermittent Motion mechanisms –Geneva mechanism and Ratchet and Pawl mechanism. Toggle mechanism, Pantograph, Ackerman steering gear mechanism. **06Hrs**

UNIT-2

Cams: Types of cams, Types of followers, Displacement, Velocity and Acceleration time curves for cam profiles. Disc cam with reciprocating follower having knife-edge, roller and flat-faced follower, Disc cam with oscillating roller follower, Follower motions including SHM, Uniform velocity, uniform acceleration and retardation and Cycloidal motion. **08Hrs**

UNIT-3

Balancing Of Machinery: Static and Dynamic balancing, balancing of single rotating mass in same plane and in different planes, balancing of several rotating masses in same plane and in different planes, balancing of reciprocating masses Inertia effect of crank and connecting rod**.** **05Hrs**

UNIT-4

Spur Gears: Gear terminology, law of gearing, Characteristics of involute action, Path of contact, Arc of contact, Contact ratio, Interference in involute gears, Methods of avoiding: interference, Back lash, Comparison of involute and cycloidal teeth **05Hrs**

Gear Trains: Simple gear trains, Compound gear trains for large speed reduction, epicyclic gear trains, Algebraic and tabular methods of finding velocity ratio of epicyclic gear trains. Tooth load and torque calculations in epicyclic gear trains. **05Hrs**

UNIT-5

Belts, Ropes And Chains: Introduction, Belt and Rope drives, open and crossed belt drives, action of belt on pulleys, velocity ratio, slip, law of belting, length of belt, Ratio of friction, chains, chain length and analytical, classification of chains. **03Hrs**

Governors: Types of governors; force analysis of Porter and Hartnell governors. Controlling force, stability, sensitiveness, isochronism's, effort and power. **05Hrs**

Text Books:

1. **Theory of Machines,** Rattan S.S, Tata McGraw-Hill Publishing Company Ltd., New Delhi, and 2nd Edition -2005.
2. **Theory of Machines,** Sadhu Singh, ," Pearson Education (Singapore) Pvt. Ltd., Indian Branch, New Delhi, 2nd Edition. 2006.

Reference Books:

1. **Theory of Machines**Shigley. J. V. andUickers, J.J., Oxford University press, 2004
2. **Theory of Machines -I"**, by A.S.Ravindra, Sudha Publications, Revised 5th Edition, 2004.

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Scheme: Choice from unit 1 & unit 4 , and one question each from the remaining units 2 , 3 and 5.

Course Outcomes

CO 1	Able to understand various mechanisms and nature of working
CO 2	Students learn to construct profile of Cams with analytical problems
CO 3	Students learn about gearing systems and gear trains with analytical problems
CO 4	Students learn about gearing systems and gear trains with analytical problems

ASSESSMENT

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Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

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B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

Course	TOOL ENGINEERING	Course Code	16IE5DETEG
Credits	03	L-T-P-S	3-0-0-0

PRE-REQUISITES : NIL

UNIT-1

Cutting Tool Materials : Introduction, Desirable properties of tool materials, characteristics cutting tool materials, single point cutting tool geometry, single point tool nomenclature, chip flow direction, tool angles specifications, cutting parameters and tool geometry, Indexable inserts, chip breakers. **06Hrs**

UNIT-2

Tool Wear, Tool Life and Machinability: Introduction, Tool wear mechanism, types of tool damage during cutting, wear and chipping, characteristics of different tool materials, tool wear equation, tool failure criteria, Taylor's tool life equation, effect of process parameters on tool life, tool life test, Machinability. (Includes simple problems) **06Hrs.**

UNIT-3

Tools in Milling : Milling Cutters, materials of milling cutters, Elements of fluted milling cutters (Cutter nomenclature), Geometry of milling cutter, milling parameters, effects of various factors in milling operations, selection of milling cutters, face milling cutters, end milling cutters, carbide milling cutters, Indexing. (Includes simple problems) **08Hrs**

UNIT-4

Tools in Drilling: Drilling operations, cutting speeds and feeds, various types of drills, drilling with jet pulsing, Drill points shapes for various applications, Drill wear, Drill point sharpening, chip control and chip breakers in drilling, introduction to counter boring, counter sinking, spot facing, Reaming. (Includes simple problems)

Grinding Wheels: Introduction, grinding wheels, specification of grinding wheels, recommendation for selection of grinding wheels, Operating conditions, grinding fluids, mounting of grinding wheels. (Includes simple problems) **10Hrs**

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UNIT-5

Press Tools : Introduction, press operations, components of press, classification of presses, Flywheel considerations, transfer presses, selection of presses, components of die assembly, classification of dies, clearance between Die and Punch, automation of power press.

Powder Metallurgy: Process details and special characteristics of powder metallurgy process, Compaction techniques like CIP and HIP (Cold isostatic and hot isostatic pressing), Applications of powder metallurgy. **10 Hrs**

Text Books:

1. **Production Technology**. R. K. Jain, Khanna Publications, Edition 2014, ISBN 10817409-0991
2. **Production Technology**, H M T, Tata McGraw-Hill Publishing Company Limited, 2001 Edition, ISBN-97800709-64433
3. **Text Book of Production Technology**- K. C. Jain and A. K. Chithale, PHI, edition 2014, ISBN 9788120347496
4. **Fundamentals of Metal Cutting Tools,** B. L. Juneja. G. S. SekhonNithin Seth, New age International Publishers, Edition 2007, ISBN-978-812-241-4677

Reference Books:

1. **ASM Handbook on Powder Metallurgy** - Vol 17, ASM publications, PHI Learning Pvt. Limited.
2. **Principles of Machine Tools** by G. C. Sen and Amitabha Bhattacharya, Edition 2009, ISBN -9788173811555
3. **Metal cutting theory & cutting tool design**, V. Arshinow and G. Alfseev Mir PublicationMascow.
4. **Metal cutting and Tool Design**., B.J. Ranganath, Vikas Publishers, 2nd Edition.

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COURSE OUTCOMES :

CO 1	Is able to understand Tool life, Tool wear and machinability aspects
CO 2	Is able to understand Milling operations, Milling cutter to be used, parameter in Milling and Indexing operation
CO 3	TIs able to understand types of Drilling operations, various types of drills used and other related topics
CO 4	Is able to understand Press tool operations, selection of presses, dies and punch and other related topics

Scheme of Examination: To set one question from each **units 1, 2& 3** and two questions from **unit-4** and **unit-5.**

ASSESSMENT

Continuous Internal Evaluation (CIE) includes periodic class tests, quizzes or Alternative Assessment Tools (AAT) prescribed by the faculty handling a course prior to beginning of the classes like assignments, problem solving, case studies, group discussion, seminar, mini-project etc.

Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

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DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

Course	SIMULATION MODELING AND ANALYSIS	Course Code	16IE6DCSMA
Credits	06	L-T-P-S	3-0-1-2

PRE-REQUISITES : NIL

UNIT–1

Introduction To Simulation: Simulation, advantages, Disadvantages, Areas of application, System environment, components of a system, Model of a system, types of models, steps in a simulation study.

Simulation Examples: Simulation of Queuing systems, Simulation of Inventory System, Simulation of Project Management and Other simulation examples **10Hrs**

UNIT–2

General Principles: Concepts in discrete - events simulation, event scheduling *I* Time advance algorithm

Random Numbers: Properties, Generations methods, Tests for Random number-Frequency test, Runs test, Autocorrelation test, Gap test, Poker test **08Hrs**

UNIT-3

Random Variate Generation: Inverse Transform Technique- Exponential, Uniform, Weibull, Triangular distributions, Direct transformation for Normal and log normal Distributions, Acceptance - Rejection Techniques – Poisson Distribution. **08Hrs**

UNIT-4

Analysis of Simulation Data: Input Modeling: Data collection, Identification and distribution with data, parameter, Goodness of fit tests, Selection of input models without data

Verification and Validation of Model- Model Building, Verification, Calibration and Validation of Simulation Models **08Hrs.**

UNIT-5

Output Analysis - Stochastic Nature of output data, Measures of Performance and their estimation.

Simulation Software - Selection of Simulation software, simulation packages, Trends in simulation softwares **06Hrs**

UNIT-6 (Laboratory Exercise)

Development of simulation models using the simulation language / packages studied for systems Such as, Queuing systems, Production systems, Inventory systems, Maintenance and Replacement systems, Investment analysis and Networks.

Solving Monte Carlo simulation problems using MS Excel (minimum 4 exercise)
Input analysis of Simulation data by statistical tools
Simulation of Service system considering Breaks, Schedules and resource failure etc
Activity based costing in Simulation
Simulation of Manufacturing system with multiple servers and failures
Simulation of Transport system considering Forklift and conveyor
Supply chain simulation
Network simulation.
Statistical Analysis of Simulation models (output analysis)

Self-Study Assessment: Student group consisting of 4 - 5 members to submit following assignments in Simulation modelling Analysis lab at the end of the course.

1. Problem Identification: students can choose problems pertaining to queuing systems, production systems, inventory systems, maintenance and replacement systems, investment analysis, network, other any system under consideration.
2. Data collection and analysis for the problem considered
3. Building simulation model using Arena / Witness or any simulation languages
4. Verification and Validation of the simulation model considered

5. Performing Sensitivity analysis / Post optimal analysis for the generated model

6. Documentation, presentation and report submission.

Text Books:

1. **Discrete Event system Simulation** - Jerry Banks, John S Carson, II, Berry L Nelson, Prentice Hall, 1996
2. **Discrete-event System Simulation**,David M Nicol, 5th Edition, Pearson Education, Asia, 2010
3. **Systems Simulation with Digital Computer**, Narsingh Deo,, PHI Publication (EEE).1978
4. **Simulation Modeling & Analysis Averill**, M Law, W David Kelton, - ; McGraw Hill, International Editions – Industrial Engineering series, 1991
5. **Systems Simulation**,Gordan. G. "", Prentice Hall India Ltd, 1991.

Reference Books:

1. **Simulation -- Business & Economics**Sheldon M. Ross, Academic Press, 31-Dec-2012
2. **Simulation Modeling and Analysis with Arena,**TayfurAltiok,Benjamin Melamed, 2010

Online References:

1. http://nptel.ac.in/courses.php?disciplineId=110
2. http://informs-sim.org/
3. E-learning: http://vtu.ac.in
4. http://ocw.mit.edu/
5. http:// youtube.com/ Discrete Event simulation

Software Packages

1. Simulation Packages : Arena, Quest, Witness,
2. MS Excel, Minitab

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Scheme of Examination

Each question from each unit and internal choice from **Unit 1 & Unit 2**

COURSE OUTCOMES :

CO 1	Able to understand the basics of simulation and their applications
CO 2	Able to understand the application of simulation with analytical problems
CO 3	Able to build models and analysis of models
CO 4	Able to test the models and to draw useful inferences

ASSESSMENT

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Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

Both CIE and SEE have equal (50:50) weightages. The student's performance in a course shall be judged individually and together based on the results of CIE and SEE.

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DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

Course	FINANCIAL ACCOUNTS AND COSTING	Course Code	16IE6DCFAC
Credits	04	L-T-P-S	3-1-0-0

PRE-REQUISITES : NIL

UNIT–1

Financial Accounting: Introduction to Book keeping: double-entryaccounting, journal & ledger posting. **05Hrs**

Financial Statements & Analysis: Trial balance, preparation ofTrading and Profit & Loss account, and Balance sheet. **10Hrs**

UNIT-2

Ratio Analysis: Balance sheet ratio's, profit – loss account ratio's, andcombined ratio's. **05Hrs**

UNIT-3

Costing: Objectives of costing, Elements of costing, methods of costingpreparation of cost sheet (job costing), Process costing. **05Hrs**

Standard Costing: Material, labour, overhead cost variance. **04Hrs**

UNIT-4

Working Capital Management: Factors influencing workingcapital requirement, determination of operating cycle and working capital. **05Hrs**

UNIT-5

Budgeting: Sales budget, production budget, selling and administrative expense budget, Master budget. **06Hrs**

Text Books:

1. **Cost Accounting** - Khan M Y and Jain P K, Tata McGraw-Hill, 4thEdition, 2004
2. **Financial Management -** Prasanna Chandra; Tata McGraw-Hill,4th Edition. 1998.
3. **Management Accounting & Costing -** Prasad .N.K
4. **Financial Management and Policy -** James. C Vanhorne,Pearson education, 12th edition, 2002

Reference Books:

1. **Elements of Accountancy** - B.S Raman
2. **Practical Costing** - Ahuja, Pandey, Khanna and Arora, S. Chand& Co. Ltd 2005
3. **Financial Management & Costing –**Khan& Jain, TMH - 2000

COURSE OUTCOMES :

CO 1	Able to understand the financial part of the organization which is needed to carry out an industry
CO 2	To prepare trial balance, journal entry, trading account, balance sheet, profit and loss account
CO 3	Able to Determine the ratio analysis for balance sheet, profit & loss account & combined ratios
CO 4	To understand the concepts of costing and preparation of cost sheet
CO 5	Able to Determine the operating cycle and factors affecting working capital requirement & to learn the concepts of different types of budgeting

Scheme of Examination:Two questions from unit 1 & unit 3 , and one question from units 2, 4 and 5.

Ebooks

http://www.zums.ac.ir/files/research/site/ebooks/accounting/managerial-and-cost-accounting.pdf

http://ebooks.narotama.ac.id/files/A%20Textbook%20of%20Financial%20Cost%20&%20Management%20Accounting%

ASSESSMENT

Continuous Internal Evaluation (CIE) includes periodic class tests, quizzes or Alternative Assessment Tools (AAT) prescribed by the faculty handling a course prior to beginning of the classes like assignments, problem solving, case studies, group discussion, seminar, mini-project etc.

Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

Both CIE and SEE have equal (50:50) weightages. The student's performance in a course shall be judged individually and together based on the results of CIE and SEE.

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DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

Course	PRODUCTION AND OPERATIONS MANAGEMENT	Course Code	16IE6DCPOM
Credits	03	L-T-P-S	2-1-0-0

Prerequisites: Nil

UNIT-1

Operations Management Concepts: Introduction, Historical development, The trend: Information and Non -manufacturing systems, Operations management, Factors affecting productivity, International dimensions of productivity, the environment of operations,Production systems decisions- a look ahead. **06Hrs**

UNIT-2

Forecasting Demand: Forecasting objectives and uses, Forecasting variables, Opinion and Judgmental methods, Time series methods, Exponential smoothing, Regression and Correlation methods, Application and control of forecasts. **06Hrs**

Aggregate Planning And Master Scheduling: Introduction- planning and Scheduling, Objectives of aggregate planning, Aggregate planning methods, Master scheduling objectives, Master scheduling methods. **06Hrs**

UNIT-3

Material And Capacity Requirements Planning: Overview: MRP andCRP, MRP: Underlying concepts, System parameters, MRP logic, System refinements, Capacity management, CRP activities. **04Hrs**

Scheduling And Controlling Production Activities: Introduction,PAC, Objectives and Data requirements, Scheduling strategy and guide lines

Single Machine Scheduling: Concept, measures of performance, SPT rule,Weighted SPT rule, EDD rule, minimizing the number of tardy jobs 0**6Hrs**

UNIT-4

Flow –Shop Scheduling: Introduction, Johnson's rule for 'n' jobs on 2 and 3 Machines, CDS heuristic.

Job-Shop Scheduling: Types of schedules, Heuristic procedure, scheduling 2 jobs on 'm'Machines. **06Hrs**

UNIT-5

Lean Systems: Characteristics of Just-in-Time operations, Pull method of materials flow, Consistently high quality, small lot sizes, Uniform workstation loads, Standardized components and work methods, close supplier Ties, Flexible workforce, Line flows, Automated production, Prevention maintenance, continuous improvement **06Hrs**

Text Books:

1) **OperationsManagement**William J. StevensonMcGraw-Hill Higher Education; 10th Revised Edition, April 1, 2010, ISBN-10007-802-4102.
2) **Operations Management**Monks, J.G McGraw-Hill International Editions, 3rd Edition, 1987, ISBN- 0070427275
3) **Production and Operations Management**PannerSelvam. R, PHI. 2nd Edition, 2006, ISBN-10:8120327675

Productions &Operations Management by Adam & Ebert, 5th Edition, ISBN: 978-81-203-0838-1

Reference Books:

1) **Modern Production/Operations Management,** Buffa, Wiely Eastern Ltd., 8th Edition,
2) **Production and Operations Management,** Chary, S.N, Tata-McGraw Hill., 2004
3) **Operations management** by James Dilworth, South Westtern Educational Publishing, 1999
4) **Operations Management – Strategy and Analysis** Lee J Karjewski and Larry P Ritzman, 6thEdition

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Online Resource:http://nptel.ac.in/syllabus/110102015/
EBooks:http://bookboon.com/en/operations-management-ebook

Course Outcomes

CO 1	Able to Manage operations, differentiate between manufacturing and non-manufacturingoperations and identify factors affecting productivity
CO 2	Able to use different methods of forecasting and apply them for demand forecasting
CO 3	Able to differentiate between aggregate planning and master scheduling and usethem for allocating load to machine centers.
CO 4	Able to use MRP and CRP techniques to plan for materials and capacity in theOrganization.
CO 5	Able to use different methods of scheduling and sequencing of jobs through differentproduction systems

Scheme of examination

One question from each unit and internal choice from **unit 2&3**

ASSESSMENT

Continuous Internal Evaluation (CIE) includes periodic class tests, quizzes or Alternative Assessment Tools (AAT) prescribed by the faculty handling a course prior to beginning of the classes like assignments, problem solving, case studies, group discussion, seminar, mini-project etc.

Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

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B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

Course	SUPPLY CHAIN AND LOGISTIC MANAGEMENT	Course Code	16IE6DCSCL
Credits	05	L-T-P-S	3-0-0-2

Prerequisites Nil

UNIT-1

Introduction to Materials Management: Definition and Importance of Materials Management. Scientific principles of buying meaning of inventory and types, EOQ derivation and analytical problems and safety stock. ABC classification. Standardization and variety reduction Codification system. **06Hrs**

UNIT-2

Building A Strategic Frame Work to Analyse Supply Chains: Supply chain stages and decision phases process view of a supply chain. Supply chain flows. Examples of supply chains. Competitive and supply chain strategies. Achieving strategic fit. Expanding strategic scope. Drivers of supply chain performance. Framework for structuring drivers – Inventory, Transportation, Facilities, Information. Obstacles to achieving fit. **10Hrs**

UNIT-3

Designing the Supply Chain Network: Distribution Networking – Role, Design. Supply Chain Network (SCN) – Role, Factors, Framework for Design Decisions.

Planning And Managing Inventories In a Supply Chain: Review of inventory concepts. Trade promotions, Managing multi-echelon cycle inventory, safety inventory determination. Impact of supply uncertainty aggregation and replenishment policies on safety inventory. Optimum level of product availability; importance factors. Managerial levers to improve supply chain profitability.

Sourcing, Transportation And Pricing Products: Role of sourcing, supplier – scoring & assessment, selection and contracts. Design collaboration. **08Hrs**

UNIT-4

Transportation And Pricing Products: Role of transportation, Factors affecting transportation decisions. Modes of transportation and their performance characteristics. Designing transportation network. Trade-off in transportation design. Tailored transportation, Role of Revenue Management in the supply chain, Revenue management for: Multiple customer segments, perishable assets, seasonal demand, bulk and spot contracts. **08Hrs**

UNIT-5

Coordination And Technology In The Supply Chain: Co-ordination in a supply chain: Bullwhip effect. Obstacles to coordination. Managerial levers to achieve co-ordination, Building strategic partnerships. The role of IT supply Chain, The Supply Chain IT framework, CRM, Internal SCM, SRM. The role of E-business in a supply chain, The E-business framework, E-business in practice.

Emerging Concepts: Reverse Logistics; Reasons, Activities, Role. RFID Systems; Components, applications, implementation. Lean supply chains, Implementation of Six Sigma in Supply Chains **08Hrs**

Text Book:

1) **Supply Chain Management** –Strategy, Planning & Operation. Sunil Chopra & Peter Meindl, Pearson Education Asia, ISBN: 81-7808-272-1.2001,
2) **Materials Management**: A K Datta, Procedures, Text and cases

Reference Book:

1) **Supply Chain Redesign** – Transforming Supply Chains into Integrated Value Systems -Robert B Handfield, Ernest L Nichols, Jr., Pearson Education Inc, ISBN: 812-970-1138,2002,
2) **Modeling the Supply Chain** -Jeremy F Shapiro, Duxbury;, Thomson Learning,
3) ISBN 0-534-37363,2002,
4) **Designing & Managing the Supply Chain** -David Simchi Levi, Philip Kaminsky& Edith Simchi Levi;; McGraw Hill

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Scheme of Exam: One question from each unit and choice from unit 1 and unit 3

Course Outcomes

CO 1	Able to understand the stages of supply chain and their roles in supply chain profitability
CO 2	Students learn about to fitting the supply chain and obstacles to achieve fit.
CO 3	Students get exposure to modes of transportation and their importance.
CO 4	Students get exposure on inventory management and its role in supply chain
CO 5	Able to understand the importance of coordination in managing supply chain

ASSESSMENT

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DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

Course	FLUID MECHANICS	Course Code	16IE6DEFM
Credits	03	L-T-P-S	3-0-0-0

Prerequisites: Nil

UNIT-1

Introduction to Properties of Fluids: Introduction, Properties of fluids-mass density, weight density, specific volume, specific gravity, viscosity, surface tension, capillarity, vapour pressure compressibility and bulk modulus. Fluid pressure at a point, Pascal's law, pressure variation in a static fluid in 2D. Related Numerical Problems. **06Hrs**

UNIT-2

Fluid Statics : Types of Fluids, Absolute, gauge, atmospheric and vacuum pressures, Hydrostatic force on submerged plane surfaces submerged in static fluid.Related Numerical Problems. **06Hrs**

UNIT-3

Buoyancy and Floatation: Buoyancy, center of buoyancy, meta center and meta centric height, Determination of meta-centric height by analytical method. Stability of floating bodies. Related Numerical Problems.

Fluid Kinematics : Types of fluid flow, continuity equation in 2D & 3D (Cartesian co-ordinate system only), velocity potential function and stream function. Related Numerical Problems. **10Hrs**

UNIT-4

Basic Equations of Fluid Flow: Forces acting on fluid in motion, Euler's equation of motion, Bernoulli's equation from Euler's equation, Bernoulli's equation for real fluids. Related Numerical Problems.

Fluid flow measurements: Introduction, Vena-contracta, Jet of water, Application of Bernoulli's equation, Venturimeter, Orifice meter, Pitot tube. Hydraulic Coefficients, Related Numerical Problems. **10Hrs**

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UNIT-5

Flow through Pipes: Major &Minor losses-Darcy-Weisbach Equation for loss of head due to friction in pipes, Chezy's equation for loss of head due to friction in pipes, Hagen Poiseulle's equation, Bend losses, Hydraulic gradient and total energy lines, pipes in series and parallel, branched pipes and equivalent pipes. Related Numerical Problems. **08Hrs**

Text Books:

1) **Fluid Mechanics** by Dr. Bansal.R.K, Lakshmi Publications, Edition 2010,

   ISBN-8131802949

2) **Hydraulics, Fluid Mechanics and Fluid Machines**, S Ramamrutham, DhanpatRai publishers, Edition 2012, ISBN-139-788-1874-33804

3) **Fluid Mechanics and Hydraulic Machinery**. DomkundwarDhanpatRai&Co.Edition 2014

Reference books:

1) **Fluid Mechanics, and Hydraulics Machines** by R.K. Rajput, S.Chand& Company, edition 1998, ISBN-978-812-191-6660

2) **A Textbook of Hydraulics &Fluid Mechanics & Hydro Machines** by Khurmi R.S, S.Chand& Co, Edition 2014, ISBN-978-812-190-1628

3) .**Fluid Mechanics and Fluid Power Engineering.** Dr. D.S. Kumar. Publishers: S.K. Kataria&Sons, Edition 2013, ISBN-978-935-014-3926

4) **Fluid Mechanics, Fundamental & applications**, by Yunus A, Cenegel, John M,Cimbala, Tata McGraw Hill, 2013, ISBN-978-007-3380-322.

Online Resource: www.nptel.ac.in

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Course Outcomes

CO 1	Is able to acquire the knowledge of types of fluids, properties and their characteristics. Will know how to measure the pressure of a fluid at a point
CO 2	Will have the knowledge of gauge, Absolute and vacuum pressure, is able to understand the behavior of the fluid on the submerged surfaces in static conditions
CO 3	Will have the understanding about the concept of buoyancy and floatation , the condition of the body to be in equilibrium, is able to understand the behavior of the fluid in motion
CO 4	Is able to understand the energy transfer in fluid dynamics, the various types of equipments used to determine the rate of fluid flow and other related topics.
CO 5	Is able to learn about the major and minor energy losses that are involved in a fluid flow and their accountability

Scheme of Examination: To set one question from **units1, 2, & 5** and two questions from **units3& 4**

ASSESSMENT

Continuous Internal Evaluation (CIE) includes periodic class tests, quizzes or Alternative Assessment Tools (AAT) prescribed by the faculty handling a course prior to beginning of the classes like assignments, problem solving, case studies, group discussion, seminar, mini-project etc.

Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

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B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

Course	SOFTWARE ENGINEERING AND MANAGEMENT	Course Code	16IE6DESEM
Credits	03	L-T-P-S	3-0-0-0

Prerequisites: Nil

UNIT-1

The Product And The Process: The product-Evolving role of Software, Characteristics, Components, and Applications. The Process Software Process, Models - Linear, sequential, Prototype, RAD, Process Technology, Software DevelopmentLife cycle. **07 Hrs**

UNIT–2

Software Project Management Concepts: The Management Specification, People, Problem, Process

Software Project Planning: Objectives, Scope, Resource, Project estimation, Decomposition techniques, Empirical Estimation Models. Make-buy decision, automated estimation tools.

RISK MANAGEMENT: Reactive v/s Proactive Risk Strategies, Software Risks, Risk identification, Risk projection, Monitoring. **10Hrs**

UNIT-3

Software Project Scheduling And Tracking: Basic concepts, defining a task set selection, Defining Scheduling, Project Plan.

Object Oriented Concept And Principles: Object Oriented Concepts, Identifying the elements of an object model, Examples.

OperatingSystem: Exposure of concepts on Unix, Linux, Windows, Android **06Hrs**

UNIT-4

System Analysis Concept And Principles: Requirement analysis, Principles, software prototyping, specifications, Data Modeling, Functional Modeling/and Information Flow, Structured Analysis, Data Dictionary. **05Hrs**

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UNIT-5

System Design Concepts And Principles: Design Process Concept, Modular design, Documentation Design Methods, Data Design, Interface Design, Procedural Design, and Design for Real Time Systems, Considerations, Analysis and Simulation of Real Time Systems

Software Testing: Objectives, Principles, Testability.

Software Quality And Reliability: Introduction, Software failure modes, software structure and modularity, language, Data reliability, Fault tolerance, software checking and software testing.

Software Quality Assurance: Quality assurance concept, Cost impact of software defects, Technical Review, statistical Quality assurance, software reliability, ISO 9000 Quality standards **12 Hrs**

Text Book:

1) **Software Engineering** Pressman, Computer Science Series TATA McGraw-Hill Publications, 6th edition

Reference Books:

1) **Software Engineering** - Somerville, Pearson Education, Delhi 2001
2) **Software Engineering** - Shooman, TATA McGraw Hill Publications. 6th Edition, 1983
3) **An Integrated approach to Software Engineering**, PankajJalota, 2nd Edition, 1997

Online Reference:

1. http://ocw.mit.edu/courses/aeronautics-and-astronautics/16-355j-software-engineering-concepts-fall-2005/lecture-notes/

http://nptel.ac.in/courses/106105087/ **(Basic issues in Software Engineering)**

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

Course Outcomes

CO 1	Able to compare different software process
CO 2	Learnt the concepts of software project management
CO 3	Ability to software project planning, scheduling and tracking
CO 4	Know system analysis concept and principles and software testing
CO 5	Learnt about object oriented concepts and principles

Scheme of Examination:

One question from each Unit and internal choice from Units 2 &5

ASSESSMENT

Continuous Internal Evaluation (CIE) includes periodic class tests, quizzes or Alternative Assessment Tools (AAT) prescribed by the faculty handling a course prior to beginning of the classes like assignments, problem solving, case studies, group discussion, seminar, mini-project etc.

Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

Both CIE and SEE have equal (50:50) weightages. The student's performance in a course shall be judged individually and together based on the results of CIE and SEE.

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

Course	DATA BASE MANAGEMENT SYSTEM	Course Code	16IE6DEDBM
Credits	03	L-T-P-S	3-0-0-0

Prerequisites: Nil

UNIT-1

Databases And Database Users: Introduction, characteristics of data base approach, intended use of a DBMS, advantages and implication of database approach.

Database Systems Concepts And Architecture: Data models, Schemas and instances' DBMS architecture and data independence, database languages and interfaces, database system environment, classification of data base management Systems. **06Hrs**

Data Modeling: High level conceptual data models for database design. Entity types, entity. Sets, attributes, and keys. Relationships, relationship types, roles, and Structural constraints, Weak entity types. ER Diagrams **06 Hrs**

UNIT-2

Record Storage And Primary File Organizations: Secondary storage devices, buffering of blocks, placing fi1l records on disk, operations on files, heap files a sorted files, hashing techniques. **04 Hrs**

Index Structure Of Files: Single-level and multilevel ordered indexes, dynamic multi-level indexes usingB-trees and B+trees. **02 Hrs**

UNIT-3

Relational Data Mode And Relational Algebra: Brief' discussion on Codd rules, relational model concepts, constraints, and schemas. Update operation on relations, basic and additional relational algebra operations, and queries in relational algebra.

Structured Query Language (SQL): Data definition etc. in SQL2.Basic and complex queries in SQL. Insert, delete, update statements, and views in SQL, embedded SQL. **10Hrs**

UNIT-4

Database Design: Design guidelines for relational schemes, functional Dependencies, normalization -1st, 2nd, 3'd, 4 , and 5th normal forms. Database design process, factors influencing physic I database design guidelines, and guidelines for relational systems. **06Hrs**

UNIT-5

System Implementation: System catalog for RDBMSs, transaction processing and system concepts, properties of transactions, brief discussion on concurrency, control and recovery techniques, database security and authorization. **04 Hrs**

Brief Discussion On: Distributed databases, objected oriented databases, next generation databases, and interfacing with other technologies. **02 Hrs**

Online Reference:

http://nptel.ac.in/video.php?subjectId=106106093

Text Books:

1) **Fundamentals of database systems**RamezElmasri and Shamkanth B. Navathe, Addison Wesley Publishing Company,6th Edition, 2009.
2) **Database Management System** -Raghu Ramakrishnan and Johanne'sGehrke, , TATA McGraw Hill, 3rd Edition, ISBN 0-071231511 , 2005

Reference Books:

1) Modern Data base management: McLfadden, hoffer, Prescott,Prentice-Hall, 2006.
2) **Database Management Design** Gary W. Hansen and James V. Hansen, PHI Pvt . Ltd, 2nd Edition, 1991



B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

Course Outcomes

1	Able to use, appreciate advantages and implication of database
2	Able to understand DBMS architecture, languages, interfaces, data modeling
3	Able to carry out indexing, understand relational model concepts, schemas
4	Able to use SQL, design database, carryout transaction processing, implement systems

Scheme: One Question to be set from each unit and Two Questions will be set from the **Unit 1 &Unit-3**.Student will answer any 5 questions selecting at least one from each unit.

ASSESSMENT

Continuous Internal Evaluation (CIE) includes periodic class tests, quizzes or Alternative Assessment Tools (AAT) prescribed by the faculty handling a course prior to beginning of the classes like assignments, problem solving, case studies, group discussion, seminar, mini-project etc.

Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

Both CIE and SEE have equal (50:50) weightages. The student's performance in a course shall be judged individually and together based on the results of CIE and SEE.

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

Course	WORLD CLASS MANUFACTURING	Course Code	16IE6DEWCM
Credits	03	L-T-P-S	3-0-0-0

Prerequisites: Nil

UNIT-1

Introduction To World Class Manufacturing: Manufacturing Excellence and Competitiveness, What is World-Class Manufacturing? - Hall's Framework of Value-added Engineering, Schonerger's Framework of World-Class Manufacturing (WCM), Gunn's Model of World-Class Manufacturing, Mask ell's Model of World-Class Manufacturing, America's Best Plants Model of World Class Manufacturing.The Philosophy of World-Class Manufacturing - The Evolution of World-Class Manufacturing, The First Principles of World-Class Manufacturing, The Practices of WorldClass Manufacturing The customer Interface, The Supplier Interface, World-Class Practices in the Factory, Quality in World Class Manufacturing - Deming's Approach to Quality Management, Shingo's Approach to Quality Management, Assessing he Two Basic Approaches to Quality, Conclusion - The Culmination of World-Class Manufacturing. **10 Hrs**

UNIT-2

Benchmarking: Definition, mission and objectives, managing benchmarking process, training and code of conduct, future scope and benchmarking process.

What to benchmark: Concept of step zero, priorities, business processes - linking to goals etc., investigation, documentation, performance measures, improving business processes.

Whom to benchmark: Developing candidate list, systematic search, refining the initial list.

Data Collection and Analyzing the Performance Gap: Data collection plan, research - internal, public domain sources, outside experts' etc. original research, site visits, and code of conduct.

Analyzing the gap: Tools, displaying data, deciding and combining best work practices, validation, recommendations etc. **10 Hrs**

UNIT-3

Reengineering: Definition of reengineering, importance of 3Cs - customers takes charge, competition intensifies, and change becomes constant. Detailed definition of reengineering –fundamental rethinking, radical redesign, and dramatic improvement.

Reengineering: Rethinking business process, new world of work, and enabling role of information technology. **08 Hrs**

UNIT-4

Six Sigma: The Basics, The core of Six Sigma (DMAIC), Design for Six Sigma, DFSS and the customer, Quality time & the Bottom line, Core of DFSS - IDOV method, DFSS Metrics, DFSS Infrastructure - People & Resources, Implementing DFSS. **0 Hrs**

UNIT-5

Activity Based Management (ABM): Introduction, Traditional Cost Systems, Activity Based Costing, Activity Based Management, ABM Implementation, and Case Study. **04 Hrs**

Total Productive Maintenance: Introduction, the plan, learning the new philosophy, promoting the philosophy, training, improvement needs, goals, developing plans, autonomous work groups, summary, examples. **02 Hrs**

Text Books:

1. **World Class Manufacturing**Sahay B S. Saxena K.B C, Ashish Kumar, - A Strategic Perspective; MacMillan India Ltd., ISBN 0333-93-4741
2. **Business Process Benchmarking:. Finding and Implementing Best Practices**,Champ, Robert C. Vision Books, New Delhi, 1995.
3. **Reengineering the Corporation A Manifesto for Business Revolution**, Hammer, Michael and James Champy. Nicholas Brealey Publishing, London, ISBN-0-06-662112-7

4. **Design for Six Sigma,** Gerg Brue, TMH 2003, ISBN 0-07-058120
5. **Six Sigma for Managers,** Greg Brue, TMH 2002; ISBN - 0-07-048639-5

Reference Books:

1. **Design for Six Sigma in Technology and Product Development** Creveling, Pearson Education.
2. **Total Quality Management** Dale H. Besterfield, Carol Besterfield-Minchna, Glen H Bester field & Mary Bester field Sacre, , 3rd edn, Pearson Education, ISBN 81-297-0260-6

Course Outcomes

CO 1	To understand various models, philosophies for achieving WCM
CO 2	To understand the concepts of benchmarking and how to collect data, analyse & implement
CO 3	To understand the concepts of re-engineering, six sigma and activity based management

Scheme for examination: Five questions choosing one each from each unit and **Unit 1 and 2** with choice questions

Online References:

https://www.youtube.com/playlist?list=PL1AF592F3CDD31C86

EBooks

http://bookboon.com/en/how-to-improve-your-production-part-i-ebook

ASSESSMENT

Continuous Internal Evaluation (CIE) includes periodic class tests, quizzes or Alternative Assessment Tools (AAT) prescribed by the faculty handling a course prior to beginning of the classes like assignments, problem solving, case studies, group discussion, seminar, mini-project etc.

Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

Both CIE and SEE have equal (50:50) weightages. The student's performance in a course shall be judged individually and together based on the results of CIE and SEE.

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

Course	INDUSTRIAL POLLUTION CONTROL	Course Code	16IE6DEIPC
Credits	03	L-T-P-S	3-0-0-0

Prerequisites: Nil

UNIT-1

Pollution and its measurementsIntroduction: Man and Environment, types of pollution, pollution control aspects **02Hrs**

Industrial pollution emissionsand Indian standards industrial emissions liquids, gasesand solids legislations,water quality management in India, Air (prevention and control ofpollution) Act, 1981. **04Hrs**

UNIT-2

Analysis of Pollutants Introduction, Industrial waste water analysis industrial gaseouseffluents, and analysis - particle size distribution. **04 Hrs**

Pollution control for specific pollutants Treatment Liquid effluents - Removal of BOD, Chromium, Mercury, Ammonia/urea,Phenolic effluents sources, measurements, removal systems. **04Hrs**

UNIT-3

Treatment of particulate matter particle dynamics,stopping distance. Separation ofparticulate matter from effluent gases, methods of separation cyclone separators,aerodynamic separation, and fabric filters, liquid scrubbers, electrostatic precipitators. **06Hrs**

Treatment of Gaseous effluents Removal of - Sulphurdioxide, Oxides of Nitrogen,organicvapour from effluent gases - Analysis, Harmful effects, ISI standards, ControlMeasures. **04Hrs**

UNIT-4

PC is selected process in industries General considerations of Pollution Control in

Chemical industries, Fertilizer Industries,Petrochemical Refineries, Pulp and Paper Industries, Process Industries (Tanning, Alcohol,Sugar, Electroplating and Metal Finishing), Treating E-wastes, radioactive wastes. **06Hrs**.

UNIT- 5

Case studies and details of Industrial disasters and their impact on Human HabitationBhopal gas tragedy, nuclear disasters - Chernobyl, US, Fukushima Daichi, HeavyMetalContamination. **06 Hrs**

Introduction to Pollution Prevention Definition, Drivers of Pollution Prevention, Path toPollution Prevention, Program Elements, Incentives for Pollution Prevention, StructuredPollution Prevention Program Case Studies.

Bhopal gas tragedy, nuclear disasters - Chernobyl, US, Fukushima Daichi, Heavy MetalContamination. **04Hrs**.

Text books:

1) **Pollution control in process industries**, S.P.Mahajan, IIT Bombay, Tata-McGraw Hill Publishing Co., New Delhi, 1985.
2) **Pollution Prevention** – Methodology, Technologies & Practice, Kenneth L. Mulholland, James A. Dyer, American Institute of Chemical Engineers, New York, 1999.

Reference Books:

1) **Industrial Pollution and Management**, Arvind Kumar, APH Publishing Corp., New Delhi, 2004.
2) **Environmental Planning – Machinery and Management**, V.S.Mahajan, Deep & Deep Publishing, 1991
3) **Industrial Air Pollution Engineering,** Edited by Vincent Cavaseno& Staff of Chemical Engg., McGraw Hill Publishing Co., New York, 1980

Course Outcomes

CO 1	Learn various treatment methods of liquid effluents, treatment of particulate matter as well as treatment of gaseous effluents. Also, various control measures adopted all over the globe
CO 2	Be exposed to general consideration of pollution control in various industries such as chemical, fertilizers, petrochemicals, pulp & paper, process industries. Treating E- wastes and radioactive wastes will also be taught.
CO 3	Be able to discuss and understand through various practical case studies the extent of environmental, social and economic damage due grave industrial disasters all over the globe
CO 4	Learn theoretically various pollution prevention methods adopted across industries all over the world
CO 5	Be able to discuss and understand through various practical case studies the extent of environmental, social and economic damage due grave industrial disasters all over the globe.
CO 6	Learn theoretically various pollution prevention methods adopted across industries all over the world.

Scheme of examination: 5 questions to be set with one question from each unit carrying 20 marks each. **Unit 3 and Unit 5** will have an internal choice.

ASSESSMENT

Continuous Internal Evaluation (CIE) includes periodic class tests, quizzes or Alternative Assessment Tools (AAT) prescribed by the faculty handling a course prior to beginning of the classes like assignments, problem solving, case studies, group discussion, seminar, mini-project etc.

Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

Both CIE and SEE have equal (50:50) weightages. The student's performance in a course shall be judged individually and together based on the results of CIE and SEE.

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

Course	ADVANCED OPERATIONS RESEARCH	Course Code	16IE6DEAOR
Credits	03	L-T-P-S	3-0-0-0

Prerequisites: Nil

UNIT–1

Advanced Linear Programming: Two phase simplex techniques, Revised simplex techniques. Sensitivity analysis **08Hrs**

UNIT–2

Integer Programming: Gomorey's Algorithm and Branch & Board Technique, Solution of Assignment & Travelling salesman Problem **05Hrs**

Goal Programming: Introduction and simple Problem formulation. **03Hrs**

UNIT–3

Non-Linear Programming: Introduction, Lagrange and Kuhn – Tucker conditions for constrained problems **06Hrs**

Queuing Theory: M/Ek/1, M/D/1, M/M/C and M/G/1 **06 Hrs**

UNIT-4

Dynamic Programming: Characteristics and DP model, Computational procedure(no problem solving, only formulation) **04Hrs**

Advanced CPM Techniques: Advanced CPM Techniques: Resource leveling network techniques, scheduling activities to level the demands on key resources, time cost of trade off aspects in network techniques. Determination of least cost schedule. **04Hrs**

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

UNIT-5

Markov Chains: Discrete Stochastic Process, Markovian process, Stationary Markovchains, Markov diagrams, Ergodic and Absorbing Markov chains, Steady State probabilities,stochastic matrix, transition m, matrix and their applications. **04Hrs**

Or In Practice: A Soft Approach: Soft O.R./Problem Structuring Methods, Strategic Options Development Analysis (SODA), Soft Systems Methodology (SSM) **02 Hrs**

Texts books:

1) **Operation Research an Introduction**, Hamdy A Taha, Pearson Education; 9 edition (2014), ISBN- 13: 978-9332518223.
2) **Introduction to Operations Research**. Frederick K. Hiller and others, McGraw Hill Education India Private Limited; 9 edition (2011), ISBN-13: 978-0071333467.
3) **Operations Research: Principles and Practice**, Ravindran and others, Wiley; Second edition (2007), ISBN-13: 978-8126512560
4) Introduction to Optimization techniques (Operations Research),Pant J.C. -, Jain Brothers, 6th Edition,(2005)

References books:

1) **Operation Research**,SesieniYaspan and Freidan –Wiley International
2) **Introduction to OR**,Ackoff –– Wiley International
3) **Principles of Operation Research: With Applications to Managerial Decisions**, H.M.Wagner –Prentice Hall, ISBN –0-87692-162-4

Online Reference:

1. http://nptel.ac.in/courses/117103017/
2. http://people.brunel.ac.uk/~mastjjb/jeb/or/contents.html

Course Outcomes

CO 1	To be able to understand the advanced concepts, approaches and optimization in Linear programming and implementation of these tools in real life
CO 2	To be able to recognize and optimize single and multi criteria programming problems
CO 3	To be able to recognize and optimize Non-Liner Programming problems and Waiting line Models
CO 4	To be able to recognize and Dynamic Programming and Network models for solving real life situation cases
CO 5	To be able to recognize Markov Chains problems for solving real life situation cases and also to understand Soft approach in Operation research.

Scheme of Examination:

Each question from each unit and internal choice from **Unit 1&Unit 3**

ASSESSMENT

Continuous Internal Evaluation (CIE) includes periodic class tests, quizzes or Alternative Assessment Tools (AAT) prescribed by the faculty handling a course prior to beginning of the classes like assignments, problem solving, case studies, group discussion, seminar, mini-project etc.

Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

Both CIE and SEE have equal (50:50) weightages. The student's performance in a course shall be judged individually and together based on the results of CIE and SEE.

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

Course	COMPUTERS IN MANUFACTURING	Course Code	16IE5DCCIM
Credits	06	L-T-P-S	3-0-0-0

Prerequisites: Nil

UNIT-1

Introduction: Introduction to automation, definition, types of automation, reasons for automating, arguments for and against automation.

Productivity concepts and mathematical models:
Introduction, manufacturing lead-time, components of operating time, production rate, plant capacity, utilization and availability, work-in-process, automation strategies. (Problems) **10Hrs**

UNIT-2

High volume production system: Introduction to automated flow lines, Configuration of flow lines,Methods of work-part transport systems, Performanceanalysis of automated flow lines, analysis of automated transfer lines without buffer, automated flow lines with storage buffer, analysis of a two-stage line. Line balancing of assembly systems.(Problems on line balancing only). **10Hrs**

UNIT-3

Group Technology: Part families, part classification and coding systems, machine cell design, application consideration in group technology.
Computerized manufacturing planning systems: Introduction, computer aided process planning, retrieval and generative type of process planning, benefits of computer aided process planning. **06Hrs**

UNIT-4

Flexible manufacturing systems: Introduction to FMS, components of FMS, types of FMS,Layout configurations, computer control system, application and benefits of FMS. FMS planning and implementation issues

Computer networks for manufacturing: Introduction, h**ierarchy** of computers in manufacturing, local area networks, manufacturing automation control. **08Hrs**

UNIT-5

Automated inspection and testing: Introduction, contact and non-contact inspection techniques, Types of coordinate measuring machines, applications and benefits, machine vision.

The future automated factory: Introduction, trends in manufacturing, the future automated factory, the social impact of automated systems. **06Hrs**

Text books:

1) **Automation, Production Systems and Computer IntegratedManufacturing**-Mikell P. Groover, Pearson – Education, New Delhi, 5th printing 1996, ISBN-812030618X, Edition 2003, ISBN-81-7808-511-9

2) Computer Control Of Manufacturing Systems, YoremKoren, Edition 2005, Tata McGraw Hill, ISBN -0-7-Y66379-3

Reference books:

1) Automation, Production Systems and Computer IntegratedManufacturing-Mikell P. Groover, PHI, New Delhi, Edition 2007, ISBN-978-0132-393218

2) **CAD/CAM**Mikell P. Groover and Emory W.Zimmers, PHI, NewDelhi, 22 printing, 2003, ISBN-81-203-0402-0.

3) **An Introduction to Automated Process Planning System**–TiessChieu Chang and Richard A WyskPHI , Edition 1985.

Online Resource:www.nptel.ac.in/

Course Outcomes

CO 1	Is able to acquire the knowledge of fundamentals of automation, the types of automation and the need to go in for automation. Learn about the concepts of production automation, strategies in automation.
CO 2	Is able to learn the transfer mechanisms, analysis of production and assembly automated flow lines and balancing of flow lines.
CO 3	Is able to learn about computerized process planning system, types of computer aided process planning, and benefits of CAPP, and Group Technology.
CO 4	Is able to understand Flexible Manufacturing system, and its application. Is able to understand Computer networks for production automation, network topology, Manufacturing automation protocol and other related topics
CO 5	Is able to understand the various types of techniques and equipment used in automated inspection and testing, is able to understand the concept of future automated factory, the trends in manufacturing and the importance of automation in enhancing the standard of living.

Scheme of examination:

To set one question from **Units 3, 4 & 5**, and two questions from **Units 1 &2**.

ASSESSMENT

Continuous Internal Evaluation (CIE) includes periodic class tests, quizzes or Alternative Assessment Tools (AAT) prescribed by the faculty handling a course prior to beginning of the classes like assignments, problem solving, case studies, group discussion, seminar, mini-project etc.

Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

Both CIE and SEE have equal (50:50) weightages. The student's performance in a course shall be judged individually and together based on the results of CIE and SEE.

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

Course	MARKETING MANAGEMENT	Course Code	16IE6DEMKM
Credits	03	L-T-P-S	3-0-0-0

Prerequisites: Nil

UNIT-1

Introduction: Historical development of marketing management, Definition of Marketing, Marketing Management philosophies, Micro and Macro Environment, importance of marketing in the India Socio – economic system.

Marketing Information Systems And Research: Components, benefits & uses, marketing research procedure, measurement of market demand. Types of markets, Marketing Vs. MIS, Marketing Mix **10 Hrs**

UNIT-2

Consumer Markets And Buying Behaviour: Characteristics affecting Consumer behaviour, Types of buying decisions, buying decision process, Classification of consumer products, Market Segmentation. Marketing of Industrial products.

Product Planning And Development: The concept of a product, features of a product, classification of products, product policies – product planning and development, product line, product mix – factors influencing change in product mix, product mix strategies, meaning of New – product; major stages in new – product development, product life cycle. **10 Hrs**

UNIT-3

Branding: Branding, Reasons .0for branding, functions of branding, features and types of brands, kinds of brand name.

Labeling: Types, functions, advantages and disadvantages

Packaging: Meaning, growth of packaging, function of packaging, kinds of packaging. **06 Hrs**

UNIT-4

Advertising And Sales Promotion: Objectives of advertisement function of advertising, classification of advertisement copy, advertisement media – Ethical Code, kinds of media, advantages of advertising, Advt. Standards Council of India – Role and Responsibilities.Objectives of sales promotion, advantages of sales promotion. **07 Hrs**

UNIT-5

Personal Selling: Objectives of personal selling, establishing the Sales force objectives, sales force strategy, sales force structure and size, salesmanship, qualities of good salesman, types of salesman.

Pricing : Problems in Pricing, methods in pricing.

Typical Case Studies – Examples from MNCs and Indian Companies penalized for wrong promotion methods. **07 Hrs**

Text Books:

1) **Modern Marketing – Principles and Practices –** RSN Pillai & Bhagavathi – S.Chand and Co. Ltd, New Delhi.,2001
2) **Marketing Management – Planning, Implementation and Control** – The Indian Context - V S Ramaswamy, S Namakumari, Mac Millan India Ltd, 1990.
3) **Principles of Marketing** - Philip Kotler & K Gary Amstrong , Prentice – Hall. 11th Edn., 2008
4) **Marketing Management** - Philip Kotler , Prentice – Hall. 12th Edn.2009.
5) **Marketing Management** - Michael R Czinkota, , 2nd Edition, Vikas Publishing House.

Reference Books:

1) **Marketing Management** – ICFAI Centre for Management Research, Hyderabad., 1st Edition, 2004,
2) **Fundamentals of Marketing -**Wiliam J Stanton, McGraw Hill, 1994
3) **Marketing Management**–Russel, S Winar, Pearson education series, 3rd Edition,2009

4) **Marketing Management Text &Cases,** Rajagopal - Vias Publishing House, 2006

Course Outcomes

CO 1	Learn Marketing as an important function to accomplish the ultimate interest of any organization, its evolution, various aspects connected with it and also modern marketing approaches
CO 2	Be exposed to consumer behavior, marketing systems and stages of buying processes which gives confidence for him/her to excel in the field
CO 3	Provided with knowledge of MIS and the research work done in the field and also marketing of industrial and consumer goods, the challenges faced
CO 4	Be given the knowledge of product, its development, growth, maturity and decline i.e. product development life cycle, role of branding, packaging and labeling to make him/her good marketer
CO 5	Be exposed to the role of pricing, pricing mechanisms, rationality and irrationality of pricing and strategies and decision making.
CO 6	Understand marketing channels and movement of products and services and its physical distribution. This knowledge will make the student an effective marketer in future.

Scheme of Examination: One question from each unit and choice from **unit 1 and unit 2**

ASSESSMENT

Continuous Internal Evaluation (CIE) includes periodic class tests, quizzes or Alternative Assessment Tools (AAT) prescribed by the faculty handling a course prior to beginning of the classes like assignments, problem solving, case studies, group discussion, seminar, mini-project etc.

Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

Both CIE and SEE have equal (50:50) weightages. The student's performance in a course shall be judged individually and together based on the results of CIE and SEE.

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

Course	HYDRAULICS & PNEUMATICS	Course Code	16IE6DEHP
Credits	03	L-T-P-S	3-0-0-0

Prerequisites: Nil

UNIT-1

Introduction To Hydraulic Power: Pascal's law and problems on Pascal's Law, continuityequations. Structure of HydraulicControl System. The Source of Hydraulic Power: Pumps pumping theory, pumpclassification, gear pumps, vane pumps, piston pumps, pump performance, pump selection. **09 Hrs**

UNIT-2

Hydraulic Actuators And Motors: Linear Hydraulic Actuators [cylinders], Mechanics of Hydraulic Cylinder loading, Hydraulic Rotary Actuators, Gear motors, vane motors, piston motors, Hydraulic motor theoretical torque, power and flow rate, hydraulic motor performance **08Hrs**

UNIT-3

Control Components In Hydraulic Systems: Directional Control Valves – Symbolic representation, Constructional features, pressure control valves – direct and pilot operated types, flow control valves. **08 Hrs**

UNIT-4

Hydraulic Circuit Design And Analysis: Control of single and double – acting Hydraulic Cylinder, regenerative circuit, pump unloading circuit, Double pump Hydraulic system, Counter Balance Valve application, Hydraulic cylinder sequencing circuits. Locked cylinder using pilot check valve, cylinder synchronizing circuits, **05 Hrs**

Maintenance Of Hydraulic Systems: Hydraulic oils; Desirable properties, general type of fluids, Sealing devices, reservoir system, filters and strainers, problem caused by gases in hydraulic fluids, wear of moving parts due to solid particle contamination **05 Hrs**

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

UNIT-5

Introduction To Pneumatic Control: Compressed air: Production of compressed air – compressors, preparation of compressed air- Driers, Filters, Regulators, Lubricators, Distribution of compressed air- Piping layout. Characteristics of compressed air.Structure of Pneumatic control system. Pneumatic Actuators: Linear cylinders – Types, conventional type of cylinder working, end position cushioning, seals, mounting arrangements applications. **05 Hrs**

Text Books:

1) Fluid Power with applications, Anthony Esposito, Fifth edition Pearson education, Inc. 1996, ISBN-10-0133998908
2) Pneumatics and Hydraulics, Andrew Parr. JaicoPublishing Co. 3rd Edition, 2000.

Reference Books:

1) Oil Hydraulic Systems - Principles and Maintenance, S.R. Majumdar, Tata McGraw Hill Publishing company Ltd. 2001.
2) Pneumatic Systems, S.R. Majumdar, Tata McGraw Hill publishing Co., 1995.
3) Industrial Hydraulics, Pippenger, Hicks, McGraw Hill, New York, 1979.

Online Resource:www.nptel.com

Course Outcomes

CO 1	Able to understand the concepts of fluid power and its advantages, disadvantages andapplications
CO 2	Learnt about different types of fluid power generating elements along with the iradvantages, disadvantages and applications.
CO 3	Learnt about different types of fluid power utilizing elements along with theiradvantages, disadvantages and applications
CO 4	Learnt about different types of fluid power controlling elements along with theiradvantages, disadvantages and applications
CO 5	Able to design hydraulic and pneumatic circuits for different applications



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Scheme of Examination:

Answer Five full questions selecting one from each unit.One question from each Unit and internal choice from Units1 & 4

ASSESSMENT

Continuous Internal Evaluation (CIE) includes periodic class tests, quizzes or Alternative Assessment Tools (AAT) prescribed by the faculty handling a course prior to beginning of the classes like assignments, problem solving, case studies, group discussion, seminar, mini-project etc.

Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

Both CIE and SEE have equal (50:50) weightages. The student's performance in a course shall be judged individually and together based on the results of CIE and SEE.

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Course	COMPUTERS IN MANUFACTURING	Course Code	16IE5DCCIM
Credits	06	L-T-P-S	3-0-0-0

Prerequisites: Nil

UNIT-1

Operation research

1. Solving& sensitivity analysis of LPP models
2. Solving& sensitivity analysis of transportation models
3. Solving of assignment models
4. Solving of Travelling Sales men models,
5. Determination of Critical path for CPM model
6. Crashing of activities using CPM model
7. Determination of Critical path for PERT model and its estimation
8. Determination of steady state condition using Markov models
9. Solving & analysis of NLPP models

UNIT-2

10. Presentation Data in tables & charts
11. Sampling distributions of mean & Proportions
12. Chi-square test for different between two proportions
13. Nonparametric analysis for two independent populations
14. t Test of Hypothesis for mean (σ unknown)
15. Z Test of Hypothesis for Proportions
16. Multi-criteria decision making problems

Suggested Software Packages

1. Statistical Packages : SYSTAT / MINITAB / SPSS and such others
2. OR Packages : Lindo / Lingo / STORM / such others
3. MS Excel

Reference Books:

1) **Operation Research an Introduction**, Hamdy A Taha, Pearson Education; 9 edition (2014), ISBN- 13: 978-9332518223.
2) Introduction to Optimization techniques (Operations Research), Pant J.C. -, Jain Brothers, 6th Edition,(2005)
3) **Applied statistics and Probability for Engineers** - Douglas C Montgomery, George C Runger, 2nd Edn, John Wiley and Sons, ISBN-0-471-17027-5
4) **Probability and Statistics** - Walpole & Mayer, MacMillan Publishing Company, 1989

Online Reference:

1. http://people.brunel.ac.uk/~mastjjb/jeb/or/contents.html

Scheme of Examination: Student will appear for Examination and will conduct 2 Experiment choosing Unit-1 and Unit-2 suggested by the Examiners.

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
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Department Vision

To emerge as an excellent center for imparting quality higher education and generating highly proficient technical manpower to adopt to the constantly changing global scenario with professional and ethical values.

Department Mission

- Providing excellent education in curricular, co- curricular and extra-curricular activities to students.
- Facilitating to continue their education through research activities
- Catering to the needs of the Industry and society.
- Nurturing and mentoring students to acceptance by stake holders

Program Outcomes (POs)

PO 1	An ability to apply knowledge of science, computing, mathematics, and industrial engineering fundamentals appropriate to the discipline.
PO 2	An ability to analyze a problem, and identify and formulate the industrial engineering principles appropriate to its solution
PO 3	An ability to design, implement, and evaluate a computer-based industrial engineering system or/and process to meet desired needs with appropriate consideration for public health and safety, cultural, societal and environmental considerations
PO 4	An ability to design and conduct experiments using IE models and IT tools , to analyze and interpret data leading to feasible solutions
PO 5	An ability to use current techniques, modern tools and skills necessary for industrial engineering practice
PO 6	An ability to analyze the local and global impact of industrial engineering solutions on individuals, organizations, and society
PO 7	Develop a Knowledge of contemporary issues and solutions
PO 8	Develop an understanding of security, professional, ethical, legal, and social issues and responsibilities of an industrial engineer
PO 9	An ability to function effectively, individually and in a team, in diverse and multi-disciplinary environments to accomplish a common goal
PO 10	Develop an ability to communicate effectively with a range of audiences in all situations
PO 11	An understanding of engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects in a multidisciplinary environment
PO 12	Recognize the need for and an ability to engage in continuing professional development

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NOTATIONS

AY	Academic Year
AAT	Alternative Assessment Tools
BOE	Board of Examiners
BOS	Board of Studies
CBCS	Choice Based Credit System
CGPA	Cumulative Grade Point Averages
CIE	Continuous Internal Evaluation
DC	Departmental Core
GC	Group Core
HSS	Humanity and Social Science Courses
IC	Institutional Core
IE	Institutional Elective
IL	Institutional Lab.
LTPS	Lecture – Tutorial-Practical-Self Study
NFTE	Not Fit for Technical Education
PCC	Professional Core Courses
PEC	Professional Elective Courses
SEE	Semester End Examination
SGPA	Semester Grade Point Average
ST	Studio
SS	Self Study
CO	Course Outcome
PO	Program Outcome
PEO	Program Educational Objectives

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SCHEME OF INSTRUCTIONS FOR THIRD SEMESTER

Sl No	Course Code	Course Title	Credits				
			L	T	P	S	Total
1	15MA3DCMIE	HIGHER ENGINEERING MATHEMATICS	3	1	0	0	4
2	15IM3DCPT1	PRODUCTION TECHNOLOGY-I	3	0	1	2	6
3	15IM3DCSOM	STRENGTH OF MATERIALS	3	0	0	0	3
4	15IM3DCMMM	MECHANICAL MEASUREMENTS & METROLOGY	3	0	1	0	4
5	15IM3DCEES	ELEMENTS OF ENERGY SYSTEMS	3	0	0	0	3
6	15IM3GCCMD	COMPUTER AIDED MACHINE DRAWING	1	0	2	2	5
		Total	16	1	4	4	25

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III SEMESTER

Course Name	Higher Engineering Mathematics	Course Code	15MA3DCHEM
Credits	04	L – T –P–S	3-1-0-0

Prerequisites: Matrices,concepts of Trigonometry andTrigonometric formulas, methods of differentiation, methods of integration, partial derivatives, solution methods of ordinary differential equations.

Course Outcomes:

On completion of the course, the student will have the ability to:

CO 1 Compute solution of a system of algebraic equations
CO 2 Demonstrate an understanding to Fourier series and Fourier transforms.
CO 3 Formulate boundary value problems involving one dimensional heat and wave equation.
CO 4 Employ analytical techniques to solve partial differential equations with appropriate boundary conditions
CO 5 Apply Z- transforms techniques to solve difference equations
CO 6 Obtain the extremal of a functional.

UNIT-1

MATRICES **[9 hours]**

Introduction: Elementary row transformations, Echelon form of a matrix, rank of a matrix by elementary row transformations. Consistency of system of linear equations and solution. Solution of a system of non-homogenous equations: Gauss elimination method, LU decomposition method, Gauss-Seidel method. Eigenvalues and eigenvectors of matrices. Reduction of a matrix to diagonal form. **(7L + 2T)**
Suggested Reading: Inverse of a matrix using Gauss-Jordan method. Largest eigenvalue and corresponding eigenvector using Rayleigh power method.

UNIT-2

FOURIER SERIES **[9 hours]**

Introduction: Periodic function, Dirchlet's conditions, statement of Fourier Theorem, Fourier series of a periodic function of period $2l$, Fourier series of functions having points of discontinuity.

Applications: Fourier series of typical waveforms -saw toothed waveform, triangular waveform, square waveform, half-wave rectifier, full wave rectifier and modified saw tooth waveform.Practical harmonic analysis. **(7L + 2T)** Suggested Reading: Half range Fourier series, Fourier series of discrete functions, Complex
Fourier series.

UNIT-3

FOURIER TRANSFORMS **[10 hours]**

Infinite Fourier transform, Fourier Sine and Cosine transforms, properties, Inverse transforms, Fourier transforms of derivatives. **(7L + 3T)** Suggested Reading: Convolution theorem, Parseval's identities and physical significance of Parseval's identities.

UNIT-4

PARTIAL DIFFERENTIAL EQUATIONS **[10 hours]**

Formation of Partial differential equations-elimination of arbitrary constants, elimination of arbitrary functions. Equations of first order- The linear equation $P\,p + Q\,q = R$ **(**Lagrange's partial differential equation).
Applications: One-dimensional heat equation and wave equation (without proof), various possible solutions of these by the method of separation of variables. **(7L + 3T)**

Suggested Reading: Direct integration method, method of separation of variables, D'Alembert's solution of wave equation.

UNIT-5

Z –TRANSFORMS AND CALCULUS OF VARIATIONS **[10 hours]**

Z-transforms**:** Definition, Properties, Transforms of standard functions, Inverse transforms.
Applications:Solution of difference equations using Z- transforms.
Calculus of variations: Variation of a functional, Euler's equation, variational problems.
Applications: Hanging cable problem, Geodesics on a right circular cylinder, Brachistochrone problem. **(8L + 2T)** Suggested Reading: Minimal surface of revolution, Geodesics of a right circular cone and sphere.

Mathematics Lab

- Solution of system of algebraic equations using Gauss Seidel method
- LU decomposition of matrices.
- Eigenvalues and eigenvectors of matrices.
- Largest and smallest eigenvalue and corresponding eigenvector of a matrix.
- Diagonalisation of matrices
- Z-transforms

Bibliography

Text Books

1. "Advanced Engineering Mathematics", Erwin Kreyszig, 10th edition Vol.1 and Vol.2, 2014, Wiley-India.
2. "Advanced Engineering Mathematics", Dennis G. Zill and Cullen, 4th edition, 2011, Jones and Bartlett India Pvt. Ltd.

Reference Books:

1. "Higher Engineering Mathematics", B.V. Ramana, 6th edition, 2007, Tata McGraw Hill.
2. "Higher Engineering Mathematics", B.S. Grewal, 43rd edition, 2013, Khanna Publishers.

E books and online course materials

(1) Engineering Mathematics, K. A. Stroud, Dexter J. Booth, Industrial Press, 2001 http://books.google.co.in/books/about/Engineering_Mathematics.html?id=FZncL-xB8dEC&redir_esc=y.
(2) Advanced Engineering Mathematics, P. V. O'Neil, 5th Indian reprint, 2009, Cengage learning India Pvt. Ltd.

Online Courses and Video Lectures:

(1) http://ocw.mit.edu/courses/mathematics/ (online course material)
(2) http://nptel.ac.in/courses.php?disciplineId=111
(3) https://www.khanacademy.org/
(4) E-learning: www.vtu.ac.in
(5) https://www.class-central.com/subject/math (MOOCS)

On completion of the course students will be able to:

Course Code	CO#	COURSE OUTCOME (CO)	PO	Bloom's level
	CO 1	Compute solution of a system of algebraic equations.	2, 3	2, 3
	CO 2	Determine whether a given system is stable or unstable.	2, 3	2, 3
	CO 3	Express given functions to form Fourier series.	2, 3, 4	2, 3, 4
	CO 4	Demonstrate an understanding of Fourier transforms techniques	2, 3, 4	2, 3, 4
	CO 5	Employ analytical techniques to solve partial differential equations with appropriate boundary conditions	2, 3, 4	2, 3, 4
	CO 6	Apply Z- transforms techniques to solve difference equations.	2, 3	2, 3
	CO 7	Use calculus of variations to find the extremal of a functional	2, 3	2, 3

Question Paper Pattern

1. Each unit consists of one full question.
2. Each full question consists of three or four subdivisions.
3. Five full questions to be answered.
4. Internal choice in unit-3 and unit-5

Assessment:

1. Each unit consists of one full question.
2. Each full question consists of three or four subdivisions.
3. Five full questions to be answered.
4. To set one question from Units 1, 2, 5 and two questions from Unit 3 and Unit 4

Questions for CIE and SEE will be designed to evaluate the various educational components (Blooms taxonomy) such as:

5. Remembering and understanding the course contents (weightage: 40%)
6. Applying the knowledge acquired from the course (weightage: 35%)
7. Analyzing various engineering problems (weightage: 15%)
8. Understanding of various system models (weightage: 5%)

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III SEMESTER

Course	PRODUCTION TECHNOLOGY - I	Course Code	15IM3DCPT1
Credits	06	L -T – P-S	3 -0- 1-2

PRE-REQUISITES: NIL

Unit- 1

Theory of Metal Cutting:
Single point cutting tool nomenclature, Merchants circle diagram and analysis, Ernst Merchant's solution, shear angle relationship, problems of Merchant's analysis, tool wear and tool failure, tool life, effects of cutting parameters on tool life, tool failure criteria, Taylor's tool life equation, problems on tool life evaluation.

07Hrs.

Cutting tool materials:
Types of cutting tool materials HSS, carbides coated carbides, ceramics

02Hrs.

Cutting fluids:
Desired properties, types and selection, Heat generation in metal cutting, factors affecting heat generation, Heat distribution in tool and W/P, Measurement of tool tip temperature. Desired properties of Cutting tool materials

02Hrs.

Unit-2

Production Lathe: Classification of Lathes, Capstans & Turret lathes- Constructional features. Tool and work holding devices, Tool layout. 0**4Hrs.**

Shaping, Slotting and planning machines:
Classification, constructional features of shaping m/c, slotting m/c, planning m/c. driving mechanisms of shaping, slotting and planning machines. Operations done on shaping machine, slotting machine and planning machine. Calculation of machining time. 0**4Hrs.**

Drilling machines:
Classification, constructional features of Drilling Machines. Drilling & related operations, types of drill & drill bit nomenclature, drill materials. Calculation of machining time.

0**3Hrs.**

Unit- 3

Milling machines:
Classification, constructional features, milling cutters nomenclature. Milling operations, up milling and down milling concepts. Calculation of machining time. 0**2Hrs.**

Indexing:
Simple, compound, differential and angular indexing calculations, Simple numerical on indexing. 0**4Hrs.**

Unit- 4

Grinding:
Types of abrasives, bonding process, classification, constructional features (cylindrical and surface grinding, center less grinding), selection of grinding wheel. **01Hr.**

Laping and Honing:
Construction, applications, Principles of operation. **01Hr.**

Non-traditional machining processes:
Principle, need, equipment, operation and LBM, plasma arc machining, Electro chemical machining, ultrasonic machining, abrasive let machining, water jet machining. **04Hrs.**

Unit- 5

Rapid Prototyping:
Introduction: Need for the compression in product development, history of RP systems, Survey of applications, Growth of RP industry, and classification of RP systems.
Stereo Lithography Systems, Selective Laser Sintering and Fusion Deposition Modeling: Principle, Process parameter, Process details, Data preparation, data files and machine details, Application. **06Hrs.**

MACHINE SHOP LAB.

Preparation of three models on lathe involving: Facing, Plain turning, Taper turning, Step turning, Thread cutting, Knurling, Drilling, Boring, Internal Thread cutting and Eccentric turning.
Cutting of "V" Groove/ Dovetail / Rectangular groove: Using Shaping Machine, Cutting of Gear Teeth Using Milling Machine. Demonstration on Grinding Machine.

Text Books:
1. **Workshop Technology**, Hazra Choudhry, Vol -II, Media Promoters & Publishers Pvt. Ltd. 2004, ISBN-81-85099-15-4
2. **Production Technology**, R.K.Jain, Khanna Publications, 2003. ISBN 8174090991, 9788174090997
3. **Stereo Lithography and other RP & M Technologies** – Paul F. Jacobs – SME NY 1996.

Reference Books:
1. **Production technology,** HMT, Tata McGraw Hill, 2001.ISBN-978-0-07-096443-3
2. **Fundamentals of Metal Machining and Machine Tools**, G. Boothroyd, McGraw Hill, 2000,ISBN-13-978-57444-659-3,
3. **Workshop Technology**, N.W.A.J. Chapman ,Vol.II,, CBS Publications, 2005, ISBN-10:8123904010, ISBN-13:978-8123904016

1. http://nptel.ac.in/courses/112105126/
2. http://nptel.ac.in/courses/112105127/
3. https://www.class-central.com/subject/

COURSE OUTCOMES

CO1	To understand different types of machine tools and their mechanism, types, applications and operations
CO2	Ability to solve machining time, tool life, indexing problems
CO3	Ability to understand failure criteria, heat generation & distribution, selection of cutting fluids
CO4	To understand the principles, advantages and limitations of Non-conventional machining and Rapid Prototyping

Assessment of Self Study:

Student group of 5 members to submit following assignments on Rapid Prototyping at the end of the course.

1. Creation of CAD model of component
2. Conversion of CAD model to STL format
3. Slicing the STL file into thin cross section layers
4. Construction of the model one layer at a time
5. Cleaning and finishing the model
6. Documentation and report submission

Scheme of examination: One question from each unit and choice from Unit 1 and 2.

ASSESSMENT:

Continuous Internal Evaluation (CIE) includes mid-term tests, weekly/fortnightly class test, homework assignments, problem solving, group discussions quiz, seminar, mini-project and other Alternate Assessment Tools (AAT)prescribed by the faculty handling a course prior to beginning of the classes.

Semester End Examination(SEE)-a written examination for theory courses and practical/ design examination with built-in oral part (Viva Voice).

Both CIE and SEE have equal (50:50) weightages. The student's performance in a course shall be judged individually and together based on the results of CIE and SEE.

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III SEMESTER

Course	STRENGTH OF MATERIALS	Course Code	15IM3DCSOM
Credits	03	L-T-P-S	3-0-0-0

PRE-REQUISITES : NIL

Unit – 1

Simple stress and strain: Introduction, stress, strain, mechanical properties of materials, Linear elasticity, Hooke's Law and Poisson's ratio, Stress-Strain relation – behavior in Tension for Mild steel and nonferrous metals. Extension / Shortening of a bar, bars with cross sections varying in steps, Total elongation of tapering bars of circular cross section . Principle of super position, Elongations due to self-weight for constant cross section, simple shear stress, shear strain, elastic constants and their relations, volumetric strain.

Compound bars: General Introduction, plane stress, stresses on inclined sections, General two dimensional stress system, principal stresses and maximum shear stresses, Mohr's circle for plane stress. 1**2Hrs.**

Unit - 2

Bending moment and Shear force in beams: Introduction, Types of beams, loads and reactions, shear forces and bending moments, rate of loading, sign conventions, relationship between shear force and bending moments, shear force and bending moment diagrams for different beams subjected to concentrated loads, uniformly distributed load and couple for different types of beams. **06Hrs.**

Unit - 3

Bending and shear stresses in beams: Introduction, theory of simple bending, assumptions in simple bending, relationship between bending stresses, radius of curvature and bending moment, moment carrying capacity of a section, Shear stress diagram for rectangular, symmetrical I and T section (composite / fletched beams not included).Derivation of Euler Bernoulli deflection equation only. 1**0Hrs.**

Unit - 4

Torsion of circular shafts: Introduction, pure torsion, assumptions, derivation of torsional equations, polar modulus, torsional rigidity / stiffness of shafts, power transmitted by solid and hollow circular shafts**.** **06Hrs.**

Unit - 5

Thick and thin cylinders: Stresses in thin cylinders, changes in dimensions of cylinder (diameter, length and volume), Thick cylinders subjected to internal and external pressures (Lame's equation), (compound cylinders not included).

Columns and Struts: Introduction: Euler's formula for critical load of columns for different end conditions, limitations of Euler's theory, Rankine's formula. No derivation, No Numerical. **06Hrs.**

Text Books:

1. **Strength of Materials**, B.C Punmia, Ashok Jain, Arun Jain, Lakshmi Publications, New Delhi. 3rd Edition, 2002
2. **Elements of Strength of Materials**, Timoshenko and Young- Published by Affiliated East- West Press, 1962
3. **Strength of Materials**, Ramamrutham, Dhanpath Rai Publishers, 2008.

Reference Books:

1. **Mechanics of Solids**, Mubeen, Pearson Edu. India, 2002
2. **Strength of Materials**, W.A. Nash, Schaum's Outline Series, Fourth Edition-2007
3. **Mechanics of materials**, S.I. Units, Ferdinand Beer & Russell Johnstan, TATA McGrawHill-2003.
4. **Strength of Materials**, L. S. Srinath, Prakash Desai &AnanthRamu TMH Publishers, Chennai, 2008.
5. **Elements of Strength of Materials** Timoshenko and Young, Published by Affiliated East-West Press, 1962

E-books:

1. http://engineeringebookstore.blogspot.in/2013/07/som-strength-of-materials.html
2. http://free-onlineebooks.blogspot.in/2014/11/download-bc-punmia-strength-of_29.html

MOOCS:

1. http://nptel.ac.in/courses/Webcourse-contents/IIT-ROORKEE/strength%20of%20materials/homepage.htm
2. http://www.onesmartclick.com/engineering/strength-of-material.html
3. https://www.class-central.com/subject

Scheme of examination: One Question from Unit 2, 4, 5 & two questions from unit 1 & 3.

COURSE OUTCOMES

CO 1	Understand the concepts and principles applied to members under various loadings and the effects of these loadings
	Analyze and design structural members subjected to stresses.
CO 3	Analyze columns and pressure vessels under various loadings
CO 4	To design machine parts and structures to prevent failure.

ASSESSMENT:

Continuous Internal Evaluation (CIE) includes mid-term tests, weekly/fortnightly class test, homework assignments, problem solving, group discussions quiz, seminar, mini-project and other Alternate Assessment Tools (AAT)prescribed by the faculty handling a course prior to beginning of the classes.

Semester End Examination(SEE)-a written examination for theory courses and practical/ design examination with built-in oral part (Viva Voice).

Both CIE and SEE have equal (50:50) weightages. The student's performance in a course shall be judged individually and together based on the results of CIE and SEE.

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III SEMESTER

Course	MECHANICAL MEASUREMENTS AND METROLOGY	Course Code	15IM3DCMMM
Credits	04	L-T-P-S	3-0-1-0

PRE-REQUISITES: NIL

Unit- 1

Introduction to metrology: definition, types, need of inspection, terminologies, and methods of measurement, selection of instruments, measurement errors, units, measurement standards, calibration.

Comparators: Introduction, features, classification, Mechanical comparators, sigma comparators, electrical and electronic comparators, Solex pneumatic gauge, microscope.

Limits, fits and gauges: Limits, fits, tolerance and allowance, theory of limits and fits and their selection, hole basis and shaft basis system, Indian standard system of limits and fits, simple problems. Interchangeability, selective assembly, limit gauges, Taylor's principle of limit gauging, plug gauges, ring gauges. **10Hrs.**

Unit- 2

Measurement of screw threads and gears: Measurement of various elements of threads, major, minor and effective diameter, measurement of pitch, gear inspection, measurement of tooth thickness, gear tooth caliper, Parkinson's gear tester. **06Hrs.**

Unit-3

Measurement of surface finish: Representation of surface finish as per BIS- methods of measuring surface finish: comparison method and direct instrument measurement- surface inspection by comparison methods: touch inspection, visual inspection, scratch inspection, microscopic inspection, and comparison with standard specimen, surface photographs-Direct instrument measurement: stylus probe instruments. **06Hrs.**

Unit- 4

Transducers: introduction, primary and secondary transducers, classifications of transducers, mechanical transducers: thermal (thermocouple, bimetallic, temp-stik) elastic members: bourdon tube, diaphragm. Electrical transducers: active and passive transducers, piezo-electric transducers (modes of operation of piezoelectric crystals and uses)

08Hrs.

Unit- 5

Measurement and measurement system: definition, significance of measurement, generalized measurement system, definitions and concept of accuracy, precision, calibration, threshold, sensitivity, hysteresis, repeatability, linearity, loading effect, system response-times delay. Errors in measurements, classification of errors.

Pressure measurement: elastic pressure transducers viz. Bourdon tubes, diaphragm, bellows and piezoelectric pressure sensors, high pressure measurements, bridge man gauge. Vacuum measurement: vacuum gauges viz. McLeod gauge.

Temperature measurement: electrical methods of temperature measurement resistance thermometers, thermistors and thermocouples, pyrometer. **10Hrs.**

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LAB EXPERIMENTS

1. Calibration of Pressure Gauge
2. Calibration of Thermocouple
3. Calibration of LVDT
4. Calibration of Load cell
5. Determination of modulus of elasticity of a mild steel specimen using strain gauges.
6. Measurements using Optical Projector / Toolmaker Microscope.
7. Measurements of angle using Sine Center / Sine bar / bevel protractor
8. Measurements of cutting tool forces using
   a) Lathe tool Dynamometer b) Drill tool Dynamometer.
9. Measurements of gear tooth profile using gear tooth Vernier /gear tooth micrometer.
10. Calibration of micrometer using slip gauges

Text Books:

1. **Mechanical measurements**, Beckwith Marangoni and Lienhard, Pearson Education, 6th Ed, 2006.
2. **Engineering Metrology**, R.K.Jain, Khanna Publishers, 1994.
3. **A course in Mechanical Measurements and Instrumentation**, A K Sawhney, J.C Kapur Publishers, 3rd Ed., 1989.

Reference Books:

1. **Engineering Metrology**, I.C.Gupta, DhanpatRai Publications, Delhi
2. **Measurements Systems**, Applications & Design, Ernen O Dobeblein, 5TH ed.
3. **Industrial Instrumentation**, Alsutko, Jerry. D.Faulk, Thompson Asia Pvt. Ltd.2002.
4. **Mechanical Measurements**, R.S. Shirohi& H.C. Radhakrishna, 3rd Ed., New Age Intl. Pvt Ltd.

MOOCS :

1) www.nptel.ac.in/courses/112106138/
2) www.nptel.ac.in/courses/112106139/
3) https://www.class-central.com/subject/

COURSE OUTCOMES:

CO 1	Is able to understand the concepts of metrology, various standards that are in practice and their applications. Learns about comparators and their use in different contexts, Indian standard system of limits and fits practiced in the manufacturing of products.
CO 2	will possess the knowledge of terminology of Screw threads and Gears. Will be able to measure the different elements of screw threads and gears using different instruments.
CO 3	is able to know understand the meaning of surface finish, BIS- methods of measuring surface finish, is able to use the instruments to assess the surface finish.
CO 4	will possess the knowledge transducers and their types, advantages, and usage of transducers for different applications.
CO 5	is able to understand the concept of measurement and the measurement system, error in measurement, pressure and its measurement using different instruments, temperature and its measurement using different Instruments.

Scheme of Examination: One question from unit 2,3 & 4 and 2 questions from unit 1 & 5.

ASSESSMENT:

Continuous Internal Evaluation (CIE) includes mid-term tests, weekly/fortnightly class test, homework assignments, problem solving, group discussions quiz, seminar, mini-project and other Alternate Assessment Tools (AAT)prescribed by the faculty handling a course prior to beginning of the classes.

Semester End Examination(SEE)-a written examination for theory courses and practical/ design examination with built-in oral part (Viva Voice).

Both CIE and SEE have equal (50:50) weightages. The student's performance in a course shall be judged individually and together based on the results of CIE and SEE.

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Course Title	ELEMENTS OF ENERGY SYSTEMS	Course Code	15IM3DCEES
Credits	03	L -T – P-S	3 -0- 0-0

III SEMESTER

PRE-REQUISITES: NIL

UNIT - 1

BASICS OF THERMODYNAMICS

Systems, zeroth law, first law - concept of internal energy and enthalpy- applications to closed and open systems - second law - concept of entropy - Clausius inequality. **08Hrs.**

UNIT- 2

CYCLES AND SYSTEMS

Otto, Diesel and Brayton cycles. IC engines - 4 stroke and 2 stroke engines - brake power - efficiencies - heat balance test - simple problems only. Properties of steam - use of steam tables and Mollier diagram - Rankine cycle – simple problems. **08Hrs.**

UNIT- 3

REFRIGERATION AND AIR CONDITIONING SYSTEMS

Vapour compression refrigeration systems - COP - simple problems – basics and types of air conditioning systems. Reciprocating compressors – volumetric efficiency - power required - simple problems - rotary compressors. Heat transfer - modes of heat transfer - simple problems on conduction-composite wall, cylinder and sphere - convection - flow over flat plate-and radiation. **08Hrs.**

UNIT- 4

BASICS OF FLUID MECHANICS

Introduction - properties of fluid - density, viscosity, pressure and velocity – types of fluid flow - continuity equation - energy - head of fluid - Euler's equation - Bernoulli's equation, flow through pipes - Hagen Poiseulli's law - major and minor losses. **08Hrs.**

UNIT- 5

FLUID MEASUREMENTS

Flow measurements - orifice meter, venturimeter- Rota meter and elbow meter. Pressure measurement - total and static pressure measurements using Pitot tube, manometer, mechanical gauges. Velocity measurements – different types. **08Hrs.**

TEXT BOOKS:

1. **Fluid Mechanics**, Dr.R.K.Bansal, Lakshmi Publications.
2. **Basic & Applied Thermo Dynamics**, Nag P. K. Tata McGraw Hill Co. Ltd., India, 2002.

REFERENCE BOOKS:

1. **Thermal Engineering**, Sarkar B. K, Tata McGraw Hill Co. Ltd., India, 2005.
2. **Fluid Mechanics and Hydraulic Machines**, Rajput R.K. S.Chand& Co., India 2008.
3. **Engineering Thermo Dynamics**, Nag P.K Tata McGraw Hill Co. Ltd., India, 2005.
4. **Thermal Engineering**, Rajput R.K, Laxmi Publications (P) Ltd., New Delhi, Edition. 2010.
5. **Fluid Mechanics and Fluid Power Engineering**, Kumar D.S, S.K.Kataria& Sons Publishers, India, 6th Edition, 2003

MOOCS :

1. https://www.edx.org/course/iitbombayx/iitbombayx-me209x-thermodynamics-1384#.U8aBL_mSx8E
2. https://www.coursera.org/course/introthermodynamics
3. https://www.coursera.org/course/thermodynamics
4. https://www.class-central.com/subject/

COURSE OUTCOMES

CO 1	Be able to understand the basic concepts of thermodynamics and describe energy exchange processes in terms of various forms of energies like heat and work in the systems.
CO 2	Be able to state the First Law for a closed system, open system and apply the steady flow energy equation to a system of thermodynamic components (heaters, coolers, pumps, turbines etc.) to estimate required balances of heat, work and energy flow.
CO 3	Be able understand the Second Law of Thermodynamics- Heat engines and Refrigerators, Reversible and irreversible processes, Carnot cycle and Entropy.
CO 4	Is able to acquire the knowledge of types of fluids, properties and their characteristics. Will know how to measure the pressure of a fluid at a point will have the knowledge of gauge, absolute and vacuum pressure.
CO 5	Is able to learn about the use of manometers for pressure measurement, pressure of the fluid in static condition on immersed surfaces. Will learn about the concepts of buoyancy and floatation, and the conditions for the body to be in equilibrium.
CO 6	Is able to learn about the kinematics of fluid flow, rate of discharge, and types of fluid flow.

Scheme of Examination: One question from each unit and choice in unit-1 and unit-4

ASSESSMENT:

Continuous Internal Evaluation (CIE) includes mid-term tests, weekly/fortnightly class test, homework assignments, problem solving, group discussions quiz, seminar, mini-project and other Alternate Assessment Tools (AAT)prescribed by the faculty handling a course prior to beginning of the classes.

Semester End Examination(SEE)-a written examination for theory courses and practical/ design examination with built-in oral part (Viva Voice).

Both CIE and SEE have equal (50:50) weightages. The student's performance in a course shall be judged individually and together based on the results of CIE and SEE.

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III SEMESTER

Course	COMPUTER AIDED MACHINE DRAWING	Course Code	15IM3GCCMD
Credits	05	L-T-P-S	1-0-2-2

PRE-REQUISITES: NIL

Unit- 1

Sections of Solids: Sectioning, Sectional view, Representation of section plane, Hatching, Sectioning of engineering objects like: Square, Pentagonal, Hexagonal prisms, Square, Hexagonal pyramids, Cylinder, Cone and Tetrahedron (Direct and indirect method). **08Hrs.**

Unit- 2

3D Modeling from Orthographic views: Given the 2 or 3 views of a machine component, Generation of the object in 3D environment using software. (**Assignment** - Drawing sheets from industries will be supplied to the group of students and to analyze and create the product using software) 0**8Hrs.**

Unit- 3

Threaded Fasteners: Thread terminology, sectional views of threads.ISO Metric (Internal & External) BSW (Internal & External) square and Acme. Sellers thread, American Standard thread. Etc.

Fasteners: Hexagonal headed bolt and nut with washer (assembly), square headed bolt and nut with washer (assembly), Proportions for square and hexagonal headed bolts & nuts, simple assembly using stud bolts with nut and lock nut. Flanged nut, slotted nut, taper and split pin for locking, counter sunk head screw, grub screw, Allen screw. **04Hrs.**

Unit- 4

Joints: Assembly of Socket and Spigot cotter joint, Pin or Knuckle joint, protected type flanged coupling, Universal coupling. **08Hrs.**

Unit- 5

Assembly Drawings: Screw jack, Machine vice, Plummer block, Tail stock, Steam stop valve, Ram's bottom safety valve, and simple eccentric. **24Hrs.**

REFERENCES :

Text books:

1. **Machine Drawing**, K.R.Gopalkrishna, 20th Edition, Subhas stores, 2007.
2. **Computer Aided Machine Drawing ,** K.R.Gopalkrishna, A.S.Ravindra, Revised Edition, ISBN978-93-83214-81-5,2017

Reference Book:

1. **Machine Drawing with Auto CAD**. Goutam Pohit & Goutham Ghosh, 1st Indian print Pearson Education, 2005.
2. **Auto CAD 2006, for Engineers and Designers**. Sham Tickoo Dream tech 2005.
3. **Machine Drawing**, Sri N.D.Bhat &V.M.Panchal, 42nd Edition, Charotar Publishing House, 2007
4. **Machine Drawing**, N. Siddeshwar, P. Kanniah, V.V.S. Sastri, published by Tata McGraw Hill, 2006

MOOCS :

1) http://nptel.ac.in/courses/112104172/1,
2) https://www.class-central.com/subject/

COURSE OUTCOMES

CO 1	Able to draw different sectional views of engineering objects.
CO 2	Able to draw orthographic views of objects and assemble into 3-D views using software.
CO 3	Able to differentiate between different types of threaded fasteners and joints
CO 4	Able to assemble various engineering assembly drawings.

Scheme of Examination:

Test 1 - covering the syllabus from Unit 1and 2.
Test 2 - covering syllabus from Unit 3, 4 and 5 (manual drafting).

SEE:One question from unit 1 for 20 marks
One question from unit 4 for 20 marks
One question from unit 5 for 60 marks

Assessment of Self Study:

2D Drawing sheets from Industry will be provided to the group of students to study and create the 3D solid models using software.

ASSESSMENT:

Continuous Internal Evaluation (CIE) includes mid-term tests, weekly/fortnightly class test, homework assignments, problem solving, group discussions quiz, seminar, mini-project and other Alternate Assessment Tools (AAT)prescribed by the faculty handling a course prior to beginning of the classes.

Semester End Examination(SEE)-a written examination for theory courses and practical/ design examination with built-in oral part (Viva Voice).

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SCHEME OF INSTRUCTIONS FOR FOURTH SEMESTER

Sl No	Course Code	Course Title	Credits				
			L	T	P	S	Total
1	15IM4DCIEG	INDUSTRIAL ENGINEERING	3	0	1	2	6
2	15IM4DCSFE	STATISTICS FOR ENGINEERS	3	0	0	0	3
3	15IM4DCMAE	MANAGEMENT AND ENTREPRENEURSHIP	3	0	0	0	3
4	15IM4DCPT2	PRODUCTION TECHNOLOGY-II	3	0	1	2	6
5	15IM4DCMCD	MACHINE DESIGN	3	0	0	0	3
6	15IM4DCMSM	MATERIAL SCIENCE & METALLURGY	3	0	1	0	4
		Total	18	0	3	4	25

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IV SEMESTER

Course Title	INDUSTRIAL ENGINEERING	Course Code	15IM4DCIEG
Credits	06	L-T-P-S	3-0-1-2

PRE-REQUISITES : NIL

UNIT 1

INDUSTRIAL ENGINEERING: Meaning, Definition, Objective, Need, Scope, Evolution and developments.

PRODUCTIVITY: Definition of productivity, individual enterprises, task of management Productivity of materials, land, building, machine and power. Measurement of productivity, factors affecting the productivity, productivity improvement programs, wages and incentives (simple numerical problems). **06 Hrs.**

UNIT 2

WORK STUDY: Definition, objective and scope of work study. Human factors in work study. Work study and management, work study and supervision, work study and worker.

METHOD STUDY: Definition, objective and scope of method study, activity recording and exam aids. Charts to record moments in shop operation – process charts, flow process charts, travel chart and multiple activity charts. (With simple problems).

MICRO AND MEMO MOTION STUDY: Charts to record moment at work place – principles of motion economy, classification of moments two handed process chart, SIMO chart, and micro motion study. Development, definition and installation of the improved method, brief concept about synthetic motion studies. **09 Hrs.**

UNIT 3

WORK MEASUREMENT: Definition, objective and benefit of work measurement. Work measurement techniques. Work sampling: need, confidence levels, sample size determinations, random observation, conducting study with the simple problems.

TIME STUDY: Time Study, Definition, time study equipment, selection of job, steps in time study. Breaking jobs into elements, recording information. Rating & standard Rating, standard performance, scale of rating, factors of affecting rate of working, allowances and standard time determination. Predetermined motion time study – Method time measurement (MTM) **09Hrs.**

UNIT 4

ERGONOMICS: Introduction, areas of study under ergonomics, system approach to ergonomics model, man-machine system. Components of man-machine system and their functions – work capabilities of industrial worker, study of development of stress in human body and their consequences. Computer based ergonomics.

DESIGN OF MAN-MACHINE SYSTEM: Fatigue in industrial workers, Quantitative qualitative representation and alphanumeric displays, Controls and their design criteria,

control types, relation between controls and displays, layouts of panels and machines. Design of work places, influence of climate on human efficiency. Influence of noise, vibration and light. **08Hrs**.

UNIT 5

CURRENT TRENDS: Introduction to Agile manufacturing, Lean and Six Sigma, Value Engineering, Just in time, Total quality management, Enterprise resource planning, Supply chain and logistics management. **08Hrs.**

INDUSTRIAL ENGNINEERING LABORATORY
METHOD STUDY

- Recording Techniques using charts.
  - Outline process chart.
  - Flow process chart.
  - Multiple Activity Chart.
- Recording Techniques using diagrams.
  - Flow diagram.
  - String diagram.
- Application of principle of motion economy:
  - Two handed process chart.
- Assembling simple components.
  - Peg board assembly.
- Development of Plant Layout using:
  - Black board

WORK MEASUREMENT

3. Rating practice using:
   - Walking simulator.
   - Pin board assembly
   - Dealing a deck of cards.
   - Marble collection activity
4. Determining the standard time using:
   - Simple operations using stopwatch time study.
   - Predetermined Method Time Study (PMTS).

III. ERGONOMICS

5. Measurement of heart beat rate, calorie consumption parameters using:
   - Walking simulator.
   - Cycle Ergo-meter.
6. Effect of human efficiency in work environments:
   - Noise.
   - Light.

Text Books :

1. **Introduction to work study**, ILO, - III Revised Edition, 1981
2. **Motion and Time study** - Ralph M Barnes; John Wiley, 8th Edition, 1985.
3. **Engineered work Measurement** - Weldon, ELBS, Marvin E. Mundel- Motion and Time study, PHI, 1st edition, 1991.
4. **Human Factors in Engineering Design** - S Sanders and E J McCormick, 6th Edition, McGraw Hill, ISBN0071128263, 9780071128261
5. **Work Study and Ergonomics** - S Dalela and Sourabh, Chand Publishers, 3rd edition.

Self Study

1. Productivity measurement a case study.
2. Work study measurement a case study.
3. Work measurement application.
4. Design of effective systems of operation.
5. Work Sampling.

MOOCS

9. https://www.class-central.com/subject/

COURSE OUTCOMES

CO1	Industrial Engineering; to take the right decisions to optimize resources utilization by improving productivity of the Lands, Buildings, People, Materials, Machines, Money, Methods and Management effectively
CO2	Work Study; to eliminate unproductive activities under the control of the Management, Supervisor, worker and the Design of Products and Processes
CO3	Method Study; to use the Charts to record the Activities of the people, materials and Equipment to find alternative methods which minimize waste and to implement the best method.
CO4	Work Measurement Techniques; to improve the processes and find the Standard Time.
CO5	Ergonomics; to design the Man – Machine System to improve Human Efficiency and reduce the effort of the workers

Scheme of Examination :

FIVE Questions to be set with one question from units 1 to 5 carrying 20 marks each.
Questions in unit 2 & 3 units will have an internal choice.

ASSESSMENT:

Continuous Internal Evaluation (CIE) includes mid-term tests, weekly/fortnightly class test, homework assignments, problem solving, group discussions quiz, seminar, mini-project and other Alternate Assessment Tools (AAT)prescribed by the faculty handling a course prior to beginning of the classes.

Semester End Examination(SEE)-a written examination for theory courses and practical/ design examination with built-in oral part (Viva Voice).

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Course	STATISTICS FOR ENGINEERS	Course Code	15IM4DCSFE
Credits	03	L -T – P-S	3 -0- 0-0

PRE-REQUISITES : NIL

Unit 1

The Role of Statistics in Engineering (Data Summary and Presentation): Statistical Thinking, Collecting data, Statistical Modeling Frame work, measure of central tendency and variance, Importance of Data summary and Display, Practical problems solving through tools like Tabular and Graphical display, Pie charts, Constructions of Box Plots, S curves, Frequency polygon, Pareto Graph. **07Hrs.**

Unit 2

Discrete Random Variables and Probability Distributions: Discrete Random variables, Probability distributions and Probability mass functions, Cumulative distribution functions, Mean and Variance of a discrete random variable, discrete uniform distribution, Binominal distribution, Hyper Geometric distribution, Applications.

Continuous Random Variables and Probability Distributions: Continuous random variables, Probability distributions and probability density functions, cumulative distribution functions, Mean and Variance of a continuous random variable, uniform distribution, Normal distribution, Normal approximation to Binominal and Poisson distribution, Applications. Chi-square Distributions, Exponential distribution Weibull Distribution (Underlined Distributions - Exposure limited to theoretical concepts). **10 Hrs.**

Unit 3

Estimation Theory: Statistical Inference, Random sampling, Properties of Estimators, Sampling distribution, Sampling distribution of means, variance and proportion, Introduction to confidence intervals. **05Hrs.**

Unit 4

Statistical Inference for a Single Sample and Two Samples: Hypothesis testing, Inference on the mean of a population (variance known and unknown), Inference on the variance of a normal population, Inference on a population proportion.

Statistical Inference for a Single Sample and Two Samples: Testing for Goodness of Fit, Inference for a difference in Means, Variances known, Inference for a difference in means of two normal distributions, Variances unknown, Inference on the Variances of two normal populations, Inference on two population proportions. **10Hrs.**

Unit 5

Simple Linear Regressions and Correlation: Simple Linear Regression, Properties of Least square Estimators and Estimation of variances, Common abuses of regression, Prediction of new observations, Assessing the adequacy of regression model, Transformations to a straight line, Introduction to multiple regression (will not have problems), Correlation. Design of Experiments: Strategy of experimentation, completely randomized single - factor experiment, Tests on individual treatment means, the random effects model, the randomized complete block design, one way analysis of variance and two way analysis of variance. (Exposure limited to theoretical concepts **08 Hrs.**

Statistical Software to be utilized extensively wherever possible to solve problems.

Text books:

1. **Applied statistics and Probability for Engineers**, Douglas C Montgomery, George C Runger, 2nd Edn, John Wiley and Sons, ISBN-0-471-17027-5
2. **Statistics for Management**, - Richard I Levin, David S Rubin, 06th Edn, Prentice Hall India, ISBN-81-203-0893-X.

Reference books:

1. **Probability and Statistics in Engineering**, - William W Hines, Douglas C Montgomery, 2nd Edn, John Wiley & Sons
2. **Business Statistics for Management and Economics**, - Daniel, Terrell, 06th Edn, Houghton Mifflin Company, ISBN-0-395-062835-0
3. **Probability and Statistics**, - Walpole & Mayer, MacMillan Publishing Company, 1989.

Online Reference: http://nptel.ac.in/courses.php

MOOCS

4. https://www.class-central.com/subject/

COURSE OUTCOMES :

CO 1	Able to Identify the role that statistics in engineering problem-solving process and know methods that engineers use to collect data for making decisions
CO 2	Able to Construct and interpret visual data displays and understand how these graphical techniques are useful in uncovering and summarizing patterns in data
CO 3	Able to Determine probabilities for discrete random variables from probability mass functions and for continuous random variables
CO 4	Able to Perform hypothesis tests and construct confidence intervals on the mean, variance and population proportion of a normal distribution
CO 5	Able to Use linear or multiple linear regressions for building empirical models of engineering and scientific data and use it to estimate a mean or to make a prediction of a future observation.
CO 6	Able to Design and conduct engineering experiments involving several factors using the factorial design approach and know how ANOVA is used to analyze and interpret main effects and interactions

Scheme of Examination : One Question to be set from each unit and Two Questions will be set from the unit 2 & 4. Student will answer any 5 questions selecting at lead stone from each unit.

ASSESSMENT:

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DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

IV SEMESTER

Course	MANAGEMENT AND ENTREPRENEURSHIP	Course Code	15IM4DCMAE
Credits	03	L -T – P-S	3 -0- 0-0

PRE-REQUISITES : NIL

UNIT- 1

MANAGEMENT : Introduction- Historical evolution of management, Thought and its Development, Scope and Functional areas of management, Management as a science, art of profession Management and Administration Roles of Management, Levels of Management, functions of Management **08 Hrs.**

UNIT- 2

PLANNING AND ORGANIZING: Nature, importance and purpose of planning process Objectives Types of plans Importance of planning steps in planning and planning premises Hierarchy of plans.

Introduction of organization-Principles of organization Types of organization, centralization Vs decentralization of authority and responsibility Span of control, MBO and MBE. **08 Hrs.**

UNIT- 3

STAFFING, DIRECTING & CONTROLLING: Purpose and importance of staffing-selection process and recruitment, appraisal, Meaning and purpose of Directing Leadership styles, motivation theories, communication and Coordination. Techniques of Co-ordination, Meaning and steps in controlling- essentials of a sound control system-methods of establishing control **08 Hrs.**

UNIT- 4

ENTREPRENEURSHIP: Meaning of Entrepreneur, evolution of the concept, functions of an entrepreneur, types of an entrepreneur, Concept of Entrepreneurship, stages in entrepreneurial process; role of entrepreneurs in economic development, Entrepreneurship in India, barriers for entrepreneurship. **04Hrs.**

SMALL SCALE INDUSTRIES : Definition, characteristics; scope and role of SSI in economic development, advantages of SSI, steps to start and SSI changes in government policy towards SSI in the past 4 decades, Impact of Liberalization, Privatization, Globalization on SSI, Effect of WTO/GATT on SSI, Ancillary industry and tiny industry **04Hrs.**

UNIT- 5

INSTITUTIONAL SUPPORT : Government agencies supporting industrial activities, schemes; TECKSOK, KIADB, KSSIDC, KSIMC,DIC Single window agency, SISI; NSIC, SIDBI, KSFC.-Industrial Finance **04Hrs.**

PREPARATION OF PROJECT: Meaning of project; Project identification; Project selection; project report; need and significance of report; Contents: Network analysis; Errors of Project report: project appraisal, identification of business opportunities; Market

Feasibility study technical feasibility study, financial feasibility study and social feasibility study. **04Hrs.**

Text Books:

1. **Management and Entrepreneurship**, NVR Naidu& T. Krishna Rao, I K Publishing, 2008, ISBN978-1-906757-8-9
2. **Dynamics of Entrepreneurial Development & Management**, Vasant Desai, Himalaya Publishing House,2001, ISBN 8183184111, 9788183184113
3. **Entrepreneurship Development**, Poornima M. Charantimath, Small Business Enterprises Pearson Education 2006 , ISBN 978-81-7758-260-4(For Unit-2 & 4).

Reference Books:

1. **Essentials of Management**,- Harold Koontz, Heinz Weihrich, Ramachandra Aryasri, Tata McGraw Hill, 2010. ISBN-13-978-93-392-2287-1, ISBN-10-93-392-2287-3
2. **Principles of Management**, P.C.Tripathi, P.N.Reddy Tata McGraw Hill.,2012,ISBN-13-978-0-07-1333337
3. **Management Fundamentals Concepts, Application, Skill Development**- Roberts Lusier Thomson,2014, ISBN-978-1-4833-5226-8
4. **Entrepreneurship Development**, S. S. Khanka S. Chand & Co.
5. **Management,** Stephen Robbins Pearson Education/PHI 17th Edition, 2003.

Online Reference: http://nptel.ac.in/courses.php

MOOCS
https://www.class-central.com/subject/

Scheme of Examination: There will be 7 Question to be set one question from each unit and choice from unit 4 and unit 5.

COURSE OUTCOMES :

CO 1	Be exposed to the concept of management as such and the historical evolution and emergence of various management theories and thought starting from industrial revolution of England up to modern management thought
CO 2	Learn importance of planning, organizing and staffing their functions and types adopted in industries.
CO 3	Be exposed to various leadership styles needed to carry out organizational objectives along with the importance of directing and controlling functions and coordination techniques
CO 4	Be hardened to venture into arena of entrepreneurship giving an insight into it. Learn the role of an entrepreneur in the economy, problems associated with it and various facets of this issues.
CO 5	Be made understand the role of SSIs in the economy, governmental policy initiatives, effects of LPG policies the way to prepare projects and identify them etc.
CO 6	Be given the knowledge of Institutional support he/she can expect while venturing in to become an entrepreneur and to be a leader, to have success and be a model to the society

ASSESSMENT:

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IV SEMESTER

Course	PRODUCTION TECHNOLOGY-II	Course Code	15IM4DCPT-II
Credits	06	L-T-P-S	3-0-1-2

PRE-REQUISITES : NIL

Unit- 1

CASTING PROCESS: Introduction to casting process & steps involved, Varieties of components produced by casting process advantages and limitations of casting process.
Patterns: Definition, functions, materials used for pattern, various pattern allowances and their importance, classification of patterns. Orientation and Parting **Binder**: Definition, Types of binder used in moulding sand.
Additives: Need, type of additives used.
Casting Design: Introduction**,** design consideration on pattern the mould, the parting line, cast holes- cored holes, machined holes, identifying the possible parting line, casting requiring special sand cores, design to obviate sand cores, problems on designing castings.
07Hrs.

Unit- 2

Sand Moulding and special moulding process: Types of base sand, requirement of base sand, Types of sand moulds.
Sand moulds: Moulding sand mixture ingredients (base sand, binder & additives) for different sand mixtures. Method used for sand moulding.
Cores: Definition, Need, Types. Method of making cores, Binders used, Concept of Gating &Risering. Principle involved and types, Fettling and cleaning of castings. Basic steps involved. Casting defects causes, features and remedies.
Moulding Machines: Jolt type, squeeze type, Jolt &Squeeze type and Sand slinger.
Special moulding Process: Study of important moulding processes Green sand, Core sand, Dry sand, Sweep mould, CO*2*sand, Shell mould, Investment mould& Full mould.
Metal moulds: Gravity die-casting, centrifugal casting, Squeeze Casting, Slush Casting, Thixo-casting and continuous casting processes. **10Hrs.**

Unit- 3

Melting Furnaces: Classification of furnaces, Constructional features & working principle of Gas fired pit furnace, Resistance furnace, Coreless Induction furnace, Electric Arc Furnace, Cupola furnace.
Solid Modeling of Casting: Casting features, Modeling Techniques, Graphical user Interphase, Model Representation, model exchange format, Model Verification. **06Hrs.**

Unit- 4

WELDING*:* Welding process: Definition, Principles, Classification, Application, Advantages & limitations of welding, Weld Joints, Welding Symbol.
Arc Welding: Principle, Metal Arc welding **(MAW)**, Flux Shielded Metal Arc Welding (**FSMAW)**, Inert Gas Welding **(TIG & MIG) Submerged** Arc Welding **(SAW)** and Atomic Hydrogen Welding processes **(AHW)**

Gas Welding: Principle, Oxy Acetylene welding, Reaction in Gas welding, Flame characteristics, Gas torch construction & working, forward and backward welding.

Special type of welding: Resistance welding - principles, Seam welding, Butt welding, Spot welding and projection welding, Friction welding, Explosive welding, Thermit welding, Laser welding Electron beam welding. **10Hrs.**

Unit- 5

Metallurgical aspect in welding and Casting: Structural analysis, Formation of different zones during Casting and welding. Heat affected zone **(HAZ).** .

Inspection methods: Welding and Casting defects, Detection causes & remedies Methods used for inspection of casting & welding, visual, magnetic particle, Fluorescent particle, and Ultrasonic, Radiography, Eddy Current, and Holography methods of inspection. **07Hrs.**

LAB

3. Testing of Moulding sand and Core sand Preparation of sand specimens and Conduction of the following tests:

Compression, Shear and Tensile tests on Universal Sand Testing Machine.
Permeability test
Core hardness &Mould hardness tests.
Grain fineness number test (Sieve Analysis test)
Clay content test.
Moisture Content tests.

4. Foundry Practice

- Use of foundry tools and other equipment
- Preparation of moulds using two moulding boxes using patterns or without patterns (Split pattern, Match plate pattern and Core boxes)
- Preparation of one casting (Aluminum or Cast Iron –Demonstration Only).
- Gating System, Bottom gate, Top gate, Parting Gate and Step gate.

5. Welding Process

Preparation of Welding Models using GAS, TIG and MIG Welding.

Self- Study:

Each group consists of minimum two and maximum five students.
At the end of the project students should submit the project report for final assessment.

1. Preparation of Components using Casting Techniques.
2. Flow analysis using appropriate software for Casting.
3. Testing of casted components.
4. Preparation of components using various joints in ARC Welding.
5. Preparation of components using various joints in GAS Welding.
6. Preparation of components using various joints in TIG and MIG Welding.
7. Preparation of components using Brazing techniques.
8. Testing of welded parts.

Text Books:

1. **Manufacturing Process-I**, Dr K. Radhakrishna, Sapna Book House ,5th Ed, 2006.
2. **Manufacturing & Technology : Foundry Forming and Welding**, P.N. Rao 2nd Ed., Tata McGraw Hill , 2003

Reference Books:

1. **Manufacturing Technology,** Swaroop Kalpakjian, Steuen R Sechmid, Pearson Education Asia, 5th Ed. 2006.
2. **Process and Materials of Manufacturing**, Roy A Lindberg, 4th Ed. Pearson Education, 2006, ISBN - 8120306635, 9788120306639
3. **Workshop Technology**, Vol-I, H.K. HajraChoudhry& A. K. HajraChoudhry, 12th Edition, MPP Publisher, 2001.
4. **Modern Manufacturing Methods,** M. Grover, John Wiley & Sons, 4th Edition, 2010., ISBN – 978 – 0470 – 467-008
5. **Metal casting: Computer Aided Design and Analysis**, B. Ravi PHI, 2005, ISBN-8120327268.
6. **Design for Manufacture**, Harry Peck, Pitman Publishing. 1983, ISBN-0273000071
7. **Product Design and Manufacturing**, by A. K. Chitale and R. C. Guptha. Fifth Edition, 2013, ISBN-8120348737.

Online Reference:

1. http://nptel.ac.in/courses/112107077/ (Advanced Manufacturing Process)
2. http://nptel.ac.in/courses/112107089/ (Welding)
3. http://nptel.ac.in/courses/112107090/ (Welding)
4. https://www.class-central.com/subject/

COURSE OUTCOMES :

CO 1	To have understood various processes carried out in Foundry.
CO 2	To have studied sand, its importance, it's testing and types of Sand.
CO 3	To have studied and understood various specialized casting process. The technical knowledge will help the learner to move ahead with gait
CO 4	Be able to grasp knowledge regarding various metals joining process. Problems associated with them in the industries.
CO 5	Able to make a Comparative study of all the joining processes such as welding, soldering and brazing along with metallurgical aspects and changes

Scheme of Examination:

One question from each Unit and internal choice from Units 2 & 4

ASSESSMENT:

Continuous Internal Evaluation (CIE) includes mid-term tests, weekly/fortnightly class test, homework assignments, problem solving, group discussions quiz, seminar, mini-project and other Alternate Assessment Tools (AAT)prescribed by the faculty handling a course prior to beginning of the classes.

Semester End Examination(SEE)-a written examination for theory courses and practical/ design examination with built-in oral part (Viva Voice).

Both CIE and SEE have equal (50:50) weightages. The student's performance in a course shall be judged individually and together based on the results of CIE and SEE.

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

IV SEMESTER

Course	MACHINE DESIGN	Course Code	15IM4DCMCD
Credits	03	L-T-P-S	3-0-0-0

PRE-REQUISITES : NIL

UNIT–1

Design for Static Strength: Design considerations: Codes and Standards, Static strength; Static loads and factor of safety; Theories of failure -Maximum normal stress theory, maximum shear stress theory, Distortion energy theory; Failure of brittle materials, Failure of ductile materials. Stress concentration, Determination of Stress concentration factor. Combined Stress concentration factor. **06Hrs.**

Design for Fatigue Strength: Introduction, S -N diagram, Low cycle fatigue, High cycle fatigue, and Endurance limit. Modifying factors -size effect, surface effect, Stress concentration effects; Fluctuating stresses, Fatigue strength under fluctuating stresses, Goodman and Soderberg relationship; Stresses due to combined loading. **06Hrs.**

UNIT–2

Joints and Coupling: Design of rigid flange coupling & Bushed pin type flexible coupling. Cotter and Knuckle joints. **06Hrs. Design of Shafts:** Torsion of shafts, design for strength & rigidity, with steady loading, ASME & BIS codes for design of transmission shafting, shafts under fluctuating loads and combined loads **05Hrs.**

UNIT- 3

Design of Gears: Introduction to Spur, Helical & Bevel gears, Design of spur gear, stresses in gear tooth, Lewis equation, form factor- dynamic and wear load. **05Hrs.**

UNIT- 4

Mechanical Joints: Riveted Joints -Types, rivet materials, Failures of Riveted joints, Efficiency, Welded Joints -Types, Strength of butt and fillet welds. **06Hrs.**

UNIT -5

Lubrication and Bearings: Mechanisms of Lubrication -Viscosity, bearing modulus, coefficient of friction, minimum oil film thickness-Heat Generated, Heat dissipated, bearing materials, lubricants and properties. Examples of journal bearing and thrust bearing design. **06Hrs.**

REFERENCES :

Text Books:

1. **Mechanical Engineering Design,** Joseph Edward Shigley, Tata McGraw Hill, New Delhi 1986.
2. **Machine Design,** V.L. Maleev and Hartman, CBS Publishers &Distribution, Delhi, 1983.
3. **Machine Design,** R.S Khurmi and J.K. Gupta, Eurasia Publishing house (P) Ltd., New Delhi, ISBN- 8121925371, 9788121925372

Design Data Hand Book:

Design Data Hand Book Vol .l & Vol.2 -Dr. K. Lingaiah, Suma Publications, Bangalore.

Reference Books:

1. **Machine Design,** Robert .L , Norton -Pearson Education Asia, New Delhi, 2001
2. **Theory and Problems of Machine Design**, -Hall, Holowinko, Laughlin, - Schaums Outline Series, 2002.
3. **Elements of Machine Design**, N. C. Pandey& C. S. Shah, - Chorotar Publishing House, 2002.
4. **Design of Machine Elements**, V.B.Bahandri, Tata McGraw Hill Publishing Co. Ltd., New-Delhi
5. **Machine Component & Design**, William Orthwan, Jaico Publishing Co.
6. **Fundamentals of Design** -Benerad J Hamrock, Bo -Jacobson & Steven R. Schmid, ISBN-13-978-1-4822-4750-3.
7. **Fundamentals of Machine Design Component**, Robert C. Juvinall and Kurt M. Marshek, John Wiley & sons, ISBN - 1119342813, 9781119342816
8. **Machine Design,** R. K. Jain, Khanna Publications, New Delhi.
9. **Design of Machine Elements,** J B K Das and P L Srinivasa Murthy, -Sapna Book House, Bangalore.

Online References:

1. http://nptel.ac.in/courses/112105124/
2. http://nptel.ac.in/courses/Webcourse-contents/IIT%20Kharagpur/Machine%20design1/New_index1.html
3. http://nptel.ac.in/courses/IIT-MADRAS/Machine_Design_II/

E-books

1. http://www.faadooengineers.com/threads/2060687-Machine-design-by-shigley-ebook-download-pdf
2. http://www.free4ebook.com/mec.html

Course Outcome

CO 1	Be able to analyze the stress and strain on mechanical components and understand, identify, and quantify failure modes for mechanical components
CO 2	Demonstrate knowledge on basic machine elements used in machine design, design machine elements to withstand loads and deformations for given application while considering additional specifications
CO 3	Be able to approach a design problem successfully taking decision when there is not a unique answer.
CO 4	To develop an ability to use techniques, skills, and modern engineering tools necessary for engineering practice

MOOCS

1. https://www.class-central.com/subject/

Scheme of Examination: 2 questions from units 1 & 2 and one question from units 3, 4 & 5.

ASSESSMENT:

Continuous Internal Evaluation (CIE) includes mid-term tests, weekly/fortnightly class test, homework assignments, problem solving, group discussions quiz, seminar, mini-project and other Alternate Assessment Tools (AAT)prescribed by the faculty handling a course prior to beginning of the classes.

Semester End Examination(SEE)-a written examination for theory courses and practical/ design examination with built-in oral part (Viva Voice).
Both CIE and SEE have equal (50:50) weightages. The student's performance in a course shall be judged individually and together based on the results of CIE and SEE.

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IV SEMESTER

Course	MATERIAL SCIENCE AND METALLURGY	Course Code	15IM4DCMSM
Credits	04	L-T-P-S	3-0-1-0

PRE-REQUISITES : NIL

Unit – 1

Introduction to Material Science and Metallurgy: Classification of Engineering Materials, Engineering requirements of materials, Factors affecting mechanical properties, Selection of materials for Engineering application, Effect of grain size on properties of metals, Crystal imperfections: point, line, surface defects. Diffusion in solids: Diffusion Mechanism, Fick's laws of diffusion. Plastic deformation by slip& twinning **06Hrs**

Unit - 2

Testing of Materials: Tensile properties, Engineering stress-strain, true stress &strain, Hardness testing (Brinell hardness testing, Vickers, Rockwell hardness test)

Types of Fracture: Brittle and Ductile fracture, Brittle to ductile transition, Griffith's criterion.
Creep: The creep curves, creep mechanism and factors affecting creep.
Fatigue: Fatigue cycles, Fatigue test, S.N curves, Fatigue mechanism, Factors affecting fatigue life. **08Hrs**

Unit -3

Solid solutions and phase diagrams: Types of solids solutions, Rules of governing the formation of solid solutions and intermediate phases. Cooling curves, construction of phase diagrams, Phase diagrams of Eutectic systems Phase rules: Gibbs phase rule and Lever rule. Interpretation of phase diagrams. Iron carbon equilibrium Diagram; Equilibrium phases, Invariant reactions, critical temperatures, Solidification of steels. **10Hrs**

Unit - 4

Heat treatment of Ferrous and Non-ferrous materials*:* TTT diagram, Construction of TTT diagram, TTT diagram for hypo and hyper eutectoid steels cooling curves, Non equilibrium phases, Effect of alloying elements on steels.
Heat treatment processes- Annealing, and its types, normalizing, hardening and hardenability, tempering, surface heat treatment methods. Heat treatment of Non-ferrous materials.

Ferrous, Non-ferrous and Advanced materials.
Ferrous - Types, Composition, Properties and applications of plain carbon steels and cast irons. Designation of steels.
Non-ferrous: Aluminum and its alloys, Magnesium alloys, Copper and its alloys **10Hrs**

Unit 5

Composite Materials-Definition, Classifications, Production methods, properties and applications of MMC and FRP composites.
Nano material: Nano powders, and nanomaterial, methods of preparation- plasma arcing, chemical vapor deposition electro deposition, sol-gel synthesis, ball milling, and comparative studies of the advantages and disadvantages of Nano powder production technologies. **06Hrs.**

LAB. EXPERIMENTS

Tensile, shear and compression tests of metallic and nonmetallic specimens using a Universal Testing Machine,
Torsion tests, Bending Test on metallic and nonmetallic specimens. Fatigue Test Izod and Charpy tests on M.S. Specimen Brinell, Rockwell and Vickers's Hardness test.

1. Examination of different engineering materials. Identification of microstructures of plain carbon steel, tool steel, Grey C.I, SG iron, Brass, Bronze & composites. (Preparation of specimen demo)
2. Heat treatment: Annealing, normalizing, hardening and tempering of steel Hardness studies of heat-treated Samples (Demo).
3. To study the wear characteristics of one ferrous, and one non-ferrous and composite materials for different parameters
4. Demo on Non-destructive test experiments like,
5. (a). Magnetic crack detection
6. (b). Dye penetration testing, to study the defects of Casted and Welded specimens

Text Books:

1. **Materials Science & Engineering-An Introduction**, William D. Callister Jr. Wiley India Pvt. Ltd. 6th Edition, New Delhi 2006.
2. **Foundation of Material Science and Engineering**, Smith, 3rd Edition McGraw Hill, 1997.

Reference Books:

1. **Introduction to Material Science for Engineering**, 6th edition James F. Shackel ford, Pearson, Prentice Hall, New Jersey, 2006.
2. **Mechanical Metallurgy**, 3rd Edn. George. E. Dieter, McGraw Hill, 2001. ISBN-9351342727
3. **Basic Science and Emerging technique**, Mick Wilson , Kamali Kannangara, First Indian edition ,2005.

COURSE OUTCOMES :

CO 1	Understand all class of materials and their structure, properties, processing, applications and performance.
CO 2	Understand the process of testing materials and to study the behavior of material.
CO 3	Know the importance and construction of Iron-carbon diagram time temperature transformation curve, heat treatment processes
CO 4	Understand ferrous, nonferrous and advanced composition, properties and application
CO 5	Understand how the Nano materials are useful in production technologies

MOOCS

1) https://www.class-central.com/subject/

Online References:

1. http://nptel.ac.in/courses/113106032/ (Structures of materials)

2. http://nptel.ac.in/courses/113101003/ (Phase transformation and Heat Treatment)
3. http://nptel.ac.in/courses/113108052/ (Defects in solids)

Scheme of Examination: Each Question from each unit and internal choice from Unit 3 & 4.

ASSESSMENT:
Continuous Internal Evaluation (CIE) includes mid-term tests, weekly/fortnightly class test, homework assignments, problem solving, group discussions quiz, seminar, mini-project and other Alternate Assessment Tools (AAT)prescribed by the faculty handling a course prior to beginning of the classes.

Semester End Examination(SEE)-a written examination for theory courses and practical/ design examination with built-in oral part (Viva Voice).
Both CIE and SEE have equal (50:50) weightages. The student's performance in a course shall be judged individually and together based on the results of CIE and SEE.

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

Lateral Entry : Mathematics for Diploma students

THIRD SEMESTER B.E COURSE (All Branches)

Course Title	**Mathematics-I**	**Course Code**	**15MA3IMMAT**
Credits	**00**	**L – T – P- S**	**0 – 0 – 0 - 0**
Contact hours	**48 hours (36L+12T)**	**III semester Lateral Entry students**	

Prerequisites: Basic concepts of Trigonometry, Trigonometric formulas, concept of differentiation, concept of integration.

Course Objectives: To provide students with a solid foundation in mathematical fundamentals such as differentiation, differential equations, vectors and orthogonal curvilinear coordinates for different branches of engineering.

UNIT 1

DIFFERENTIAL AND INTEGRAL CALCULUS [9 Hours]

List of standard derivatives including hyperbolic functions, rules of differentiation. Differentiation of product of two functions using Leibnitz rule (direct problems).Taylor's and Maclaurin's series expansion for functions of single variable. List of standard integrals, integration by parts. Definite integrals – problems. **(7L+2T)**

UNIT 2

POLAR COORDINATES AND PARTIAL DERIVATIVES [10 Hours]

Polar curves: Polar coordinates, angle between radius vector and tangent, angle between two polar curves. Partial differentiation. Total differentiation-Composite and Implicit functions. Taylor's and Maclaurin's series expansion for functions of two variables. Jacobians and their properties (without proof) – Problems. **(7L+3T)**

UNIT 3

FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS [8 Hours]

Introduction to first order differential equations. Linear equation and its solution. Bernoulli's equation and its solution. Exact differential equation and its solution. Orthogonal Trajectories. **(6L+2T)**

UNIT 4

SECOND AND HIGHER ORDER ORDINARY DIFFERENTIAL EQUATIONS [9 Hours]

Ordinary differential equations with constant coefficients: Homogeneous differential equations, non-homogeneous differential equations – Particular integral for functions of the

type f (x) = e^{ax}, sin(ax), cos(ax), x^n, e^{ax}sin(bx), e^{ax}cos(bx). Method of variation of parameters. Cauchy's and Legendre differential equations. **(7L+2T)**

UNIT 5

VECTOR CALCULUS AND ORTHOGONAL CURVILINEAR COORDINATES (OCC) [8 Hours]

Recapitulation of scalars, vectors and operation on scalars and vectors. Scalar and vector point functions. Del operator, gradient-directional derivative, divergence, curl and Laplacian operator. Vector identities (without proof).Cylindrical and Spherical polar coordinate systems. Expressing a vector point function in cylindrical and spherical systems. Expressions for gradient, divergence, curl and Laplacian in OCC. **(6L+2T)**

Text Books:

- Advanced Engineering Mathematics, Erwin Kreyszig, Wiley Precise Textbook series, Vol. 1 and Vol. 2, 10th edition, 2014, Wiley- India.
- Higher Engineering Mathematics, B.V. Ramana, 7th reprint, 2009, Tata Mc. Graw Hill.

Reference Books:

- Higher Engineering Mathematics, B.S. Grewal, 43rd edition, 2014, Khanna Publishers
- Advanced Engineering Mathematics, 4th edition, 2011, by Dennis G. Zill and Cullen, Jones and Bartlett India Pvt. Ltd.
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E books and online course materials

- (1) Engineering Mathematics, K. A. Stroud, Dexter J. Booth, Industrial Press, 2001 http://books.google.co.in/books/about/Engineering_Mathematics.html?id=FZncL-xB8dEC&redir_esc=y.
- (2) Advanced Engineering Mathematics, P. V. O'Neil, 5th Indian reprint, 2009, Cengage learning India Pvt. Ltd.
- (3)http://ocw.mit.edu/courses/mathematics/ (online course material)

Online Courses

1. https:// www.khanacademy.org/Math
2. https:// www.class-central.com/subject/math (MOOCS)
3. E-learning: www.vtu.ac.in .

On completion of the course the student will have the ability to

Course Code	CO	PO	Bloom's level
15MA3IMMAT	**CO-1:** Understand the basic concepts of differentiation and integration.	1	2
	CO-2: Apply the concepts of polar curves and multivariate calculus.	1	2
	CO-3: Apply analytical techniques to compute solutions of first and higher order ordinary differential equations.	1	3
	CO-4: Apply techniques of vector calculus to engineering problems.	1	3
	CO-5: Comprehend the generalization of vector calculus in curvilinear coordinate system.	1	3

Program Outcome:

1. Graduates will apply knowledge of Mathematics, Science and Engineering concepts to solve problems pertinent to relevant engineering field.

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DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

FOURTH SEMESTER B.E COURSE

Course Title	**Mathematics-II**	**Course Code**	**15MA4IMMAT**
Credits	**00**	**L – T – P- S**	**0 – 0 – 0 - 0**
Contact hours	**48 hours (36L+12T)**	**IV semester Lateral Entry Students**	

Prerequisites: Basic concepts of Trigonometry, Trigonometric formulas, concept of differentiation, concept of integration.

Course Objectives: To provide students with a solid foundation in mathematical fundamentals such as Laplace Transforms, Solution of ordinary differential equations using Laplace Transforms, vector integration, computation of area and volume using double integrals and triple integrals respectively.

UNIT 1

LAPLACE TRANSFORMS **[8 Hours]**

Laplace transforms of standard functions. Properties and problems. Laplace Transform of Periodic functions with plotting. Unit step function. **(6L+2T)**

UNIT 2

INVERSE LAPLACE TRANSFORMS **[9 Hours]**

Inverse Laplace transforms of standard functions. Properties and problems. Solution of ODE-Initial and Boundary value Problems. **(7L+2T)**

UNIT 3

DOUBLE INTEGRAL **[11 Hours]**

Evaluation of double integral. Change of order of integration. Change of variables to polar coordinates. Application: Area. **(8L+3T)**

UNIT 4

TRIPLE INTEGRALS AND IMPROPER INTEGRALS **[8 Hours]**

Evaluation of triple integral. Application: Volume. Gamma and Beta functions-definition Relation between Gamma and Beta functions. Properties and Problems. **(6L+2T)**

UNIT 5

VECTOR INTEGRATION **[8 Hours]**

Line integral.Green's theorem.Stokes' theorem.Gauss divergence theorem. **(6L+2T)**

Bibliography

Text Book:

- Advanced Engineering Mathematics, Erwin Kreyszig, Wiley Precise Textbook series, Vol. 1 and Vol. 2, 10th edition, 2014, Wiley- India.
- Advanced Engineering Mathematics, 4th edition, 2011, by Dennis G. Zill and Cullen, Jones and Bartlett India Pvt. Ltd

Reference Book:

- Higher Engineering Mathematics, B.S. Grewal, 43rd edition, 2014, Khanna
- Publishers.
  Higher Engineering Mathematics, B.V. Ramana, 7th reprint, 2009, Tata Mc. Graw Hill.

E books and online course materials

(1) Engineering Mathematics, K. A. Stroud, Dexter J. Booth, Industrial Press, 2001 http://books.google.co.in/books/about/Engineering_Mathematics.html?id=FZncL-xB8dEC&redir_esc=y.

(2) Advanced Engineering Mathematics, P. V. O'Neil, 5th Indian reprint, 2009, Cengage learning India Pvt. Ltd.

(3) http://ocw.mit.edu/courses/mathematics/ (online course material)

Online Courses

1. https:// www.khanacademy.org/Math
2. https:// www.class-central.com/subject/math (MOOCS)
3. E-learning: www.vtu.ac.in

On completion of the course the student will have the ability to

Course Code	CO	PO	Bloom's level
15MA4IMMAT	**CO-1:** Obtain solution of ordinary differential equations using Laplace Transform techniques.	1	3
	CO-2: Apply double integrals to compute areas and triple integrals in computing volumes.	1	3
	CO-3: Use Gamma and Beta functions to evaluate integrals.	1	2
	CO-4: Use of integral calculus in scalar and vector fields.	1	3

Program Outcome:

1. Graduates will apply knowledge of Mathematics, Science and Engineering concepts to solve problems pertinent to relevant engineering field.

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DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

Course	COMPUTERS IN MANUFACTURING	Course Code	16IE5DCCIM
Credits	06	L-T-P-S	3-0-1-2

Prerequisites: Nil

UNIT-1

Introduction: Role of computers in design and manufacturing. Influence of computers in manufacturing environment. Product cycle in conventional and computerized manufacturing environment, Introduction to CAD and CAM, Advantages and disadvantages of CAD and CAM .Application of computers in design process. **06**Hrs

UNIT- 2

Computer Graphics: Software configuration of a graphic system, functions of a graphics package, construction of geometry, wire frame and solid modeling, geometric 2D homogeneous transformation with simple problems. **06**Hrs

UNIT- 3

Introduction to Computer Numerical Control: Fundamental concepts of Numerical control, Numerical control modes, Numerical control elements, open and closed loop systems, advantages and limitations.

Drives of CNC system: Hydraulic drives, DC Motors, Stepper motors. Adaptive control systems: ACO and ACC systems.

Turning tool geometry, modular tooling system, milling tooling systems, tool presetting, automatic tool changers (ATC), Tool magazines. **10**Hrs

UNIT- 4

Programming of CNC Machine Tools: Introduction to part programming, coordinate systems, dimensioning, axes and motion nomenclature, structure of a part program, tool radius and length compensation, subroutines, canned cycles. Manual part programming, APT programming, writing programs using G& M codes, and by APT Language. **12**Hrs

UNIT- 5

Introduction to Robotics: Introduction, robot configuration, robot motions, Programming the robots, Robot programming methods, End effectors, work cell control and interlocks Robot sensors, Robot applications. **06**Hrs

UNIT-6

Laboratory Experiments:

- CNC Turning: Writing and simulation of manual part program using G & M codes forSimple parts including turning, taper turning, and shoulder turning and cutting. Use ofradiuscompensation, canned cycles. (4 programs)

Demonstration of one CNC program

- CNC Milling- Writing and simulation of manual part program using G & M codes forsimple parts including Surface milling, Edge milling, Contour milling, Drilling, and pocket milling. Tool length compensation, use of canned cycles.(4 programs)

Demonstration of one CNC program

- Programming of Robots by lead through and off line methods. Use of robot to pick and place, stacking of objects in increasing or decreasing order. (4 programs)

Assessment of Self Study:

Student group of 5 members to submit following assignments in CNC &Robotics lab at the end of the course.

1. Writing a CNC program for a part drawing.
2. Simulating the CNC program using G & M codes manual part programming software.
3. Loading of CNC program on to the machine.
4. Executing the program on CNC Machine to prepare the part.
5. Checking the model with respect to dimensions and accuracy of the contours, surface finish etc.
6. Documentation, presentation and report submission.

Text Books:

1. **Computer Control of Manufacturing Systems**, YoremKoren ,McGraw Hill, 1983 ISBN-0-07-Y66379-3,
2. **CAD/CAM**, Mikell P. Grover, Emory, W. Zimmers Pearson Education Inc.,2003 ISBN-81-203-0402-0,
3. **CAD/CAM Principle and Applications**, PN Rao, Tata McGraw Hill, 7th Reprint, 2007 ISBN-0-07-058373-0,

References:

1. **Principle of interactive Computer Graphics,** Newman and Sproull, TMH,2nd Edition, 1978, ISBN13-978-0070463-387
2. **CAD/CAM**, IbhrahimZeid, THM, 1991, ISBN-00707-28577,
3. **Numerical control and CAM,**Kundra, Rao and Tiwary, Tata McGraw Hill PublishingCo., NewDelhi, 1987, ISBN 13-978 00 745 17 406,
4. **Mechatronics**HMT – Tata McGraw Hill publishing company,ISBN 0-07-462127-5
5. **CAD/CAM/CIM** – P. Radhakrishnan, S. Subramanyan and Raju – New Age International Publishers, 2009 Edition, ISBN-13-978-8122422368

OnlineResource:www.nptel.ac.in

Scheme of Examination: To set one question each from Units **1**, **2, & 5** and two questions each from Units **3& 4**.

Course Outcomes

CO1	Is able tounderstand the roleof computersin designand manufacturing,computerized manufacturing environment, CAD and CAM, their advantages and willacquire the knowledge of hardware of computer systems used in CAD/CAM
CO2	Is able to understand, the variousfunctions of graphic packages and will be in a position to use the computers for theengineering design applications. Students will be knowing the concepts of geometricalmodeling, study the various types of geometrical models and their possibleapplications and limitations
CO3	Able to ascertain about the development and principles of numerical controltechnology, understand the basics of CNC hardware, Control systems, CNC toolingand work holding devices.
CO4	Is able to understand the different types of CNC programming, requirements of programming, structure of a program and other related topics. The students will have practical experience in writing CNC programs and alsooperating of CNC machines
CO5	Is able to empathize a Robot – types of robots, configuration, robot motions, endeffectors, robot programming methods, and their applications.

ASSESSMENT:

Continuous Internal Evaluation (CIE) includes periodic class tests, quizzes or Alternative Assessment Tools (AAT) prescribed by the faculty handling a course prior to beginning of the classes like assignments, problem solving, case studies, group discussion, seminar, mini-project etc.

Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

Both CIE and SEE have equal (50:50) weightages. The student's performance in a course shall be judged individually and together based on the results of CIE and SEE.

Course	OPERATIONS RESEARCH	CourseCode	16IE5DCOPR
Credits	04	L-T-P-S	3-1-0-0

Prerequisites: Nil

UNIT-1

Introduction:OR definition, scope, phases, limitations, models, applications and advantages of OR **02Hrs**

Linear programming: Definition, mathematical formulation, standard form, graphical method: feasible, infeasible, multiple solution, unbounded solution and simplex method: feasible, infeasible, multiple solution, unbounded solution, introduction to duality in LPP with simple problems **13 Hrs**

UNIT - 2

Transportation problem: Formulation of transportation model, basic feasible solution using different methods, optimal solutions, degeneracy in transportation problems, unbalanced transportation problem **07Hrs**

Assignment problem: Formulation, balanced, unbalanced and maximization assignment problem, travelling salesman problem using Hungarian method **07Hrs**

UNIT - 3

Queuing theory: Queuing system and their characteristics, analysis of markovian queues, M/M/1, M/M/K queuing system **07Hrs**

UNIT - 4

Project management using network analysis: Network construction, determination of critical path and duration, floats using CPM. PERT-Estimation of project duration, Variance and crashing of projects **09Hrs**

UNIT - 5

Game theory: Two persons - zero sum game, games with and without saddle point, graphical solution, dominance property **07Hrs**

Text books:

1. **Operations Research and Introduction**, Taha H A, Pearson Education, 9th Edition, 2014
2. **Introduction to Operation Research**, F K Hiller and Liberman, McGraw hill Education Pvt Ltd, 9th Edition, 2011
3. **Operations Research –Principles and practice**, Philips Ravindaran and Soleberg, Wiley Publication, 2nd Edition, 2007

Reference books:

1. **Operations Research**, S D Sharma, KedarNath, Ram Nath Publication, 2014
2. **Operations Research**, Kanthiswarup and others ,Sulta Chand and sons, 2014
3. **Operations Research Problems and Solutions**, J K Sharma, McMillan Publishers, 3rd Edition, 2009.
4. **Operations Research**,P K Gupta and Hira, S Chand Publications, 2007.

Online Reference:www.nptel.ac.in

Course Outcomes

CO1	To be able to understand the fundamental concept and approach of linear programming appropriate to the further study of operations research and identify problems in real life
CO2	To be able to recognize and optimize the transportation and assignment problems
CO3	To be able to recognize and solve Queuing theory problems
CO4	To be able to use network planning procedures for solving logistics problems
CO5	To be able to recognize and solve Game theory problems

Scheme of Examination: Each question from each unit and internal choice from **unit-1** and **unit-2**

ASSESSMENT

Continuous Internal Evaluation (CIE) includes periodic class tests, quizzes or Alternative Assessment Tools (AAT) prescribed by the faculty handling a course prior to beginning of the classes like assignments, problem solving, case studies, group discussion, seminar, mini-project etc.

Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

Both CIE and SEE have equal (50:50) weightages. The student's performance in a course shall be judged individually and together based on the results of CIE and SEE.

Course	QUALITY ASSURANCE AND RELIABILITY	Course Code	16IE5DCQAR
Credits	06	L-T-P-S	3-0-1-2

Prerequisites: Nil

UNIT-1

Introduction to Quality: Definition of Quality, Quality function, Dimensions of Quality, Quality Engineering terminology, Brief history of quality methodology, statistical methods for quality improvement, Quality costs – four categories costs and hidden costs. Brief discussion on sporadic and chronic quality problems, Introduction to Quality function deployment. **06Hrs**

UNIT- 2

Quality Assurance: Definition and concept of quality assurance, departmental assurance activities. Quality audit concept, audit approach etc. structuring the audit program, planning and performing audit activities, audit reporting, ingredients of a quality program. **04Hrs**

Statistical Process Control: Introduction to statistical process control–chance and assignable causes variation. Basic principles of control charts, choice of control limits, sample size and sampling frequency, rational subgroups. Analysis of patterns of control charts. Case Studies on application of SPC, Process capability–Basic definition and six sigma concept of process capability, Seven QC tools. **07 Hrs**

UNIT- 3

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. Control charts for individual measurements**.** Gauge R and R and MSA. **06Hrs**

Control Charts For Attributes: Controls chart for fraction non- conforming (defectives) development and operation of control chart, brief discussion on variables sample size.

Control chart for non-conformities (defects) – Development and operation of control chart for constant sample size and variable sample size. Choice between variables and attributes control charts. Guidelines for implementing control charts. **06Hrs**

UNIT-4

Sampling Inspection: Concept of accepting sampling, economics of inspection, Acceptance plans–single, double sampling. Operating characteristic curves–construction and use. Determinations of average outgoing quality, average outgoing quality level, average total inspection, producer risk and consumer risk, published sampling plans. **06Hrs**

UNIT-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 **05Hrs**

UNIT-6

1. To test the Goodness of fit for the given quality characteristic using Uniform distribution
2. To test the Goodness of fit for the given quality characteristic using Binomial distribution
3. To test the Goodness of fit for the given quality characteristic using Poisson distribution
4. To test the Goodness of fit for the given quality characteristic using Normal distribution
5. Conduction of Repeatability and Reproducibility studies for appraiser and instrument using R & R Software
6. Assessing Process Capability of the given manufacturing process using Normal Probability Paper method and process capability indices
7. Experiments on Application of 7 QC Tools as applied to Manufacturing and Service Operations.

Construction of control chart for attribute equality characteristic
Construction of control charts using Systat Software/Minitab

1. Attribute sampling Plans–Single, Double and multiple sampling plans.
2. Experiments on correlation and Simple linear regressions
3. Experiments on multiple linear regressions
4. 13.Conduction of Design of Experiments Full Factorial approach for the given quality characteristic for machining operations/ catapult/Golf experiment
5. 14. Exercises to demonstrate Taguchi's Orthogonal Array technique through DOE software.

TextBooks

1. **Introduction to statistical Quality Control**- DC Montgomery, John Wiley and Sons, 7th Edition ISBN : 978-1-118-32416-5
2. **Quality Planning & Analysis** - J M Juran, Frank M Gryna; Tata Mc Graw Hill, 4th edition, ISBN-13: 978-0070393684

ReferenceBooks

1. **Statistical QualityControl** - Grant and Leavenworth, McGraw Hill,7th Edition ISBN-13: 978-0078443541
2. **Total Quality Management** – NVR Naidu, KM Babu and G. Rajendra –New Age International Pvt.Ltd–2006
3. **Total Quality Management**-Kesavan R,I.K International, New Delhi – 2007 ISBN-13: 978-8189866860

Online Reference: www.nptel.com

E-Books :http://bookboon.com/en/quality-management-ebook

Course Outcomes

CO1	To understand the underlying reasons for modern quality philosophies & methodologies, as compared with the earlier practices
CO2	To develop abilities to construct control charts and analyze process data generated overtime
CO3	To understand the statistical basis of control charts, process capability analysis and acceptance sampling
CO4	To understand various issues regarding reliability engineering

Scheme for Examination: Five questions choosing one each from each unit and **Unit2** and **3** with choice questions

ASSESSMENT

Continuous Internal Evaluation (CIE) includes periodic class tests, quizzes or Alternative Assessment Tools (AAT) prescribed by the faculty handling a course prior to beginning of the classes like assignments, problem solving, case studies, group discussion, seminar, mini-project etc.

Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

Both CIE and SEE have equal (50:50) weightages. The student's performance in a course shall be judged individually and together based on the results of CIE and SEE.

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Course	ENGINEERING ECONOMY	CourseCode	16IE5DCENE
Credits	03	L-T-P-S	2-1-0-0

Prerequisites: Nil

UNIT-1

Introduction: Engineering Decision- Makers, Engineering and Economics, Problem solving and Decision making, Intuition and Analysis, Tactics and Strategy, Decision maze. Practical oriented decision making. **05Hrs**

Interest and Interest Factors: Interest rate, simple interest Compound interest, Cash- flow diagrams, Exercises and Discussion on time value of money. **05Hrs**

UNIT- 2

Present Worth Comparison: Conditions for present worth comparisons, Basic Present worth comparisons, Present worth equivalence, Net Present worth, Assets with unequal lives, infinite lives, Future worth comparison, Pay – back comparison, Exercises, Discussions and problems. **06 Hrs**

UNIT- 3

Equivalent Annual Worth Comparisons: Equivalent Annual Worth Comparison methods, Situations for Equivalent Annual Worth Comparison Consideration of asset life, Comparison of assets with equal and unequal lives, Use of sinking fund method, Annuity contract for guaranteed income, Exercises, Problems. **06 Hrs**

Rate of Return Calculations: Rate of return, Minimum acceptable rate of return, IRR, IRR misconceptions, Cost of capital concepts. **03 Hrs**

Depreciation: Causes of Depreciation, Basic methods of computing depreciation charges **03 Hrs**

UNIT-4

Replacement Analysis: Deterioration, obsolescence, inadequacy, Economic life for cycle replacements **03 Hrs**

Structural Analysis of Alternatives: Identifying and Defining alternatives, IRR analysis of mutually exclusive alternatives, Capital Budget view point, Rankine criteria. **04 Hrs**

UNIT-5

Estimating & Costing: Components of costs such as Direct Material Cost, Direct Labour Cost, Fixed, Over – Heads, Factory Costs, Administrative – Over Heads, First Cost, Marginal Cost, Selling price, Estimation for simple components

Effects of Inflation: Causes, consequences and control of inflation. After tax actual cash flow comparisons, Lease/ Buy decisions **05 Hrs**

Text Books:

1. **Engineering Economy**- Riggs J.L. McGraw Hill, 2002, ISBN 0-07912248-5.
2. **Engineering Economy** - Paul Degarmo, Macmillan Pub, Co. 2001, ISBN-00-232 86008.
3. **Engineering Economy** - Naidu, Babu and Rajendra –, New Age International Pvt. Ltd 2008, ISBN-13:4788122419092
4. **Engineering Economics**- R Panner Selvam – PHI Publishing Pvt Ltd, 2nd Edition, ISBN; 978-81-203-4837-0 2008

Reference Books:

1. **Industrial Engineering and Management**–O. P.Khanna, Dhanpat Rai & Sons 2000, ISBN-818992835X
2. **Financial Management** - I M Pandey, Vikas Publishing House 11th Edition, 2002, ISBN- 978932598229
3. **Engineering Economy** -Thuesenh.G. PHI, 9th Edition, 2002, ISBN-10:01 30281289

Online reference:www.ntpel.com
Books :http://bookboon.com/en/search?q=enginnering%20economics&p=1

Course Outcome

CO1	Able to learn Problem solving and Decision making using Intuition and Analysis,
CO2	Know Decision maze, Interest and Interest Factors: time value of money
CO3	Able to use Present Worth Comparison: Future worth comparison, Pay –back comparison, Equivalent Annual Worth Comparison methods, sinking fund method, Rate of Return Calculations to solve complete engineering problems
CO4	To calculate Depreciation charges, Replacement Analysis, Structural Analysis of Alternatives
CO5	Know Estimating & Costing, Effects of Inflation: Lease/ Buy decisions

Scheme of Examination: One Question to be set from each unit and Two Questions will be set from the unit 1 & 3.Student will answer any 5 questions selecting at least one from each unit.

ASSESSMENT

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Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

Both CIE and SEE have equal (50:50) weightages. The student's performance in a course shall be judged individually and together based on the results of CIE and SEE.

Course	FACILITIES PLANNING AND DESIGN	Course Code	16IE5DCFPD
Credits	03	L-T-P-S	3-0-0-0

Prerequisites: Nil

UNIT - 1

Plant Location: Factors influencing plant location, Theories of plant location and Locational Economics.

Capitals- Objectives of plant layout, Principles of plant layout, types of plant layout, their merits and demerits. **05 Hrs Material Handling:** Objectives and principles of Material handling, Unit load concept,
classification of material handling equipment. **03 Hrs**

UNIT - 2

Plant Layout Design: Traditional Layout procedures: Immer's Basic Steps, Nadler's ideal systems approach, Muther's SLP, Apple's Plant Layout Procedure and Reed's procedure,
Activity relationship chart, relationship Diagram, Space relationship diagram. **04 Hrs Computerized Layout Planning:** Classification of Layout Algorithms – distance based Vs. Adjacency based approaches, Pairwise Exchange Method, Graph based method. CRAFT,

CORELAP, ALDEP – Input requirements and procedure Introduction to Simulated Annealing and Genetic Algorithm in Layout design. **06 Hrs**

UNIT - 3

Space Determination & Area Allocation: Factors for consideration in space planning, receiving, storage, production, shipping, tool room and tool crib, other auxiliary service actions. Establishing total space requirement. The area allocation procedure, the plot plan.
Constructing The Layout: Methods of constructing the layout, Evaluation of layout, efficiency indices, presenting layout to management. **08 Hrs**

UNIT - 4

Quantitative Approaches To Location Models: Facility location models - Single and Multi-facility, Location allocation Models and numerical problems. **04 Hrs**

Other Facilities Layout Models: – Quadratic Assignment Problem, Warehouse layout models. Machine Layout Models and Simple Problems **04 Hrs**

UNIT – 5

Layout Models And Decision Making: Conventional Storage models, AS & RS, Simulation Models–simple problems, Introduction to MCDM, MADM approaches-AHP **06 Hrs**

Text Books:

1. **Facilities Planning** – James A. Tomkins, John A. White, YavuzA. Bozer, J M.A. Tanchoco, John Wiley and Sons, 2010, ISBN 978-0-470-44404-7
2. **Plant Layout and Material handling -** James M Apple,, John, Wiely and Sons, 2nd Edition, 1977
3. **Facility layout and Location -** Francies,R.L. and White,J.A., McGraw Hill 2nd edition 1992.

Reference Books:

1. **Practical layout** - Muther Richard, McGraw Hill-1955.
2. **Facilities Design** – SundereshHeragu, PWS Publishing Company, ISBN-0-534-95183.
3. **Plant Layout Design -** James M Moore, McMilan Co.1962 LCCCN61- 5204.

Course Outcomes

CO1	Be able to learn various factors influencing the decision regarding locations ofindustrial plants, plant layouts and material handling.
CO2	Be able to get an insight into traditional layout procedures, and the how the earlierlayout designers used to address the problem. A comparative study is possible after gaining the knowledge regarding computerized layout planning procedures
CO3	Understand the functions that demand space in a layout, services that are to beprovided, building constraints, area allocation procedures etc.that in turn helphim/her to visit the layout problem in a new light and construct a layout in a step bystep manner
CO4	Learn to address the problems in an quantitative manner for problem solving, eithertaking a single facility or multiple facilities for analysis at any given time and gather ahuge data involving a large number of people.
CO5	Be able to understand various layout models developed over a long period of timemathematically. This exposure is important from the point of view of layout.

Scheme of Examination:

Five Questions to be set with one question from each unit carrying 20 marks each. **Unit-2** & **Unit-3** units will have an internal choice.

ASSESSMENT

Continuous Internal Evaluation (CIE) includes periodic class tests, quizzes or Alternative Assessment Tools (AAT) prescribed by the faculty handling a course prior to beginning of the classes like assignments, problem solving, case studies, group discussion, seminar, mini-project etc.

Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

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ELECTIVE – I

Course	APPLIED THERMODYNAMICS	CourseCode	16IE5DEAPT
Credits	03	L-T-P-S	3-0-0-0

Prerequisites: Nil

UNIT- 1

Gas Power Cycles: Air standard cycles; Carnot, Otto, Diesel, Dual and Stirling cycles, P-V and T-S diagrams, description, efficiencies. Comparison of Otto, Diesel and Dual cycle and numerical problems **06Hrs**

UNIT- 2

Gas turbines: Classification of Gas Turbines, Analysis of open cycle gas turbine cycle. Advantages and disadvantages of closed cycle. Methods to improve thermal efficiency and numerical problems. **06Hrs**

UNIT- 3

Vapour Power Cycles: -Carnot vapour power cycle, drawbacks as a reference cycle. Simple Rankine cycle; description, T – S diagram, analysis for performance. Comparison of Carnot and Rankine cycles. Effects of pressure and temperature on Rankine cycle performance. Actual vapour power cycles. Ideal and practical regenerative Rankine cycles, open and closed feed water heaters. Reheat Rankine cycle and numerical problems. **11Hrs**

UNIT- 4

Reciprocating Compressors: - Operation of a single stage reciprocating compressors. Work input through P – S diagram and steady state steady flow analysis. Effects of clearance, volumetric efficiency. Adiabatic, isothermal and mechanical efficiencies. Multi-stage compressor, optimum intermediate pressure, inter-cooling, minimum work for compression and numerical problems. **11Hrs**

UNIT -5

I.C. Engines: Testing I C engine performance, related numerical problems, heat balance sheet, Morse test and numerical problems. **06 Hrs**

Text Books:

1. **Basic and Applied Thermodynamics,** P. K. Nag, Tata Mc Graw Hill,3rd Edition, 2009.
2. **Thermodynamics an Engineering approach,** Yunus A. Cengeland Michael A. Boles, Tata Mc. Graw hill Publication, 2008.

Reference Books:

1. **Engineering Thermodynamics,** Rajput, Laxmi Publications pvt ltd., 3rdEdition, 2007.
2. **Fundamentals of Thermodynamics,** G.J. Van Wylen and R.E. Sonntag, Wiley Eastern
3. **I C Engines,** M.L. Mathur and R.P. Sharma, 2014

Online course: www.nptel.ac.in

Scheme of Examination: One question from **units 1, 2 & 5** and two questions from **units 3 & 4**

Course Outcomes

CO1	Be able to understand the basic concepts of thermodynamics and describe energy exchange processes in terms of various forms of energies like heat and work in the systems
CO2	Be able to state the First Law for a closed system, open system and apply the steady flow energy equation to a system of thermodynamic components (heaters, coolers, pumps, turbines etc.) to estimate required balances of heat, work and energy flow
CO3	Be able understand the Second Law of Thermodynamics - Heat engines and Refrigerators, Reversible and irreversible processes, Carnot cycle and Entropy
CO4	Be able to apply ideal cycle analysis to simple Heat Engine and Gas Turbine cycles to estimate thermal efficiency and work as a function of pressures and temperatures at various points in the cycle.
CO5	Be able to conduct experiments on Petrol and Diesel engines. Be able to calculate the efficiencies of the Petrol and Diesel engines

ASSESSMENT

Continuous Internal Evaluation (CIE) includes periodic class tests, quizzes or Alternative Assessment Tools (AAT) prescribed by the faculty handling a course prior to beginning of the classes like assignments, problem solving, case studies, group discussion, seminar, mini-project etc.

Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

Both CIE and SEE have equal (50:50) weightages. The student's performance in a course shall be judged individually and together based on the results of CIE and SEE.

Course	PRODUCT DESIGN & DEVELOPMENT	Course Code	16IE5DEPDD
Credits	03	L-T-P-S	3-0-0-0

Prerequisites: Nil

UNIT-1

Introduction: Characteristics of successful product development, Design and development of products, duration and cost of product development, the challenges of product development.

Development Processes and Organizations: A generic development process, concept development: the front-end process, adopting the generic product development process, the AMF development process, product development organizations, the AMF organization.

Product Planning: The product planning process, identify opportunities. Evaluate and prioritize projects, allocate resources and plan timing, complete pre project planning, reflect all the results and the process. **10Hrs**

UNIT-2

Identifying Customer Needs: Gather raw data from customers, interpret raw data in terms of customer needs, organize the needs into a hierarchy, establish the relative importance of the needs and reflect on the results and the process.

Product Specifications: What are specifications, when are specifications established, establishing target specifications, setting the final specifications.

Concept Generation: The activity of concept generation clarify the problem, search externally, search internally, explore systematically, reflect on the results and the process. **06 Hrs**

UNIT-3

Concept Selection: Overview of methodology, concept screening, and concept scoring,

Concept Testing: Define the purpose of concept test, choose a survey population, choose a survey format, communicate the concept, measure customer response, interpret the result, and reflect on the results and the process.

Product Architecture: What is product architecture, implications of the architecture, establishing the architecture, variety and supply chain considerations, platform planning, related system level design issues. **10 Hrs**

UNIT- 4

Industrial Design: Assessing the need for industrial design, the impact of industrial design, industrial design process, managing the industrial design process, assesses the quality of industrial design.

Design for Manufacturing: Definition, estimation of manufacturing cost, reducing the cost of components, assembly, supporting production, impact of DFM on other factors.

Prototyping: Prototyping basics, principles of prototyping, technologies, planning for prototypes **06 Hrs**

UNIT-5

Intellectual Property Rights: Basic principles of IP laws: Introduction, Concept of property, Need for a holistic approach, Basis for protection, Invention, Criteria for patentability, Non – patentable inventions. Patents: Introduction, principles underlying the patent law in India, patentable invention. Procedure for obtaining patent. **04Hrs**

Product Development Economics: Elements of economic analysis, base case financial model,. Sensitive analysis, project trade-offs, influence of qualitative factors on project success, qualitative analysis.

Managing Projects: Understanding and representing task, baseline project planning, accelerating projects, project execution, postmortem project evaluation. **04 Hrs**

Text Books:

1. **Product Design & Development** - Karl T. Ulrich & Steven D., Tata McGraw Hill, 5th Edition, 2006

Reference Books:

1. **Product Design and Manufacturing** by A.K. Chitale and R.C. Gupta, PHI.
2. **Basic principles and acquisition of Intellectual Property Rights**", Dr. T Ramakrishna, CIPRA, NSLIU -2005.
3. **Intellectual Property Law Handbook**, Dr.B.L.Wadehhra, Universal Law Publishing Co. Ltd., 2002.
4. **New Product Development** by Tim Jones, Butterworth Heinr1ann, Oxford, UIC 1997.
5. **New Product Development**: Design & 'Analysis by Roland Enene, Kinetovicz, John Wiley and Sons Inc., N. Y. 1990.

6. **Product Design for Manufacture and Assembly** by Gefferry Boothroyd, Peter Dewhurst and Winston Knight, Taylor & Fransis group, 3rd Edition, 2011
7. **Successful Product Design** by Jill Hollins, Stwout Pugh, Butterworth, London 1 990.

Online Links:
http://nptel.ac.in/courses.php

Scheme for examination: Five questions choosing one each from each unit and **Unit 1** and **3** with choice questions

Course Outcomes

CO1	Understand the basic concepts of product design
CO2	Understand the product design process in industry
CO3	Understand the economic factors involved in PD
CO4	Understand the basic concepts of IPR
CO5	Understand modern approaches helpful in product design

ASSESSMENT

Continuous Internal Evaluation (CIE) includes periodic class tests, quizzes or Alternative Assessment Tools (AAT) prescribed by the faculty handling a course prior to beginning of the classes like assignments, problem solving, case studies, group discussion, seminar, mini-project etc.

Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

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B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19

DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

Course	ORGANIZATIONAL BEHAVIOR	Course Code	16IE5DEOBE
Credits	03	L-T-P-S	3-0-0-0

Prerequisites: Nil

UNIT - 1

Introduction: Definition of Organization Behavior and Historical development, Environmental context (Information Technology and Globalization, Diversity and Ethics, Design and Cultural, Reward Systems.

The Individual: Foundation of individual behavior, Ability.

Learning: Definition, Theories of Learning, Individual Decision Making, classical conditioning, operant conditioning, social Making, learning theory, continuous and intermittent reinforcement.

06 Hrs

UNIT - 2

Perception: Definition, Factors influencing perception, attribution theory, selective perception, projection, stereotyping, Halo effect.

Values And Attitudes: Definitions, values, Attitudes: Types of values, job satisfaction, job involvement, professional Ethics, Organizational commitment, cognitive dissonance.

10 Hrs

UNIT – 3

Motivation: Maslow's Hierarchy of Needs, Mc. Gregor's theory X and Y, Herzberg's motivation Hygiene theory, David Mc Cleland three needs theory, Victor vroom's expectancy theory of motivation.

The Group: Definition and classification of groups, Factors affecting group formation, stages of group development, Norms, Hawthorne studies, group processes, group tasks, group decision making.

Conflict Management: Definition of conflict, functional and dysfunctional conflict, stages of conflict process. **10 Hrs**

UNIT – 4

Leader Ship: Definition, Behavioral theories – Blake and Mounton managerial grid, Contingency theories, Hersey - Blanchard's situational theory, Leadership styles, characteristics, Transactional, transformation leaders. **08 Hrs**

UNIT - 5

The Organization: Mechanistic and Organic structures, Minitberg's basic elements of organization, Organizational Designing and Employee behaviour, organization development, quality of work life (QWL), Team building. **06 Hrs**

Text Books:

1. **Organizational Behavior**, Stephen P Robbins, 9th Edn, Pearson Education Publications, ISBN–81–7808–561-5, 2002

2. **Organizational Behavior** – Fred Luthans, 9th Edn, McGraw Hill International Edition, ISBN– 0–07– 20412–1, 2011

Reference Books:

1. **OrganizationBehavior** – Hellriegel, Srocum and woodman, Thompson Learning, 9th Edition, PHI, 2001
2. **Organizational Behavior** – Aswathappa – Himalaya Publishers. 2001.
3. **Organizational Behavior** – VSP Rao and others, Konark Publishers 2002.
4. **Organizational Behavior** (Human behaviour at work) 9th Edition John Newstron / Keith Davis. 2002.
5. **Management of Organizational Behavior**, Paul Henry and Kenneth H. Blanchard, Prentice Hall of India, 1996.

On line reference: organizational-behavior-15e-stephen-p-robbins-timothy-a-judge-pdf

Course Outcomes

CO1	About the individual and learning: In the context of Environment, Information Technology, Globalization, Diversity and Ethics. To design Organizations in various Cultural and reward systems including individual behavior. Learning process to Modify behavior to meet organizations goals, to condition and reinforce positive attitudes and values.
CO2	About Perception: to be satisfied, to involve professionally, ethically and commitment to the job with High moral values and attitudes
CO3	About Motivation: to motivate people to work efficiently in groups to increase the effectiveness of the Organization using group dynamics, decisions, tasks and manage conflicts
CO4	About Leadership; to lead, acquire leadership characteristics, to become transactional and Transformational leaders.
CO5	About organization: To Design Conducive Behavior to Develop Quality of Work life Balance and to Work in Teams

Scheme Of Examination:

FIVE Questions to be set with one question from units 1 to 5 carrying 20 marks each.
Questions in **unit 2 & 3 units** will have an internal choice.

ASSESSMENT

Continuous Internal Evaluation (CIE) includes periodic class tests, quizzes or Alternative Assessment Tools (AAT) prescribed by the faculty handling a course prior to beginning of the classes like assignments, problem solving, case studies, group discussion, seminar, mini-project etc.

Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

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Course	THEORY OF MACHINES	Course Code	16IE5DETOM
Credits	03	L-T-P-S	3-0-0-0

Prerequisites: Nil

UNIT-1

Introduction: Definitions: Link or element, kinematic pairs, degrees of freedom, Grubler's criterion (without derivation), Kinematic chain, Mechanism, structure, Mobility of Mechanism, Inversion.

Kinematic Chains and Inversions: Inversions of Four bar chain; Single slider crank chain and Double slider crank chain. **05Hrs**

Mechanisms: Quick return motion mechanisms-Drag link mechanism, Whitworth mechanism and Crank and slotted lever Mechanism. Straight line motion mechanisms –Peaucellier's mechanism and Robert's mechanism, Intermittent Motion mechanisms – Geneva mechanism and Ratchet and Pawl mechanism. Toggle mechanism, Pantograph, Ackerman steering gear mechanism. **06Hrs**

UNIT- 2

Cams: Types of cams, Types of followers, Displacement, Velocity and Acceleration time curves for cam profiles. Disc cam with reciprocating follower having knife-edge, roller and flat-faced follower, Disc cam with oscillating roller follower, Follower motions including SHM, Uniform velocity, uniform acceleration and retardation and Cycloidal motion. **08Hrs**

UNIT- 3

Balancing Of Machinery: Static and Dynamic balancing, balancing of single rotating mass in same plane and in different planes, balancing of several rotating masses in same plane and in different planes, balancing of reciprocating masses Inertia effect of crank and connecting rod. **05Hrs**

UNIT-4

Spur Gears: Gear terminology, law of gearing, Characteristics of involute action, Path of contact, Arc of contact, Contact ratio, Interference in involute gears, Methods of avoiding: interference, Back lash, Comparison of involute and cycloidal teeth **05Hrs**

Gear Trains: Simple gear trains, Compound gear trains for large speed reduction, epicyclic gear trains, Algebraic and tabular methods of finding velocity ratio of epicyclic gear trains. Tooth load and torque calculations in epicyclic gear trains. **05Hrs**

UNIT- 5

Belts, Ropes And Chains: Introduction, Belt and Rope drives, open and crossed belt drives, action of belt on pulleys, velocity ratio, slip, law of belting, length of belt, Ratio of friction, chains, chain length and analytical, classification of chains. **03Hrs**

Governors: Types of governors; force analysis of Porter and Hartnell governors. Controlling force, stability, sensitiveness, isochronism's, effort and power. **05Hrs**

Text Books:

1. **Theory of Machines,** Rattan S.S, Tata McGraw-Hill Publishing Company Ltd., New Delhi, and 2nd Edition -2005.
2. **Theory of Machines,** Sadhu Singh, ," Pearson Education (Singapore) Pvt. Ltd., Indian
3. Branch, New Delhi, 2nd Edition. 2006.
4. **Theory of Machine,** Jagadish Lal, , Dhanpat Rai Publications, New Delhi, 1971

Reference books:

1. **Theory of Machines** Shigley. J. V. and Uickers, J.J., Oxford University press, 2004
2. **Theory of Machines -I"**, by A.S.Ravindra, Sudha Publications, Revised 5th Edition, 2004.

Scheme: Choice from unit 1 & unit 4 , and one question each from the remaining units 2 , 3 and 5.

Course Outcomes

CO1	Able to understand various mechanisms and nature of working
CO2	Students learn to construct profile of Cams with analytical problems
CO3	Students learn about gearing systems and gear trains with analytical problems
CO4	Students learn about gearing systems and gear trains with analytical problems

ASSESSMENT

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Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

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Course	TOOL ENGINEERING	Course Code	16IE5DETEG
Credits	03	L-T-P-S	3-0-0-0

Prerequisites: Nil

UNIT -1

Cutting Tool Materials : Introduction, Desirable properties of tool materials, characteristics cutting tool materials, single point cutting tool geometry, single point tool nomenclature, chip flow direction, tool angles specifications, cutting parameters and tool geometry, Indexable inserts, chip breakers. **06Hrs**

UNIT-2

Tool Wear, Tool Life and Machinability: Introduction, Tool wear mechanism, types of tool damage during cutting, wear and chipping, characteristics of different tool materials, tool wear equation, tool failure criteria, Taylor's tool life equation, effect of process parameters on tool life, tool life test, Machinability. (Includes simple problems) **06Hrs**

UNIT –3

Tools in Milling : Milling Cutters, materials of milling cutters, Elements of fluted milling cutters (Cutter nomenclature), Geometry of milling cutter, milling parameters, effects of various factors in milling operations, selection of milling cutters, face milling cutters, end milling cutters, carbide milling cutters, Indexing. (Includes simple problems) **08Hrs**

UNIT-4

Tools in Drilling: Drilling operations, cutting speeds and feeds, various types of drills, drilling with jet pulsing, Drill points shapes for various applications, Drill wear, Drill point sharpening, chip control and chip breakers in drilling, introduction to counter boring, counter sinking, spot facing, Reaming. (Includes simple problems)

Grinding Wheels: Introduction, grinding wheels, specification of grinding wheels, recommendation for selection of grinding wheels, Operating conditions, grinding fluids, mounting of grinding wheels. (Includes simple problems) **10Hrs**

UNIT-5

Press Tools : Introduction, press operations, components of press, classification of presses, Flywheel considerations, transfer presses, selection of presses, components of die assembly, classification of dies, clearance between Die and Punch, automation of power press.

Powder Metallurgy: Process details and special characteristics of powder metallurgy process, Compaction techniques like CIP and HIP (Cold isostatic and hot isostatic pressing), Applications of powder metallurgy. **10 Hrs**

Text Books:

1. **Production Technology**. R. K. Jain, Khanna Publications, Edition 2014, ISBN 10817409-0991
2. **Production Technology**, H M T, Tata McGraw-Hill Publishing Company Limited, 2001 Edition, ISBN-97800709-64433
3. **Text Book of Production Technology**- K. C. Jain and A. K. Chithale, PHI, edition 2014, ISBN 9788120347496
4. **Fundamentals of Metal Cutting Tools,** B. L. Juneja. G. S. Sekhon Nithin Seth, New age International Publishers, Edition 2007, ISBN-978-812-241-4677

Reference Book:

1. **ASM Handbook on Powder Metallurgy** - Vol 17, ASM publications, PHI Learning Pvt. Limited.
2. **Principles of Machine Tools** by G. C. Sen and Amitabha Bhattacharya, Edition 2009, ISBN -9788173811555
3. **Metal cutting theory & cutting tool design**, V. Arshinow and G. Alfseev Mir Publication Mascow.
4. **Metal cutting and Tool Design**., B.J. Ranganath, Vikas Publishers, 2nd Edition.

Course Outcomes:

CO1	Is able to select proper tool for given machining operation, the designation of cutting tool, cutting tool parameters and other related topics.
CO2	Is able to understand Tool life, Tool wear and machinability aspects
CO3	Is able to understand Milling operations, Milling cutter to be used, parameter in Milling and Indexing operation
CO4	Is able to understand types of Drilling operations, various types of drills used and other related topics
CO5	Is able to understand Press tool operations, selection of presses, dies and punch and other related topics

Scheme of Examination: To set one question from each **units 1, 2& 3** and two questions from **unit-4** and **unit-5.**

ASSESSMENT

Continuous Internal Evaluation (CIE) includes periodic class tests, quizzes or Alternative Assessment Tools (AAT) prescribed by the faculty handling a course prior to beginning of the classes like assignments, problem solving, case studies, group discussion, seminar, mini-project etc.

Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

Both CIE and SEE have equal (50:50) weightages. The student's performance in a course shall be judged individually and together based on the results of CIE and SEE.

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19

DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

VI SEMESTER

Course	SIMULATION MODELING AND ANALYSIS	Course Code	16IE6DCSMA
Credits	06	L-T-P-S	3-0-1-2

Prerequisites: Nil

UNIT-1

Introduction To Simulation: Simulation, advantages, Disadvantages, Areas of application, System environment, components of a system, Model of a system, types of models, steps in a simulation study.

Simulation Examples: Simulation of Queuing systems, Simulation of Inventory System, Simulation of Project Management and Other simulation examples **10Hrs**

UNIT - 2

General Principles: Concepts in discrete - events simulation, event scheduling *I* Time advance algorithm

Random Numbers: Properties, Generations methods, Tests for Random number- Frequency test, Runs test, Autocorrelation test, Gap test, Poker test **08Hrs**

UNIT –3

Random Variate Generation: Inverse Transform Technique- Exponential, Uniform, Weibull, Triangular distributions, Direct transformation for Normal and log normal Distributions, Acceptance - Rejection Techniques – Poisson Distribution. **08Hrs**

UNIT - 4

Analysis of Simulation Data: Input Modeling: Data collection, Identification and distribution with data, parameter, Goodness of fit tests, Selection of input models without data

Verification and Validation of Model- Model Building, Verification, Calibration and Validation of Simulation Models **08Hrs**

UNIT - 5

Output Analysis - Stochastic Nature of output data, Measures of Performance and their estimation.

Simulation Software - Selection of Simulation software, simulation packages, Trends in simulation softwares **06Hrs**

UNIT -6 (Laboratory Exercise)

Development of simulation models using the simulation language / packages studied for systems Such as, Queuing systems, Production systems, Inventory systems, Maintenance and Replacement systems, Investment analysis and Networks.

- Solving Monte Carlo simulation problems using MS Excel (minimum 4
- exercise) Input analysis of Simulation data by statistical tools
- Simulation of Service system considering Breaks, Schedules and resource failure
- etc Activity based costing in Simulation
- Simulation of Manufacturing system with multiple servers and failures
- Simulation of Transport system considering Forklift and conveyor
- Supply chain simulation
- Network simulation.
- Statistical Analysis of Simulation models (output analysis)

Self-Study Assessment: Student group consisting of 4 - 5 members to submit following assignments in Simulation modeling Analysis lab at the end of the course.

1. Problem Identification: students can choose problems pertaining to queuing systems, production systems, inventory systems, maintenance and replacement systems, investment analysis, network, other any system under consideration.
2. Data collection and analysis for the problem considered
3. Building simulation model using Arena / Witness or any simulation languages
4. Verification and Validation of the simulation model considered
5. Performing Sensitivity analysis / Post optimal analysis for the generated model
6. Documentation, presentation and report submission.

Text Books:

1. **Discrete Event system Simulation** - Jerry Banks, John S Carson, II, Berry L Nelson, Prentice Hall, 1996
2. **Discrete-event System Simulation**, David M Nicol, 5th Edition, Pearson Education, Asia, 2010
3. **Systems Simulation with Digital Computer**, Narsingh Deo, PHI Publication (EEE), 1978
4. **Simulation Modeling & Analysis** Averill, M Law, W David Kelton, - McGraw Hill, International Editions – Industrial Engineering series, 1991
5. **Systems Simulation**,Gordan. G. "", Prentice Hall India Ltd, 1991.

Reference Books:

1. **Simulation -- Business & Economics** Sheldon M. Ross, Academic Press, 31-Dec-2012
2. **Simulation Modeling and Analysis with Arena,** Tayfur Altiok, Benjamin Melamed, 2010

Online courses

1. http://nptel.ac.in/courses.php?disciplineId=110
2. http://informs-sim.org/
3. E-learning: http://vtu.ac.in
4. http://ocw.mit.edu/
5. http:// youtube.com/ Discrete Event simulation

Software Packages

1. Simulation Packages: Arena, Quest, Witness,
2. M S Excel, Minitab

Scheme of Examination

Each question from each unit and internal choice from **Unit 1 & Unit 2**

Course Outcomes

CO1	Able to understand the basics of simulation and their applications
CO2	Able to understand the application of simulation with analytical problems
CO3	Able to build models and analysis of models
CO4	Able to test the models and to draw useful inferences

ASSESSMENT

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Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

Both CIE and SEE have equal (50:50) weightages. The student's performance in a course shall be judged individually and together based on the results of CIE and SEE.

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19

DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

Course	FINANCIAL ACCOUNTS AND COSTING	Course Code	16IE6DCFAC
Credits	04	L-T-P-S	3-1-0-0

Prerequisites: Nil

UNIT - 1

Financial Accounting: Introduction to Book keeping: double-entry accounting, journal & ledger posting. **05Hrs**

Financial Statements & Analysis: Trial balance, preparation of Trading and Profit & Loss account, and Balance sheet. **10Hrs**

UNIT - 2

Ratio Analysis: Balance sheet ratio's, profit – loss account ratio's, and combined ratio's. **05Hrs**

UNIT - 3

Costing: Objectives of costing, Elements of costing, methods of costing preparation of cost sheet (job costing), Process costing. **05Hrs**

Standard Costing: Material, labour, overhead cost variance. **04Hrs**

UNIT - 4

Working Capital Management: Factors influencing working capital requirement, determination of operating cycle and working capital. **05Hrs**

UNIT - 5

Budgeting: Sales budget, production budget, selling and administrative expense budget, Master budget. **06Hrs**

Text Books:

1. **Cost Accounting** - Khan M Y and Jain P K, Tata McGraw-Hill, 4thEdition, 2004
2. **Financial Management -** Prasanna Chandra; Tata McGraw-Hill,4th Edition. 1998.
3. **Management Accounting & Costing -** Prasad .N.K
4. **Financial Management and Policy -** James. C Vanhorne, Pearson education, 12th edition, 2002

Reference Books:

1. **Elements of Accountancy** - B.S Raman
2. **Practical Costing** - Ahuja, Pandey, Khanna and Arora, S. Chand& Co. Ltd 2005
3. **Financial Management & Costing –** Khan & Jain, TMH - 2000

Course Outcomes

CO1	Able to understand the financial part of the organization which is needed to carry out an industry
CO2	To prepare trial balance, journal entry, trading account, balance sheet, profit and loss account
CO3	Able to Determine the ratio analysis for balance sheet, profit & loss account & combined ratios
CO4	To understand the concepts of costing and preparation of cost sheet
CO5	Able to Determine the operating cycle and factors affecting working capitalrequirement& to learn the concepts of different types of budgeting

Scheme of Examination : Two questions from **unit 1 & unit 3** , and one question from **units 2, 4 and 5.**

E Books:

http://www.zums.ac.ir/files/research/site/ebooks/accounting/managerial-and-cost-accounting.pdf
http://ebooks.narotama.ac.id/files/A%20Textbook%20of%20Financial%20Cost%20&%20Management%20Accounting%

ASSESSMENT

Continuous Internal Evaluation (CIE) includes periodic class tests, quizzes or Alternative Assessment Tools (AAT) prescribed by the faculty handling a course prior to beginning of the classes like assignments, problem solving, case studies, group discussion, seminar, mini-project etc.

Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

Both CIE and SEE have equal (50:50) weightages. The student's performance in a course shall be judged individually and together based on the results of CIE and SEE.

Course	PRODUCTION AND OPERATIONS MANAGEMENT	Course Code	16IE6DCPOM
Credits	03	L-T-P-S	2-1-0-0

Prerequisites: Nil

UNIT – 1

Operations Management Concepts: Introduction, Historical development, The trend: Information and Non -manufacturing systems, Operations management, Factors affecting productivity, International dimensions of productivity, the environment of operations,Production systems decisions- a look ahead. **06Hrs**

UNIT – 2

Forecasting Demand: Forecasting objectives and uses, Forecasting variables, Opinion and Judgmental methods, Time series methods, Exponential smoothing, Regression and Correlation methods, Application and control of forecasts. **06Hrs**

Aggregate Planning And Master Scheduling: Introduction- planning and Scheduling, Objectives of aggregate planning, Aggregate planning methods, Master scheduling objectives, Master scheduling methods. **06Hrs**

UNIT – 3

Material And Capacity Requirements Planning: Overview: MRP andCRP, MRP: Underlying concepts, System parameters, MRP logic, System refinements, Capacity management, CRP activities. **04Hrs**

Scheduling And Controlling Production Activities: Introduction, PAC, Objectives and Data requirements, Scheduling strategy and guide lines

Single Machine Scheduling: Concept, measures of performance, SPT rule, Weighted SPT rule, EDD rule, minimizing the number of tardy jobs **06Hrs**

UNIT –4

Flow –Shop Scheduling: Introduction, Johnson's rule for 'n' jobs on 2 and 3 Machines, CDS heuristic.

Job-Shop Scheduling: Types of schedules, Heuristic procedure, scheduling 2 jobs on 'm'Machines. **06**Hrs

UNIT –5

Lean Systems: Characteristics of Just-in-Time operations, Pull method of materials flow, Consistently high quality, small lot sizes, Uniform workstation loads, Standardized components and work methods, close supplier Ties, Flexible workforce, Line flows, Automated production, Prevention maintenance, continuous improvement **06Hrs**

Text Books:

1. **OperationsManagement**William J. StevensonMcGraw-Hill Higher Education; 10th Revised Edition, April 1, 2010, ISBN-10007-802-4102.
2. **Operations Management**Monks, J.G McGraw-Hill International Editions, 3rd Edition, 1987, ISBN- 0070427275
3. **Production and Operations Management** Panner Selvam. R, PHI. 2nd Edition, 2006, ISBN-10:8120327675
4. **Productions &Operations Management** by Adam & Ebert, 5th Edition, ISBN: 978-81-203-0838-1

Reference Books:

1. **Modern Production/Operations Management,** Buffa, Wiely Eastern Ltd., 8th Edition, 2007, ISBN-10:812-651-3721
2. **Production and Operations Management,** Chary, S.N, Tata-McGraw Hill., 2004
3. **Operations management** by James Dilworth, South Westtern Educational Publishing, 1999
4. **Operations Management – Strategy and Analysis** Lee J Karjewski and Larry P Ritzman, 6thEdition

Online Resource: http://nptel.ac.in/syllabus/110102015/
E Books: http://bookboon.com/en/operations-management-ebook

Course Outcomes

CO1	Able to Manage operations, differentiate between manufacturing and non-manufacturingoperations and identify factors affecting productivity
CO2	Able to use different methods of forecasting and apply them for demand forecasting
CO3	Able to differentiate between aggregate planning and master scheduling and usethem for allocating load to machine centers.
CO4	Able to use MRP and CRP techniques to plan for materials and capacity in theOrganization.
CO5	Able to use different methods of scheduling and sequencing of jobs through differentproduction systems

Scheme of examination

One question from each unit and internal choice from **unit 2 &3**

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Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

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Course	SUPPLY CHAIN AND LOGISTIC MANAGEMENT	Course Code	16IE6DCSCL
Credits	05	L-T-P-S	3-0-0-2

Prerequisites: Nil

UNIT-1

Introduction to Materials Management: Definition and Importance of Materials Management. Scientific principles of buying meaning of inventory and types, EOQ derivation and analytical problems and safety stock. ABC classification. Standardization and variety reduction Codification system. **06Hrs**

UNIT – 2

Building A Strategic Frame Work to Analyze Supply Chains: Supply chain stages and decision phases process view of a supply chain. Supply chain flows. Examples of supply chains. Competitive and supply chain strategies. Achieving strategic fit. Expanding strategic scope. Drivers of supply chain performance. Framework for structuring drivers – Inventory, Transportation, Facilities, Information. Obstacles to achieving fit. **10Hrs**

UNIT – 3

Designing the Supply Chain Network: Distribution Networking – Role, Design. Supply Chain Network (SCN) – Role, Factors, Framework for Design Decisions.

Planning And Managing Inventories In a Supply Chain: Review of inventory concepts. Trade promotions, Managing multi-echelon cycle inventory, safety inventory determination. Impact of supply uncertainty aggregation and replenishment policies on safety inventory. Optimum level of product availability; importance factors. Managerial levers to improve supply chain profitability.

Sourcing, Transportation And Pricing Products: Role of sourcing, supplier – scoring & assessment, selection and contracts. Design collaboration. **08Hrs**

UNIT – 4

Transportation And Pricing Products: Role of transportation, Factors affecting transportation decisions. Modes of transportation and their performance characteristics. Designing transportation network. Trade-off in transportation design. Tailored transportation, Role of Revenue Management in the supply chain, Revenue management for: Multiple customer segments, perishable assets, seasonal demand, bulk and spot contracts. **08Hrs**

UNIT – 5

Coordination And Technology In The Supply Chain: Co-ordination in a supply chain: Bullwhip effect. Obstacles to coordination. Managerial levers to achieve co-ordination, Building strategic partnerships. The role of IT supply Chain, The Supply Chain IT framework, CRM, Internal SCM, SRM. The role of E-business in a supply chain, The E-business framework, E-business in practice.

Emerging Concepts: Reverse Logistics; Reasons, Activities, Role. RFID Systems; Components, applications, implementation. Lean supply chains, Implementation of Six Sigma in SupplyChains **08Hrs**

Text Book:

1) **Supply Chain Management** –Strategy, Planning & Operation. Sunil Chopra & Peter Meindl, Pearson Education Asia, ISBN: 81-7808-272-1.2001,
2) **Materials Management**: A K Datta, Procedures, Text and cases

Reference Books:

1) **Supply Chain Redesign** – Transforming Supply Chains into Integrated Value Systems - Robert B Handfield, Ernest L Nichols, Jr., Pearson Education Inc, ISBN: 812-970-1138,2002,
2) **Modeling the Supply Chain** -Jeremy F Shapiro, Duxbury;, Thomson Learning,
3) ISBN 0-534-37363,2002,
4) **Designing & Managing the Supply Chain** -David Simchi Levi, Philip Kaminsky & Edith Simchi Levi;; McGraw Hill

Scheme of Exam: One question from each unit and choice from unit 1 and unit 3

Course Outcomes

CO1	Able to understand the stages of supply chain and their roles in supply chain profitability
CO2	Students learn about to fitting the supply chain and obstacles to achieve fit.
CO3	Students get exposure to modes of transportation and their importance.
CO4	Students get exposure on inventory management and its role in supply chain
CO5	Able to understand the importance of coordination in managing supply chain

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DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

ELECTIVE –II

Course	FLUID MECHANICS	Course Code	16IE6DEFM
Credits	03	L-T-P-S	3-0-0-0

Prerequisites: Nil

UNIT- 1

Introduction to Properties of Fluids: Introduction, Properties of fluids-mass density, weight density, specific volume, specific gravity, viscosity, surface tension, capillarity, vapour pressure compressibility and bulk modulus. Fluid pressure at a point, Pascal's law, pressure variation in a static fluid in 2D. Related Numerical Problems. **06Hrs**

UNIT- 2

Fluid Statics : Types of Fluids, Absolute, gauge, atmospheric and vacuum pressures, Hydrostatic force on submerged plane surfaces submerged in static fluid.Related Numerical Problems.

06Hrs

UNIT- 3

Buoyancy and Floatation: Buoyancy, center of buoyancy, meta center and meta centric height, Determination of meta-centric height by analytical method. Stability of floating bodies. Related Numerical Problems.

Fluid Kinematics : Types of fluid flow, continuity equation in 2D & 3D (Cartesian co-ordinate system only), velocity potential function and stream function. Related Numerical Problems.

10Hrs

UNIT-4

Basic Equations of Fluid Flow: Forces acting on fluid in motion, Euler's equation of motion, Bernoulli's equation from Euler's equation, Bernoulli's equation for real fluids. Related Numerical Problems.

Fluid flow measurements: Introduction, Vena-contracta, Jet of water, Application of Bernoulli's equation, Venturimeter, Orifice meter, Pitot tube. Hydraulic Coefficients, Related Numerical Problems. **10Hrs**

UNIT- 5

Flow through Pipes: Major &Minor losses-Darcy-Weisbach Equation for loss of head due to friction in pipes, Chezy's equation for loss of head due to friction in pipes, Hagen Poiseulle's equation, Bend losses, Hydraulic gradient and total energy lines, pipes in series and parallel, branched pipes and equivalent pipes. Related Numerical Problems. **08Hrs**

Text Books:

1) **Fluid Mechanics** by Dr. Bansal.R.K, Lakshmi Publications, Edition 2010, ISBN-8131802949
2) **Hydraulics, Fluid Mechanics and Fluid Machines**, S Ramamrutham, Dhanpat Rai publishers, Edition 2012, ISBN-139-788-1874-33804
3) **Fluid Mechanics and Hydraulic Machinery**. Domkundwar Dhanpat Rai & Co. Edition 2014

Reference books:

1) **Fluid Mechanics, and Hydraulics Machines** by R.K. Rajput, S. Chand & Company, edition 1998, ISBN-978-812-191-6660
2) **A Textbook of Hydraulics &Fluid Mechanics & Hydro Machines** by Khurmi R.S, S. Chand & Co, Edition 2014, ISBN-978-812-190-1628
3) **Fluid Mechanics and Fluid Power Engineering.** Dr. D.S. Kumar. Publishers: S.K. Kataria & Sons, Edition 2013, ISBN-978-935-014-3926
4) **Fluid Mechanics, Fundamental & applications**, by Yunus A, Cenegel, John M, Cimbala, Tata McGraw Hill, 2013, ISBN-978-007-3380-322.

Online Resource: www.nptel.ac.in

Course Outcomes

CO1	Is able to acquire the knowledge of types of fluids, properties and their characteristics. Will know how to measure the pressure of a fluid at a point
CO2	Will have the knowledge of gauge, Absolute and vacuum pressure, is able to understand the behavior of the fluid on the submerged surfaces in static conditions
CO3	Will have the understanding about the concept of buoyancy and floatation , the condition of the body to be in equilibrium, is able to understand the behavior of the fluid in motion
CO4	Is able to understand the energy transfer in fluid dynamics, the various types of equipments used to determine the rate of fluid flow and other related topics.
CO5	Is able to learn about the major and minor energy losses that are involved in a fluid flow and their accountability

Scheme of Examination: To set one question from **units1, 2, & 5** and two questions from **units 3 & 4**

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Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

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Course	SOFTWARE ENGINEERING AND MANAGEMENT	Course Code	16IE6DESEM
Credits	03	L-T-P-S	3-0-0-0

Prerequisites: Nil

UNIT - 1

The Product And The Process: The product-Evolving role of Software, Characteristics, Components, and Applications. The Process Software Process, Models - Linear, sequential, Prototype, RAD, Process Technology, Software DevelopmentLife cycle. **07 Hrs**

UNIT – 2

Software Project Management Concepts: The Management Specification, People, Problem, Process

Software Project Planning: Objectives, Scope, Resource, Project estimation, Decomposition techniques, Empirical Estimation Models. Make-buy decision, automated estimation tools.

RISK MANAGEMENT: Reactive v/s Proactive Risk Strategies, Software Risks, Risk identification, Risk projection, Monitoring. **10Hrs**

UNIT-3

Software Project Scheduling And Tracking: Basic concepts, defining a task set selection, Defining Scheduling, Project Plan.

Object Oriented Concept And Principles: Object Oriented Concepts, Identifying the elements of an object model, Examples.

Operating System: Exposure of concepts on Unix, Linux, Windows, Android **06Hrs**

UNIT - 4

System Analysis Concept And Principles: Requirement analysis, Principles, software prototyping, specifications, Data Modeling, Functional Modeling/and Information Flow, Structured Analysis, Data Dictionary. **05Hrs**

UNIT - 5

System Design Concepts And Principles: Design Process Concept, Modular design, Documentation Design Methods, Data Design, Interface Design, Procedural Design, and Design for Real Time Systems, Considerations, Analysis and Simulation of Real Time Systems **Software Testing**: Objectives, Principles, Testability.

Software Quality And Reliability: Introduction, Software failure modes, software structure and modularity, language, Data reliability, Fault tolerance, software checking and software testing.

Software Quality Assurance: Quality assurance concept, Cost impact of software defects, Technical Review, statistical Quality assurance, software reliability, ISO 9000 Quality standards

12 Hrs

Text Book:

1) **Software Engineering** Pressman, Computer Science Series TATA McGraw-Hill Publications, 6th edition

Reference Books:

1) **Software Engineering** - Somerville, Pearson Education, Delhi 2001
2) **Software Engineering** - Shooman, TATA McGraw Hill Publications. 6th Edition, 1983
3) **An Integrated approach to Software Engineering**, Pankaj Jalota, 2nd Edition, 1997

Online Reference:

1. http://ocw.mit.edu/courses/aeronautics-and-astronautics/16-355j-software-engineering-concepts-fall-2005/lecture-notes/
2. http://nptel.ac.in/courses/106105087/ **(Basic issues in Software Engineering)**

Course Outcomes

CO1	Able to compare different software process
CO2	Learnt the concepts of software project management
CO3	Ability to software project planning, scheduling and tracking
CO4	Know system analysis concept and principles and software testing
CO5	Learnt about object oriented concepts and principles

Scheme of Examination:

One question from each Unit and internal choice from **Units 2 &5**

ASSESSMENT

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Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

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Course	DATA BASE MANAGEMENT SYSTEM	Course Code	16IE6DEDBM
Credits	03	L-T-P-S	3-0-0-0

Prerequisites: Nil

UNIT - 1

Databases And Database Users: Introduction, characteristics of data base approach, intended use of a DBMS, advantages and implication of database approach.

Database Systems Concepts And Architecture: Data models, Schemas and instances' DBMS architecture and data independence, database languages and interfaces, database system environment, classification of data base management Systems. **06Hrs**

Data Modeling: High level conceptual data models for database design. Entity types, entity. Sets, attributes, and keys. Relationships, relationship types, roles, and Structural constraints, Weak entity types. ER Diagrams **06 Hrs**

UNIT - 2

Record Storage And Primary File Organizations: Secondary storage devices, buffering of blocks, placing fi1l records on disk, operations on files, heap files a sorted files, hashing techniques. **04 Hrs**

Index Structure Of Files: Single-level and multilevel ordered indexes, dynamic multi-level indexes using B -trees and B + trees. **02 Hrs**

UNIT - 3

Relational Data Mode And Relational Algebra: Brief' discussion on Codd rules, relational model concepts, constraints, and schemas. Update operation on relations, basic and additional relational algebra operations, and queries in relational algebra.

Structured Query Language (SQL): Data definition etc. in SQL2.Basic and complex queries in SQL. Insert, delete, update statements, and views in SQL, embedded SQL. **10Hrs**

UNIT - 4

Database Design: Design guidelines for relational schemes, functional Dependencies, normalization -1st, 2nd, 3'd, 4 , and 5th normal forms. Database design process, factors influencing physic I database design guidelines, and guidelines for relational systems. **06Hrs**

UNIT - 5

System Implementation: System catalog for RDBMSs, transaction processing and system concepts, properties of transactions, brief discussion on concurrency, control and recovery techniques, database security and authorization. **04 Hrs**

Brief Discussion On: Distributed databases, objected oriented databases, next generation databases, and interfacing with other technologies. **02 Hrs**

Online Reference:
http://nptel.ac.in/video.php?subjectId=106106093

Text Books:

1) **Fundamentals of database systems** Ramez Elmasri and Shamkanth B. Navathe, Addison Wesley Publishing Company, 6th Edition, 2009.
2) **Database Management System** -Raghu Ramakrishnan and Johanne's Gehrke, , TATA McGraw Hill, 3rd Edition, ISBN 0-071231511 , 2005

Reference Books:

1) Modern Data base management: Mc Lfadden, hoffer, Prescott, Prentice- Hall, 2006.
2) **Database Management Design** Gary W. Hansen and James V. Hansen, PHI Pvt . Ltd, 2nd Edition, 1991

Course Outcomes

1	Able to use, appreciate advantages and implication of database
2	Able to understand DBMS architecture, languages, interfaces, data modeling
3	Able to carry out indexing, understand relational model concepts, schemas
4	Able to use SQL, design database, carryout transaction processing, implement systems

Scheme: One Question to be set from each unit and Two Questions will be set from the **Unit 1 & Unit-3**.Student will answer any 5 questions selecting at least one from each unit.

ASSESSMENT

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Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

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Course	WORLD CLASS MANUFACTURING	Course Code	16IE6DEWCM
Credits	03	L-T-P-S	3-0-0-0

Prerequisites: Nil

UNIT-1

Introduction To World Class Manufacturing: Manufacturing Excellence and Competitiveness, What is World-Class Manufacturing? - Hall's Framework of Value-added Engineering, Schonerger's Framework of World-Class Manufacturing (WCM), Gunn's Model of World-Class Manufacturing, Mask ell's Model of World-Class Manufacturing, America's Best Plants Model of World Class Manufacturing. The Philosophy of World-Class Manufacturing - The Evolution of World-Class Manufacturing, The First Principles of World-Class Manufacturing, The Practices of World Class Manufacturing The customer Interface, The Supplier Interface, World-Class Practices in the Factory, Quality in World Class Manufacturing - Deming's Approach to Quality Management, Shingo's Approach to Quality Management, Assessing he Two Basic Approaches to Quality, Conclusion - The Culmination of World-Class Manufacturing. **10 Hrs**

UNIT- 2

Benchmarking: Definition, mission and objectives, managing benchmarking process, training and code of conduct, future scope and benchmarking process.

What to benchmark: Concept of step zero, priorities, business processes - linking to goals etc., investigation, documentation, performance measures, improving business processes.

Whom to benchmark: Developing candidate list, systematic search, refining the initial list.
Data Collection and Analyzing the Performance Gap: Data collection plan, research - internal, public domain sources, outside experts' etc. original research, site visits, and code of conduct.

Analyzing the gap: Tools, displaying data, deciding and combining best work practices, validation, recommendations etc. **10 Hrs**

UNIT- 3

Reengineering: Definition of reengineering, importance of 3Cs - customers takes charge, competition intensifies, and change becomes constant. Detailed definition of reengineering – fundamental rethinking, radical redesign, and dramatic improvement.

Reengineering: Rethinking business process, new world of work, and enabling role of information technology. **08 Hrs**

UNIT- 4

Six Sigma: The Basics, The core of Six Sigma (DMAIC), Design for Six Sigma, DFSS and the customer, Quality time & the Bottom line, Core of DFSS - IDOV method, DFSS Metrics, DFSS Infrastructure - People & Resources, Implementing DFSS. **06 Hrs**

UNIT- 5

Activity Based Management (ABM): Introduction, Traditional Cost Systems, Activity Based Costing, Activity Based Management, ABM Implementation, and Case Study. **04 Hrs**

Total Productive Maintenance: Introduction, the plan, learning the new philosophy, promoting the philosophy, training, improvement needs, goals, developing plans, autonomous work groups, summary, examples. **02 Hrs**

Text Books:

1. **World Class Manufacturing** Sahay B S. Saxena K.B C, Ashish Kumar, - A Strategic Perspective; MacMillan India Ltd., ISBN 0333-93-4741
2. **Business Process Benchmarking:. Finding and Implementing Best Practices**, Champ, Robert C. Vision Books, New Delhi, 1995.
3. **Reengineering the Corporation A Manifesto for Business Revolution**, Hammer, Michael and James Champy. Nicholas Brealey Publishing, London, ISBN-0-06-662112-7
4. **Design for Six Sigma,** Gerg Brue, TMH 2003, ISBN 0-07-058120
5. **Six Sigma for Managers,** Greg Brue, TMH 2002; ISBN - 0-07-048639-5

Reference Books:

1. **Design for Six Sigma in Technology and Product Development** Creveling, Pearson Education.
2. **Total Quality Management** Dale H. Besterfield, Carol Besterfield- Minchna, Glen H Besterfield & Mary BesterfieldSacre, , 3rd edn, Pearson Education, ISBN 81-297-0260-6

Course Outcomes

CO1	To understand various models, philosophies for achieving WCM
CO2	To understand the concepts of benchmarking and how to collect data, analyse& implement
CO3	To understand the concepts of re-engineering, six sigma and activity based management

Scheme for examination: Five questions choosing one each from each unit and **Unit 1 and 2** with choice questions

Online References:

https://www.youtube.com/playlist?list=PL1AF592F3CDD31C86

EBooks

http://bookboon.com/en/how-to-improve-your-production-part-i-ebook

ASSESSMENT

Continuous Internal Evaluation (CIE) includes periodic class tests, quizzes or Alternative Assessment Tools (AAT) prescribed by the faculty handling a course prior to beginning of the classes like assignments, problem solving, case studies, group discussion, seminar, mini-project etc.

Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

Both CIE and SEE have equal (50:50) weightages. The student's performance in a course shall be judged individually and together based on the results of CIE and SEE.

Course	INDUSTRIAL POLLUTION CONTROL	Course Code	16IE6DEIPC
Credits	03	L-T-P-S	3-0-0-0

Prerequisites: Nil

UNIT- 1

Pollution and its measurements Introduction: Man and Environment, types of pollution, pollution control aspects **02Hrs**

Industrial pollution emissionsand Indian standards industrial emissions liquids, gasesand solids legislations,water quality management in India, Air (prevention and control ofpollution) Act, 1981. **04Hrs**

UNIT-2

Analysis of Pollutants Introduction, Industrial waste water analysis industrial gaseouseffluents, and analysis - particle size distribution. **04 Hrs**

Pollution control for specific pollutants Treatment Liquid effluents - Removal of BOD, Chromium, Mercury, Ammonia/urea,Phenolic effluents sources, measurements, removal systems. **04Hrs**

UNIT- 3

Treatment of particulate matter particle dynamics,stopping distance. Separation ofparticulate matter from effluent gases, methods of separation cyclone separators,aerodynamic separation, and fabric filters, liquid scrubbers, electrostatic precipitators. **06Hrs**

Treatment of Gaseous effluents Removal of - Sulphurdioxide, Oxides of Nitrogen, organic vapour from effluent gases - Analysis, Harmful effects, ISI standards, ControlMeasures. **04Hrs**

UNIT- 4

PC is selected process in industries General considerations of Pollution Control in Chemical industries, Fertilizer Industries,Petrochemical Refineries, Pulp and Paper Industries, Process Industries (Tanning, Alcohol,Sugar, Electroplating and Metal Finishing), Treating E-wastes, radioactive wastes. **06 Hrs**.

UNIT- 5

Case studies and details of Industrial disasters and their impact on Human HabitationBhopal gas tragedy, nuclear disasters - Chernobyl, US, Fukushima Daichi, Heavy Metal Contamination.

06 Hrs

Introduction to Pollution Prevention Definition, Drivers of Pollution Prevention, Path toPollution Prevention, Program Elements, Incentives for Pollution Prevention, StructuredPollution Prevention Program Case Studies.

Bhopal gas tragedy, nuclear disasters - Chernobyl, US, Fukushima Daichi, Heavy Metal Contamination. **04Hrs**.

Text books:

1) **Pollution control in process industries**, S.P.Mahajan, IIT Bombay, Tata-McGraw Hill Publishing Co., New Delhi, 1985.
2) **Pollution Prevention** – Methodology, Technologies & Practice, Kenneth L. Mulholland, James A. Dyer, American Institute of Chemical Engineers, New York, 1999.

Reference Books:

1) **Industrial Pollution and Management**, Arvind Kumar, APH Publishing Corp., New Delhi, 2004.
2) **Environmental Planning – Machinery and Management**, V.S.Mahajan, Deep & Deep Publishing, 1991
3) **Industrial Air Pollution Engineering,** Edited by Vincent Cavaseno & Staff of Chemical Engg., McGraw Hill Publishing Co., New York, 1980

Course Outcomes

CO1	Learn various treatment methods of liquid effluents, treatment of particulate matter as well as treatment of gaseous effluents. Also, various control measures adopted all over the globe
CO2	Be exposed to general consideration of pollution control in various industries such as chemical, fertilizers, petrochemicals, pulp & paper, process industries. Treating E- wastes and radioactive wastes will also be taught.
CO3	Be able to discuss and understand through various practical case studies the extent of environmental, social and economic damage due grave industrial disasters all over the globe
CO4	Learn theoretically various pollution prevention methods adopted across industries all over the world
CO5	Be able to discuss and understand through various practical case studies the extent of environmental, social and economic damage due grave industrial disasters all over the globe.
CO6	Learn theoretically various pollution prevention methods adopted across industries all over the world.

Scheme of examination: 5 questions to be set with one question from each unit carrying 20 marks each. **Unit 3 and Unit 5** will have an internal choice.

ASSESSMENT

Continuous Internal Evaluation (CIE) includes periodic class tests, quizzes or Alternative Assessment Tools (AAT) prescribed by the faculty handling a course prior to beginning of the classes like assignments, problem solving, case studies, group discussion, seminar, mini-project etc.

Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

Both CIE and SEE have equal (50:50) weightages. The student's performance in a course shall be judged individually and together based on the results of CIE and SEE.

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19

DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

ELECTIVE-III

Course	ADVANCED OPERATIONS RESEARCH	Course Code	16IE6DEAOR
Credits	03	L-T-P-S	3-0-0-0

Prerequisites: Nil

UNIT – 1

Advanced Linear Programming: Two phase simplex techniques, Revised simplex techniques. Sensitivity analysis **08Hrs**

UNIT – 2

Integer Programming: Gomorey's Algorithm and Branch & Board Technique, Solution of Assignment & Travelling salesman Problem **05Hrs**

Goal Programming: Introduction and simple Problem formulation. **03Hrs**

UNIT –3

Non-Linear Programming: Introduction, Lagrange and Kuhn – Tucker conditions for constrained problems **06Hrs**

Queuing Theory: M/Ek/1, M/D/1, M/M/C and M/G/1 **06 Hrs**

UNIT - 4

Dynamic Programming: Characteristics and DP model, Computational procedure(no problem solving, only formulation) **04Hrs**

Advanced CPM Techniques: Advanced CPM Techniques: Resource leveling network techniques, scheduling activities to level the demands on key resources, time cost of trade off aspects in network techniques. Determination of least cost schedule. **04Hrs**

UNIT - 5

Markov Chains: Discrete Stochastic Process, Markovian process, Stationary Markov chains, Markov diagrams, Ergodic and Absorbing Markov chains, Steady State probabilities, stochastic matrix, transition m, matrix and their applications. **04Hrs**

Or In Practice: A Soft Approach: Soft O.R./Problem Structuring Methods, Strategic Options Development Analysis (SODA), Soft Systems Methodology (SSM) **02 Hrs**

Texts books:

1) **Operation Research an Introduction**, Hamdy A Taha, Pearson Education; 9 edition (2014), ISBN- 13: 978-9332518223.

2) Introduction to Operations Research. Frederick K. Hiller and others, McGraw Hill Education India

Private Limited; 9 edition (2011), ISBN-13: 978-0071333467.

3) Operations Research: Principles and Practice, Ravindran and others, Wiley; Second edition (2007), ISBN-13: 978-8126512560

4) **Introduction to Optimization techniques (Operations Research),** Pant J.C. -, Jain Brothers, 6th Edition,(2005)

References books:

1) **Operation Research**, Sesieni Yaspan and Freidan –Wiley International

2) **Introduction to OR**, Ackoff — Wiley International

3) **Principles of Operation Research: With Applications to Managerial Decisions**, H.M.Wagner –Prentice Hall, ISBN –0-87692-162-4

Online Reference:

1. http://nptel.ac.in/courses/117103017/
2. http://people.brunel.ac.uk/~mastjjb/jeb/or/contents.html

Course Outcomes

CO1	To be able to understand the advanced concepts, approaches and optimization in Linear programming and implementation of these tools in real life
CO2	To be able to recognize and optimize single and multi criteria programming problems
CO3	To be able to recognize and optimize Non-Liner Programming problems and Waiting line Models
CO4	To be able to recognize and Dynamic Programming and Network models for solving real life situation cases
CO5	To be able to recognize Markov Chains problems for solving real life situation cases and also to understand Soft approach in Operation research.

Scheme of Examination:

Each question from each unit and internal choice from **Unit 1&Unit 3**

ASSESSMENT

Continuous Internal Evaluation (CIE) includes periodic class tests, quizzes or Alternative Assessment Tools (AAT) prescribed by the faculty handling a course prior to beginning of the classes like assignments, problem solving, case studies, group discussion, seminar, mini-project etc.

Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

Both CIE and SEE have equal (50:50) weightages. The student's performance in a course shall be judged individually and together based on the results of CIE and SEE.

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19

DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

Course	AUTOMATION IN MANUFACTURING	Course Code	16IE6DEAIM
Credits	03	L-T-P-S	3-0-0-0

Prerequisites: Nil

UNIT- 1

Introduction: Introduction to automation, **d**efinition, types of automation, reasons for automating, arguments for and against automation.

Productivity concepts and mathematical models:

Introduction, manufacturing lead-time, components of operating time, production rate, plant capacity, utilization and availability, work-in-process, automation strategies. (Problems) **10Hrs**

UNIT- 2

High volume production system: Introduction to automated flow lines, Configuration of flow lines, Methods of work-part transport systems, Performance analysis of automated flow lines, analysis of automated transfer lines without buffer, automated flow lines with storage buffer, analysis of a two-stage line. Line balancing of assembly systems.(Problems on line balancing only). **10Hrs**

UNIT- 3

Group Technology: Part families, part classification and coding systems, machine cell design, application consideration in group technology.

Computerized manufacturing planning systems: Introduction, computer aided process planning, retrieval and generative type of process planning, benefits of computer aided process planning. **06Hrs**

UNIT- 4

Flexible manufacturing systems: Introduction to FMS, components of FMS, types of FMS, Layout configurations, computer control system, application and benefits of FMS. FMS planning and implementation issues

Computer networks for manufacturing: Introduction, hierarchy of computers in manufacturing, local area networks, manufacturing automation control. **08Hrs**

UNIT- 5

Automated inspection and testing: Introduction, contact and non-contact inspection techniques, Types of coordinate measuring machines, applications and benefits, machine vision.

The future automated factory: Introduction, trends in manufacturing, the future automated factory, the social impact of automated systems. **06Hrs**

Text books:

1) **Automation, Production Systems and Computer Integrated Manufacturing-** Mikell P. Groover, Pearson – Education, New Delhi, 5th printing 1996, ISBN-812030618X, Edition 2003, ISBN-81-7808-511-9
2) **Computer Control Of Manufacturing Systems,** Yorem Koren, Edition 2005, Tata McGraw Hill, ISBN -0-7-Y66379-3

Reference books:

1) **Automation, Production Systems and Computer Integrated Manufacturing-** Mikell P. Groover, PHI, New Delhi, Edition 2007, ISBN-978-0132-393218
2) **CAD/CAM** Mikell P. Groover and Emory W.Zimmers, PHI, NewDelhi, 22 printing, 2003, ISBN-81-203-0402-0.
3) **An Introduction to Automated Process Planning System**– Tiess Chieu Chang and Richard A Wysk PHI , Edition 1985.

Online Resource: www.nptel.ac.in/

Course Outcomes

CO1	Is able to acquire the knowledge of fundamentals of automation, the types of automation and the need to go in for automation. Learn about the concepts of production automation, strategies in automation.
CO2	Is able to learn the transfer mechanisms, analysis of production and assembly automated flow lines and balancing of flow lines.
CO3	Is able to learn about computerized process planning system, types of computer aided process planning, and benefits of CAPP, and Group Technology.
CO4	Is able to understand Flexible Manufacturing system, and its application. Is able to understand Computer networks for production automation, network topology, Manufacturing automation protocol and other related topics
CO5	Is able to understand the various types of techniques and equipment used in automated inspection and testing, is able to understand the concept of future automated factory, the trends in manufacturing and the importance of automation in enhancing the standard of living.

Scheme of examination:

To set one question from **Units 3, 4 & 5**, and two questions from **Units 1 &2**.

ASSESSMENT

Continuous Internal Evaluation (CIE) includes periodic class tests, quizzes or Alternative Assessment Tools (AAT) prescribed by the faculty handling a course prior to beginning of the classes like assignments, problem solving, case studies, group discussion, seminar, mini-project etc.

Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

Both CIE and SEE have equal (50:50) weightages. The student's performance in a course shall be judged individually and together based on the results of CIE and SEE.

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19

DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

Course	MARKETING MANAGEMENT	Course Code	16IE6DEMKM
Credits	03	L-T-P-S	3-0-0-0

Prerequisites: Nil

UNIT - 1

Introduction: Historical development of marketing management, Definition of Marketing, Marketing Management philosophies, Micro and Macro Environment, importance of marketing in the India Socio – economic system.

Marketing Information Systems And Research: Components, benefits & uses, marketing research procedure, measurement of market demand. Types of markets, Marketing Vs. MIS, Marketing Mix **10 Hrs**

UNIT - 2

Consumer Markets And Buying Behaviour: Characteristics affecting Consumer behaviour, Types of buying decisions, buying decision process, Classification of consumer products, Market Segmentation. Marketing of Industrial products.

Product Planning And Development: The concept of a product, features of a product, classification of products, product policies – product planning and development, product line, product mix – factors influencing change in product mix, product mix strategies, meaning of New – product; major stages in new – product development, product life cycle.

10 Hrs

UNIT - 3

Branding: Branding, Reasons .0for branding, functions of branding, features and types of brands, kinds of brand name.

Labeling: Types, functions, advantages and disadvantages

Packaging: Meaning, growth of packaging, function of packaging, kinds of packaging.

06 Hrs

UNIT - 4

Advertising And Sales Promotion: Objectives of advertisement function of advertising, classification of advertisement copy, advertisement media – Ethical Code, kinds of media, advantages of advertising, Advt. Standards Council of India – Role and Responsibilities.Objectives of sales promotion, advantages of sales promotion. **07 Hrs**

UNIT-5

Personal Selling: Objectives of personal selling, establishing the Sales force objectives, sales force strategy, sales force structure and size, salesmanship, qualities of good salesman, types of salesman.

Pricing : Problems in Pricing, methods in pricing.

Typical Case Studies – Examples from MNCs and Indian Companies penalized for wrong promotion methods. **07 Hrs**

Text Books:

1) **Modern Marketing – Principles and Practices –** RSN Pillai & Bhagavathi – S.Chand and Co. Ltd, New Delhi.,2001
2) **Marketing Management – Planning, Implementation and Control** – The Indian Context - V S Ramaswamy, S Namakumari, Mac Millan India Ltd, 1990.
3) **Principles of Marketing** - Philip Kotler& K Gary Amstrong , Prentice – Hall. 11th Edn., 2008
4) **Marketing Management** - Philip Kotler , Prentice – Hall. 12th Edn.2009.
5) **Marketing Management** - Michael R Czinkota, , 2nd Edition, Vikas Publishing House.

Reference Books:

1) **Marketing Management** – ICFAI Centre for Management Research, Hyderabad., 1st Edition, 2004,
2) **Fundamentals of Marketing** -Wiliam J Stanton, McGraw Hill, 1994
3) **Marketing Management**– Russel, S Winar, Pearson education series, 3rd Edition,2009
4) **Marketing Management Text &Cases,** Rajagopal - Vias Publishing House, 2006

Course Outcomes

CO1	Learn Marketing as an important function to accomplish the ultimate interest of any organization, its evolution, various aspects connected with it and also modern marketing approaches
CO2	Be exposed to consumer behavior, marketing systems and stages of buying processes which gives confidence for him/her to excel in the field
CO3	Provided with knowledge of MIS and the research work done in the field and also marketing of industrial and consumer goods, the challenges faced
CO4	Be given the knowledge of product, its development, growth, maturity and decline i.e. product development life cycle, role of branding, packaging and labeling to make him/her good marketer
CO5	Be exposed to the role of pricing, pricing mechanisms, rationality and irrationality of pricing and strategies and decision making.
CO6	Understand marketing channels and movement of products and services and its physical distribution. This knowledge will make the student an effective marketer in future.

Scheme of Examination: One question from each unit and choice from **unit 1 and unit 2**

ASSESSMENT

Continuous Internal Evaluation (CIE) includes periodic class tests, quizzes or Alternative Assessment Tools (AAT) prescribed by the faculty handling a course prior to beginning of the classes like assignments, problem solving, case studies, group discussion, seminar, mini-project etc.

Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

Both CIE and SEE have equal (50:50) weightages. The student's performance in a course shall be judged individually and together based on the results of CIE and SEE.

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19

DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

Course	HYDRAULICS & PNEUMATICS	CourseCode	16IE6DEHP
Credits	03	L-T-P-S	3-0-0-0

Prerequisites: Nil

UNIT - 1

Introduction To Hydraulic Power: Pascal's law and problems on Pascal's Law, continuityequations. Structure of HydraulicControl System. The Source of Hydraulic Power: Pumps pumping theory, pumpclassification, gear pumps, vane pumps, piston pumps, pump performance, pump selection. **09 Hrs**

UNIT - 2

Hydraulic Actuators And Motors: Linear Hydraulic Actuators [cylinders], Mechanics of Hydraulic Cylinder loading, Hydraulic Rotary Actuators, Gear motors, vane motors, piston motors, Hydraulic motor theoretical torque, power and flow rate, hydraulic motor performance **08Hrs**

UNIT - 3

Control Components In Hydraulic Systems: Directional Control Valves – Symbolic representation, Constructional features, pressure control valves – direct and pilot operated types, flow control valves. **08 Hrs**

UNIT - 4

Hydraulic Circuit Design And Analysis: Control of single and double – acting Hydraulic Cylinder, regenerative circuit, pump unloading circuit, Double pump Hydraulic system, Counter Balance Valve application, Hydraulic cylinder sequencing circuits. Locked cylinder using pilot check valve, cylinder synchronizing circuits, **05 Hrs**

Maintenance Of Hydraulic Systems: Hydraulic oils; Desirable properties, general type of fluids, Sealing devices, reservoir system, filters and strainers, problem caused by gases in hydraulic fluids, wear of moving parts due to solid particle contamination **05 Hrs**

UNIT - 5

Introduction To Pneumatic Control: Compressed air: Production of compressed air – compressors, preparation of compressed air- Driers, Filters, Regulators, Lubricators, Distribution of compressed air- Piping layout. Characteristics of compressed air.Structure of Pneumatic control system. Pneumatic Actuators: Linear cylinders – Types, conventional type of cylinder working, end position cushioning, seals, mounting arrangements applications. **05 Hrs**

Text Books:

1) **Fluid Power with applications,** Anthony Esposito, Fifth edition Pearson education, Inc. 1996, ISBN-10-0133998908
2) **Pneumatics and Hydraulics,** Andrew Parr Jaico Publishing Co. 3rd Edition, 2000.

Reference Books:

1) **Oil Hydraulic Systems - Principles and Maintenance,** S.R. Majumdar, Tata McGraw Hill Publishing company Ltd.2001.
2) **Pneumatic Systems,** S.R. Majumdar, Tata McGraw Hill publishing Co., 1995.
3) **Industrial Hydraulics,** Pippenger, Hicks, McGraw Hill, New York, 1979.

Online Resource:www.nptel.com

Course Outcomes

CO1	Able to understand the concepts of fluid power and its advantages, disadvantages andapplications
CO2	Learnt about different types of fluid power generating elements along with theiradvantages, disadvantages and applications.
CO3	Learnt about different types of fluid power utilizing elements along with theiradvantages, disadvantages and applications
CO4	Learnt about different types of fluid power controlling elements along with theiradvantages, disadvantages and applications
CO5	Able to design hydraulic and pneumatic circuits for different applications

Scheme of Examination:

Answer Five full questions selecting one from each unit.One question from each Unit and internal choice from **Units1 & 4**

ASSESSMENT

Continuous Internal Evaluation (CIE) includes periodic class tests, quizzes or Alternative Assessment Tools (AAT) prescribed by the faculty handling a course prior to beginning of the classes like assignments, problem solving, case studies, group discussion, seminar, mini-project etc.

Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

Both CIE and SEE have equal (50:50) weightages. The student's performance in a course shall be judged individually and together based on the results of CIE and SEE.

Course	DECISION MODELLING LAB	Course Code	16IE6DCDML
Credits	01	L-T-P-S	0-0-1-0

Prerequisites: Nil

UNIT-1

Operation research

1. Solving& sensitivity analysis of LPP models
2. Solving& sensitivity analysis of transportation models
3. Solving of assignment models
4. Solving of Travelling Sales men models,
5. Determination of Critical path for CPM model
6. Crashing of activities using CPM model
7. Determination of Critical path for PERT model and its estimation
8. Determination of steady state condition using Markov models
9. Solving & analysis of NLPP models

UNIT-2

10. Presentation Data in tables & charts
11. Sampling distributions of mean & Proportions
12. Chi-square test for different between two proportions
13. Nonparametric analysis for two independent populations
14. t Test of Hypothesis for mean (σ unknown)
15. Z Test of Hypothesis for Proportions
16. Multi-criteria decision making problems

Suggested Software Packages

1. Statistical Packages : SYSTAT / MINITAB / SPSS and such others
2. OR Packages : Lindo / Lingo / STORM / such others
3. MS Excel

Reference Books:

1) **Operation Research an Introduction**, Hamdy A Taha, Pearson Education; 9 edition (2014), ISBN- 13: 978-9332518223.
2) **Introduction to Optimization techniques (Operations Research)**, Pant J.C. -, Jain Brothers, 6th Edition,(2005)
3) **Applied statistics and Probability for Engineers** - Douglas C Montgomery, George C Runger, 2nd Edn, John Wiley and Sons, ISBN-0-471-17027-5
4) **Probability and Statistics** - Walpole & Mayer, MacMillan Publishing Company, 1989

Online Reference:

1. http://people.brunel.ac.uk/~mastjjb/jeb/or/contents.html

Scheme of Examination: Student will appear for Examination and will conduct 2 Experiment choosing Unit-1 and Unit-2 suggested by the Examiners.

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT
SCHEME FOR THE ACADEMIC YEAR 2017-18
VII SEMESTER B.E. INDUSTRIAL ENGINEERING AND MANAGEMENT

Course Code										Course Title	Teaching Department	Credit Hours/week					Contact Hrs/Wk
												L	T	P	S	Total	
1	7	I	E	7	D	C	E	R	P	ENTERPRISE RESOURCE PLANNING	IEM	3	0	1	2	6	5
1	7	I	E	7	D	C	T	Q	M	TOTAL QUALITY MANAGEMENT	IEM	3	0	0	0	3	3
1	7	I	E	7	D	E				ELECTIVE –IV	IEM	3	0	0	0	3	3
1	7	I	E	7	D	E				ELECTIVE-V	IEM	2	1	0	0	3	3
1	7	I	E	7	D	E				ELECTIVE –VI	IEM	3	0	0	0	3	3
1	7	I	E	7	I	E				INSTITUTION ELECTIVE I	IEM	3	0	0	0	3	3
1	7	I	E	7	D	C	P	W	I	PROJECT WORK-PHASE- I	IEM	1	0	1	2	4	3
										Total		18	1	2	4	25	23

L-Lecture Hours/Week, 1 Credit=1hour, P -Practical Hours/Week, 1 Credit=2Hours, T- Tutorial Lecture Hours/Week, 1Credit =1 hour, S-Self-Study to be added to contact Hrs. / Week, CIE-Continuous Internal Evaluation, SEE-Semester End Examination (of 3 hours duration)

ELECTIVE-IV

17IE7DEDFM	Design for Manufacturability
17IE7DEIDE	Industrial Design & Ergonomics
17IE7DESMD	System Dynamics
17IE7DENCM	Non-Conventional Machining

ELECTIVE – V

17IE7DECOO	Combinatorial Optimization
17IE7DEAIE	Artificial Intelligence & Expert Systems
17IE7DETOC	Theory of Constraints
17IE7DEIEX	Industrial Experimentation

ELECTIVE-VI

17IE7DELNM	Lean Manufacturing
17IE7DEMIS	Management Information System
17IE7DEHRM	Human Resource Management
17IE7DERLE	Reliability Engineering

INSTITUTIONAL ELECTIVE-I

17IE7IEDBM	Data Base Management System
17IE7IEHRM	Human Resource Management
17IE7IEOPR	Operations Research
17IE7IEPDD	Product Design & Development
17IE7IEAIM	Automation in Manufacturing
17IE7IESS	Six Sigma
17IE7IESMA	Simulation Modelling and Analysis

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

Course	ENTERPRISE RESOURCE PLANNING	Course Code	17IE7DCERP
Credits	06	L-T-P-S	3-0-1-2

Prerequisites: Nil.

UNIT - 1

Introduction to ERP:
Introduction, Evolution of ERP, What is ERP?, Reasons for the growth of the ERP market, the advantages of ERP, Why do Many ERP Implementations Fail? Why are ERP packages being used now?
Enterprise An Overview: Introduction, Integrated Management Information, Business modeling, Integrated Data Model. **6Hrs**

UNIT - 2

ERP and Related Technologies: Introduction, Business Process Reengineering, Management Information System, Decision Support System, Executive Information Systems, Data Warehousing, Data Mining, On-line Analytical Processing, Supply Chain Management. **6 Hrs ERP-Manufacturing Perspective:** Introduction, ERP.CAD/CAM, Materials Requirements Planning, Bill of Material, Closed Loop MRP. Manufacturing Resource Planning, Distribution Requirements Planning. **6 Hrs**

UNIT - 3

KANBAN: JIT and Kanban, Product Data Management, Benefits of PDM, Make-to-order, and Make-to Stock, Assemble to order, Engineer to order, Configure-to order.
ERP Modules: Introduction, Finance, Plant Maintenance, Quality Management, Materials Management. **6 Hrs**

UNIT – 4

Benefits of ERP: Introduction, Reduction of Lead time, On-time shipment, Reduction in Cycle Time, Improved Resource Utilization, Better Customer Satisfaction, Improved Suppler Performance, Increased Flexibility, Reduced Quality Costs, Improved Information Accuracy and Decision making capability. **6Hrs**

UNIT – 5

ERP Implementation Life Cycle: Pre-evaluations Screening, Package Evaluation, Project Planning Phase, Gap Analysis, Reengineering, Configuration, Implementation of Team Training, Testing, Going Live, End user Training, Post implementation **Vendor, Consultants and Users:** Introduction, In-house implementation Pros and Cons, Vendors, Consultants, End-users.

Future Direction in ERP: Introductions, New Markets, New Channels, Faster Implementation Methodologies, Business models and BAPIs, Convergence on Windows NT, Application Platforms, New business segments, web enabling, market snapshot **10 Hrs**

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

UNIT 6

Laboratory Experiments:

- Process of customer orders under seasonal
- Processing of unseasonable customer with blanket orders.
- Generating Bill of Materials for Various Engineering Designs
- Creating Item Master for various Engineering Designs
- Performing inventory transactions
- Conduction of Vendor Evaluation/Rating exercise
- MRP - II Generating of Various reports for confirmed orders
- Processing MRP for seasonal and parametric runs
- Creating Purchase order for Items
- Creating Work order for Items
- Creating Quotation process for Items
- Creating Payment reconciliation.

ERP- Assessment of Self Study:

Student group of 5 members will submit assignments in ERP at the end of the course featuring the extension of current learning in the course. The faculty shall suggest/assign various tasks to enhance curiosity and learning under the following topics (not limited to)

- Developing technical documents concerning the ERP process
- Executing Case studies in industry related activities
- Modeling a system process for ERP
- Identify critical success factors for effective implementation
- Any other interesting topics featuring current and relevant technologies

TEXT BOOKS:

1. **Enterprise Resource Planning** -Alexis Leon, , 1999, Tata Mc Graw Hill Publishing Company Ltd.,
2. **Manufacturing Planning and Control Systems** Thomas E. Vollmann, William L. Berry, D. Clay Why bark Irwin/McGraw-Hill, 1997 - Technology & Engineering

REFERENCE BOOKS:

1. **ERP: Making It Happen: The Implementers'** Guide to Success with Enterprise Resource Planning by Thomas F. Wallace, Michael H. Kremzar Wiley
2. **Concepts in Enterprise Resource Planning,** Ellen Monk, Bret Wagner Cengage Learning, 4th Edition Inc USA

(3) **Production and Operations Management**: Manufacturing and Services 8th Edition 1998 by Richard B. Chase, Nicholas J. Aquilano, F. Robert Jacbos, Irwin Professional Publishing
(4) **A Guide to ERP Benefits, Implementation and Trends** Prof Lineke Sneller RC Bookboon

COURSE OUTCOMES

CO1	Have understood business functions and business processes, concepts of ERP, importance of ERP, benefits and risk factors of ERP implementation
CO2	Able to establish relationship between ERP and other technologies
CO3	Known about the functional modules of ERP software
CO4	Understood the basics of ERP implementation, Package selection, transition strategies, implementation process
CO5	Able to differentiate between consultants and vendors in ERP implementation process and had knowledge about future directions and trends in ERP

SCHEME OF EXAMINATION: Five Questions to be set with one question from each unit carrying 20 marks each. Any three units will have an internal choice

Question Paper: One Question to be set from each unit and Two Questions will be set from the unit 2 & 5. Student will answer any 5 questions selecting at least one from each unit.

ASSESSMENT

Continuous Internal Evaluation (CIE) includes periodic class tests, quizzes or Alternative Assessment Tools (AAT) prescribed by the faculty handling a course prior to beginning of the classes like assignments, problem solving, case studies, group discussion, seminar, mini-project etc.

Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

Both CIE and SEE have equal (50:50) weightages. The student's performance in a course shall be judged individually and together based on the results of CIE and SEE.

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

Course	TOTAL QUALITY MANAGEMENT	Course Code	17IE7DCTQM
Credits	03	L-T-P-S	3-0-0-0

Prerequisites: Nil

UNIT - 1

Introduction: BUSINESS EVOLUTION

The Evolution of the Customer Satisfaction Concept: Evolution of Customer Satisfaction Methods, Evolution of Company Integration, Continuing Evolution.

Survival in a Rapidly Changing World: Practice Systematic Development of Skill, Treat Management as a Coherent System, Focus on People and Their Purposes, Integrate Best Practices, Financial Benefit

Developing a Unique Organizational Capability: Four Practical Revolutions in Management, Evolution of our Understanding, Four Levels of Practice

The First Revolution: CUSTOMER FOCUS

Change in the Work Concept: Market-in, Customers, Philosophy-in and Philosophy-out Evolution of Customer Focus and Its Challenges: Three Stages of Customer Focus, Customer Concerns, Integration of Concerns, Individualizing Customers **7 Hrs**

UNIT – 2

The Second Revolution: CONTINUOUS IMPROVEMENT

Improvement as a Problem-Solving Process: Management by Process, WV Model of Continuous Improvement, Continuous Improvement of Processes for All Types of Work, Continuous Improvement and the Scientific Method

Managing Existing Processes

Process Discovery and Management: Thinking In Terms of Process, Process Discovery

Process Control and Variation: A Typical Example of (Mishandling) Variation, Making the Most of Variation, Process Control and Process Improvement

Reactive Improvement and the 7 Steps Method ; Identifying the Problem , Standard Steps and Tools The 7 Steps: A Case Study , The 7 QC Tools

Management Diagnosis of the 7 Steps of Reactive Improvement: General Guidelines for Managers

Diagnosing a QI Story , Step-by-Step Guidelines for Managers Diagnosing a QI Story , Case Study for Diagnosis of the 7 Steps, Run PDCA and Develop Skill

Process Management Mobilization Case Study: Introduction to the Teradyne Mobilization story

Introduction of the 7 Steps, Experience Using the 7 Steps, Improving Mobilization, Process Discovery and Process Control

Planning Projects or Tasks: The 9 Steps Compared with the 7 Steps, The 9 Steps Mobilization at Teradyne, A Teradyne Illustration of the 9 Steps Use, Relationship of the 9 Steps to Other Methods **9 Hrs**

UNIT – 3

Proactive Improvement: Collecting Data for Proactive Improvement, Language Data and Use of Semantics, Toward Standard Tools and Steps for Proactive Improvement, Customer Visitation as a Method of Collecting Proactive Improvement Data

Applying Proactive Improvement to Develop New Products; Develop Understanding of Customers' Needs and Environment, Convert Understanding into Requirements, Operationally Define Requirements for Downstream Development, Generating Concepts and Selecting the Concept, Expanding View of WV Model and Proactive Improvement **7 Hrs**

UNIT -4

The Third Revolution: TOTAL PARTICIPATION

Engagement and Alignment of Organization Members: Engaged Employees for a Rapidly Changing World, Explicit Joining of Improvement and Routine Work , Processes and People, Coordinating Behavior; Societal Networking Case Study of the CQM Study Group on Conversation, Expansion of the Principles of Semantics, Some Types and Models of Conversations Leading Change: Technical Skill, Human Skill, Conceptual Skill

Self-Development: Lessons from the Non-business World, Local Improvement in Absence of a Supportive Environment, The Bottom Line

Team Skill Development: Teamwork Skill, Some Fundamentals, Some Types of Teams substantially, Models for Team Development

Initiation Strategies; CEO Involvement, Case Study: Teradyne Strategy for Introduction

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT Infrastructure for Mobilization: Create Explicit Structures for Mobilization, A General Model for Mobilization: The 7 Infrastructures
Phase-In: Orientation Phase, Empowerment Phase, Alignment Phase, Evolution of the Parallel Organization, Common Patterns of Phase-In
U.S. Focused Strategies for Phase-In: Benchmarking, Six Sigma, Cycle-Time Reduction

9 Hrs

UNIT – 5

Hoshin Management: Hoshin Management and Its Parts, Management by Objectives and Conventional Business Planning, Hoshin Management at Analog Devices
Leading Process Improvement: Modeling Personal Improvement, Employee Development at NIMS,

Company Strategies, Individual Practice of CAPD by Managers' case studies
The Practice of Breakthrough; Process versus Business Breakthrough, Case Studies and a Model of Business Breakthrough, Biggest Obstacle to Business Breakthrough, Integration of Ideas

The Fourth Revolution: SOCIETAL NETWORKING

Networking and Societal Diffusion: Regional and National Networking The Japanese Model, Taking a Lesson from Japan—CQM, Comparison of National Methods, Use of Indirect Influence
Ongoing Integration of Methods: Applying Idealized Design to Hoshin Management, Structural Process Improvement Case Study SerVend Case Study **7Hrs**

TEXT BOOK:

1. "Four Practical Revolutions in Management: systems for creating unique organizational capability" - Shoji Shiba and David Walden,– Productivity Press & Center for Quality Management, (USA) , 2001, ISBN-9781563273889/9781563272172/ 9781563272318

REFERENCE BOOKS:

1. "Management for Total Quality" -N Logothetis- Prentice Hall of India, New Delhi, 2003, ISBN-81-203-1137-X

2. "Total Quality Management"- Besterfield, Pearson Education, 2011. ISBN, 817758412X, 9788177584127.

ONLINE LINKS:

1. http://nptel.ac.in/syllabus/110101010/

SCHEME OF EXAMINATION: Five questions choosing one each from each unit and Unit 2 and 3 with choice questions

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

COURSE OUTCOMES: The students,

CO1	Ability to understand the quality concepts and the practical evolution in management, revolution in total quality management
CO2	Ability to analyze the TQM related cases
CO3	Diagnose problems in the quality improvement process
CO4	Apply the quality tools and methods in the manufacturing and service processes
CO5	Ability to make an effective oral presentation on the cases analyzed

ASSESSMENT

Continuous Internal Evaluation (CIE) includes periodic class tests, quizzes or Alternative Assessment Tools (AAT) prescribed by the faculty handling a course prior to beginning of the classes like assignments, problem solving, case studies, group discussion, seminar, mini-project etc.

Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

Both CIE and SEE have equal (50:50) weightages. The student's performance in a course shall be judged individually and together based on the results of CIE and SEE.

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

ELECTIVE-IV

Course	DESIGN FOR MANUFACTURABILITY	Course Code	17IE7DEDFM
Credits	03	L-T-P-S	3-0-0-0

Prerequisites: Nil

UNIT-1

Material and process selection – Introduction, Advantages of applying DFMA, General requirements of early materials and process selection, Selection of Manufacturing processes, Process capabilities, Selection of materials, Primary process/ materials selection, Systematic selection of processes and materials. 6**Hrs**

UNIT-2

Engineering Design features. – Dimensioning, Tolerances, General Tolerance, Geometric Tolerances, Assembly limits, achieving larger machining tolerances. Screw threads, Ground surfaces, holes. Examples

Datum features – Functional datum, machining sequence, manufacturing datum, changing the datum. Examples **6 Hrs**

UNIT-3

Component design – **Machining Considerations** – Drills, Milling cutters, Drilling, Keyways, Dowels, Screws, Reduction in machining areas, Simplification by separation and amalgamation, work piece holding, surface grinding, Component surface design, Examples.

Component design – **Casting Considerations** – Pattern, Mould, parting line, cast holes, machined holes, identifying parting line, special sand cores, designing to obviate sand cores, Examples **10Hrs**

UNIT-4

Design for Injection molding and Sheet metal working – Injection molding materials, Molding cycle, Systems, molds, machine size, cycle time, Cost estimation, Insert molding, Design guidelines, Introduction to sheet metalworking, Dedicated Dies and Press working, Press selections, Design Rules, Over Molding, Design of Undercuts, Collapsible cores.

Design for Die casting and Powder metal processing – Die casting alloys, cycle, machines, dies, finishing, Assembly techniques, Design principles, Powder metallurgy processing, stages, compaction characteristics, Tooling, Sintering, Design guidelines, Surface definition, Example **10 Hrs**

UNIT-5

Geometric Tolerance – Symbols, Three datum concept of dimensioning, Straightness, concentricity, Run-out, Location Tolerance, Assembly of parts having concentric cylinders, Control of feature location by true position, Body of revolution, Roundness, Profile dimensioning, Tapers, Shaft of two diameters. Examples. **8 Hrs**

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DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

TEXT BOOKS:

1. **Designing for Manufacturing** - Harry Peck, Pitman Publications, 1983.
2. **Machine Design** - Dieter ,McGraw hill Publications for topic 1.
3. **Metrology** - R.K. Jain Khanna, Publication for topic 6.
4. **Product design for manufacture and assembly** - Geoffrey Booth Royd, peter Dewhurst, Winston Knight, Mercel Dekker. Inc. New York.
5. **Material selection and Design**, - ASM Hand book,Vol. 20

REFERENCE BOOKS:

1. **Product Design for Manufacture and Assembly**, Geoffrey Booth Royd - Peter Dewhurst – Winston Knight – Marcel Dekker,Inc.– New York -Second Revision, ISBN 0-8247-0584-X.
2. **Designing for Manufacturing** – Harry Peck - Pitman Publications – 1983.
3. **Dimensioning and Tolerance for Quantity Production**,Merhyle F Spotts –Inc. Englewood Cliffs - New Jersey - Prentice Hall, 5th edition.

ONLINE REFERENCE:

http://nptel.ac.in/courses/112101005/

COURSE OUTCOMES:

CO1	To have the capability to systematically design products and/or processes to get the lowest cost, quickest response time, and best-achieved customer expectations.
CO2	Identify opportunities for design.
CO3	Address technical considerations of design and manufacturing.
CO4	Make business decisions concerning the feasibility of a design.
CO4	Utilize DFM and Concurrent Engineering Principles on a "real life" project.

SCHEME OF EXAMINATION: Scheme of Examination: Answer one question from each unit. Choice is to be given in Unit-3 and Unit-4.

ASSESSMENT

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Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

Both CIE and SEE have equal (50:50) weightages. The student's performance in a course shall be judged individually and together based on the results of CIE and SEE.

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

Course	INDUSTRIAL DESIGN AND ERGONOMICS	Course Code	17IE7DEIDE
Credits	03	L-T-P-S	3-0-0-0

Prerequisites: Nil

UNIT -1

Introduction: An approach to Industrial Design -elements of design structure for Industrial Design in engineering application in modern manufacturing systems. **4Hrs**

UNIT-2

Ergonomics and Industrial Design: Introduction -general approach to the man- machine relationship- workstation design-working position.

Control and Displays: Shapes and sizes of various controls and displays-multiple displays and control situations -

Design of major controls in automobiles, machine tools etc., design of furniture -redesign of instruments. **10Hrs**

UNIT-3

Ergonomics and Production: Ergonomics and product design -ergonomics in automated systems- expert systems for Ergonomic, design, Anthropometric data and its applications in ergonomic design- limitations of anthropometric data use of computerized database. Case study. **8Hrs**

UNIT-4

Visual Effects of Line and Form: The mechanics of seeing- psychology of seeing general influences of line and Form.

Colour: Colour and light -colour and objects- colour and the eye -colour consistency- colour terms- reactions to Colour and colour continuation -colour on engineering equipment. **8Hrs**

UNIT-5

Aesthetic Concepts: Concept of unity- concept of order with variety -concept of purpose style and environment Aesthetic expressions. Style-components of style- house style, observation style in capital goods, case study.

Industrial Design in Practice: General design -specifying design equipment- rating the importance of industrial design -industrial design in the design process. **10Hrs**

TEXT BOOKS:

1. **Industrial Design for Engineers** - Mayall W.H. - London Hiffee books Ltd. -1988.
2. **Applied Ergonomics Hand Book** - Brain Shakel (Edited) - Butterworth scientific London - 1988.
3. **Introduction to Ergonomics** - R. C. Bridger - McGraw Hill Publications - 1995.
4. **Human Factor Engineering** - Sanders & McCormick - McGraw Hill Publications – 6th edition, 2002.

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

COURSE OUTCOMES

CO1	To understand the issues regarding Industrial design
CO2	Able to understand the human factors, system, human outcome and control
CO3	Able to apply basic knowledge of physical ergonomics such as physical load, anthropometry, biological variation and biomechanics.
CO4	Apply basic knowledge of physical factors affecting human beings in relation to lighting, sound and noise, climate and vibrations
CO5	Apply basic knowledge of cognitive ergonomics such as perception, memory, information processing, attention, learning decision-making , stress and mental workload

SCHEME OF EXAMINATION: To set one question from units **1, 2**&**4**and two questions from units 3 and**5**.

ASSESSMENT

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Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

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B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

Course	SYSTEM DYNAMICS	Course Code	17IE7DESMD
Credits	03	L-T-P-S	3-0-0-0

Prerequisites: Nil

UNIT -1

Introduction to systems thinking, modeling and dynamic simulation, Causal loops and feedbacks, building blocks of system dynamics: stocks and levels, **8Hrs**

UNIT -2

Equations underlying the modeling, Positive and negative feedback loops, Dynamics of growth, modeling delays, co-flows & decision making, Capturing nonlinear relationships, instability and oscillation, business and supply chain models, Model validation and testing, **8 Hrs**

UNIT -3

Control theory concepts of transfer functions, time domain analysis, and state space formulation, solution of the state equation and determination of the system's response. **8 Hrs**

UNIT -4

Characteristic equation and roots; Frequency-domain techniques; Stability analysis, and design of feedback regulators, controllability and observability. **8 Hrs**

UNIT -5

Applications will be presented to emphasis cross-functional management issues, new product development, management of fluctuating workloads, market growth and stagnation, and project management. **8 Hrs**

TEXT BOOKS:

1. **Business Dynamics:** Systems Thinking and Modeling for a Complex World, **John Sterman,** Irwin/McGraw-Hill (2000)
2. **System Dynamics,** Palm William J III, III edition, McGrawhill College 2009

REFERENCES

1. **System Dynamics: A Practical Approach for Managerial Problems**,Sushil, Wiley Eastern (1993)
2. **System Dynamics Modelling: A Practical Approach**, R.G. Coyle, Chapman &
3. **The Fifth Discipline**, Peter Senge Currency (2006)
4. **Control Systems Engineering,** Norman Nise, 4th ed., John Wiley and Sons (2004)
5. **System Dynamics**,K. Ogata, 4th ed., Prentice Hall (2003)
6. **Digital Control, K. Mougdalya, John Wiley & Sons (2007)**

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DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

COURSE OUTCOMES

CO1	To introduce students to mathematical modeling of Dynamic Systems
CO2	To develop skills in analyzing Simulating and identifying systems based upon their I/P and O/P responses
CO3	To introduce to design and analysis of basic feedback systems

ASSESSMENT

Continuous Internal Evaluation (CIE) includes periodic class tests, quizzes or Alternative Assessment Tools (AAT) prescribed by the faculty handling a course prior to beginning of the classes like assignments, problem solving, case studies, group discussion, seminar, mini-project etc.
Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

Both CIE and SEE have equal (50:50) weightages. The student's performance in a course shall be judged individually and together based on the results of CIE and SEE.

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

Course	NON-CONVENTIONAL MACHINING	Course Code	17IE7DENCM
Credits	03	L-T-P-S	3-0-0-0

Prerequisites: Nil.

UNIT -1

Introduction: History, Classification, Comparison between conventional and nonconventional machining process selection.

Mechanical Process: Ultrasonic machining (USM): Introduction, Equipment, tool materials & tool Size, Abrasive slurry, Effect of parameter: Effect of amplitude of frequency and vibration, Effect of grain diameter, Effect of applied static load, effect of slurry, Tool and work material, USM process Characteristics: Material removal rate, tool wears, Accuracy, surface finish, Applications, advantages& disadvantages of USM. **8 Hrs**

UNIT-2

Abrasive Jet Machining (AJM): Introduction, Equipment, Variables in AJM: Carrier Gas,Type of abrasive, Size of abrasive grain, Velocity of the abrasive jet, Mean No. abrasiveparticles per unit volume of the carrier gas, Work material, Standoff Distance (SOD),Nozzle design, Shape of cut. Process characteristics Material removal rate, Nozzle wear,
Accuracy & Surface finish applications,advantages & disadvantages of AJM.

Water Jet Machining (WJM): Process principle, equipment, process parameters, process capabilities, applications, advantages and disadvantages, Demonstration of WJM **6 Hrs**

UNIT- 3

Chemical Machining (CHM): Introduction, Elements of process, chemical blankingprocess: Preparation of work piece, Preparation of masters, masking with photo resists,etching for blanking, applications of chemical blanking, chemical milling (Contour machining) :- Process steps : masking, Etching, process characteristics of CHM :Materialremoval rate, accuracy, surface finish, Hydrogen embrittlement, Advantages &applications of CHM.

Electrochemical Machining (ECM): Introduction, classification of ECM process,Fundamental principles of ECM, Elements of ECM process: Cathode tool, Anode workpiece, source of DC power, Electrolyte, Tool-work gap, Chemistry of the ECM process, ECMprocess characteristics: Material removal rate, Accuracy, Surface finish.ECM Tooling:ECM tooling techniques and examples, Tool & insulation materials, Tool size, Electrolyteflow arrangement, Handling of slug, Economics of ECM, Determination of metal removalrate, evaluation of metal removal rate of an alloy, Applications, Advantages, Limitations of ECM, **10 Hrs**

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DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

UNIT-4

EDM Process: Introduction, machine, dielectric fluid, spark generator, EDM tools(Electrodes): Electrode manufacture, Electrode wear, EDM electrode holders, EDM tooldesign: Choice of matching operation, electrode materiel selection, machine settings,under sizing and length of electrode, Machining time. Flushing: Pressure flushing,Suction flushing, Side flushing, pulsed flushing synchronized with electrode movement,EDM process characteristic: Metal removal rate, Accuracy, surface finish, Heat affectedZone. Applications: EDM accessories applications, Electrical Discharge Grinding(EDG), Travelling wire EDM, Demonstration of wire EDM. **10Hrs**

UNIT- 5

Plasma Arc Machining (PAM): Introduction, process principle, equipment, non – thermalgeneration of plasma, selection of gas, Mechanism of Metal removal, PAM processparameters, Process characteristics. Safety precautions, applications, advantages andlimitations of PAM. **6 Hrs**

TEXT BOOKS:

1. **Modern Machining Process** Pandey and Shan, Tata McGraw Hill 2009.
2. **Production Technology**HMT, Tata McGraw Hill 2001.

REFERENCE BOOKS:

1. **New Technology,**Bhattacharya, 2000.
2. **Unconventional Machining Process**, M K Singh, New Age Publications.
3. **Thermal Metal Cutting Process**, B G Ranganath, I K International Publishing House Pvt Ltd.
4. **Fundamentals of Machining and Machine Tools**, R K Singal, I K International Publishing House Pvt Ltd.

COURSE OUTCOMES

CO1	Be able to explain how nontraditional machining techniques differ from traditional machining processes and the Ultrasonic machining
CO2	Be able to describe Abrasive jet Machining and Electrochemical techniques
CO3	Be able to describe the Chemical Metal Removal Processes
CO4	Be able to describe the Electrical Discharge Machining and Plasma Arc Machining Processes

SCHEME OF EXAMINATION: One Question to be set from each unit and Two Questions to be setfrom the units 3& 4.
Student has to answer any 5 questions selecting at least one questionfrom each unit.

ONLINE REFERENCE: http://nptel.ac.in/courses/112104028/

ASSESSMENT

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Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

Both CIE and SEE have equal (50:50) weightages. The student's performance in a course shall be judged individually and together based on the results of CIE and SEE.

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

ELECTIVE-V

Course	COMBINATORIAL OPTIMIZATION	Course Code	17IE7DECOO
Credits	03	L-T-P-S	3-0-0-0

Prerequisites: Nil

UNIT-1

Classification of optimization Theory**:** Unconstrained problems-necessary and sufficient conditions, The Newton-Raphson method, Constrain problems-Equality Constraints, Inequality Constraints.

7Hrs

UNIT-2

NP Hard and NP complete Problems: Basic Concepts, Non deterministic Algorithms, the classes NP hard and NP Complete, NP Hard Scheduling Identical processors, flow shop scheduling, job shop scheduling.Review of graphs and network, review of computational complexity **10 Hrs**

UNIT-3

Shortest Path Algorithm, Minimum Cost Network Flows, Maximum Flow Algorithm, Matching Algorithm: Travelling Salesman Problem, Postman Problems, and Machine Scheduling Problem.

10 Hrs

UNIT-4

Meta Heuristics: Iterative Improvement,Variable Neighborhood Search and GRASP Simulated Annealing: Advantages, Acceptance Function,TabuSearch **6Hrs**

UNIT-5

Genetic Algorithm: What Are Genetic Algorithm?, Robustness Of Traditional Optimization And Search Methods, The Goals Of Optimization, How Are Genetic Algorithm Different From Traditional Methods, A Simple Genetic Algorithm, Genetic Algorithm At Work- Asimulation By Hand, Grist For The Search Mill- Important Similarities, Similarity Templates (Schemata) **7 Hrs**

TEXT BOOKS:

1. **Optimization Algorithms for Networks and Graphs**- Jrevans and E. Mineika, 1st Edition.
2. **Genetic Algorithm**- David E Goldberg, - Pearson Education Asia, 2nd Edition.
3. **Operation Research**- Hamdy A Taha- 7th edition, Pearson Education,
4. **Fundamentals of Computer Algorithms-** Ellis Horowitz, SartazSahaniand SanguthevarRajasekaran- Galgotia Publications 1stEdition.

REFERENCE BOOKS:

1. **Operations Research**-Ravindran, Philips and Solberg, Wiley International, 2nd edition.
2. **Operations research**- Hiller leiberman- holdenday / CBS publishers 1994 Edition.
3. **Operations research**- S. D. Sharma-kedarnathramanth and Co. 2000

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ONLINE REFERENCE:
http://nptel.ac.in/courses/110106059/

COURSE OUTCOMES:

CO1	Able to formulate the combinatorial optimization efficiently
CO2	Able to explain how a Combinatorial Optimization problem can be solved
CO3	Able to explain how fast a Combinatorial Optimization problem can be solved
CO4	Explain mathematical theory underlying the algorithm for combinatorial Optimization problems
CO5	Apply Evolutionary Computation Methods to find solutions to complex problems by genetic Algorithm.

ASSESSMENT

Continuous Internal Evaluation (CIE) includes periodic class tests, quizzes or Alternative Assessment Tools (AAT) prescribed by the faculty handling a course prior to beginning of the classes like assignments, problem solving, case studies, group discussion, seminar, mini-project etc.

Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

Both CIE and SEE have equal (50:50) weightages. The student's performance in a course shall be judged individually and together based on the results of CIE and SEE.

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

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Course	ARTIFICIAL INTELLEGENCE AND EXPERT SYSTEM	Course Code	17IE7DEAIE
Credits	03	L-T-P-S	3-0-0-0

Prerequisites: Nil

UNIT-1

Artificial intelligence: Introduction, definition, underlying, assumptions, importance of AI,AI and related fields. State space representations, defining a problem,productionsystems and its characteristics, search and control strategies introduction preliminaryconcepts, examples of search problems.

Uniformed or preliminary concepts: Examples of search problems. Uniformed or blind search, informed search, OR graphs, heuristic search techniques generate and test, hill climbing, best first search, problem reduction, constraint satisfaction, means ends analysis. **8Hrs**.

UNIT-2

Knowledge representation issues: Representations and mapping, approaches, issues in KR, types of knowledge procedural Vs declarative, logic programming, forward Vs backward reasoning, matching, non-monotonic reasoning, and its logic. **6 Hrs**. **Use of Predicate logic** : Representing simple facts, Instance and Is a relationships, syntax and semantics for propositional logic, FOPL and properties of wffs, conversion to causal form,
resolution, natural deduction. **6 Hrs**.

UNIT-3

Statistical and Probabilistic reasoning: Symbolic reasoning under uncertainty, probability and Baye's theorem, certainty factors and rule based systems, Bayesian networks, Demster Shafer theory, fuzzy logic. **6 Hrs**.

UNIT-4

Expert systems : Introduction, structure and uses, representing and using domain knowledge, expert system shells, pattern recognition, introduction to recognition and classification process, learning classification patterns, recognizing and understanding speech. **6 Hrs**.

UNIT- 5

Introduction to knowledge acquisition: Types of learning, generallearning model and performance measures, Typical expert systems: MYCIN variants of MYCIN, PROSPECTOR, DENDRAL, PUFF. **8 Hrs**

Introduction to machine learning: Perceptrons, checker playing examples, learningautomata, genetic algorithm, intelligent editors. **4 Hrs**.

TEXT BOOKS:

1. **Artificial Intelligence and Expert systems** Elaine Rich and Kevin Knight, M/H, 1983.
2. **Introduction to Artificial Intelligence and Expert systems** Dan W. Patterson, PHI,New Delhi, 999.
3. **Artificial Intelligence in business, science and industry**Wendry B, Ranch,Vl,IIapplication, PHI, 1985.

REFERENCE BOOKS :

1. **A guide to expert systems** Waterman, D.A, Addison-Wesley Inc., 1986.
2. **Building expert systems** Hayes, Roth, Waterman, D.A (ed), AW, 1983.
3. **Designing expert systems** Weis, S.M. and Kulliknowske, London, Champion Hull,1984.

COURSE OUTCOMES

CO1	Be able to get an insight into fundamentals of AI and related areas
CO2	Learn applications of AI and ES in various fields such as 1.Defense, Medical Diagnostics, Surgery etc
CO3	Determine the Knowledge Representation issues, Reasoning mechanisms, Logic Programming, properties of wffs etc.
CO4	Learn logic programming basics, Reasoning under uncertainty, Baye's theorem, Bayesian Networks and other related reasoning methods
CO5	Study Expert Systems – their logic, growth and development along with applications,concept of knowledge Acquisition, working of typical ES's such as MYCIN, DENDRAL,PROSPECTOR, PUFF etc. and also Machine Learning, Genetic Algorithm

SCHEME OF EXAMINATION:
Five questions to be set with one question from each unit carrying 20 marks each. 1 and 2 units will have an internal choice

ASSESSMENT
Continuous Internal Evaluation (CIE) includes periodic class tests, quizzes or Alternative Assessment Tools (AAT) prescribed by the faculty handling a course prior to beginning of the classes like assignments, problem solving, case studies, group discussion, seminar, mini-project etc.

Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

Both CIE and SEE have equal (50:50) weightages. The student's performance in a course shall be judged individually and together based on the results of CIE and SEE.

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

Course	THEORY OF CONSTRAINTS	Course Code	17IE7DETOC
Credits	03	L-T-P-S	3-0-0-0

Prerequisites: Nil

UNIT-1

Introduction to Theory of constraints. TOC Thinking Tools: Current Reality tree and core conflicts, conflict clouds, Negative branch reservations, prerequisite tree, categories of legitimate reservation, layers of resistance. **8Hrs**

UNIT-2

TOC applications in production/Opereations: Concept of Drum,Buffer, Rope, Simplified Drum Buffer rope, Drum Buffer rope, Use of simulator to explain DBR. **9Hrs**

UNIT-3

TOC application in Distribution: Replenishment Model and case discussions. **7Hrs**

UNIT-4

TOC applications in finance and measurements: Throughput accounting **8Hrs**

UNIT-5

TOC applications in project management: Critical chain and case discussion **8Hrs**

TEXT BOOKS

1. Theory of constraints: Goldsratt
2. Project Management: Choudhary S

ONLINE RESOURCES

www.nptel.ac.in

SCHEME OF EXAMINATION: Unit- 1 and Unit- 2 will have internal choice.

ASSESSMENT

Continuous Internal Evaluation (CIE) includes periodic class tests, quizzes or Alternative Assessment Tools (AAT) prescribed by the faculty handling a course prior to beginning of the classes like assignments, problem solving, case studies, group discussion, seminar, mini-project etc.

Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

Course	INDUSTRIAL EXPERIMENTATION	Course Code	17IE7DEIEX
Credits	03	L-T-P-S	3-0-0-0

Prerequisites: Nil

UNIT- 1

INTRODUCTION: History of quality engineering: Japan versus U.S. track records. Taguchi Approach to Quality: Definition of quality, Loss function, Off-line and On-line quality control, Taguchi's quality philosophy. ANOVA, Test of hypothesis. **6Hrs**

UNIT - 2

BASIC DESIGNS: Completely Randomized Design, Randomized Block Design, Latin Square Designs, one way analysis of variance and two way analysis of variance.

FACTORIAL EXPERIMENTATION - TWO LEVELS: Full Factorial Designs: Experimentation as a learning process. Traditional scientific experiments, Two factor design, Four-factor design, replicating experiments, Factor interactions. Fractional factorial designs based on eight-run experiments. **12 Hrs**

UNIT -3

TAGUCHI TECHNIQUES:

CONSTRUCTING ORTHOGONAL ARRAYS: Counting degrees of freedom, selecting a standard orthogonal array, dummy level technique and compound factor method, Linear graphs and interaction assignment, Modification of linear graphs, column merging method, branching design, Strategy for constructing an orthogonal array, Comparison with the classical statistical experiment design. **10 Hrs**

UNIT 4

STEPS IN ROBUST DESIGN: Case study discussion, Noise factors and testing conditions, Quality characteristics and objective functions, Control factors and their levels, Matrix experiment and data analysis plan, Conducting the matrix experiment, data analysis, verification experiment and future plan. **6 Hrs**

UNIT - 5

SIGNAL-TO-NOISE RATIO FOR STATIC PROBLEMS: Evaluation of sensitivity to noise, S/N ratios for Smaller-the-better, Larger-the-better, Nominal-the-best and Asymmetric Cases.

SHAININ TECHNIQUE: Introduction, salient features, case studies in sequential DOE tools to solve chronic problems. **6 Hrs**

TEXTBOOKS:

1. **Quality Engineering Using Robust Design** - Madhav S. Phadke, Prentice Hall PTR, Englewood Cliffs, New Jersey 07632.
2. **Design of Experiments** - D.C. Montgomery, John Wiley and Sons, 2002.
3. **World Class Quality using DOE to make it happen**, Keki R. Bhote, American Management Association publications, 2nd Ed. 2000

REFERENCE BOOK:

1. Designing for Quality - Robert H. Lochner and Joseph E. Matar, - an Introduction Best of Taguchi and Western Methods or Statistical Experimental Design", Chapman and Hall Madras, 2nd edition.

ONLINE REFERENCE:

http://www.nptel.ac.in/syllabus/110104020/
http://www.eformacion.com.
http://www.sas.com/storefront/aux/en/spdesignanlysisjmp/66584_excerpt.pdf

COURSE OUTCOMES

CO1	To understand principles of analysis of variance, experimental designs like CRD, factorial, Taguchi and shainin design
CO2	To select & construct the appropriate experimental design for a particular problem.
CO3	To analyze the data & interpret the experimental results

SCHEME FOR EXAMINATION: Five questions choosing one each from each unit and Unit 2 and 3 with choice questions

ASSESSMENT

Continuous Internal Evaluation (CIE) includes periodic class tests, quizzes or Alternative Assessment Tools (AAT) prescribed by the faculty handling a course prior to beginning of the classes like assignments, problem solving, case studies, group discussion, seminar, mini-project etc.

Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

Both CIE and SEE have equal (50:50) weightages. The student's performance in a course shall be judged individually and together based on the results of CIE and SEE.

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

ELECTIVE-VI

Course	LEAN MANUFACTURING	Course Code	17IE7DELNM
Credits	03	L-T-P-S	3-0-0-0

Prerequisites: Nil

UNIT- 1

Introduction to Lean Manufacturing:
Objectives of Lean manufacturing-key principles and implications of lean manufacturing-traditional Vs Lean manufacturing. **5Hrs**

Lean manufacturing Concepts:
Value creation and waste elimination-man kinds of waste- pull production- different models of pull production- continuous flow-continuous improvement/Kaizen-worker involvement-cellular layout-administrative lean **6 Hrs**

UNIT- 2

Lean manufacturing Tools and Methodologies:
Standard work-communication of standard work employees- standard work and flexibility- visual control –quality at the source- 5S principles- preventive maintenance – total quality management - total productive maintenance- changeover/setup time-batch size reduction-production leveling **6Hrs**

UNIT- 3

Value stream mapping:
The as-is diagram-the future state map-application to the factory simulation scenario-line balancing-Poke Yoke- Kanban- Overall equipment effectiveness. **6Hrs**

UNIT- 4

Just in time Manufacturing:
Introduction-elements of JIT-uniform production rate-pull versus push method-Kanban system-small lot size-quick, inexpensive set-up-continuous improvement, Optimized production technology **6Hrs**

One piece flow: Process razing techniques-cells for assembly line- case studies. **4Hrs**

UNIT- 5

Implementing Lean: Road map- senior management Involvement-best practices. **4Hrs**

Reconciling lean with other Systems: Toyota production system-lean six sigma- lean and ERP-lean with ISO9001:2000 **3Hrs**

TEXT BOOKS:

1. "**A Study of the Toyota Production System**" Shigeo Shingo , Andrew P. Dillon , 1989.
2. "**The Machine that changed the World**", James P. Womack, Daniel T. Jones and Daniel RoosSimon and Schuster Inc.

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

REFERENCE BOOKS:

1. '**Design and Analysis of Lean Production Systems**Askin R G and Goldberg J B,", John
2. Wiley and Sons Inc., 2003.
3. **What is lean Six sigma Micheal** L George, David T Rowlands, Bill Kastle, "", McGraw
4. Hill, New york, 2004.
5. **Lean Tools; A Pocket Guide to Implement Lean Practices**:, Productivity And Quality
6. Micheal Wader, "PuplishingPvt Ltd, 2002.
7. **"One-piece Flow",** Productivity Press Kenichi Sekine, , Portland Oregon, 1992.
8. "**Continuous Improvement in Operations**Alan Robinson", Productivity Press, Portland
9. Oregon, 1991.
10. **Juran Institute's Six Sigma break Through and Beyond**Joseph A De Feo, William W
11. Bearnard, "Juran Institute's Six Sigma break Through and Beyond ", Tata McGraw hill
12. Edition, New Dehli, 2004.
13. "**Operations, Management for Competitive Advantage** Richrad B Chase F Robert Jacobs and Nicholas J Aquilano,", McGraw Hill/Irwin; Tenth Edition, 2003.
14. **Improving Product Quality by preventing defects**:Poke-Yoke, ", Productivity press, 1992.

E-BOOKS:www.scodanibbio.com/site/access/e_courses/downloads/.../vsm_pw.pdf
www.amazon.in/How-To...**Lean-Manufacturing-ebook**/dp/B002LC8HF(Lonnie Wilson)

ONLINE REFERENCES:http://nptel.ac.in/courses/110105039/ (Six Sigma)

COURSE OUTCOMES:

CO1	To define and describe, lean manufacturing practices such as value stream mapping, lead-time reduction, setup time reduction, just-in-time techniques, and process management tools.
CO2	To identify the elements of 5S program and demonstrate implementation
CO3	To plan, implement, and evaluate the impact of a lean manufacturing practice
CO4	To identify and describe the potential enterprise issues associated with the planning, implementation, and evaluation of lean manufacturing principles
CO5	To describe the relevance of lean manufacturing principles to manufacturing processes and equipment, supply chain management, product development, and human resource management

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

SCHEME OF EXAMINATION: Answer one question from each unit. Choice is to be given in Unit-1 and Unit-4

ASSESSMENT

Continuous Internal Evaluation (CIE) includes periodic class tests, quizzes or Alternative Assessment Tools (AAT) prescribed by the faculty handling a course prior to beginning of the classes like assignments, problem solving, case studies, group discussion, seminar, mini-project etc.

Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

Both CIE and SEE have equal (50:50) weightages. The student's performance in a course shall be judged individually and together based on the results of CIE and SEE.

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

Course	MANAGEMENT INFORMATION SYSTEM	Course Code	17IE7DEMIS
Credits	03	L-T-P	3-0-0

Prerequisites: Nil

UNIT - 1

FUNDAMENTALS OF INFORMATION SYSTEMS: Information systems in business, fundamentals of information systems solving business problems with information systems. 6**Hrs**

UNIT - 2

INFORMATION SYSTEMS FOR BUSINESS OPERATIONS: Business information systems, Transaction processing systems, management information systems and decision support systems. Artificial intelligence technologies in business, information system for strategic applications and issues in information technology.

ISSUES IN MANAGING INFORMATION TECHNOLOGY: Managing information resources and technologies global information technology, management, planning and implementing change, integrating business change with IT, security and ethical challenges in managing IT, social challenges of information technology. **10Hrs**

UNIT - 3

INTRODUCTION TO E-BUSINESS: E-commerce frame work, Media convergence, Consumer applications, Organization applications.

E-BUSINESS MODEL: Architectural frame work for E-commerce, Application services and transaction Models – B2C Transactions, B2B Transactions, Intra-Organizational Transactions.

E-BUSINESS MODEL: WWW Architecture: Client server structure of the web, e-Commerce architecture, Technology behind the web. 12**Hrs**

UNIT - 4

CONSUMER-ORIENTED E-COMMERCE: Consumer oriented Application: Finance and Home Banking, Home shopping, Home Entertainment, Mercantile Process Models, Consumers perspective, Merchants perspective. **6 Hrs**

UNIT - 5

ELECTRONICS DATA INTERCHANGE (EDI): EDI Concepts, Applications in business – components of international trade, Customs Financial EDI, Electronic fund transfer, Manufacturing using EDI, Digital Signatures and EDI. **6 Hrs**

TEXT BOOKS:

1. **Management Information systems**- managing information technology in the internet worked enterprise- jams. A O'Brien – Tata McGraw Hill publishing company limited, 2002.
2. **Frontiers of E-Commerce** – Ravi Kalakota and Andrew B. Whinston Pearson Education

REFERENCE BOOKS:

1. **Management Information systems**- S. Sadogopan.PHI 1998Edn.ISBN 81-203-1180-9
2. **Information systems for modern management** - G.R. Murdick PHI, 2nd Edition.

E-books:

http://www.mu.ac.in/mis.pdf
http://www.academia.edu/5275161/Management_Information_Systems_12th_Edition_

Online References:

https://books.=Management+Information+system+ebooks

Course Outcome : Student will be

CO1	Able to acquire knowledge of the functional areas of business and the interrelationships among the functional areas within a business to solve business problems
CO2	Able to use analytical and reflective skills in decision making and recognize legal and ethical issues confronting them
CO3	Able to understand technical knowledge of computer networks, information security and information assurance
CO4	Contribute to the performance of a group within a business setting
CO5	Know the differences among global economies, institutions, business practices and cultures

Scheme of Examination:one question each from units 1 , 4, 5 & two questions from unit2 & unit 3
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ASSESSMENT

Continuous Internal Evaluation (CIE) includes periodic class tests, quizzes or Alternative Assessment Tools (AAT) prescribed by the faculty handling a course prior to beginning of the classes like assignments, problem solving, case studies, group discussion, seminar, mini-project etc.

Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

Both CIE and SEE have equal (50:50) weightages. The student's performance in a course shall be judged individually and together based on the results of CIE and SEE.

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

Course	HUMAN RESOURCE MANAGEMENT	Course Code	17IE7DEHRM
Credits	03	L-T-P-S	3-0-0-0

Prerequisites: Nil

UNIT – 1

INTRODUCTION: Evolution of HRM, Objectives, Functions and Policies. **5Hrs**

HUMAN RESOURCE PLANNING: Uses and benefits, Man Power Inventory, Man Power Forecasting, Methods of Man Power Forecasting, job Description, Job Specification. **5Hrs**

UNIT - 2

RECRUITMENT: Sources of Man power, Advertisement, Short Listing of Candidates calling Candidates for selection Process. **5Hrs**

SELECTION: Selection procedure – Written Test, Group Discussion. Interview – Different methods, advantages and Limitations, Psychological testing – Advantages and limitations, Induction procedure, transfers, promotion exit interview, (Tutorial on written test, Group discussion,Interviews). **5 Hrs**

UNIT - 3

TRAINING AND DEVELOPMENT: Identification of Training needs, Training Evaluation, Training Budget, Executive Development – Different Approaches, Non-executive development – Different methods. **5 Hrs**

PERFORMANCE APPRAISAL: Components (all round performance appraisal), Methods. Advantages and limitations of different methods, Personal Counseling based on Annual Confidential Reports. **5 Hrs**

UNIT - 4

COUNSELLING AND HUMAN RESOURCE ACCOUNTING: Characteristics, Need, Function, Types, Suggestions for personnel development, communication function, communication process, effective communication. Human resource records, Advantages of HR accounting, various methods of accounting. **5 Hrs**

UNIT – 5

INDUSTRIAL RELATIONS: Indian trade union act, standing orders act, Indian factories act.

INDUSTRIAL DISPUTES AND SETTLEMENT: Indian Industrial Disputes act, Industrial disputes settlement machinery. Works committee, Board of Conciliation, Voluntary Arbitration, Compulsory arbitration, Court of inquiry, Industrial tribunal, Adjudication. **4 Hrs**

TEXT BOOKS:

1. **Human Resources Management** – Dr. K Ashwathappa, Tata McGraw Hill, Edition 1999
2. **Management of OrganisationsBehaviour** – Hersey and Blanchard – Prentice Hall of India Edn – 1998
3. **Industrial Relations** – ArunMonappa – TMH, ISBN – 0-07-451710-8

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

REFERENCES BOOKS:

1. **Personnel / Human resource Management** – Decenoz and robbins PHI, 2002
2. **Management of Human Resources** – CB Mamoria – Himalaya Publication House, 2003
3. **Industrial Acts** by Jain, 2004

ONLINE REFERENCE:www.shrm.org,

COURSE OUTCOMES

CO1	Human Resource Management objectives, functions and polices to describe and specify job, they also learn to plan for man power requirement.
CO2	Selection procedure, process, write tests, discuss in groups and attend interviews.
CO3	Training and Development to train and develop employees of the industry and to do Performance appraisal for continuous improvement.
CO4	Counseling and human resource accounting to suggest for personnel development, communication and to maintain records.
CO5	Industrial relations to follow factory acts, to resolve Industrial Disputes and settle industrial disputes.

SCHEME OF EXAMINATION:

FIVE Questions to be set with one question from units 1 to 5 carrying 20 marks each. Questions in unit 2& 3 units will have an internal choice

ASSESSMENT

Continuous Internal Evaluation (CIE) includes periodic class tests, quizzes or Alternative Assessment Tools (AAT) prescribed by the faculty handling a course prior to beginning of the classes like assignments, problem solving, case studies, group discussion, seminar, mini-project etc.

Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

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B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

Course	RELIABILITY ENGINEERING	Course Code	17IE7DERLE
Credits	03	L-T-P-S	3-0-0-0

Prerequisites: Nil

UNIT- 1

INTRODUCTION: Concepts, terms, and definitions of reliability and related performance measure, Terminology in reliability, Failure rate, MTBF, Life test, importance of reliability, definition, meaning of adequate performance, reliability-engineering Programme and its scope, Typical applications.

RELIABILITY MANAGEMENT: Reliability goals & policies, economics of reliability, reliability data Collection. Reliability requirement data collection and agreement, Design validation for reliability 6 **Hrs**

UNIT- 2

COMPONENT LIFE: Failure distribution function, reliability function and hazard rate function, interrelationships, MTTF, MTBF, bath tub curve (Mortality curve),conditional reliability function, constant and time dependent failure models, Accelerated tests and testing conditions for component life.

PRACTICAL FAILURE PATTERNS: Failure behavior of mechanical, electrical, electronic parts, common failure distribute. **6 Hrs COMBINATORIAL RELIABILITY (RELIABILITY OF SYSTEMS):** Reliability analysis of systems: (Success-Failure models only) Analysis of Series, parallel, series parallel and parallel series configurations. R out of n configurations, redundancy improvement factor, stand by systems.

6 Hrs

TECHNIQUES FOR COMPLEX SYSTEMS RELIABILITY EVALUATION:
Inspection methods, event space methods, path tracing methods, decomposition methods, cut set methods, tie set methods. **2 Hrs**

UNIT- 3

DESIGN FOR RELIABILITY: System effectiveness measures and life cycle cost analysis, reliability allocation, methods for reliability in design, failure analysis, systems safety and fault tree analysis, multistate model. Failure mode effect and criticality analysis. House of Reliability

4 Hrs

MARKOV MODELS FOR SYSTEM RELIABILITY: Reliability analysis of state dependent systems, Markov analysis, and stand by system analysis. **4 Hrs**

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

UNIT- 4

MAINTENABILITY AND AVAILABILITY: Analysis of Down time, Repair Time distributions, maintainability, Maintenance increment, Design for maintainability. Availability analysis, Different forms of availability, system availability analysis, mission availability, Availability of stand by system **6 Hrs**

UNIT- 5

ANALYSIS FAILURE DATA: Types of life testing, data collection, Empirical methods, Estimation of Static life, types of life testing: development of confidence intervals, acceptance test procedures for life estimation using exponential, Weibull and Gamma distribution models, Sequential life tests and acceptance criteria.

APPLICATION AND CASE STUDIES: Case example involving redundancy, burning tests, preventive maintenance analysis, Repairable system analysis, Software reliability.

6Hrs

TEXT BOOKS:

1. **Concepts of Reliability Engineering** -L. S. Srinath, - Affiliated East West Press Pvt. Ltd 2nd ed.
2. **Reliability Engineering** - Dr. Balaguru Swamy Tata McGraw Hilll, Fourth Edition2003
3. **An introduction to Reliability and Maintainability** - Charles E Ebeling TMH, Edition 2000.ISBN 0-07-042138-2

REFERENCES BOOKS:

1. **Reliability Hand Book** Ireson and Grant -1995
2. **Mathematical Theory of Reliability and Mathematics** Barlow and Proschan, 1st Edition.
3. **Probability Reliability & Engineering approach**-Shooman-1976.
4. **Practical Reliability Engineering** Patrick D.T.O John Wiley and Sons 2002.
5. **Introduction to Reliability Engineering** E E Lewis John Wiley & Sons, 2nd edition.

COURSE OUTCOMES

CO1	To understand the fundamentals of reliability like failure rate, availability, maintainability etc.
CO2	Ability to predict systems reliability availability, maintainability component failure data
CO3	To analyze the interference between strength and stress, or life data for estimating reliability and also strategies for enhancing reliability of components and systems

SCHEME FOR EXAMINATION: Five questions choosing one each from each unit and Unit 2and 3 with choice questions

ASSESSMENT

Continuous Internal Evaluation (CIE) includes periodic class tests, quizzes or Alternative Assessment Tools (AAT) prescribed by the faculty handling a course prior to beginning of the classes like assignments, problem solving, case studies, group discussion, seminar, mini-project etc.

Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

Both CIE and SEE have equal (50:50) weightages. The student's performance in a course shall be judged individually and together based on the results of CIE and SEE

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

INSTITUTIONAL ELECTIVE-I

Course	DATA BASE MANAGEMENT SYSTEM	Course Code	17IE7IEDBM
Credits	03	L-T-P-S	3-0-0-0

Prerequisites: Nil

UNIT - 1

DATABASES AND DATABASE USERS: Introduction, characteristics of data base approach, intended use of a DBMS, advantages and implication of database approach.

DATABASE SYSTEMS CONCEPTS AND ARCHITECTURE: Data models, Schemas and instances' DBMS architecture and data independence, database languages and interfaces, database system environment, classification of data base management Systems. **6Hrs**

DATA MODELING: High level conceptual data models for database design. Entity types, entity. Sets, attributes, and keys. Relationships, relationship types, roles, and Structural constraints, Weak entity types. ER Diagrams **6 Hrs**

UNIT - 2

RECORD STORAGE AND PRIMARY FILE ORGANIZATIONS: Secondary storage devices, buffering of blocks, placing fi1l records on disk, operations on files, heap files a sorted files, hashing techniques. **4 Hrs**

INDEX STRUCTURE OF FILES: Single-level and multilevel ordered indexes, dynamic multi-level indexes usingB-trees and B+trees. **2 Hrs**

UNIT - 3

RELATIONAL DATA MODE ANQ RELATIONAL ALGEBRA: Brief' discussion on Codd rules, relational model concepts, constraints, and schemas. Update operation on relations, basic and additional relational algebra operations, and queries in relational algebra.

Structured Query Language (SQL): Data definition etc. in SQL2.Basic and complex queries in SQL. Insert, delete, update statements, and views in SQL, embedded SQL. **10Hrs**

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19 DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT UNIT - 4

DATABASE DESIGN: Design guidelines for relational schemes, functional Dependencies, normalization -1st, 2nd, 3'd, 4 , and 5th normal forms. Database design process, factors influencing physic I database design guidelines, and guidelines for relational systems. **6Hrs**

UNIT - 5

SYSTEM IMPLEMENTATION: System catalog for RDBMSs, transaction processing and system concepts, properties of transactions, brief discussion on concurrency, control and recovery techniques, database security and authorization. **4 Hrs**

BRIEF DISCUSSION ON: Distributed databases, objected oriented databases, next generation databases, and interfacing with other technologies. **2 Hrs**

ONLINE REFERENCE:
http://nptel.ac.in/video.php?subjectId=106106093

TEXTBOOKS:

1. **Fundamentals of database systems**"-RamezElmasri and Shamkanth B. Navathe, , Addison Wesley Publishing Company, 6th Edition,
2. **"Database Management System**", -Raghu Ramakrishnan and Johanne'sGehrke, , TATA McGraw Hill, 3'd Edition, ISBN 0-071231511 I

REFERENCE BOOKS:

1. **Modern Data base management**: McLfadden, hoffer, Prescott
2. **Database Management Design** Gary W. Hansen and James V. Hansen, PHI Pvt . Ltd, 2nd Edition

COURSE OUTCOMES

F	Able to use, appreciate advantages and implication of database
G	Able to understand DBMS architecture, languages, interfaces, data modeling
H	Able to carry out indexing, understand relational model concepts, schemas
I	Able to use SQL, design database, carryout transaction processing, implement systems

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

SCHEME OF EXAMINATION: One Question to be set from each unit and Two Questions will be set from the Unit 1 & Unit-3.Student will answer any 5 questions selecting at least one from each unit.

ASSESSMENT

Continuous Internal Evaluation (CIE) includes periodic class tests, quizzes or Alternative Assessment Tools (AAT) prescribed by the faculty handling a course prior to beginning of the classes like assignments, problem solving, case studies, group discussion, seminar, mini-project etc.

Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

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B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

Course	HUMAN RESOURCE MANAGEMENT	Course Code	17IE7IEHRM
Credits	03	L-T-P-S	3-0-0-0

Prerequisites: Nil

UNIT – 1

INTRODUCTION: Evolution of HRM, Objectives, Functions and Policies. **5 Hrs**

HUMAN RESOURCE PLANNING: Uses and benefits, Man Power Inventory, Man Power Forecasting, Methods of Man Power Forecasting, job Description, Job Specification. **5 Hrs**

UNIT - 2

RECRUITMENT: Sources of Man power, Advertisement, Short Listing of Candidates calling Candidates for selection Process. **5Hrs**

SELECTION: Selection procedure – Written Test, Group Discussion. Interview – Different methods, advantages and Limitations, Psychological testing – Advantages and limitations, Induction procedure, transfers, promotion exit interview, (Tutorial on written test, Group discussion, Interviews). **5 Hrs**

UNIT - 3

TRAINING AND DEVELOPMENT: Identification of Training needs, Training Evaluation, Training Budget, Executive Development – Different Approaches, Non-executive development – Different methods. **5 Hrs**

PERFORMANCE APPRAISAL: Components (all round performance appraisal), Methods. Advantages and limitations of different methods, Personal Counseling based on Annual Confidential Reports. **5 Hrs**

UNIT - 4

COUNSELLING AND HUMAN RESOURCE ACCOUNTING: Characteristics, Need, Function, Types, Suggestions for personnel development, communication function, communication process, effective communication. Human resource records, Advantages of HR accounting, various methods of accounting. **5 Hrs**

UNIT – 5

INDUSTRIAL RELATIONS: Indian trade union act, standing orders act, Indian factories act.

INDUSTRIAL DISPUTES AND SETTLEMENT: Indian Industrial Disputes act, Industrial disputes settlement machinery. Works committee, Board of Conciliation, Voluntary Arbitration, Compulsory arbitration, Court of inquiry, Industrial tribunal, Adjudication. **4 Hrs**

TEXT BOOKS:

1. **Human Resources Management** – Dr. K Ashwathappa, Tata McGraw Hill, Edition 1999
2. **Management of OrganisationsBehaviour** – Hersey and Blanchard – Prentice Hall of India Edn – 1998
3. **Industrial Relations** – ArunMonappa – TMH, ISBN – 0-07-451710-8

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

REFERENCES BOOKS:

1. **Personnel / Human resource Management** – Decenoz and robbins PHI, 2002
2. **Management of Human Resources** – CB Mamoria – Himalaya Publication House, 2003
3. **Industrial Acts** by Jain, 2004

ONLINE REFERENCE:www.shrm.org,

COURSE OUTCOMES

CO1	Human Resource Management objectives, functions and polices to describe and specify job, they also learn to plan for man power requirement.
CO2	Selection procedure, process, write tests, discuss in groups and attend interviews.
CO3	Training and Development to train and develop employees of the industry and to do Performance appraisal for continuous improvement.
CO4	Counseling and human resource accounting to suggest for personnel development, communication and to maintain records.
CO5	Industrial relations to follow factory acts, to resolve Industrial Disputes and settle industrial disputes.

SCHEME OF EXAMINATION:

FIVE Questions to be set with one question from units 1 to 5 carrying 20 marks each. Questions in unit 2& 3 units will have an internal choice

ASSESSMENT

Continuous Internal Evaluation (CIE) includes periodic class tests, quizzes or Alternative Assessment Tools (AAT) prescribed by the faculty handling a course prior to beginning of the classes like assignments, problem solving, case studies, group discussion, seminar, mini-project etc.

Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

Both CIE and SEE have equal (50:50) weightages. The student's performance in a course shall be judged individually and together based on the results of CIE and SEE.

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

Course	OPERATIONS RESEARCH	Course Code	17IE7IEOPR
Credits	03	L-T-P-S	3-0-0-0

Prerequisites: Nil

Introduction: OR definition, scope, phases, limitations, models, applications and advantages of Operations Research **2 Hrs**

Linear programming: Definition, mathematical formulation, standard form, graphical method: feasible, infeasible, multiple solution, unbounded solution and simplex method: feasible, infeasible, multiple solution, unbounded solution and degeneracy. **8 Hrs**

UNIT - 2

Transportation problem: Formulation of transportation model, basic feasible solution using North west and VAM methods, optimal solutions, degeneracy in transportation problems. **6 Hrs**

Assignment problem: Formulation, balanced, unbalanced and maximization assignment problem, travelling salesman problem using Hungarian method **6 Hrs**

UNIT - 3

Queuing theory: Queuing system and their characteristics, M/M/1, M/M/K queuing systems **6 Hrs**

UNIT - 4

Project management using network analysis: Network construction, determination of critical path and duration, floats using CPM. PERT-Estimation of project duration, Variance of project activities **6 Hrs**

UNIT - 5

Game theory: Two persons - zero sum game, games with and without saddle point, graphical solution, dominance property **5 Hrs**

TEXT BOOKS:

1. **Operations Research and Introduction**, Taha H A, Pearson Education, 9th Edition, 2014
2. **Introduction to Operation Research**, F K Hiller and Liberman, McGraw hill Education Pvt Ltd, 9th Edition, 2011
3. **Operations Research –Principles and practice**, Philips Ravindaran and Soleberg, Wiley Publication, 2nd Edition, 2007

REFERENCE BOOKS:

1. **Operations Research**, S D Sharma, KedarNath, RamNath Publication, 2014
2. **Operations Research,**Kanthiswarup and others, Sultan Chand and sons, 2014
3. **Operations Research Problems and Solutions**, J K Sharma, McMillan Publishers, 3rd Edition, 2009.
4. **Operations Research**, P K Gupta and Hira, S Chand Publications, 2007

ONLINE REFERENCE: www.nptel.ac.in

COURSE OUTCOMES

CO1	To be able to understand the fundamental concept and approach of linear programming appropriate to the further study of operations research and identify problems in real life
CO2	To be able to recognize and optimize the transportation and assignment problems
CO3	To be able to recognize and solve Queuing theory problems
CO4	To be able to use network planning procedures for solving logistics problems
CO5	To be able to recognize and solve Game theory problems

SCHEME OF EXAMINATION: Each question from each unit and internal choice from unit-1 and unit-2

ASSESSMENT

Continuous Internal Evaluation (CIE) includes periodic class tests, quizzes or Alternative Assessment Tools (AAT) prescribed by the faculty handling a course prior to beginning of the classes like assignments, problem solving, case studies, group discussion, seminar, mini-project etc.

Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

Both CIE and SEE have equal (50:50) weightages. The student's performance in a course shall be judged individually and together based on the results of CIE and SEE.

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

Course	PRODUCT DESIGN & DEVELOPMENT	Course Code	17IE7IEPDD
Credits	03	L-T-P-S	3-0-0-0

Prerequisites: Nil

UNIT- 1

Introduction: Characteristics of successful product development, Design and development of products, duration and cost of product development, the challenges of product development.

Development Processes and Organizations: A generic development process, concept development: the front-end process, adopting the generic product development process, the AMF development process, product development organizations, the AMF organization.

Product Planning: The product planning process, identify opportunities. Evaluate and prioritize projects, allocate resources and plan timing, complete pre project planning, reflect all the results and the process. **8Hrs**

UNIT- 2

Identifying Customer Needs: Gather raw data from customers, interpret raw data in terms of customer needs, organize the needs into a hierarchy, establish the relative importance of the needs and reflect on the results and the process.

Product Specifications: What are specifications, when are specifications established, establishing target specifications, setting the final specifications. **6 Hrs**

UNIT-3

Concept Generation: The activity of concept generation clarify the problem, search externally, search internally, explore systematically, reflect on the results and the process.

Concept Selection: Overview of methodology, concept screening, and concept scoring,

Concept Testing: Define the purpose of concept test, choose a survey population, choose a survey format, communicate the concept, measure customer response, interpret the result, and reflect on the results and the process.

Design for Manufacturing: Definition, estimation of manufacturing cost, reducing the cost of components, assembly, supporting production, impact of DFM on other factors.

Prototyping: Prototyping basics, principles of prototyping, technologies, planning for prototypes. **10 Hrs**

UNIT- 4

Product Architecture: What is product architecture, implications of the architecture, establishing the architecture, variety and supply chain considerations, platform planning, related system level design issues.

INDUSTRIAL DESIGN: Assessing the need for industrial design, the impact of industrial design, industrial design process, managing the industrial design process, assesses the quality of industrial design. **6 Hrs**

UNIT- 5

Intellectual Property Rights: Basic principles of IP laws: Introduction, Concept of property, Need for a holistic approach, Basis for protection, Invention, Criteria for patentability, Non – patentable inventions. Patents: Introduction, principles underlying the patent law in India, patentable invention. Procedure for obtaining patent. **6 Hrs Product Development Economics:** Elements of economic analysis, base case financial mode,. Sensitive analysis, project trade-offs, influence of qualitative factors on project success, qualitative analysis.

Managing Projects: Understanding and representing task, baseline project planning, accelerating projects, project execution, postmortem project evaluation. **4 Hrs**

TEXT BOOKS:

1. **Product Design & Development** - Karl T. Ulrich & Steven D., Tata McGraw Hill, 3'd Edition, 2003
2. **Product Design and Manufacturing** by A.K. Chitale and R.C. Gupta, PHI.
3. "**Basic principles and acquisition of Intellectual Property Rights**", Dr. T Ramakrishna, CIPRA, NSLIU -2005.
4. **"Intellectual Property Law Handbook**", Dr.B.L.Wadehhra, Universal Law Publishing Co. Ltd., 2002.

REFERENCE BOOKS:

1. **New Product Development** by Tim Jones, Butterworth Heinr1ann, Oxford, UIC 1997.

2. New Product Development: Design & 'Analysis by Roland Enene, Kinetovicz, John Wiley and Sons Inc., N. Y. 1990.

3. **Product Design for Manufacture and Assembly** by GefferryBoothroyd, Peter Dewhurst and Winston Knight. '.
4. **Successful Product Design** by Jill Hollins, Stwout Pugh, Butterworth, London 1 990.

ONLINE LINKS:

http://nptel.ac.in/courses.php

SCHEME FOR EXAMINATION: Five questions choosing one each from each unit and Unit 1 and 2 with choice questions

COURSE OUTCOMES

CO1	Understand the basic concepts of product design
CO2	Understand the product design process in industry
CO3	Understand the economic factors involved in PD
CO4	Understand the basic concepts of IPR
CO5	Understand modern approaches helpful in product design

ASSESSMENT

Continuous Internal Evaluation (CIE) includes periodic class tests, quizzes or Alternative Assessment Tools (AAT) prescribed by the faculty handling a course prior to beginning of the classes like assignments, problem solving, case studies, group discussion, seminar, mini-project etc.

Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

Both CIE and SEE have equal (50:50) weightages. The student's performance in a course shall be judged individually and together based on the results of CIE and SEE.

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

Course	AUTOMATION IN MANUFACTURING	Course Code	17IE7IEAIM
Credits	03	L-T-P-S	3-0-0-0

Course Out comes:

CO1	Is able to acquire the knowledge of fundamentals of automation, the types of automation and the need to go in for automation. Learn about the concepts of production automation, strategies in automation.
CO2	Is able to learn about the transfer mechanisms, analysis of production and assembly automated flow lines and balancing of flow lines.
CO3	Is able to understand the philosophy of Group technology and learn about computerized process planning system, types of computer aided process planning, and benefits of CAPP.
CO4	Is able to acquire the knowledge of Flexible manufacturing systems, Layout configurations, and implementation of FMS. Is able to understand about computer networks for production automation, hierarchy, network topology, manufacturing automation protocol.
CO5	Is able to understand the concept of computerized measuring systems, types of equ ipments used in the automated systems. Is also able to acquire the knowledge of trends in manufacturing, and the future automated factory.

Unit - 1

Introduction: Introduction to automation, **d**efinition, types of automation, reasons for automating, arguments for and against automation.

Productivity concepts and mathematical models:
Introduction, manufacturing lead-time, components of operating time, production rate, plant capacity, utilization and availability, work-in-process, automation strategies. (Problems) **10Hrs**

Unit - 2

High volume production system: Introduction to automated flow lines, Configuration of flow lines, Methods of work-part transport systems, Performance analysis of automated flow lines, analysis of automated transfer lines without buffer, automated flow lines with storage buffer, analysis of a two-stage line. Line balancing of assembly systems. (Problems on line balancing only). **10 Hrs**

Unit - 3

Group Technology: Part families, part classification and coding systems, machine cell design, application consideration in group technology.

Computerized manufacturing planning systems: Introduction, computer aided process planning, retrieval and generative type of process planning, benefits of computer aided process planning.

6 Hrs

Unit – 4

Flexible manufacturing systems: Introduction to FMS, components of FMS, types of FMS, Layout configurations, computer control system, application and benefits of FMS. FMS planning and implementation issues.

Computer networks for manufacturing: Introduction, hierarchy of computers in manufacturing, local area networks, manufacturing automation control. **8 Hrs**

Unit - 5

Automated inspection and testing: Introduction, contact and non-contact inspection techniques, Types of coordinate measuring machines, applications and benefits, machine vision.

The future automated factory: Introduction, trends in manufacturing, the future automated factory, the social impact of automated systems, Industry 4.0 **6 Hrs**

SCHEME OF EXAMINATION:
To set two questions from units 1 & 2 and one question from units 3, 4 & 5.

TEXT BOOKS:

1. **Automation, Production Systems and Computer Integrated Manufacturing** - Mikell P. Groover, Pearson – Education, New Delhi
2. **Computer control of manufacturing systems. -** Yorem coren

REFERENCE BOOKS:

1. **Automation, Production Systems and Computer Integrated Manufacturing** - Mikell P. Groover, PHI, New Delhi
2. **CAD/CAM**, Mikell P. Groover and Emory W.Zimmers, PHI, New Delhi
3. **Numerical Control and Computer aided Manufacture**, Pressman and Williams PHI
4. **An Introduction to Automated Process Planning System** – Tiess Chieu Chang and Richard A Wysk PHI

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

Course Title	SIX SIGMA	Course Code	17IE7IESS
Credits	03	L-T-P	3-0-0

Prerequisites: Nil

UNIT – 1

Introduction: Six Sigma Introductory Overview, Project Selection, Process and Financial Metrics, Project Reporting Expectations **7 Hrs**

UNIT – 2

Project Definition: Project Charters, Estimating Financial Metrics, Definition of process outputs (characteristics, defects, and defectives), Process Mapping **7 Hrs**

UNIT – 3

Measurement System Analysis: Fundamental Statistical Measures, Control Charts, Common and Special Cause Improvement Strategies, Introduction to Minitab, Variable Gage R&R, Attribute Agreement Analysis, Variables Data Capability Analysis, Attribute Agreement Analysis **8 Hrs**

UNIT – 4

Quality Tools/Hypothesis Testing: Quality Tools, Introduction to Hypothesis Testing, one proportion Tests, Two proportion Tests, Chi Square Testing, t Tests, ANOVA, Correlation Analysis, Single Regression, Multiple Regression **8 Hrs**

UNIT – 5

Design of Experiments (DOE): Introduction to Design of Experiments, Non Parametric tests and analysis, General Full Factorial Designs, Two-Level Factorial Designs, Three-Level Factorial Designs, Post-hoc Analysis, Fractional Factorials,

Improve and Control: Solution Selection and Prioritization, Pilot Studies (assessing counter measures), Final Capability Analysis, Process Controls, Wrap-Up , Demonstration on Catapault Experiment **9 Hrs**

TEXT BOOKS:

1. Design for Six Sigma, Gerg Brue, TMH 2003, ISBN 0-07-058120
2. Six Sigma for Managers, Greg Brue, TMH 2002; ISBN - 0-07-048639-5

SCHEME FOR EXAMINATION: Five questions choosing one each from each unit and Unit 2 and 3 with choice questions

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

ASSESSMENT

Continuous Internal Evaluation (CIE) includes periodic class tests, quizzes or Alternative Assessment Tools (AAT) prescribed by the faculty handling a course prior to beginning of the classes like assignments, problem solving, case studies, group discussion, seminar, mini-project etc.

Semester End Examination (SEE)-a written examination for theory courses and practical/ design examination with built-in-oral part (Viva voice)

Both CIE and SEE have equal (50:50) weightages. The student's performance in a course shall be judged individually and together based on the results of CIE and SEE.

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

Course	SIMULATION MODELING AND ANALYSIS	Course Code	17IE7IESMA
Credits	03	L-T-P-S	3-0-0-0

Prerequisites: Nil

UNIT-1

Introduction To Simulation: Simulation, advantages, Disadvantages, Areas of application, System environment, components of a system, Model of a system, types of models, steps in a simulation study.

Simulation Examples: Simulation of Queuing systems, Simulation of Inventory System, Simulation of Project Management and Other simulation examples **10Hrs**

UNIT - 2

General Principles: Concepts in discrete - events simulation, event scheduling *I* Time advance algorithm

Random Numbers: Properties, Generations methods, Tests for Random number- Frequency test, Runs test, Autocorrelation test, Gap test, Poker test. **08Hrs**

UNIT –3

Random Variate Generation: Inverse Transform Technique- Exponential, Uniform, Weibull, Triangular distributions, Direct transformation for Normal and log normal Distributions, Acceptance - Rejection Techniques – Poisson Distribution. **08Hrs**

UNIT - 4

Analysis of Simulation Data: Input Modeling: Data collection, Identification and distribution with data, parameter, Goodness of fit tests, Selection of input models without data

Verification and Validation of Model- Model Building, Verification, Calibration and Validation of Simulation Models. **08Hrs**

UNIT - 5

Statistical Analysis of Simulation Data -Estimation Methods, Simulation Run Statistics, Replication of Runs, Batch Means, Spectral Analysis.

Output Analysis - Stochastic Nature of output data, Measures of Performance and their estimation. **05Hrs**

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

TEXT BOOKS:

1. **Discrete Event system Simulation** - Jerry Banks, John S Carson, II, Berry L Nelson, Prentice Hall, 1996
2. **Discrete-event System Simulation**, David M Nicol, 5th Edition, Pearson Education, Asia, 2010
3. **Systems Simulation with Digital Computer**, Narsingh Deo,, PHI Publication (EEE).1978
4. **Simulation Modeling & Analysis Averill**, M Law, W David Kelton, - ; McGraw Hill, International Editions – Industrial Engineering series, 1991
5. **Systems Simulation**,Gordan. G. "", Prentice Hall India Ltd, 1991.

REFERENCE BOOKS:

1. **Simulation -- Business & Economics** Sheldon M. Ross, Academic Press, 31-Dec-2012
2. **Simulation Modeling and Analysis with Arena,** Tayfur Altiok, Benjamin Melamed, 2010

ONLINE COURSES

1. http://nptel.ac.in/courses.php?disciplineId=110
2. http://informs-sim.org/
3. E-learning: http://vtu.ac.in
4. http://ocw.mit.edu/
5. http:// youtube.com/ Discrete Event simulation

SOFTWARE PACKAGES

1. Simulation Packages : Arena, Quest, Witness,
2. MS Excel, Minitab

SCHEME OF EXAMINATION

Each question from each unit and internal choice from **Unit 1 & Unit 2**

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

COURSE OUTCOMES

CO1	**Understand** concepts, steps and different types of simulation and its models.
CO2	**Explain** the simulation applications with analytical problems
CO3	**Explain & Solve** random number generators and its testing
CO4	**Apply & Solve** inverse transformation techniques in simulation modeling
CO5	**Evaluate** input data and output by means of statistical tests

ASSESSMENT

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Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

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B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT
SCHEME FOR THE ACADEMIC YEAR 2017-18
VIII SEMESTER B.E. INDUSTRIAL ENGINEERING AND MANAGEMENT

Course Code										Course Title	Teaching Department	Credit Hours/week					Contact Hrs/Wk
												L	T	P	S	Total	
1	7	I	E	8	D	E				ELECTIVE-VII	IEM	3	0	0	0	3	3
1	7	I	E	8	I	E				INSTITUTIONAL ELECTIVEII/MOOCs	IEM	3	0	0	0	3	3
1	7	I	E	8	D	C	P	M		PROJECT MANAGEMENT	IEM	3	0	0	0	3	3
1	7	I	E	8	D	E	A	P	E	APPLIED PSYCHOLOGY FOR ENGINEERS (HSS Elective Course) /NSS/NCC/Yoga/Sports/ Foreign language/performing Arts	IEM	2	0	0	0	2	2
1	7	I	E	8	D	C	P	W	II	PROJECT WORK-PHASE II	IEM	0	0	10	0	10	10
1	7	I	E	8	S	S				SOFT SKILLS (Placement)	IEM	2	0	0	0	2	0
1	7	I	E	8	D	C	T	S	E	TECHNICAL SEMINAR	IEM	0	0	2	0	2	2
										Total		13	0	12	0	25	23

L-Lecture Hours/Week, 1 Credit= 1hour, P-Practical Hours/Week, 1 Credit = 2Hours, T- Tutorial Lecture Hours/Week, 1 Credit =2 hours, S-Self-Study to be added to contact Hrs/Week CIE- Continuous Internal Evaluation, SEE-Semester End examination (of 3 hours duration)

INSTITUTIONAL ELECTIVE – II

17IE8IEERP	Enterprise Resource Planning
17IE8IEOPR	Operations Research
17IE8IEAOR	Advanced Operations Research
17IE8IEMM	Marketing Management
17IE8IEMAE	Management and Entrepreneurship

Elective-VII

17IE8DETM	Technology Management
17IE8DEVAE	Value Engineering
17IE8DESS	Six Sigma
17IE8DERSM	Retail & Service Management

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT
VIII SEMESTER
ELECTIVE-VII

Course	TECHNOLOGY MANAGEMENT	Course Code	17IE8DETM
Credits	03	L-T-P-S	3-0-0-0

Prerequisites: Nil

UNIT-1

The Concept of Technology: Introduction, The nature of knowledge, Aspects of classification, Concept and Meaning of technology, the character of a specific technology, Scope of technology, Examples of classification of technology, Scale of technology information, Levels of technology, Technology portfolios, Technology as an environment.

The Nature of Technological Change: Introduction, Meaning of technological change, Concept of invention, Nature of innovation, Emergence of new technologies, Life cycle of a technology, Motivation for technological change, Nature of technological progress, Nature of mature technology, Nature of diffusion, Technological convergence. **10Hrs**

UNIT-2

The Economics of Technology: Introduction, Meaning of technological economics, Examples of technological economics, Scope of technological economics, Engineering economics, Production economics, Concept of economy of scale, Concept of optimum size, Technology as a commodity, Technology at the macro-economic level.

Corporate Technology Strategy: Introduction, The business mission, Where is the business? Concept of business strategy, Capability for strategic planning, Corporate technology strategy, Competitive technology, Focus of strategy, Technological alliances, Realization of strategy, Technology crisis. **10Hrs**

UNIT-3

Analysis for Technology Strategy: Introduction, Technology assessment, Technology forecasting, Main techniques of technology forecasting, Technology forecasting system, Yield of technology forecasting. **6 Hrs**

UNIT-4

The Realization of New Technology: Introduction, Concept of R&D, R&D policy, Stimuli for innovation, Sources of innovation, Intelligence function of R&D, Management of R&D, R&D team, Effectiveness of R&D, Marketing aspects of R&D, Finance for R&D, Design, Development, Manufacture and Marketing, Reduction of development lead time, Patterns for new technology development, Remaining a going concern.

The Adoption of New Manufacturing Technology: Introduction, Manufacturing strategy, Introduction of new technology, Challenges of factory automation, Stages of factory automation, Manufacturing cells, FMS, CIM, CAD/CAM, Intelligent manufacturing systems, Operation of new technology, Change management, People and technology at work, Work structures. **8 Hrs**

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

UNIT-5

Technology- An Instrument of Competition: Introduction, Securing competitive advantage, Technological competition analysis, Technological leadership, Adoption of new technology, marketing a new technology product, Retention of competitive advantage. **6 Hrs**

TEXT BOOK:

1. The Management of Technology Paul Lowe,: Perceptions and Opportunities, Chapman and Hall, London, 1995.

REFERENCE BOOKS:

1. Strategic Management of Technology Frederick Betz, , McGraw-Hill Inc, 1993.
2. Management of Technology and Innovation: Competing Through Technological ExcellenceRastogi, P.N., , Sage Publications, 1995

SCHEME FOR EXAMINATION: One question from each unit and Unit 1 and 2 will have internal choice.

ONLINE LINKS:
http://ocw.mit.edu/courses/sloan-school-of-management/15-912-technology-strategy-fall-2008/
COURSE OUTCOMES

Co1	Students get an exposure to concept and meaning of Technology
Co2	Able to understand Invention and Innovation
Co3	Able to understand business and business strategies
Co4	Get an exposure to effective R & D and marketing concepts

ASSESSMENT
Continuous Internal Evaluation (CIE) includes periodic class tests, quizzes or Alternative Assessment Tools (AAT) prescribed by the faculty handling a course prior to beginning of the classes like assignments, problem solving, case studies, group discussion, seminar, mini-project etc.

Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

Both CIE and SEE have equal (50:50) weightages. The student's performance in a course shall be judged individually and together based on the results of CIE and SEE.

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

Course	VALUE ENGINEERING	Course Code	17IE8DEVAE
Credits	03	L-T-P-S	3-0-0-0

Prerequisites: Nil

Unit – 1

INTRODUCTION TO VALUE ANALYSIS: Definition of Value, Value Analysis, Value Engineering, Value management, Value Analysis versus Value Engineering, uses, applications, advantages and limitations of Value analysis. Symptoms to apply value analysis. Types of values, Reasons for poor value & unnecessary cost of product, Peeling cost Onion concept, unsuspected areas responsible for higher cost, Value Analysis Zone, attractive features of value analysis.

10Hrs

UNIT - 2

VALUE ENGINEERING JOB PLAN: Meaning and Importance of Value Engineering Job plan. Phases of job plan proposed by different value engineering experts, Information phase, Analysis phase, Creative phase, Judgement phase, Development planning phase, and case studies. Cost reduction programs, **8Hrs**

UNIT –3

FUNCTIONAL COST AND ITS EVALUATION: Meaning of Function and Functional cost, Rules for functional definition, Types of functions, primary and secondary functions using verb and Noun, Function evaluation process, Methods of function evaluation. Evaluation of function by comparison, Evaluation of Interacting functions, Evaluation of function from available data, matrix technique. **7Hrs**

UNIT - 4

IMPLEMENTATION OF VE TECHNIQUES: Guidelines for selecting VE projects, Guidelines for formation of VE teams, Application of VE for cost reduction and improving competitiveness – some examples, Relevance of VE for Materials Management. **5Hrs**

UNIT - 5

INTRODUCTION TO SOME ADVANCED TECHNIQUES: FAST diagramming, Life Cycle costing. VE and some new variants – BPR, Product Reengineering, QFD, Benchmarking. Value analysis of Management practice (VAMP): Steps involved in VAMP.

Typical Case Studies – Tapping device of transformer, front rings, conveyor rollers, speedometer of a motorcycle, oil pump etc. **10 Hrs**

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

TEXT BOOKS:

1. **Value Engineering for COST REDUCTION and PRODUCT IMPROVEMENT** – M.S. Vittal, Systems Consultancy Services Edn 1993.
2. **Achieving competitive edge through Value Engineering** – M.S.Vittal, Systems Consultancy Services Edn 1993.
3. **Value Engineering** - S.S Iyer,
4. **Value Engineering**- A Practical approach for Owners, Designers and Contractors – Larry Zimmerman, P.E., Glen Hart, CBS Publishers & Distributors, 1988.

REFERENCE BOOKS:

1. **Value Analysis for Better Management** – Warren J Ridge American Management Association Edn 1969
2. **Elements of Production Planning and Control** – Samuel Eilon, Universal Book Corporation. Edn 1981
3. **Getting More at Less Cost (The Value Engineering Way)** – G. Jagannathan Tata Mcgraw Hill Pub. Comp. Edn 1995
4. **Value Engineering** – Arther E Mudge McGraw Hill Book Comp. Edn 1981
5. **An Introduction to Operational Research** – C R Kothari Vikas Pub. House Pvt. Ltd., Edn. 1982.
6. **Value Management, Value Engineering and Cost Reduction** – Edward D Heller Addison Wesley Publishing Company 1971

ONLINE RESOURCE

www.nptel.com

COURSE OUTCOMES

CO1	Able to differentiate between value Engg., value analysis and value management and know when to apply value Engg.
CO2	Able to use VE job plan to improve value and reduce cost of an item
CO3	Able to understand, differentiate, classify and evaluate functions
CO4	Able to select right VE projects, form VE teams, apply VE for cost reduction and competitiveness
CO5	Able to use advanced techniques related to VE for value, quality improvement

SCHEME OF EXAMINATION: One question from each unit and choice from **unit I and unit V**

ASSESSMENT

Continuous Internal Evaluation (CIE) includes periodic class tests, quizzes or Alternative Assessment Tools (AAT) prescribed by the faculty handling a course prior to beginning of the classes like assignments, problem solving, case studies, group discussion, seminar, mini-project etc.

Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

Both CIE and SEE have equal (50:50) weightages. The student's performance in a course shall be judged individually and together based on the results of CIE and SEE.

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

Course Title	SIX SIGMA	Course Code	17IE8DESS
Credits	03	L-T-P	3-0-0

Prerequisites: Nil

UNIT – 1

Introduction: Six Sigma Introductory Overview, Project Selection, Process and Financial Metrics, Project Reporting Expectations **7 Hrs**

UNIT – 2

Project Definition: Project Charters, Estimating Financial Metrics, Definition of process outputs (characteristics, defects, and defectives), Process Mapping **7 Hrs**

UNIT – 3

Measurement System Analysis: Fundamental Statistical Measures, Control Charts, Common and Special Cause Improvement Strategies, Introduction to Minitab, Variable Gage R&R, Attribute Agreement Analysis, Variables Data Capability Analysis, Attribute Agreement Analysis **8 Hrs**

UNIT – 4

Quality Tools/Hypothesis Testing: Quality Tools, Introduction to Hypothesis Testing, one proportion Tests, Two proportion Tests, Chi Square Testing, t Tests, ANOVA, Correlation Analysis, Single Regression, Multiple Regression **8 Hrs**

UNIT – 5

Design of Experiments (DOE): Introduction to Design of Experiments, Non Parametric tests and analysis, General Full Factorial Designs, Two-Level Factorial Designs, Three-Level Factorial Designs, Post-hoc Analysis, Fractional Factorials,

Improve and Control: Solution Selection and Prioritization, Pilot Studies (assessing counter measures), Final Capability Analysis, Process Controls, Wrap-Up , Demonstration Catapault Experiment **9 Hrs**

TEXT BOOKS:

1. Design for Six Sigma, Gerg Brue, TMH 2003, ISBN 0-07-058120
2. Six Sigma for Managers, Greg Brue, TMH 2002; ISBN - 0-07-048639-5

SCHEME FOR EXAMINATION: Five questions choosing one each from each unit and Unit 2 and 3 with choice questions

ASSESSMENT

Continuous Internal Evaluation (CIE) includes periodic class tests, quizzes or Alternative Assessment Tools (AAT) prescribed by the faculty handling a course prior to beginning of the classes like assignments, problem solving, case studies, group discussion, seminar, mini-project etc.

Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

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B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

Course	RETAIL AND SERVICE MANAGEMENT	Course Code	17IE8DERSM
Credits	03	L-T-P-S	3-0-0-0

Prerequisites: Nil

UNIT- 1

Marketing Channels: Definition & Importance, Functions of Marketing Channels – Intensive, Selective & Exclusive distribution strategies, Decisions in Channel Management Wholesaling: Concept, Importance, Functions –Wholesaler Marketing Decisions – Trends in Wholesaling **4 Hrs**

UNIT- 2

Modern Retail Management: Retail Development, Theories of Retail Development, Retail Development in India, Current Retail Scenario in India, Overview of Different Sectors of Retailing in India , Growth Factors of Retailing in India, Role of Retail in Indian Economy, Retailing in Rural India, Retailing in India Vs. Retailing in Other Countries **8Hrs**

UNIT- 3

International Retailing: International Retailers- Explanations of Internationalization- Market Selection and Growth Stages of Internationalization, International Opportunities, Market Entry Strategies- Factors Determining Choice of Entry Methods- Standardization versus Adaption Strategies- Problems for New entrants, Internationalization Process, Retail Structures, Issues in Implementing International Strategies, List of Leading International Retailers Multichannel

Retailing and Ownership Structures in Retail: Key Features of New Technology Retail Formats, Concept of Multichannel Retailing **8 Hrs**

UNIT- 4

Store Design: Interiors and Exteriors - Store layout – Types of layouts – Factors affecting store layout – Store image mix – Store Façade – The Internet Store. Store Administration: Floor space management–Managing store inventories and display, Merchandising: Concept, Importance, Functions – Steps in merchandising planning , Category management: Definition and process – Introduction to Private label brands , Retail Communication Mix: Planning retail communication

- Managing in-store promotions and events **10 Hrs**

UNIT- 5

Integrated Marketing Channels: Channels for Consumer goods, Industrial goods & Services – Horizontal, Vertical, Multichannel Marketing Systems , Channel Management: Channel selection - Channel Conflicts & its Resolution Channel Performance Evaluation , Technology in distribution: Barcoding – RFID – Electronic payment systems Ethical and Legal Aspects of Retailing: Meaning of Business Ethics, Ethical Aspects in Retailing, Green Retailing, Meaning of Social Responsibility, Legal Aspects of Retailing **10 Hrs**

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

TEXT BOOK:

1. **Retail Management**,Gibson G. Vedamani -, Jaico Publishing House
2. **Retailing Management**,Michael Levy, Barton A.Weitz& Ajay Pandit, , 8th edition, reprint 2012
3. **Retailing Management**, Swapna Pradhan, Reference book:
4. **Channel Management** –Stern – El- Ansary
5. **Channel Management & Retail Management** – Meenaldhotre
6. **Cases in Retail Management** Srini. R. Srinivasan, R.K. Srivastava, (Biztantra Series)

COURSE OUTCOMES:

CO1	Should be able to define retailing
CO2	Able to understand what marketing means to business executives and academics
CO3	Able to understand the ways that retailers use marketing tools and techniques to interact with their customers
CO4	Able to describe the flow of routes and services in the retail environment

ASSESSMENT

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Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

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B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

INSTITUTIONAL ELECTIVE-II

Course	ENTERPRISE RESOURCE PLANNING	Course Code	17IE8IEERP
Credits	03	L-T-P-S	3-0-0-0

Prerequisites: Nil.

UNIT - 1

Introduction to ERP:
Introduction, Evolution of ERP, What is ERP?, Reasons for the growth of the ERP market, The advantages of ERP, Why do Many ERP Implementations Fail? Why are ERP packages being used now?
Enterprise An Overview: Introduction, Integrated Management Information, Business modeling, Integrated Data Model. **6Hrs**

UNIT - 2

ERP and Related Technologies: Introduction, Business Process Reengineering, Management Information System, Decision Support System, Executive Information Systems, Data Warehousing, Data Mining, On-line Analytical Processing, Supply Chain Management. **6 Hrs**
ERP- Manufacturing Perspective: Introduction, ERP. CAD/CAM, Materials Requirements Planning, Bill of Material, Closed Loop MRP. Manufacturing Resource Planning, Distribution Requirements Planning. **6 Hrs**

UNIT - 3

KANBAN: JIT and Kanban, Product Data Management, Benefits of PDM, Make-to-order, and Make-to Stock, Assemble to order, Engineer to order, Configure-to order.
ERP Modules: Introduction, Finance, Plant Maintenance, Quality Management, Materials Management. **6 Hrs**

UNIT – 4

Benefits of ERP: Introduction, Reduction of Lead time, On-time shipment, Reduction in Cycle Time, Improved Resource Utilisation, Better Customer Satisfaction, Improved Suppler Performance, Increased Flexibility, Reduced Quality Costs, Improved Information Accuracy and Decision making capability. **6Hrs**

UNIT - 5

ERP Implementation Life Cycle: Pre-evaluations Screening, Package Evaluation, Project Planning Phase, Gap Analysis, Reengineering, Configuration, Implementation of Team Training, Testing, Going Live, End user Training, Post implementation **Vendor, Consultants and Users:** Introduction, In-house implementation Pros and Cons, Vendors, Consultants, End-users.

Future Direction in ERP: Introductions, New Markets, New Channels, Faster Implementation Methodologies, Business models and BAPIs, Convergence on Windows NT, Application Platforms, New business segments, web enabling, market snapshot **10 Hrs**

ERP- Case studies Question Paper: One Question to be set from each unit and Two Questions will be set from the unit 2 & 5. Student will answer any 5 questions selecting at least one from each unit.

TEXT BOOKS:

1. **Enterprise Resource Planning** -Alexis Leon, , 1999, Tata Mc Graw Hill Publishing Company Ltd.,
2. **Manufacturing Planning and Control Systems** Thomas E. Vollmann, William L. Berry, D. Clay Why bark Irwin/McGraw-Hill, 1997 - Technology & Engineering

REFERENCE BOOKS:

1. **ERP: Making It Happen: The Implementers' Guide to Success with Enterprise Resource Planning** by Thomas F. Wallace, Michael H. Kremzar Wiley
2. **Concepts in Enterprise Resource Planning**, Ellen Monk, Bret Wagner Cengage Learning, 4th Edition Inc USA
3. **Production and Operations Management: Manufacturing and Services 8th** Edition 1998 by Richard B. Chase, Nicholas J. Aquilano, F. Robert Jacbos, Irwin Professional Publishing
4. **A Guide to ERP Benefits, Implementation and Trends** Prof Lineke Sneller RC Bookboon

COURSE OUTCOMES

CO1	Have understood business functions and business processes, concepts of ERP, importance of ERP, benefits and risk factors of ERP implementation
CO2	Able to establish relationship between ERP and other technologies
CO3	Known about the functional modules of ERP software
CO4	Understood the basics of ERP implementation, Package selection, transition strategies, implementation process
CO4	Able to differentiate between consultants and vendors in ERP implementation process and had knowledge about future directions and trends in ERP

SCHEME OF EXAMINATION: Five Questions to be set with one question from each unit carrying 20 marks each. Any three units will have an internal choice

ASSESSMENT

Continuous Internal Evaluation (CIE) includes periodic class tests, quizzes or Alternative Assessment Tools (AAT) prescribed by the faculty handling a course prior to beginning of the classes like assignments, problem solving, case studies, group discussion, seminar, mini-project etc.

Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

Both CIE and SEE have equal (50:50) weightages. The student's performance in a course shall be judged individually and together based on the results of CIE and SEE.

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

Course	OPERATIONS RESEARCH	Course Code	17IE8IEOPR
Credits	03	L-T-P-S	3-0-0-0

Prerequisites: Nil

UNIT-1

Introduction: OR definition, scope, phases, limitations, models, applications and advantages of OR **2 Hrs**

Linear programming: Definition, mathematical formulation, standard form, graphical method: feasible, infeasible, multiple solution, unbounded solution and simplex method: feasible, infeasible,multiple solution, unbounded solution, introduction to duality in LPP with simple problems **13 Hrs**

UNIT - 2

Transportation problem: Formulation of transportation model, basic feasible solution using different methods, optimal solutions, degeneracy in transportation problems, unbalanced transportation problem **7 Hrs**

Assignment problem: Formulation, balanced, unbalanced and maximization assignment problem, travelling salesman problem using Hungarian method **7 Hrs**

UNIT - 3

Queuing theory: Queuing system and their characteristics, analysis of markovian queues, M/M/1, M/M/K queuing system **7 Hrs**

UNIT - 4

Project management using network analysis: Network construction, determination of critical path and duration, floats using CPM. PERT-Estimation of project duration, Variance and crashing of projects **9Hrs**

UNIT - 5

Game theory: Two persons - zero sum game, games with and without saddle point, graphical solution, dominance property **7 Hrs**

TEXT BOOKS:

1. **Operations Research and Introduction**, Taha H A, Pearson Education, 9th Edition, 2014
2. **Introduction to Operation Research**, F K Hiller and Liberman, McGraw hill Education Pvt Ltd, 9th Edition, 2011
3. **Operations Research –Principles and practice**, Philips Ravindaran and Soleberg, Wiley Publication, 2nd Edition, 2007

REFERENCE BOOKS:

1.Operations Research, S D Sharma, Kedar Nath, RamNath Publication, 2014
2.Operations Research,Kanthiswarup and others, Sultan Chand and sons, 2014
3.Operations Research Problems and Solutions, J K Sharma, McMillan Publishers, 3rd Edition, 2009.
4.Operations Research, P K Gupta and Hira, S Chand Publications, 2007

ONLINE REFERENCE: www.nptel.ac.in

COURSE OUTCOMES

CO1	To be able to understand the fundamental concept and approach of linear programming appropriate to the further study of operations research and identify problems in real life
CO2	To be able to recognize and optimize the transportation and assignment problems
CO3	To be able to recognize and solve Queuing theory problems
CO4	To be able to use network planning procedures for solving logistics problems
CO5	To be able to recognize and solve Game theory problems

SCHEME OF EXAMINATION: Each question from each unit and internal choice from unit-1 and unit-2

ASSESSMENT

Continuous Internal Evaluation (CIE) includes periodic class tests, quizzes or Alternative Assessment Tools (AAT) prescribed by the faculty handling a course prior to beginning of the classes like assignments, problem solving, case studies, group discussion, seminar, mini-project etc.

Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

Both CIE and SEE have equal (50:50) weightages. The student's performance in a course shall be judged individually and together based on the results of CIE and SEE.

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

Course	ADVANCED OPERATIONS RESEARCH	Course Code	17IE8IEAOR
Credits	03	L-T-P-S	3-0-0-0

Prerequisites: Nil

UNIT – I

ADVANCED LINEAR PROGRAMMING: Two phase simplex techniques, Revised simplex techniques. Sensitivity analysis **8 Hrs**

UNIT – II

INTEGER PROGRAMMING: Gomorey's Algorithm and Branch & Board Technique **6Hrs**

GOAL PROGRAMMING: Introduction and simple Problem formulation. **2Hrs**

UNIT – III

QUEING THEORY: Introduction to queuing theory, characteristics of queues, Kendall & Lee notations for queue system, problems on M/M/C , M/G/1 M/Ek/1, M/D/1 **7 Hrs**

UNIT - IV

DYNAMIC PROGRAMMING: Characteristics and DP model, Computational procedure (no problem solving, only formulation) **4Hrs**

ADVANCED CPM TECHNIQUES: Advanced CPM Techniques: Resource leveling network techniques, scheduling activities to level the demands on key resources, time cost of trade off aspects in network techniques. Determination of least cost schedule. **6Hrs**

UNIT - V

MARKOV CHAINS: Discrete Stochastic Process, Markovian process, Stationary Markovchains, Markov diagrams, Ergodic and Absorbing Markov chains, Steady State probabilities, stochastic matrix, transition m, matrix and their applications. **4Hrs**

OR IN PRACTICE: A SOFT APPROACH

Soft O.R./Problem Structuring Methods, Strategic Options Development Analysis (SODA), Soft Systems Methodology (SSM) **2 Hrs**

TEXTS BOOKS:

1. **Operation Research an Introduction**, Hamdy A Taha, Pearson Education; 9 edition (2014), ISBN-13: 978-9332518223.
2. **Introduction to Operations Research**. Frederick K. Hiller and others, McGraw Hill Education India Private Limited; 9 edition (2011), ISBN-13: 978-0071333467.

3. **Operations Research: Principles and Practice**, Ravindran and others, Wiley; Second edition (2007), ISBN-13: 978-8126512560
4. **Introduction to Optimization techniques (Operations Research),**Pant J.C. -, Jain Brothers, 6th ed., (2005)

REFERENCES BOOKS:

1. **Operation Research**, Sesieni Yaspan and Freidan –Wiley International
   Introduction to OR, Ackoff Arnoff — Wiley International
2. **Principles of Operation Research** :**With Applications to Managerial Decisions**, .Wagner –Prentice Hall , ISBN –0-87692-162-4

ONLINE REFRENCE:

1. http://nptel.ac.in/courses/117103017/
2. http://people.brunel.ac.uk/~mastjjb/jeb/or/contents.html

COURSE OUTCOMES:

CO1	**Formulation** of mathematical models for real life situations like manufacturing, distribution of goods and services economics, and projects etc.
CO2	**Apply** the concept of various methods and its extensions to single and multi-objective functions
CO3	**Solve** the problem of operations research models with Profit maximization / cost (time) minimization.
CO4	**Convert** and **solve** the practical situations into integer programming, non-linear programming problem etc.
CO5	**Identify & Prediction** of the resources required for a project and to determine brand switching pattern, waiting time of customers and servers and also to generate a plan and work schedule.

SCHEME OF EXAMINATION:

Each question from each unit and internal choice from Unit 1&Unit 4

ASSESSMENT

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Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

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B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

Course	MARKETING MANAGEMENT	Course Code	17IE8IEMM
Credits	03	L-T-P-S	3-0-0-0

Prerequisites: Nil

UNIT - 1

INTRODUCTION: Historical development of marketing management, Definition of Marketing, Marketing Management philosophies, Micro and Macro Environment, importance of marketing in the India Socio – economic system.

MARKETING INFORMATION SYSTEMS AND RESEARCH: Components, benefits & uses, marketing research procedure, measurement of market demand. Types of markets, Marketing Vs. MIS, Marketing Mix **10 Hrs**

UNIT - 2

CONSUMER MARKETS AND BUYING BEHAVIOUR: Characteristics affecting Consumer behaviour, Types of buying decisions, buying decision process, Classification of consumer products, Market Segmentation. Marketing of Industrial products.

PRODUCT PLANNING AND DEVELOPMENT: The concept of a product, features of a product, classification of products, product policies – product planning and development, product line, product mix – factors influencing change in product mix, product mix strategies, meaning of New – product; major stages in new – product development, product life cycle.

10 Hrs

UNIT - 3

BRANDING: Branding, Reasons .0for branding, functions of branding, features and types of brands, kinds of brand name.

LABELLING: Types, functions, advantages and disadvantages

PACKAGING: Meaning, growth of packaging, function of packaging, kinds of packaging.

6 Hrs

UNIT - 4

ADVERTISING AND SALES PROMOTION: Objectives of advertisement function of advertising, classification of advertisement copy, advertisement media – Ethical Code, kinds of media, advantages of advertising, Advt. Standards Council of India – Role and Responsibilities. Objectives of sales promotion, advantages of sales promotion. **7 Hrs**

UNIT-5

PERSONAL SELLING: Objectives of personal selling, establishing the Sales force objectives, sales force strategy, sales force structure and size, salesmanship, qualities of good salesman, types of salesman.

PRICING : Problems in Pricing, methods in pricing.

 Typical Case Studies – Examples from MNCs and Indian Companies penalized for wrong promotion methods. **7 Hrs**

TEXT BOOKS:

1. **Modern Marketing – Principles and Practices –** RSN Pillai&Bhagavathi – S.Chand and Co. Ltd, New Delhi.,2001
2. **Marketing Management – Planning, Implementation and Control** – The Indian Context - V S Ramaswamy, S Namakumari, Mac Millan India Ltd, 1990.
3. **Principles of Marketing** - Philip Kotler& K Gary Amstrong , Prentice – Hall. 11th Edn., 2008
4. **Marketing Management** - Philip Kotler , Prentice – Hall. 12th Edn.2009.
5. **Marketing Management** - Michael R Czinkota, , 2nd Edition, Vikas Publishing House.

REFERENCE BOOKS:

1. **Marketing Management** – ICFAI Centre for Management Research, Hyderabad., 1st Edition, 2004,
2. **Fundamentals of Marketing -**Wiliam J Stanton, McGraw Hill, 1994
3. **Marketing Management**–Russel, S Winar, Pearson education series, 3rd Edition,2009
4. **Marketing Management Text &Cases,** Rajagopal - Vias Publishing House, 2006

COURSE OUTCOMES

CO1	Learn Marketing as an important function to accomplish the ultimate interest of any organization, its evolution, various aspects connected with it and also modern marketing approaches
CO2	Be exposed to consumer behavior, marketing systems and stages of buying processes which gives confidence for him/her to excel in the field
CO3	Provided with knowledge of MIS and the research work done in the field and also marketing of industrial and consumer goods, the challenges faced
CO4	Be given the knowledge of product, its development, growth, maturity and decline i.e. product development life cycle, role of branding, packaging and labeling to make him/her good marketer
CO5	Be exposed to the role of pricing, pricing mechanisms, rationality and irrationality of pricing and strategies and decision making.
CO6	Understand marketing channels and movement of products and services and its physical distribution. This knowledge will make the student an effective marketer in future.

SCHEME OF EXMINATION: One question from each unit and choice from unit 1 and unit 2

ASSESSMENT

Continuous Internal Evaluation (CIE) includes periodic class tests, quizzes or Alternative Assessment Tools (AAT) prescribed by the faculty handling a course prior to beginning of the classes like assignments, problem solving, case studies, group discussion, seminar, mini-project etc.

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B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

Course	MANAGEMENT AND ENTREPRENEURSHIP	Course Code	17IE8IEMAE
Credits	03	L-T-P-S	3-0-0-0

PRE-REQUISITES : NIL

UNIT- 1

MANAGEMENT : Introduction- Historical evolution of management, Thought and its Development, Scope and Functional areas of management, Management as a science, art of profession Management and Administration Roles of Management, Levels of Management, functions of Management **08 Hrs.**

UNIT- 2

PLANNING AND ORGANIZING: Nature, importance and purpose of planning process Objectives Types of plans Importance of planning steps in planning and planning premises Hierarchy of plans.

Introduction of organization-Principles of organization Types of organization, centralization Vs decentralization of authority and responsibility Span of control, MBO and MBE. **08 Hrs.**

UNIT- 3

STAFFING, DIRECTING & CONTROLLING: Purpose and importance of staffing-selection process and recruitment, appraisal, Meaning and purpose of Directing Leadership styles, motivation theories, communication and Coordination. Techniques of Co-ordination, Meaning and steps in controlling- essentials of a sound control system-methods of establishing control **08 Hrs.**

UNIT- 4

ENTREPRENEURSHIP: Meaning of Entrepreneur, evolution of the concept, functions of an entrepreneur, types of an entrepreneur, Concept of Entrepreneurship, stages in entrepreneurial process; role of entrepreneurs in economic development, Entrepreneurship in India, barriers for entrepreneurship. **04Hrs.**

SMALL SCALE INDUSTRIES : Definition, characteristics; scope and role of SSI in economic development, advantages of SSI, steps to start and SSI changes in government policy towards SSI in the past 4 decades, Impact of Liberalization, Privatization, Globalization on SSI, Effect of WTO/GATT on SSI, Ancillary industry and tiny industry **04Hrs.**

UNIT- 5

INSTITUTIONAL SUPPORT : Government agencies supporting industrial activities, schemes; TECKSOK, KIADB, KSSIDC, KSIMC,DIC Single window agency, SISI; NSIC, SIDBI, KSFC.-Industrial Finance **04Hrs.**

PREPARATION OF PROJECT: Meaning of project; Project identification; Project selection; project report; need and significance of report; Contents: Network analysis; Errors of Project report: project appraisal, identification of business opportunities; Market Feasibility study technical feasibility study, financial feasibility study and social feasibility study. **04Hrs.**

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

TEXT BOOKS:

1. "Management and Entrepreneurship"- NVR Naidu& T. Krishna Rao, I K Publishing
2. "Dynamics of Entrepreneurial Development & Management"- Vasant Desai, Himalaya Publishing House.
3. "Entrepreneurship Development",-Poornima M. Charantimath, Small Business Enterprises Pearson Education 2006 (For Unit-2 & 4).

REFERENCE BOOKS:

1. "Essentials of Management",- Harold Koontz, Heinz Weihrich, Ramachandra Aryasri, Tata McGraw Hill, 2010.
2. "Principles of Management", P.C.Tripathi, P.N.Reddy Tata McGraw Hill.
3. "Management Fundamentals Concepts, Application, Skill Development"- Roberts Lusier Thomson
4. "Entrepreneurship Development",- S. S. Khanka S. Chand & Co.
5. "Management",- Stephen Robbins Pearson Education/PHI 17th Edition, 2003.

ONLINE REFERENCE: http://nptel.ac.in/courses.php

MOOCS

1) https://www.class-central.com/subject/

Scheme of Examination: There will be 7 Question to be set one question from each unit and choice from unit 4 and unit 5.

COURSE OUTCOMES :

CO 1	Able to identify the role that statistics in engineering problem-solving process and know methods that engineers use to collect data for making decisions
CO 2	Able to Construct and interpret visual data displays and understand how these graphical techniques are useful in uncovering and summarizing patterns in data.
CO 3	Able to determine probabilities for discrete random variables from probability mass functions and for continuous random variables.
CO 4	Able to perform hypothesis tests and construct confidence intervals on the mean, variance and population proportion of a normal distribution.
CO 5	Able to Use linear or multiple linear regressions for building empirical models of engineering and scientific data and use it to estimate a mean or to make a prediction of a future observation.
CO 6	Able to Design and conduct engineering experiments involving several factors using the factorial design approach and know how ANOVA is used to analyze and interpret main effects and interactions.

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

ASSESSMENT:

Continuous Internal Evaluation (CIE) includes mid-term tests, weekly/fortnightly class test, homework assignments, problem solving, group discussions quiz, seminar, mini-project and other Alternate Assessment Tools (AAT)prescribed by the faculty handling a course prior to beginning of the classes.

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B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

Course	PROJECT MANAGEMENT	Course Code	17IE8DCPM
Credits	03	L-T-P-S	3-0-0-0

Prerequisites: Nil

UNIT-1

Concepts of Project Management: Concept of a Project, Categories of projects, Phases of project life cycle, Roles and responsibilities of project leader, tools and techniques for project management. **6Hrs**

UNIT-2

Project Planning and Estimating: Feasibility report phased Planning, Project planning steps, Objectives and goals of the project, preparation of cost estimation, and evaluation of the project profitability. **8Hrs**

UNIT-3

Organizing and Staffing the Project Team: Skills andabilities required of project manager, Authorities and responsibilities of a project manager, Project organization and types, accountability in project execution, Contracts, 3 R's of contracting, Tendering and selection of contractors, tendering procedure. 1**0Hrs**

UNIT-4

Tools & Techniques of Project Management: Bar (GANTT) chart, bar chart for combined activities, logic diagrams and networks, Project evaluation and review technique and Critical path method planning, Project cost analysis. **10Hrs**

UNIT-5

Performance Measures in Project Management: Performance indicators. Project audit and closure: Project audits, Guidelines for conducting a project audit, steps in project audit. Project closure: conditions for project closure, closure decision, project closure process, evaluation of team, team members, and project manager. **6Hrs**

TEXT BOOKS:

1. **Project Management**,ChaudhryS.TataMcGraw hill, ISBN-13:978-0-07-460068-9
2. **Project Management a System approach to Planning Scheduling & Controlling**, Harold Kerzner, CBS Publishers and Distributors.
3. **Project Management** – Clifford F. Gray, Eric W. Larson, Gautam V. Desai. Tata-McGraw Hill

REFERENCE BOOKS:

1. **Project Management** - Beningston Lawrence-McGraw Hill-1970.
2. **PERT & CPM** - L.S. Srinath, Affiliated East West Press Pvl. Ltd.

3. **A Management Guide to PERT and CPM,** WEIST &LEVY,Eastern Economy of PHI
4. **Project Management with PERT and CPM,**ModerJosepand Phillipscerel R., 2nd edition, New York VAN Nostrand, Reinhold- 1976
5. **Project Planning analysis selection implementation & review** - Prasanna Chandra, ISBNO-07-462049-5..
6. **Project planning, Scheduling & control**, James P. Lewis, Meo Publishing Company.
7. **Bhavesh M Patel, Project Management**, Vikas Publishing House ISBN 81-259-0777-7 2002.
8. **Successful Project management**,Jack Gido, James P Clements**,** Vikas Publishing House, ISBN 981-243-137-3

ONLINE REFERENCE:
www.nptel.ac.in

COURSE OUTCOMES

CO1	Is able to understand the concept of a project, categories of projects, roles and responsibilities of a Project leader.
CO2	Is able to learn how to plan and estimate a project, project planning steps, preparation of cost estimation, project Profitability
CO3	Is able to empathize about different types of organization, staffing, authorities and responsibilities of a project Manager, project execution, tenders and contracts in a project
CO4	Is able to understand about project work evaluation techniques, time frame of completing a project.
CO5	Is able to learn about the how to assess the performance in a project, performance indicators, project Management and environment, to perform project audit and evaluation of team members.

SCHEME OF EXAMINATION: To set one question from units **1, 2** & **5** and two questions from units **3** and **4**.

ASSESSMENT
Continuous Internal Evaluation (CIE) includes periodic class tests, quizzes or Alternative Assessment Tools (AAT) prescribed by the faculty handling a course prior to beginning of the classes like assignments, problem solving, case studies, group discussion, seminar, mini-project etc.

Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

Both CIE and SEE have equal (50:50) weightages. The student's performance in a course shall be judged individually and together based on the results of CIE and SEE.

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

HSS ELECTIVE COURSE

Course Title	APPLIED PSYCHOLOGY FOR ENGINEERS		
Course Code	17IE8DEAPE	L-T-P-S	2-0-0-0

PRE-REQUISITES: NIL

UNIT- 1

INTRODUCTION TO PSYCHOLOGY AND HUMAN FACTORS: Definition and goals, Role of psychology in the society, Perspectives, Research and methods **05Hrs.**

UNIT - 2

PERSONALITY: Definition and types, Approaches, Assessment and Application, Stress and conflicts: Causes and factors, Dealing with stress, Improving self-efficacy **05Hrs.**

UNIT -3

ERGONOMICS AND PSYCHOLOGY: Introduction to human factors and ergonomics, Factors affecting consumer behavior and work place designing: Perception: Visual- graphs and coding, lighting and illumination, Noise and its effects, Climate and its effects, Movement and its effects: Memory, Mental workload, Culture & Social Norms Measurement and application **07Hrs.**

UNIT - 4

APPLICATION OF PSYCHOLOGY IN WORKING ENVIRONMENT: Selection and training, IT and its psychological impact, Psychological counseling, Psychology in organizations **03Hrs.**

UNIT - 5

HUMAN ERROR AND ACCIDENTS: Human error, Human error and accidents & Warnings, Perception and automobile accidents **04Hrs.**

REFERENCES:

TEXT BOOKS:

1. **Introduction to Psychology**, Morgan, C.T, King, R.A., Weisz, J.R., and Schopler,J, 24th Reprint, New Delhi: Tata McGraw-Hill, 7th edition, 2004
2. **Human factors in Engineering and Designs**, Sanders &McCormick, McGraw Hill .Inc. 7th Edition

REFERENCE BOOKS:

1. **Psychology and Work today**, Schultz D. P., & Schultz, E. S. New York : Mac Milan publishing company. 2008.
2. **Industrial Psychology** Singh N. Delhi, India: Tata McGraw hill Education private limited, 2011.

COURSE OBJECTIVES: The students will be able to:

CO1	Understand bases of human behavior and appreciate and understand the immediate society and environment
CO2	Apply the principles of psychology in Engineering processes
CO3	Understand self and others for further learning and adjustment in personal and occupational environment
CO4	Enabled in understanding and handling stress
CO5	Introduced to psychological testing and analysis used in profiling and recruitment
CO6	Enable students to use psychological knowledge, skills and values in occupational pursuits in a variety of settings that meet personal goals and societal needs.

SCHEME OF EXAMINATION: Five Questions to be set with one question from each unit carrying 20 marks each. Internal choice questions from Unit-2 and Unit -3

ONLINE RESOURCES:
https://www.coursera.org/course/intropsych(Coursera – Introduction to Psychology from the
University of Toronto)
https://www.coursera.org/learn/human-computer-interaction(Coursera - Human-Centered Design: an Introduction)

ASSESSMENT:

Continuous Internal Evaluation (CIE) includes mid-term tests, weekly/fortnightly class test, homework assignments, problem solving, group discussions quiz, seminar, mini-project and other Alternate Assessment Tools (AAT) prescribed by the faculty handling a course prior to beginning of the classes.
Semester End Examination (SEE)-a written examination for theory courses and practical/ design examination with built-in oral part (Viva Voice).
Both CIE and SEE have equal (50:50) weightages. The student's performance in a course shall be judged individually and together based on the results of CIE and SEE.

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT
SCHEME FOR THE ACADEMIC YEAR 2017-18
VII SEMESTER B.E. INDUSTRIAL ENGINEERING AND MANAGEMENT

Course Code										Course Title	Teaching Department	Credits					Contact Hrs/Wk
												L	T	P	S	Total	
1	7	I	E	7	D	C	E	R	P	ENTERPRISE RESOURCE PLANNING	IEM	3	0	1	2	6	5
1	7	I	E	7	D	C	T	Q	M	TOTAL QUALITY MANAGEMENT	IEM	3	0	0	0	3	3
1	7	I	E	7	D	E				ELECTIVE –IV	IEM	3	0	0	0	3	3
1	7	I	E	7	D	E				ELECTIVE-V	IEM	2	1	0	0	3	3
1	7	I	E	7	D	E				ELECTIVE –VI	IEM	3	0	0	0	3	3
1	7	I	E	7	I	E				INSTITUTION ELECTIVE- I	IEM	3	0	0	0	3	3
1	7	I	E	7	D	C	P	W	I	PROJECT WORK-PHASE- I	IEM	1	0	1	2	4	3
										Total		18	1	2	4	25	23

L-Lecture Hours/Week, 1 Credit=1hour, P -Practical Hours/Week, 1 Credit=2Hours, T- Tutorial Lecture Hours/Week, 1Credit =1 hour, S-Self-Study to be added to contact Hrs. / Week, CIE-Continuous Internal Evaluation, SEE-Semester End Examination (of 3 hours duration)

ELECTIVE-IV

17IE7DEDFM	Design for Manufacturability
17IE7DEIDE	Industrial Design & Ergonomics
17IE7DESMD	System Dynamics
17IE7DENCM	Non-Conventional Machining

ELECTIVE – V

17IE7DECOO	Combinatorial Optimization
17IE7DEAIE	Artificial Intelligence & Expert Systems
17IE7DETOC	Theory of Constraints
17IE7DEIEX	Industrial Experimentation

ELECTIVE-VI

17IE7DELNM	Lean Manufacturing
17IE7DEMIS	Management Information System
17IE7DEHRM	Human Resource Management
17IE7DERLE	Reliability Engineering

INSTITUTIONAL ELECTIVE-I

17IE7IEDBM	Data Base Management System
17IE7IEHRM	Human Resource Management
16MD7IE1OR	Operations Research
17IE7IEPDD	Product Design & Development
17IE7IEAIM	Automation in Manufacturing
17IE7IESS	Six Sigma
17IE7IESMA	Simulation Modelling and Analysis

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

Course	ENTERPRISE RESOURCE PLANNING	Course Code	17IE7DCERP
Credits	06	L-T-P-S	3-0-1-2

Prerequisites: Nil.

UNIT - 1

INTRODUCTION TO ERP:
Introduction, Evolution of ERP, What is ERP?, Reasons for the growth of the ERP market, the advantages of ERP, Why do Many ERP Implementations Fail? Why are ERP packages being used now?
ENTERPRISE AN OVERVIEW: Introduction, Integrated Management Information, Business modeling, Integrated Data Model. **6Hrs**

UNIT - 2

ERP AND RELATED TECHNOLOGIES: Introduction, Business Process Reengineering, Management Information System, Decision Support System, Executive Information Systems, Data Warehousing, Data Mining, On-line Analytical Processing, Supply Chain Management. **6Hrs**
ERP- MANUFACTURING PERSPECTIVE: Introduction, ERP.CAD/CAM, Materials Requirements Planning, Bill of Material, Closed Loop MRP.Manufacturing Resource Planning, Distribution Requirements Planning. **6Hrs**

UNIT - 3

KANBAN: JIT and Kanban, Product Data Management, Benefits of PDM, Make-to-order, and Make-to Stock, Assemble to order, Engineer to order, Configure-to order.
ERP MODULES: Introduction, Finance, Plant Maintenance, Quality Management, Materials Management. **6Hrs**

UNIT – 4

BENEFITS OF ERP: Introduction, Reduction of Lead time, On-time shipment, Reduction in Cycle Time, Improved Resource Utilization, Better Customer Satisfaction, Improved Suppler Performance, Increased Flexibility, Reduced Quality Costs, Improved Information Accuracy and Decision making capability. **6Hrs**

UNIT – 5

ERP IMPLEMENTATION LIFE CYCLE: Pre-evaluations Screening, Package Evaluation, Project Planning Phase, Gap Analysis, Reengineering, Configuration, Implementation of Team Training, Testing, Going Live, End user Training, Post implementation **Vendor, Consultants and Users:** Introduction, In-house implementation Pros and Cons, Vendors, Consultants, End-users.

FUTURE DIRECTION IN ERP: Introductions, New Markets, New Channels, Faster Implementation Methodologies, Business models and BAPIs, Convergence on Windows NT, Application Platforms, New business segments, web enabling, market snapshot **10 Hrs**

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DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT
UNIT 6

LABORATORY EXPERIMENTS:

1. Process of customer orders under seasonal
2. Processing of unseasonable customer with blanket orders.
3. Generating Bill of Materials for Various Engineering Designs
4. Creating Item Master for various Engineering Designs
5. Performing inventory transactions
6. Conduction of Vendor Evaluation/Rating exercise
7. MRP - II Generating of Various reports for confirmed orders
8. Processing MRP for seasonal and parametric runs
9. Creating Purchase order for Items
10. Creating Work order for Items
11. Creating Quotation process for Items
12. Creating Payment reconciliation.

ERP- ASSESSMENT OF SELF STUDY:

Student group of 5 members will submit assignments in ERP at the end of the course featuring the extension of current learning in the course. The faculty shall suggest/assign various tasks to enhance curiosity and learning under the following topics (not limited to)

1. Developing technical documents concerning the ERP process
2. Executing Case studies in industry related activities
3. Modeling a system process for ERP
4. Identify critical success factors for effective implementation
5. Any other interesting topics featuring current and relevant technologies

TEXT BOOKS:

1. **Enterprise Resource Planning,** -Alexis Leon, Tata Mc Graw Hill Publishing Company Ltd., 1999,
2. **Manufacturing Planning and Control Systems,** Thomas E. Vollmann, William L. Berry, D. Clay Why bark Irwin/McGraw-Hill, - Technology & Engineering, 1997

REFERENCE BOOKS:

1. **ERP: Making It Happen: The Implementers',** Guide to Success with Enterprise Resource Planning by Thomas F. Wallace, Michael H. Kremzar Wiley, 2002
2. **Concepts in Enterprise Resource Planning,** Ellen Monk, Bret Wagner Cengage Learning, 4th EditionInc USA, 2012
3. **Production and Operations Management**: **Manufacturing and Services**, Richard B. Chase, Nicholas J. Aquilano, F. Robert Jacbos, Irwin Professional Publishing, 8th Edition, 1998
4. **A Guide to ERP Benefits, Implementation and Trends,** Prof LinekeSneller RC Book boon

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COURSE OUTCOMES

CO1	Have understood business functions and business processes, concepts of ERP, importance of ERP, benefits and risk factors of ERP implementation
CO2	Able to establish relationship between ERP and other technologies
CO3	Known about the functional modules of ERP software
CO4	Understood the basics of ERP implementation, Package selection, transition strategies, implementation process
CO5	Able to differentiate between consultants and vendors in ERP implementation process and had knowledge about future directions and trends in ERP

SCHEME OF EXAMINATION: Five Questions to be set with one question from each unit carrying 20 marks each. Any three units will have an internal choice

Question Paper: One Question to be set from each unit and Two Questions will be set from the unit 2& 5. Student will answer any 5 questions selecting at least one from each unit.

ASSESSMENT

Continuous Internal Evaluation (CIE) includes periodic class tests, quizzes or Alternative Assessment Tools (AAT) prescribed by the faculty handling a course prior to beginning of the classes like assignments, problem solving, case studies, group discussion, seminar, mini-project etc.

Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

Both CIE and SEE have equal (50:50) weightages. The student's performance in a course shall be judged individually and together based on the results of CIE and SEE.

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DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

Course	TOTAL QUALITY MANAGEMENT	Course Code	17IE7DCTQM
Credits	03	L-T-P-S	3-0-0-0

Prerequisites: Nil

UNIT - 1

Introduction: BUSINESS EVOLUTION

The Evolution of the Customer Satisfaction Concept: Evolution of Customer Satisfaction Methods, Evolution of Company Integration, Continuing Evolution.

Survival in a Rapidly Changing World: Practice Systematic Development of Skill, Treat Management as a Coherent System, Focus on People and Their Purposes, Integrate Best Practices, Financial Benefit

Developing a Unique Organizational Capability: Four Practical Revolutions in Management, Evolution of our Understanding, Four Levels of Practice

The First Revolution: CUSTOMER FOCUS

Change in the Work Concept: Market-in, Customers, Philosophy-in and Philosophy-out Evolution of Customer Focus and Its Challenges: Three Stages of Customer Focus, Customer Concerns, Integration of Concerns, Individualizing Customers **7 Hrs**

UNIT –2

The Second Revolution: CONTINUOUS IMPROVEMENT

Improvement as a Problem-Solving Process: Management by Process, WV Model of Continuous Improvement, Continuous Improvement of Processes for All Types of Work, Continuous Improvement and the Scientific Method

MANAGING EXISTING PROCESSES

Process Discovery and Management: Thinking In Terms of Process, Process Discovery

Process Control and Variation: A Typical Example of (Mishandling) Variation, Making the Most of Variation, Process Control and Process Improvement

Reactive Improvement and the 7 Steps Method ; Identifying the Problem , Standard Steps and Tools The 7 Steps: A Case Study , The 7 QC Tools

Management Diagnosis of the 7 Steps of Reactive Improvement: General Guidelines for Managers

Diagnosing a QI Story , Step-by-Step Guidelines for Managers Diagnosing a QI Story , Case Study for Diagnosis of the 7 Steps, Run PDCA and Develop Skill

Process Management Mobilization Case Study: Introduction to the Teradyne Mobilization story

Introduction of the 7 Steps, Experience Using the 7 Steps, Improving Mobilization, Process Discovery and Process Control

Planning Projects or Tasks: The 9 Steps Compared with the 7 Steps, The 9 Steps Mobilization at Teradyne,A Teradyne Illustration of the 9 Steps Use, Relationship of the 9 Steps to Other Methods **9Hrs**

UNIT – 3

PROACTIVE IMPROVEMENT: Collecting Data for Proactive Improvement, Language Data and Use of Semantics, Toward Standard Tools and Steps for Proactive Improvement, Customer Visitation as a Method of Collecting Proactive Improvement Data

Applying Proactive Improvement to Develop New Products; Develop Understanding of Customers' Needs and Environment, Convert Understanding into Requirements, Operationally Define Requirements for Downstream Development, Generating Concepts and Selecting the Concept, Expanding View of WV Model and Proactive Improvement **7Hrs**

UNIT -4

The Third Revolution: TOTAL PARTICIPATION

Engagement and Alignment of Organization Members: Engaged Employees for a Rapidly Changing World, Explicit Joining of Improvement and Routine Work , Processes and People, Coordinating Behavior; Societal Networking Case Study of the CQM Study Group on Conversation, Expansion of the Principles of Semantics, Some Types and Models of Conversations
Leading Change: Technical Skill, Human Skill, Conceptual Skill

Self-Development: Lessons from the Non-business World, Local Improvement in Absence of a Supportive Environment, The Bottom Line

Team Skill Development: Teamwork Skill, Some Fundamentals, Some Types of Teams substantially, Models for Team Development

Initiation Strategies; CEO Involvement, Case Study: Teradyne Strategy for Introduction

Infrastructure for Mobilization: Create Explicit Structures for Mobilization, A General Model for Mobilization: The 7 Infrastructures
Phase-In: Orientation Phase, Empowerment Phase, Alignment Phase, Evolution of the Parallel

Organization, Common Patterns of Phase-In
U.S. Focused Strategies for Phase-In: Benchmarking, Six Sigma, Cycle-Time Reduction
9Hrs

UNIT –5

Hoshin Management: Hoshin Management and Its Parts, Management by Objectives and Conventional Business Planning, Hoshin Management at Analog Devices
Leading Process Improvement: Modeling Personal Improvement, Employee Development at NIMS,

Company Strategies, Individual Practice of CAPD by Managers' case studies
The Practice of Breakthrough; Process versus Business Breakthrough, Case Studies and a Model of Business Breakthrough, Biggest Obstacle to Business Breakthrough, Integration of Ideas

The Fourth Revolution: SOCIETAL NETWORKING

Networking and Societal Diffusion: Regional and National Networking The Japanese Model, Taking a Lesson from Japan—CQM, Comparison of National Methods, Use of Indirect Influence
Ongoing Integration of Methods: Applying Idealized Design to Hoshin Management, Structural Process Improvement Case Study SerVend Case Study **7Hrs**

TEXT BOOK:

1. **Four Practical Revolutions in Management: systems for creating unique organizational capability** -Shoji Shiba and David Walden,– Productivity Press & Center for Quality Management, (USA) , 2001, ISBN-9781563273889

REFERENCE BOOKS:

1. **Management for Total Quality** -N Logothetis- Prentice Hall of India, New Delhi, 2003, ISBN-81-203-1137-X

2. **Total Quality Management**- Besterfield, Pearson Education, 2011. ISBN, 817758412X, 9788177584127.

ONLINE LINKS:
1. http://nptel.ac.in/syllabus/110101010/

SCHEME OF EXAMINATION: Five questions choosing one each from each unit and Unit 2 and 3 with choice questions

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COURSE OUTCOMES: The students,

CO1	Ability to understand the quality concepts and the practical evolution in management, revolution in total quality management
CO2	Ability to analyze the TQM related cases
CO3	Diagnose problems in the quality improvement process
CO4	Apply the quality tools and methods in the manufacturing and service processes
CO5	Ability to make an effective oral presentation on the cases analyzed

ASSESSMENT

Continuous Internal Evaluation (CIE) includes periodic class tests, quizzes or Alternative Assessment Tools (AAT) prescribed by the faculty handling a course prior to beginning of the classes like assignments, problem solving, case studies, group discussion, seminar, mini-project etc.

Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

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B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT
ELECTIVE-IV

Course	DESIGN FOR MANUFACTURABILITY	Course Code	17IE7DEDFM
Credits	03	L-T-P-S	3-0-0-0

Prerequisites: Nil

UNIT-1

MATERIAL AND PROCESS SELECTION – Introduction, Advantages of applying DFMA, General requirements of early materials and process selection, Selection of Manufacturing processes, Process capabilities, Selection of materials, Primary process/ materials selection, Systematic selection of processes and materials. 6**Hrs**

UNIT-2

ENGINEERING DESIGN FEATURES. – Dimensioning, Tolerances, General Tolerance, Geometric Tolerances, Assembly limits, achieving larger machining tolerances.Screw threads, Ground surfaces, holes. Examples

Datum features – Functional datum, machining sequence, manufacturing datum, changing the datum. Examples **6 Hrs**

UNIT-3

COMPONENT DESIGN – MACHINING CONSIDERATIONS – Drills, Milling cutters, Drilling, Keyways, Dowels, Screws, Reduction in machining areas, Simplification by separation and amalgamation, work piece holding, surface grinding, Component surface design,Examples.

COMPONENT DESIGN – CASTING CONSIDERATIONS – Pattern, Mould, parting line, cast holes, machined holes, identifying parting line, special sand cores, designing to obviate sand cores, Examples **10Hrs**

UNIT-4

DESIGN FOR INJECTION MOLDING AND SHEET METAL WORKING – Injection molding materials, Molding cycle, Systems, molds, machine size, cycle time, Cost estimation, Insert molding, Design guidelines, Introduction to sheet metalworking, Dedicated Dies and Press working, Press selections, Design Rules,Over Molding,Design of Undercuts,Collapsible cores.

DESIGN FOR DIE CASTING AND POWDER METAL PROCESSING – Die casting alloys, cycle, machines, dies, finishing, Assembly techniques, Design principles, Powder metallurgy processing, stages, compaction characteristics, Tooling, Sintering, Design guidelines,Surface definition,Example **10 Hrs**

UNIT-5

GEOMETRIC TOLERANCE – Symbols, Three datum concept of dimensioning, Straightness, concentricity, Run-out, Location Tolerance, Assembly of parts having concentric cylinders, Control of feature location by true position, Body of revolution, Roundness, Profile dimensioning, Tapers, Shaft of two diameters. Examples. **8Hrs**

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DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

TEXT BOOKS:

1. **Designing for Manufacturing** - Harry Peck, Pitman Publications, 1983.ISBN10-0273000071
2. **Machine Design** - Dieter ,McGraw hill Publications for topic 1.Metrology - R.K. Jain Khanna, Publication for topic 6.
3. **Product design for manufacture and assembly** - Geoffrey Booth Royd, peter Dewhurst, Winston Knight, Mercel Dekker. Inc. New York, CRC press, Taylor and Francis group, 2011
   ISBN:-13-978142008928-8
4. **Material selection and Design**, - ASM Hand book,Vol. 20

REFERENCE BOOKS:

1. **Product Design for Manufacture and Assembly**, Geoffrey Booth Royd - Peter Dewhurst –
   Winston Knight – Marcel Dekker,Inc.– New York -Second Revision, 1994,
   ISBN 0-8247-0584-X.
2. **Designing for Manufacturing** – Harry Peck - Pitman Publications – 1983.
3. **Dimensioning and Tolerance for Quantity Production**,Merhyle F Spotts –Inc. Englewood Cliffs - New Jersey - Prentice Hall, 5th edition.Publisher Prentice Hall, 1982,
   ISBN-13:9780132146845

ONLINE REFERENCE:

http://nptel.ac.in/courses/112101005/

COURSE OUTCOMES:

CO1	To have the capability to systematically design products and/or processes to get the lowest cost, quickest response time, and best-achieved customer expectations.
CO2	Identify opportunities for design.
CO3	Address technical considerations of design and manufacturing.
CO4	Make business decisions concerning the feasibility of a design.
CO4	Utilize DFM and Concurrent Engineering Principles on a "real life" project.

SCHEME OF EXAMINATION: Scheme of Examination: Answer one question from each unit. Choice is to be given in Unit-3 and Unit-4.

ASSESSMENT

Continuous Internal Evaluation (CIE) includes periodic class tests, quizzes or Alternative Assessment Tools (AAT) prescribed by the faculty handling a course prior to beginning of the classes like assignments, problem solving, case studies, group discussion, seminar, mini-project etc.

Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

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DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

Course	INDUSTRIAL DESIGN AND ERGONOMICS	Course Code	17IE7DEIDE
Credits	03	L-T-P-S	3-0-0-0

Prerequisites: Nil

UNIT -1

INTRODUCTION: An approach to Industrial Design -elements of design structure for Industrial Design in engineering application in modern manufacturing systems. **4Hrs**

UNIT-2

ERGONOMICS AND INDUSTRIAL DESIGN: Introduction -general approach to the man- machine relationship- workstation design-working position.

Control and Displays: Shapes and sizes of various controls and displays-multiple displays and control situations -

Design of major controls in automobiles, machine tools etc., design of furniture -redesign of instruments. **10Hrs**

UNIT-3

ERGONOMICS AND PRODUCTION: Ergonomics and product design -ergonomics in automated systems- expert systems forErgonomic, design, Anthropometric data and its applications in ergonomic design- limitations of anthropometric data use of computerized database. Case study. **8Hrs**

UNIT-4

VISUAL EFFECTS OF LINE AND FORM: The mechanics of seeing- psychology of seeing general influences of line and Form.

Colour: Colour and light -colour and objects- colour and the eye -colour consistency- colour terms- reactions to Colour and colour continuation -colour on engineering equipment.

8Hrs

UNIT-5

AESTHETIC CONCEPTS: Concept of unity- concept of order with variety -concept of purpose style and environment Aesthetic expressions. Style-components of style- house style, observation style in capital goods, case study.

INDUSTRIAL DESIGN IN PRACTICE: General design -specifying design equipment-rating the importance of industrial design -industrial design in the design process.

10Hrs

TEXT BOOKS:

1. **Industrial Design for Engineers** - Mayall W.H. - London Hiffee books Ltd. -1988.
2. **Applied Ergonomics Hand Book** - Brain Shakel (Edited) - Butterworth scientific London -1988.
3. **Introduction to Ergonomics** - R. C. Bridger - McGraw Hill Publications - 1995.
4. **Human Factor Engineering** - Sanders & McCormick - McGraw Hill Publications – 6th edition, 2002.

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COURSE OUTCOMES

CO1	To understand the issues regarding Industrial design
CO2	Able to understand the human factors, system, human outcome and control
CO3	Able to apply basic knowledge of physical ergonomics such as physical load, anthropometry, biological variation and biomechanics.
CO4	Apply basic knowledge of physical factors affecting human beings in relation to lighting, sound and noise, climate and vibrations
CO5	Apply basic knowledge of cognitive ergonomics such as perception, memory, information processing, attention, learning decision-making , stress and mental workload

SCHEME OF EXAMINATION: To set one question from units **1, 2**&**4**and two questions from units 3 and **5**.

ASSESSMENT

Continuous Internal Evaluation (CIE) includes periodic class tests, quizzes or Alternative Assessment Tools (AAT) prescribed by the faculty handling a course prior to beginning of the classes like assignments, problem solving, case studies, group discussion, seminar, mini-project etc.

Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

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Course	SYSTEM DYNAMICS	Course Code	17IE7DESMD
Credits	03	L-T-P-S	3-0-0-0

Prerequisites: Nil

UNIT -1

Introduction to systems thinking, modeling and dynamic simulation, Causal loops and feedbacks, building blocks of system dynamics: stocks and levels, **8Hrs**

UNIT -2

Equations underlying the modeling, Positive and negative feedback loops, Dynamics of growth, modeling delays, co-flows & decision making, Capturing nonlinear relationships, instability and oscillation, business and supply chain models, Model validation and testing, **8 Hrs**

UNIT -3

Control theory concepts of transfer functions, time domain analysis, and state space formulation, solution of the state equation and determination of the system's response. **8Hrs**

UNIT -4

Characteristic equation and roots; Frequency-domain techniques; Stability analysis, and design of feedback regulators, controllability and observability. **8Hrs**

UNIT -5

Applications will be presented to emphasis cross-functional management issues, new product development, management of fluctuating workloads, market growth and stagnation, and project management. **8Hrs**

TEXT BOOKS:

1. **Business Dynamics: Systems Thinking and Modeling for a Complex World**, John Sterman, Irwin/McGraw-Hill (2000), ISBN-13:978-0-07-106812-3, ISBN-10:0-07-106812
2. **System Dynamics**, Palm William J III, III edition, McGraw Hill College 2009, ISBN- 0073529273, 9780073529271

REFERENCES

1. **System Dynamics: A Practical Approach for Managerial Problems**, Sushil, Wiley Eastern (1993)
2. **System Dynamics Modelling: A Practical Approach**, R.G. Coyle, Chapman & Hall/CRC (1996)
3. **System Dynamics: A Quick Introduction**, Craig W. Kirkwood, Arizona State University (1998)
4. **The Fifth Discipline**, Peter Senge Currency,2006
5. **Control Systems Engineering,** Norman Nise, 4th ed., John Wiley & Sons, 2004
6. **System Dynamics**, K. Ogata, 4th ed., Prentice Hall, 2003
7. **Digital Control,** K. Mougdalya, John Wiley & Sons, 2007

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DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

COURSE OUTCOMES

CO1	To introduce students to mathematical modeling of Dynamic Systems
CO2	To develop skills in analyzing Simulating and identifying systems based upon their I/P and O/Presponses
CO3	To introduce to design and analysis of basic feedback systems

ASSESSMENT

Continuous Internal Evaluation (CIE) includes periodic class tests, quizzes or Alternative Assessment Tools (AAT) prescribed by the faculty handling a course prior to beginning of the classes like assignments, problem solving, case studies, group discussion, seminar, mini-project etc.
Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

Both CIE and SEE have equal (50:50) weightages. The student's performance in a course shall be judged individually and together based on the results of CIE and SEE.

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

Course	NON-CONVENTIONAL MACHINING	Course Code	17IE7DENCM
Credits	03	L-T-P-S	3-0-0-0

Prerequisites: Production Technology- I

UNIT -1

INTRODUCTION: History, Classification, Comparison between conventional and nonconventional machining process selection.

MECHANICAL PROCESS: ULTRASONIC MACHINING (USM): Introduction, Equipment, tool materials & tool Size, Abrasive slurry, Effect of parameter: Effect of amplitude of frequency and vibration, Effect of grain diameter, Effect of applied static load, effect of slurry, Tool and work material, USM process Characteristics: Material removal rate, tool wears, Accuracy, surface finish, Applications, advantages& disadvantages of USM.

8Hrs

UNIT-2

ABRASIVE JET MACHINING (AJM): Introduction, Equipment, Variables in AJM: Carrier Gas, Type of abrasive, Size of abrasive grain, Velocity of the abrasive jet, Mean No. abrasive particles per unit volume of the carrier gas, Work material, Standoff Distance (SOD),Nozzle design, Shape of cut. Process characteristics Material removal rate, Nozzle wear, Accuracy & Surface finish applications, advantages & disadvantages of AJM.

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WATER JET MACHINING (WJM): Process principle, equipment, process parameters, process capabilities, applications, advantages and disadvantages, Demonstration of WJM

6Hrs

UNIT- 3

CHEMICAL MACHINING (CHM): Introduction, Elements of process, chemical blanking process: Preparation of work piece, Preparation of masters, masking with photo resists, etching for blanking, applications of chemical blanking, chemical milling (Contour machining) :- Process steps : masking, Etching, process characteristics of CHM :Material removal rate, accuracy, surface finish, Hydrogen embrittlement, Advantages &applications of CHM.

ELECTROCHEMICAL MACHINING (ECM): Introduction, classification of ECM process, Fundamental principles of ECM, Elements of ECM process: Cathode tool, Anode workpiece, source of DC power, Electrolyte, Tool-work gap, Chemistry of the ECM process, EC M-process characteristics: Material removal rate, Accuracy, Surface finish.ECM Tooling: ECM tooling techniques and examples, Tool & insulation materials, Tool size, Electrolyte flow arrangement, Handling of slug, Economics of ECM, Determination of metal removal rate, evaluation of metal removal rate of an alloy, Applications, Advantages, Limitations of ECM,

10 Hrs

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UNIT-4

EDM PROCESS: Introduction, machine, dielectric fluid, spark generator, EDM tools(Electrodes): Electrode manufacture, Electrode wear, EDM electrode holders, EDM tool design: Choice of matching operation, electrode materiel selection, machine settings,under sizing and length of electrode, Machining time. Flushing: Pressure flushing, Suction flushing, Side flushing, pulsed flushing synchronized with electrode movement, EDM process characteristic: Metal removal rate, Accuracy, surface finish, Heat affected Zone. Applications: EDM accessories applications, Electrical Discharge Grinding(EDG), Travelling wire EDM, Demonstration of wire EDM. **10Hrs**

UNIT- 5

PLASMA ARC MACHINING (PAM): Introduction, process principle, equipment, non – thermal generation of plasma, selection of gas, Mechanism of Metal removal, PAM process parameters, Process characteristics. Safety precautions, applications, advantages and limitations of PAM. **6Hrs**

TEXT BOOKS:

1.**Modern Machining Process,** Pandey and Shan, Tata McGraw Hill 2009.
2. **Production Technology,** HMT, Tata McGraw Hill 2001.

REFERENCE BOOKS:

1. **New Technology,** Bhattacharya, 2000.
2. **Unconventional Machining Process**, M K Singh, New Age Publications.2008, ISBN-13:9788122422443
3. **Thermal Metal Cutting Process**, B J Ranganath, I K International Publishing House Pvt Ltd.,2008ISBN -9788189866907
4. **Fundamentals of Machining and Machine Tools**, R K Singal, I K International Publishing House Pvt Ltd., 2010, ISBN:9788189866662

COURSE OUTCOMES

CO1	Be able to explain how nontraditional machining techniques differ from traditional machining processes and the Ultrasonic machining
CO2	Be able to describe Abrasive jet Machining and Electrochemical techniques
CO3	Be able to describe the Chemical Metal Removal Processes
CO4	Be able to describe the Electrical Discharge Machining and Plasma Arc Machining Processes

SCHEME OF EXAMINATION: One Question to be set from each unit and Two Questions to be set from the units 3& 4.

Student has to answer any 5 questions selecting at least one question from each unit.

ONLINE REFERENCE: http://nptel.ac.in/courses/112104028/

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ASSESSMENT

Continuous Internal Evaluation (CIE) includes periodic class tests, quizzes or Alternative Assessment Tools (AAT) prescribed by the faculty handling a course prior to beginning of the classes like assignments, problem solving, case studies, group discussion, seminar, mini-project etc.

Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

Both CIE and SEE have equal (50:50) weightages. The student's performance in a course shall be judged individually and together based on the results of CIE and SEE.

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

ELECTIVE-V

Course	COMBINATORIAL OPTIMIZATION	Course Code	17IE7DECOO
Credits	03	L-T-P-S	3-0-0-0

Prerequisites: Nil

UNIT-1

Classification of optimization Theory**:** Unconstrained problems-necessary and sufficient conditions, The Newton-Raphson method, Constrain problems-Equality Constraints, Inequality Constraints. **7Hrs**

UNIT-2

NP Hard and NP complete Problems: Basic Concepts, Non deterministic Algorithms, the classes NP hard and NP Complete, NP Hard Scheduling Identical processors, flow shop scheduling, job shop scheduling. Review of graphs and network, review of computational complexity **10 Hrs**

UNIT-3

Shortest Path Algorithm, Minimum Cost Network Flows, Maximum Flow Algorithm, Matching Algorithm: Travelling Salesman Problem, Postman Problems, and Machine Scheduling Problem. **10Hrs**

UNIT-4

Meta Heuristics: Iterative Improvement, Variable Neighborhood Search and GRASP Simulated Annealing: Advantages, Acceptance Function, Tabu Search **6Hrs**

UNIT-5

Genetic Algorithm: What Are Genetic Algorithm?, Robustness of Traditional Optimization and Search Methods, The Goals of Optimization, How are Genetic Algorithm different from Traditional Methods, A Simple Genetic Algorithm, Genetic Algorithm at Work- A simulation by Hand, Grist for the Search Mill- Important Similarities, Similarity Templates (Schemata) **7 Hrs**

TEXT BOOKS:

1. **Optimization Algorithms for Networks and Graphs**- Jrevans and E. Mineika, 1st Edition.
2. **Genetic Algorithm**- David E Goldberg, - Pearson Education Asia, 2nd Edition.2008, ISBN-13: 9788177588293
3. **Operation Research**- Hamdy A Taha- 7th edition, Pearson Education,2003, ISBN-9780130323743
4. **Fundamentals of Computer Algorithms**-Ellis Horowitz, Sartaz Sahani and Sanguthevar Rajasekaran- Galgotia Publications 1st Edition., 2010ISBN 10: 8175152575 / ISBN 13: 9788175152571

REFERENCE BOOKS:

1. **Operations Research**-Ravindran, Philips and Solberg, Wiley International, 2nd edition, 2007,ISBN 10: 8175152575 / ISBN 13: 9788175152571
2. **Operations research**- Hiller Leiberman- Holdenday / CBS publishers 1994 Edition.
3. **Operations research**- S. D. Sharma-Kedarnath Ramanth and Co. 2000

ONLINE REFERENCE:
http://nptel.ac.in/courses/110106059/

COURSE OUTCOMES:

CO1	Able to formulate the combinatorial optimization efficiently
CO2	Able to explain how a Combinatorial Optimization problem can be solved
CO3	Able to explain how fast a Combinatorial Optimization problem can be solved
CO4	Explain mathematical theory underlying the algorithm for combinatorial Optimization problems
CO5	Apply Evolutionary Computation Methods to find solutions to complex problems by genetic Algorithm.

ASSESSMENT

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Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

Both CIE and SEE have equal (50:50) weightages. The student's performance in a course shall be judged individually and together based on the results of CIE and SEE.

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

.Course	ARTIFICIAL INTELLEGENCE AND EXPERT SYSTEM	Course Code	17IE7DEAIE
Credits	03	L-T-P-S	3-0-0-0

Prerequisites: Nil

UNIT-1

ARTIFICIAL INTELLIGENCE: Introduction, definition, underlying, assumptions, importance of AI,AI and related fields. State space representations, defining a problem, production systems and its characteristics, search and control strategies introduction preliminary concepts, examples of search problems.

UNIFORMED OR PRELIMINARY CONCEPTS: Examples of search problems. Uniformed or blind search, informed search, OR graphs, heuristic search techniques generate and test, hill climbing, best first search, problem reduction, constraint satisfaction, means ends analysis. **8Hrs**.

UNIT-2

KNOWLEDGE REPRESENTATION ISSUES: Representations and mapping, approaches, issues inKR, types of knowledge procedural Vs declarative, logic programming, forward Vs backward reasoning, matching, non-monotonic reasoning, and its logic. **6Hrs**.

USE OF PREDICATE LOGIC : Representing simple facts, Instance and Is a relationships, syntax and semantics for propositional logic, FOPL and properties of wffs, conversion to causal form, resolution, natural deduction. **6Hrs**.

UNIT-3

STATISTICAL AND PROBABILISTIC REASONING: Symbolic reasoning under uncertainty, probability and Baye's theorem, certainty factors and rule based systems, Bayesian networks, Demster Shafer theory, fuzzy logic. **6Hrs**.

UNIT-4

EXPERT SYSTEMS : Introduction, structure and uses, representing and using domain knowledge, expert system shells, pattern recognition, introduction to recognition and classification process, learning classification patterns, recognizing and understanding speech. **6Hrs**.

UNIT- 5

INTRODUCTION TO KNOWLEDGE ACQUISITION: Types of learning, general learning model and performance measures, Typical expert systems: MYCIN variants of MYCIN, PROSPECTOR, DENDRAL, PUFF. **8Hrs**

INTRODUCTION TO MACHINE LEARNING: Perceptrons, checker playing examples, learning automata, genetic algorithm, intelligent editors. **4Hrs**.

TEXT BOOKS:

1. **Artificial Intelligence and Expert systems,** Elaine Rich and Kevin Knight, M/H, 1983.
2. **Introduction to Artificial Intelligence and Expert systems,** Dan W. Patterson, PHI,New Delhi, 1999.
3. **Artificial Intelligence in business, science and industry,** Wendry B, Ranch, Vl, II application, PHI, 1985.

REFERENCE BOOKS :

1. **A guide to expert systems** Waterman, D.A, Addison-Wesley Inc., 1986.
2. **Building expert systems** Hayes, Roth, Waterman, D.A (ed), AW, 1983.
3. **Designing expert systems** Weis, S.M. and Kulliknowske, London, Champion Hull,1984.

COURSE OUTCOMES

CO1	Be able to get an insight into fundamentals of AI and related areas
CO2	Learn applications of AI and ES in various fields such as 1.Defense, Medical Diagnostics, Surgery etc
CO3	Determine the Knowledge Representation issues, Reasoning mechanisms, Logic Programming, properties of wffs etc.
CO4	Learn logic programming basics, Reasoning under uncertainty, Baye's theorem, Bayesian Networks and other related reasoning methods
CO5	Study Expert Systems – their logic, growth and development along with applications, concept of knowledge Acquisition, working of typical ES's such as MYCIN, DENDRAL,PROSPECTOR, PUFF etc. and also Machine Learning, Genetic Algorithm

SCHEME OF EXAMINATION:
Five questions to be set with one question from each unit carrying 20 marks each. 1 and 2 units will have an internal choice

ASSESSMENT
Continuous Internal Evaluation (CIE) includes periodic class tests, quizzes or Alternative Assessment Tools (AAT) prescribed by the faculty handling a course prior to beginning of the classes like assignments, problem solving, case studies, group discussion, seminar, mini-project etc.

Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

Both CIE and SEE have equal (50:50) weightages. The student's performance in a course shall be judged individually and together based on the results of CIE and SEE.

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

Course	THEORY OF CONSTRAINTS	Course Code	17IE7DETOC
Credits	03	L-T-P-S	3-0-0-0

Prerequisites: Nil

UNIT-1

INTRODUCTION TO THEORY OF CONSTRAINTS. TOC Thinking Tools: Current Reality tree and core conflicts, conflict clouds, Negative branch reservations, prerequisite tree, categories of legitimate reservation, layers of resistance. **8Hrs**

UNIT-2

TOC APPLICATIONS IN PRODUCTION/OPERATIONS: Concept of Drum, Buffer, Rope, Simplified Drum Buffer rope, Drum Buffer rope, Use of simulator to explain DBR. **9Hrs**

UNIT-3

TOC APPLICATION IN DISTRIBUTION: Replenishment Model and case discussions. **7Hrs**

UNIT-4

TOC APPLICATIONS IN FINANCE AND MEASUREMENTS: Throughput accounting **8Hrs**

UNIT-5

TOC APPLICATIONS IN PROJECT MANAGEMENT: Critical chain and case discussion **8Hrs**

TEXT BOOKS

1. **Goldsratt's Theory of constraints**: A Systems approach to Continuous Improvement, H. William Dettmer, 1997, ISBN-087389-370-0 ,
2. **Project Management**, Chaudhry S. Tata Mc Graw hill, ISBN-13:978-0-07-460068-9

ONLINE RESOURCES
www.nptel.ac.in

SCHEME OF EXAMINATION: Unit- 1 and Unit- 2 will have internal choice.
ASSESSMENT
Continuous Internal Evaluation (CIE) includes periodic class tests, quizzes or Alternative Assessment Tools (AAT) prescribed by the faculty handling a course prior to beginning of the classes like assignments, problem solving, case studies, group discussion, seminar, mini-project etc.

Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

Course	INDUSTRIAL EXPERIMENTATION	Course Code	17IE7DEIEX
Credits	03	L-T-P-S	3-0-0-0

Prerequisites: Nil

UNIT- 1

INTRODUCTION: History of quality engineering: Japan versus U.S. track records. Taguchi Approach to Quality: Definition of quality, Loss function, Off-line and On-line quality control, Taguchi's quality philosophy. ANOVA, Test of hypothesis. **6Hrs**

UNIT - 2

BASIC DESIGNS: Completely Randomized Design, Randomized Block Design, Latin Square Designs, one way analysis of variance and two way analysis of variance.

FACTORIAL EXPERIMENTATION - TWO LEVELS: Full Factorial Designs: Experimentation as a learning process. Traditional scientific experiments, Two factor design, Four-factor design, replicating experiments, Factor interactions. Fractional factorial designs based on eight-run experiments. **12Hrs**

UNIT -3

TAGUCHI TECHNIQUES:

CONSTRUCTING ORTHOGONAL ARRAYS: Counting degrees of freedom, selecting a standard orthogonal array, dummy level technique and compound factor method, Linear graphs and interaction assignment, Modification of linear graphs, column merging method, branching design, Strategy for constructing an orthogonal array, Comparison with the classical statistical experiment design. **10Hrs**

UNIT 4

STEPS IN ROBUST DESIGN: Case study discussion, Noise factors and testing conditions, Quality characteristics and objective functions, Control factors and their levels, Matrix experiment and data analysis plan, Conducting the matrix experiment, data analysis, verification experiment and future plan. **6Hrs**

UNIT - 5

SIGNAL-TO-NOISE RATIO FOR STATIC PROBLEMS: Evaluation of sensitivity to noise, S/N ratios for Smaller-the-better, Larger-the-better, Nominal-the-best and Asymmetric Cases.

SHAININ TECHNIQUE: Introduction, salient features, case studies in sequential DOE tools to solve chronic problems. **6Hrs**

TEXTBOOKS:

1. **Quality Engineering Using Robust Design** - Madhav S. Phadke, Prentice Hall PTR, Englewood Cliffs, New Jersey 07632.
2. **Design of Experiments** - D.C. Montgomery, John Wiley and Sons, 2002.
3. **World Class Quality using DOE to make it happen**, Keki R. Bhote, American Management Association publications, 2nd Ed. 2000

REFERENCE BOOK:

1. Designing for Quality - Robert H. Lochner and Joseph E. Matar, - an Introduction Best of Taguchi and Western Methods or Statistical Experimental Design", Chapman and Hall Madras, 2nd edition.

ONLINE REFERENCE:

http://www.nptel.ac.in/syllabus/110104020/
http://www.eformacion.com.
http://www.sas.com/storefront/aux/en/spdesignanlysisjmp/66584_excerpt.pdf

COURSE OUTCOMES

CO1	To understand principles of analysis of variance, experimental designs like CRD, factorial, Taguchi and Shainin design
CO2	To select & construct the appropriate experimental design for a particular problem.
CO3	To analyze the data & interpret the experimental results

SCHEME FOR EXAMINATION: Five questions choosing one each from each unit and Unit 2 and 3 with choice questions

ASSESSMENT

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B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

ELECTIVE-VI

Course	LEAN MANUFACTURING	Course Code	17IE7DELNM
Credits	03	L-T-P-S	3-0-0-0

Prerequisites: Nil

UNIT- 1

INTRODUCTION TO LEAN MANUFACTURING:
Objectives of Lean manufacturing-key principles and implications of lean manufacturing-traditional Vs Lean manufacturing. **5Hrs**

LEAN MANUFACTURING CONCEPTS:
Value creation and waste elimination-man kinds of waste- pull production- different models of pull production- continuous flow-continuous improvement/Kaizen-worker involvement-cellular layout-administrative lean **6Hrs**

UNIT- 2

LEAN MANUFACTURING TOOLS AND METHODOLOGIES:
Standard work-communication of standard work employees- standard work and flexibility-visual control –quality at the source- 5S principles- preventive maintenance – total quality management -total productive maintenance- changeover/setup time-batch size reduction-production leveling **6Hrs**

UNIT- 3

VALUE STREAM MAPPING:
The as-is diagram-the future state map-application to the factory simulation scenario-line balancing- Poke Yoke- Kanban- Overall equipment effectiveness. **6Hrs**

UNIT- 4

JUST IN TIME MANUFACTURING:
Introduction-elements of JIT-uniform production rate-pull versus push method-Kanban system-small lot size-quick, inexpensive set-up-continuous improvement, Optimized production technology **6Hrs**

ONE PIECE FLOW: Process razing techniques-cells for assembly line- case studies. **4Hrs**

UNIT- 5

IMPLEMENTING LEAN: Road map- senior management Involvement-best practices. **4Hrs**

RECONCILING LEAN WITH OTHER SYSTEMS: Toyota production system-lean six sigma- lean and ERP-lean with ISO9001:2000 **3Hrs**

TEXT BOOKS:

1. **A Study of the Toyota Production System,** Shigeo Shingo , Andrew P. Dillon, Productivity Press,1989, ISBN 9780915299-17-8 ,
2. **The Machine that changed the World**, James P. Womack, Daniel T. Jones and Daniel Roos Free press, Simon and Schuster Inc., New York, 2007, ISBN SBN 10: 0743249275 ISBN 13: 9780743249270

REFERENCE BOOKS:

1. **Design and Analysis of Lean Production Systems,**Askin R G and Goldberg J B, John Wiley and Sons Inc., 2003, ISBN 9812-53-027-4
2. **What is lean Six sigma,**Micheal, L George, David T Rowlands, Bill Kastle, McGraw Hill, New York, 2004.
3. **Lean Tools; A Pocket Guide to Implement Lean Practices,Productivity And Quality**Micheal Wader, PublishingPvt Ltd, 2002.
4. **One-piece Flow,** Productivity Press Kenichi Sekine, Portland Oregon, 1992.
5. **Continuous Improvement in Operations,** Alan Robinson, Productivity Press, Portland Oregon, 1991.
6. **Juran Institute's Six Sigma break Through and Beyond,** Joseph A De Feo, William W Bearnard, Juran Institute's Six Sigma break Through and Beyond, Tata McGraw hill Edition, New Dehli, 2004.
7. **Operations, Management for Competitive Advantage,**Richard B Chase F Robert Jacobs and Nicholas J Aquilano, McGraw Hill/Irwin:Tenth Edition, 2003.
8. **Improving Product Quality by preventing defects**:Poke-Yoke, Productivity press, 1992.

E-BOOKS:www.scodanibbio.com/site/access/e_courses/downloads/.../vsm_pw.pdf
www.amazon.in/How-To...**Lean-Manufacturing-ebook**/dp/B002LC8HF(Lonnie Wilson)

ONLINE REFERENCES:http://nptel.ac.in/courses/110105039/ (Six Sigma)

COURSE OUTCOMES:

CO1	To define and describe, lean manufacturing practices such as value stream mapping, lead-time reduction, setup time reduction, just-in-time techniques, and process management tools.
CO2	To identify the elements of 5S program and demonstrate implementation
CO3	To plan, implement, and evaluate the impact of a lean manufacturing practice
CO4	To identify and describe the potential enterprise issues associated with the planning, implementation, and evaluation of lean manufacturing principles
CO5	To describe the relevance of lean manufacturing principles to manufacturing processes and equipment, supply chain management, product development, and human resource management

SCHEME OF EXAMINATION: Answer one question from each unit. Choice is to be given in Unit-1 and Unit-4

ASSESSMENT

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B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

Course	MANAGEMENT INFORMATION SYSTEM	Course Code	17IE7DEMIS
Credits	03	L-T-P	3-0-0

Prerequisites: Nil

UNIT - 1

FUNDAMENTALS OF INFORMATION SYSTEMS: Information systems in business, fundamentals of information systems solving business problems with information systems. **6Hrs**

UNIT - 2

INFORMATION SYSTEMS FOR BUSINESS OPERATIONS: Business information systems, Transaction processing systems, management information systems and decision support systems. Artificial intelligence technologies in business, information system for strategic applications and issues in information technology.

ISSUES IN MANAGING INFORMATION TECHNOLOGY: Managing information resources and technologies global information technology, management, planning and implementing change, integrating business change with IT, security and ethical challenges in managing IT, social challenges of information technology. **10Hrs**

UNIT - 3

INTRODUCTION TO E-BUSINESS: E-commerce frame work, Media convergence, Consumer applications, Organization applications.

E-BUSINESS MODEL: Architectural frame work for E-commerce, Application services and transaction Models – B2C Transactions, B2B Transactions, Intra-Organizational Transactions.

E-BUSINESS MODEL: WWW Architecture: Client server structure of the web, e-Commerce architecture, Technology behind the web. **12Hrs**

UNIT - 4

CONSUMER-ORIENTED E-COMMERCE: Consumer oriented Application: Finance and Home Banking, Home shopping, Home Entertainment, Mercantile Process Models, Consumers perspective, Merchants perspective. **6Hrs**

UNIT - 5

ELECTRONICS DATA INTERCHANGE (EDI): EDI Concepts, Applications in business – components of international trade, Customs Financial EDI, Electronic fund transfer, Manufacturing using EDI, Digital Signatures and EDI. **6Hrs**

TEXT BOOKS:

1. **Management Information systems**- managing information technology in the internet worked enterprise- jams. A O'Brien – Tata McGraw Hill publishing company limited, 2002.
2. **Frontiers of E-Commerce**– Ravi Kalakota and Andrew B. Whinston Pearson Education

REFERENCE BOOKS:

1. **Management Information systems**- S. Sadogopan.PHI 1998Edn.ISBN 81-203-1180-9
2. **Information systems for modern management** - G.R. Murdick PHI, 2nd Edition.

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DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

E-books:
http://www.mu.ac.in/mis.pdf
http://www.academia.edu/5275161/Management_Information_Systems_12th_Edition_

Online References:
https://books.=Management+Information+system+ebooks

Course Outcome: Student will be

CO1	Able to acquire knowledge of the functional areas of business and the interrelationships among the functional areas within a business to solve business problems
CO2	Able to use analytical and reflective skills in decision making and recognize legal and ethical issues confronting them
CO3	Able to understand technical knowledge of computer networks, information security and information assurance
CO4	Contribute to the performance of a group within a business setting
CO5	Knowthe differences among global economies, institutions, business practices and cultures

Scheme of Examination: One question each from units 1 , 4, 5 & two questions from unit2 & unit 3 .

ASSESSMENT
Continuous Internal Evaluation (CIE) includes periodic class tests, quizzes or Alternative Assessment Tools (AAT) prescribed by the faculty handling a course prior to beginning of the classes like assignments, problem solving, case studies, group discussion, seminar, mini-project etc.

Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

Both CIE and SEE have equal (50:50) weightages. The student's performance in a course shall be judged individually and together based on the results of CIE and SEE.

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

Course	HUMAN RESOURCE MANAGEMENT	Course Code	17IE7DEHRM
Credits	03	L-T-P-S	3-0-0-0

Prerequisites: Nil

UNIT – 1

INTRODUCTION: Evolution of HRM, Objectives, Functions and Policies. **5Hrs**

HUMAN RESOURCE PLANNING: Uses and benefits, Man Power Inventory, Man Power Forecasting, Methods of Man Power Forecasting, job Description, Job Specification. **5Hrs**

UNIT - 2

RECRUITMENT: Sources of Man power, Advertisement, Short Listing of Candidates calling Candidates for selection Process. **5Hrs**

SELECTION: Selection procedure – Written Test, Group Discussion. Interview – Different methods, advantages and Limitations, Psychological testing – Advantages and limitations, Induction procedure, transfers, promotion exit interview, (Tutorial on written test, Group discussion, Interviews). **5Hrs**

UNIT - 3

TRAINING AND DEVELOPMENT: Identification of Training needs, Training Evaluation, Training Budget, Executive Development – Different Approaches, Non-executive development – Different methods. **5Hrs**

PERFORMANCE APPRAISAL: Components (all round performance appraisal), Methods, Advantages and limitations of different methods, Personal Counseling based on Annual Confidential Reports. **5Hrs**

UNIT - 4

COUNSELLING AND HUMAN RESOURCE ACCOUNTING: Characteristics, Need, Function, Types, Suggestions for personnel development, communication function, communication process, effective communication. Human resource records, Advantages of HR accounting, various methods of accounting. **5Hrs**

UNIT – 5

INDUSTRIAL RELATIONS: Indian trade union act, standing orders act, Indian factories act.

INDUSTRIAL DISPUTES AND SETTLEMENT: Indian Industrial Disputes act, Industrial disputes settlement machinery. Works committee, Board of Conciliation,Voluntary Arbitration, Compulsory arbitration, Court of inquiry, Industrial tribunal, Adjudication. **4Hrs**

TEXT BOOKS:

1. **Human Resources Management** – Dr. K Ashwathappa, Tata McGraw Hill, Edition 1999
2. **Management of Organisations Behaviour** – Hersey and Blanchard – Prentice Hall of India Edn – 1998
3. **Industrial Relations** – Arun Monappa – TMH, ISBN – 0-07-451710-8

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

REFERENCES BOOKS:

1. **Personnel / Human resource Management** – Decenoz and robbins PHI, 2002
2. **Management of Human Resources** – CB Mamoria – Himalaya Publication House, 2003
3. **Industrial Acts** by Jain, 2004

ONLINE REFERENCE:www.shrm.org,

COURSE OUTCOMES

CO1	Human Resource Management objectives, functions and polices to describe and specify job, they also learn to plan for man power requirement.
CO2	Selection procedure, process, write tests, discuss in groups and attend interviews.
CO3	Training and Development to train and develop employees of the industry and to do Performance appraisal for continuous improvement.
CO4	Counseling and human resource accounting to suggest for personnel development, communication and to maintain records.
CO5	Industrial relations to follow factory acts, to resolve Industrial Disputes and settle industrial disputes.

SCHEME OF EXAMINATION:

FIVE Questions to be set with one question from units 1 to 5 carrying 20 marks each. Questions in unit 2& 3 units will have an internal choice

ASSESSMENT

Continuous Internal Evaluation (CIE) includes periodic class tests, quizzes or Alternative Assessment Tools (AAT) prescribed by the faculty handling a course prior to beginning of the classes like assignments, problem solving, case studies, group discussion, seminar, mini-project etc.

Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

Both CIE and SEE have equal (50:50) weightages. The student's performance in a course shall be judged individually and together based on the results of CIE and SEE.

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

Course	RELIABILITY ENGINEERING	Course Code	17IE7DERLE
Credits	03	L-T-P-S	3-0-0-0

Prerequisites: Nil

UNIT- 1

INTRODUCTION: Concepts, terms, and definitions of reliability and related performance measure, Terminology in reliability, Failure rate, MTBF, Life test, importance of reliability, definition, meaning of adequate performance, reliability-engineering Programme and its scope, Typical applications.

RELIABILITY MANAGEMENT: Reliability goals & policies, economics of reliability, reliability data Collection, Reliability requirement data collection and agreement, Design validation for reliability 6**Hrs**

UNIT- 2

COMPONENT LIFE: Failure distribution function, reliability function and hazard rate function, interrelationships, MTTF, MTBF, bath tub curve (Mortality curve),conditional reliability function, constant and time dependent failure models, Accelerated tests and testing conditions for component life.

PRACTICAL FAILURE PATTERNS: Failure behavior of mechanical, electrical, electronic parts, common failure distribute. **6Hrs**

COMBINATORIAL RELIABILITY (RELIABILITY OF SYSTEMS): Reliability analysis of systems: (Success-Failure models only) Analysis of Series, parallel, series parallel and parallel series configurations. R out of n configurations, redundancy improvement factor, stand by systems. **6Hrs**

TECHNIQUES FOR COMPLEX SYSTEMS RELIABILITY EVALUATION:
Inspection methods, event space methods, path tracing methods, decomposition methods, cut set methods, tie set methods. **2Hrs**

UNIT- 3

DESIGN FOR RELIABILITY: System effectiveness measures and life cycle cost analysis, reliability allocation, methods for reliability in design, failure analysis, systems safety and fault tree analysis, multistate model. Failure mode effect and criticality analysis. House of Reliability **4Hrs**

MARKOV MODELS FOR SYSTEM RELIABILITY: Reliability analysis of state dependent systems, Markov analysis, and stand by system analysis. **4Hrs**

UNIT- 4

MAINTENABILITY AND AVAILABILITY: Analysis of Down time, Repair Time distributions, maintainability, Maintenance increment, Design for maintainability. Availability analysis, Different forms of availability, system availability analysis, mission availability, Availability of stand by system **6Hrs**

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT
UNIT- 5

ANALYSIS FAILURE DATA: Types of life testing, data collection, Empirical methods, Estimation of Static life, types of life testing: development of confidence intervals, acceptance test procedures for life estimation using exponential, Weibull and Gamma distribution models, Sequential life tests and acceptance criteria.

APPLICATION AND CASE STUDIES: Case example involving redundancy, burning tests, preventive maintenance analysis, Repairable system analysis, Software reliability.

6Hrs

TEXT BOOKS:

1. **Concepts of Reliability Engineering -**L. S. Srinath, - Affiliated East West Press Pvt.Ltd 2nd ed.
2. **Reliability Engineering -** Dr. Balaguru Swamy Tata McGraw Hilll, Fourth Edition, 2003
3. **An introduction to Reliability and Maintainability -** Charles E Ebeling TMH, Edition 2000, ISBN 0-07-042138-2

REFERENCES BOOKS:

1. **Reliability Hand Book** Ireson and Grant, McGraw Hill -1995
2. **Mathematical Theory of Reliability and Mathematics** Barlow and Proschan, 1st Edition, John Wiley and Sons, 1996, ISBN-978-0-898713-69-5
3. **Probability Reliability & Engineering approach**-Shooman-1976.
4. **Practical Reliability Engineering** Patrick D.T.O John Wiley and Sons 2002.
5. **Introduction to Reliability Engineering** E E Lewis John Wiley & Sons, 2nd edition., 1996, ISBN-0471104841, 9780471104841

COURSE OUTCOMES

CO1	To understand the fundamentals of reliability like failure rate, availability, maintainability etc.
CO2	Ability to predict systems reliability availability, maintainability component failure data
CO3	To analyze the interference between strength and stress, or life data for estimating reliability and also strategies for enhancing reliability of components and systems

SCHEME FOR EXAMINATION: Five questions choosing one each from each unit and Unit 2and 3 with choice questions

ASSESSMENT

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Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

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B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

INSTITUTIONAL ELECTIVE-I

Course	DATA BASE MANAGEMENT SYSTEM	Course Code	17IE7IEDBM
Credits	03	L-T-P-S	3-0-0-0

Prerequisites: Nil

UNIT - 1

DATABASES AND DATABASE USERS: Introduction, characteristics of data base approach, intended use of a DBMS, advantages and implication of database approach.

DATABASE SYSTEMS CONCEPTS AND ARCHITECTURE: Data models, Schemas and instances' DBMS architecture and data independence, database languages and interfaces, database system environment, classification of data base management Systems.

6Hrs

DATA MODELING: High level conceptual data models for database design. Entity types, entity. Sets, attributes, and keys. Relationships, relationship types, roles, and Structural constraints, Weak entity types. ER Diagrams **6Hrs**

UNIT - 2

RECORD STORAGE AND PRIMARY FILE ORGANIZATIONS: Secondary storage devices, buffering of blocks, placing fi1l records on disk, operations on files, heap files a sorted files, hashing techniques. **4Hrs**

INDEX STRUCTURE OF FILES: Single-level and multilevel ordered indexes, dynamic multi-level indexes using B-trees and B+trees. **2Hrs**

UNIT - 3

RELATIONAL DATA MODE ANQ RELATIONAL ALGEBRA: Brief' discussion on Codd rules, relational model concepts, constraints, and schemas. Update operation on relations, basic and additional relational algebra operations, and queries in relational algebra.

Structured Query Language (SQL): Data definition etc. in SQL2.Basic and complex queries in SQL. Insert, delete, update statements, and views in SQL, embedded SQL.

10Hrs

UNIT - 4

DATABASE DESIGN: Design guidelines for relational schemes, functional Dependencies, normalization -1st, 2nd, 3'd, 4 , and 5th normal forms. Database design process, factors influencing physic I database design guidelines, and guidelines for relational systems.

6Hrs

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
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UNIT - 5

SYSTEM IMPLEMENTATION: System catalog for RDBMSs, transaction processing and system concepts, properties of transactions, brief discussion on concurrency, control and recovery techniques, database security and authorization. **4Hrs**

BRIEF DISCUSSION ON: Distributed databases, objected oriented databases, next generation databases, and interfacing with other technologies. **2Hrs**

ONLINE REFERENCE:
http://nptel.ac.in/video.php?subjectId=106106093

TEXTBOOKS:
1. **Fundamentals of database systems**"- Ramez Elmasri and Shamkanth B. Navathe, , Addison Wesley Publishing Company, 6th Edition,
2. **Database Management System**, -Raghu Ramakrishnan and Johanne's Gehrke, , TATA McGraw Hill, 3'd Edition, ISBN 0-071231511 I

REFERENCE BOOKS:
1. **Modern Data base management**: McLfadden, Hoffer, Prescott
2. **Database Management Design** Gary W. Hansen and James V. Hansen, PHI Pvt . Ltd, 2nd Edition

COURSE OUTCOMES

CO1	Able to use, appreciate advantages and implication of database
CO2	Able to understand DBMS architecture, languages, interfaces, data modeling
CO3	Able to carry out indexing, understand relational model concepts, schemas
CO4	Able to use SQL, design database, carryout transaction processing, implement systems

SCHEME OF EXAMINATION: One Question to be set from each unit and Two Questions will be set from the Unit 1 & Unit-3.Student will answer any 5 questions selecting at least one from each unit.

ASSESSMENT
Continuous Internal Evaluation (CIE) includes periodic class tests, quizzes or Alternative Assessment Tools (AAT) prescribed by the faculty handling a course prior to beginning of the classes like assignments, problem solving, case studies, group discussion, seminar, mini-project etc.

Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

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B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

Course	HUMAN RESOURCE MANAGEMENT	Course Code	17IE7IEHRM
Credits	03	L-T-P-S	3-0-0-0

Prerequisites: Nil

UNIT – 1

INTRODUCTION: Evolution of HRM, Objectives, Functions and Policies. **5Hrs**

HUMAN RESOURCE PLANNING : Uses and benefits, Man Power Inventory, Man Power Forecasting, Methods of Man Power Forecasting, job Description, Job Specification. **5Hrs**

UNIT - 2

RECRUITMENT: Sources of Man power, Advertisement, Short Listing of Candidates calling Candidates for selection Process. **5Hrs**

SELECTION: Selection procedure – Written Test, Group Discussion. Interview – Different methods, advantages and Limitations, Psychological testing – Advantages and limitations, Induction procedure, transfers, promotion exit interview, (Tutorial on written test, Group discussion, Interviews). **5Hrs**

UNIT - 3

TRAINING AND DEVELOPMENT: Identification of Training needs, Training Evaluation, Training Budget, Executive Development – Different Approaches, Non-executive development – Different methods. **5Hrs**

PERFORMANCE APPRAISAL: Components (all round performance appraisal), Methods. Advantages and limitations of different methods, Personal Counseling based on Annual Confidential Reports. **5Hrs**

UNIT - 4

COUNSELLING AND HUMAN RESOURCE ACCOUNTING: Characteristics, Need, Function, Types, Suggestions for personnel development, communication function, communication process, effective communication. Human resource records, Advantages of HR accounting, various methods of accounting. **5Hrs**

UNIT – 5

INDUSTRIAL RELATIONS: Indian trade union act, standing orders act, Indian factories act.

INDUSTRIAL DISPUTES AND SETTLEMENT: Indian Industrial Disputes act, Industrial disputes settlement machinery. Works committee, Board of Conciliation, Voluntary Arbitration, Compulsory arbitration, Court of inquiry, Industrial tribunal, Adjudication. **4Hrs**

TEXT BOOKS:

1. **Human Resources Management** – Dr. K Ashwathappa, Tata McGraw Hill, Edition 1999
2. **Management of Organizations Behaviour** – Hersey and Blanchard – Prentice Hall of India Edn – 1998
3. **Industrial Relations** – Arun Monappa – TMH, ISBN – 0-07-451710-8

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

REFERENCES BOOKS:

1. **Personnel / Human resource Management** – Decenoz and robbins PHI, 2002
2. **Management of Human Resources** – CB Mamoria – Himalaya Publication House, 2003
3. **Industrial Acts** by Jain, 2004

ONLINE REFERENCE: www.shrm.org,

COURSE OUTCOMES

CO1	Human Resource Management objectives, functions and polices to describe and specify job, they also learn to plan for man power requirement.
CO2	Selection procedure, process, write tests, discuss in groups and attend interviews.
CO3	Training and Development to train and developemployees of the industry and to do Performance appraisal for continuous improvement.
CO4	Counseling and human resource accounting to suggest for personnel development, communication and to maintain records.
CO5	Industrial relations to follow factory acts, to resolve Industrial Disputes and settle industrial disputes.

SCHEME OF EXAMINATION:

FIVE Questions to be set with one question from units 1 to 5 carrying 20 marks each. Questions in unit 2& 3 units will have an internal choice

ASSESSMENT

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Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

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B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

Course Name	OPERATIONS RESEARCH (Institutional Elective)	Course Code	16MD7IE1OR
Credits	03	L – T – P -S	3- 0- 0-0
CIE	50 Marks(100% weightage)	SEE	100 Marks(50% weightage

Prerequisites:

Matrix computations, Statistics and Probability.

COURSE DESCRIPTION: COURSE OBJECTIVES: To acquaint the students with quantitative methods and different techniques for effective decision making; model formulation and applications that are used in solving business decision problems in various environments. The course includes linear programing, transportation, assignment problems, CPM/PERT techniques, Game theory.

UNIT-1

INTRODUCTION: Evolution, definition, scope of OR, application areas of OR, steps (phases) in OR study, characteristics and limitations of OR, models used in OR, Linear Programming Problems (LPP) - Formulation of LPP-Graphical solution. Use of slack, surplus and artificial variables, Canonical and Standard forms, Solution of LPPs using Simplex method, Big- M method. **09Hrs**

UNIT-2

TRANSPORTATION PROBLEM: Formulation of transportation problem, types, initial basic feasible solution using North-West Corner method, least cost method, Vogel approximation method, Degeneracy in transportation problems, optimal solutions by MODI method. **07Hrs**

UNIT-3

ASSIGNMENT PROBLEM- Formulation, types, Hungarian method for assignment problem, Unbalanced assignment problem, application to maximization cases and travelling salesmen problem **07 Hrs**

UNIT-4

PERT-CPM TECHNIQUES: Introduction, network construction-AON & AOA diagrams, Fulkerson's rule for numbering the events, Critical path method to find the expected completion time of a project, floats; PERT for finding expected duration of an activity and project, determining the probability of completing a project. Predicting the completion time of project; crashing of simple projects. **09Hrs**

UNIT-5

GAME THEORY: Formulation of games, types, solution of games with saddle point, Solution of games without saddle point, 2x2 games without saddle point, graphical method of solving mixed strategy games, dominance rule for solving mixed strategy games. **07Hrs**

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

TEXT BOOK:

1. S.D. Sharma-Operations Research, Kedarnath Ramanath & Co.2002
2. R. Panneer Selvam-Operations Research, second edition, PHI Learning Private Limited 2011.
3. Richard Bronson, Govindasami Naadimuthu: Schaumn Outline series-second edition, Tata McGraw Hill edition 2004, Eleventh reprint 2011.

REFERENCE BOOKS:

1. Hiller and Liberman -Introduction to Operations Research, Ninth edition Mc Graw Hill Publications.
2. Hamdy A Taha H A- Operations Research, eighth edition, Pearson Prentice Hall.
3. Kanti Swarup, P K Gupta, Man Mohan, Operations Research, Sultan Chand & Sons, 2010.

E-LEARNING:

1. **https://books.google.co.in/books?isbn=8131711048, Taha-2008**
2. **https://books.google.co.in/books?isbn=8121902819 D S Hira-2008**
3. **https://books.google.co.in/books?isbn=8131700003,A. M. Natrarajan, P Balasubramani-2006**

Question Paper Pattern:

1. Each unit consists of one full question.
2. Each full question consists of two, three or four subdivisions.
3. Five full questions to be answered.
4. Internal choice in Unit 1 and Unit 4.

COURSE OUTCOMES

CO #	COURSE OUTCOME (CO)	PO
CO 1	Formulate a real-world problem as a mathematical programming model.	1,2
CO 2	Formulate and solve transportation models by applying cost cutting strategies.	2,3
CO 3	Formulate and solve assignment models and travelling salesmen problems.	2,3
CO 4	Construct a project network and apply program evaluation review technique and critical path management.	2,3
CO 5	Employ Game theory for strategic decision making.	2,3

ASSESSMENT

Continuous Internal Evaluation (CIE) includes periodic class tests, quizzes or Alternative Assessment Tools (AAT) prescribed by the faculty handling a course prior to beginning of the classes like assignments, problem solving, case studies, group discussion, seminar, mini-project etc.

Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)

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B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

Course	PRODUCT DESIGN & DEVELOPMENT	Course Code	17IE7IEPDD
Credits	03	L-T-P-S	3-0-0-0

Prerequisites: Nil

UNIT- 1

INTRODUCTION: Characteristics of successful product development, Design and development of products, duration and cost of product development, the challenges of product development.

DEVELOPMENT PROCESSES AND ORGANIZATIONS: A generic development process, concept development: the front-end process, adopting the generic product development process, the AMF development process, product development organizations, the AMF organization.

PRODUCT PLANNING: The product planning process, identify opportunities. Evaluate and prioritize projects, allocate resources and plan timing, complete pre project planning, reflect all the results and the process. **8Hrs**

UNIT- 2

IDENTIFYING CUSTOMER NEEDS: Gather raw data from customers, interpret raw data in terms of customer needs, organize the needs into a hierarchy, establish the relative importance of the needs and reflect on the results and the process.

PRODUCT SPECIFICATIONS: What are specifications, when are specifications established, establishing target specifications, setting the final specifications. **6Hrs**

UNIT-3

CONCEPT GENERATION: The activity of concept generation clarify the problem, search externally, search internally, explore systematically, reflect on the results and the process.

CONCEPT SELECTION: Overview of methodology, concept screening, and concept scoring,

CONCEPT TESTING: Define the purpose of concept test, choose a survey population, choose a survey format, communicate the concept, measure customer response, interpret the result, and reflect on the results and the process.

PRODUCT ARCHITECTURE: What is product architecture, implications of the architecture, establishing the architecture, variety and supply chain considerations, platform planning, related system level design issues. **10Hrs**

UNIT- 4

INDUSTRIAL DESIGN: Assessing the need for industrial design, the impact of industrial design, industrial design process, managing the industrial design process, assesses the quality of industrial design

DESIGN FOR MANUFACTURING: Definition, estimation of manufacturing cost, reducing the cost of components, assembly, supporting production, impact of DFM on other factors.

Prototyping: Prototyping basics, principles of prototyping, technologies, planning for prototypes **6Hrs**

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT
UNIT- 5

INTELLECTUAL PROPERTY RIGHTS: Basic principles of IP laws: Introduction, Concept of property, Need for a holistic approach, Basis for protection, Invention, Criteria for patentability, Non – patentable inventions. Patents: Introduction, principles underlying the patent law in India, patentable invention. Procedure for obtaining patent. **6Hrs**

PRODUCT DEVELOPMENT ECONOMICS: Elements of economic analysis, base case financial mode,. Sensitive analysis, project trade-offs, influence of qualitative factors on project success, qualitative analysis.

MANAGING PROJECTS: Understanding and representing task, baseline project planning, accelerating projects, project execution, postmortem project evaluation. **4Hrs**

TEXT BOOKS:

1. **Product Design & Development**, Karl T. Ulrich & Steven D., Tata McGraw Hill, 3rdd Edition, 2003
2. **Product Design and Manufacturing**, A.K. Chitale and R.C. Gupta, PHI.,2013, 6th Edition, ISBN-978-81-203-4873-8
3. **Basic principles and acquisition of Intellectual Property Rights**, Dr. T Ramakrishna, CIPRA, NSLIU -2005.
4. **Intellectual Property Law Handbook**, Dr.B.L.Wadehhra, Universal Law Publishing Co. Ltd., 2002.

REFERENCE BOOKS:

I. **New Product Development,** Tim Jones, Butterworth Heinr1ann, Oxford, UIC 1997.
2. **New Product Development**: **Design & Analysis,** Roland Enene, Kinetovicz, John Wiley and Sons Inc., N. Y. 1990.
3. **Product Design for Manufacture and Assembly,**GefferryBoothroyd, Peter Dewhurst and Winston Knight.
4. **Successful Product Design,** Jill Hollins, Stwout Pugh, Butterworth, London 1990.

ONLINE LINKS:http://nptel.ac.in/courses.php

SCHEME FOR EXAMINATION: Five questions choosing one each from each unit and Unit 1 and 2 with choice questions

COURSE OUTCOMES

CO1	Understand the basic concepts of product design
CO2	Understand the product design process in industry
CO3	Understand the economic factors involved in PD
CO4	Understand the basic concepts of IPR
CO5	Understand modern approaches helpful in product design

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B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

Course	AUTOMATION IN MANUFACTURING	Course Code	17IE7IEAIM
Credits	03	L-T-P-S	3-0-0-0

UNIT - 1

INTRODUCTION: Introduction to automation, **d**efinition, types of automation, reasons for automating, arguments for and against automation.

PRODUCTIVITY CONCEPTS AND MATHEMATICAL MODELS:
Introduction, manufacturing lead-time, components of operating time, production rate, plant capacity, utilization and availability, work-in-process, automation strategies. (Problems)
10Hrs

UNIT - 2

HIGH VOLUME PRODUCTION SYSTEM: Introduction to automated flow lines, Configuration of flow lines, Methods of work-part transport systems, Performance analysis of automated flow lines, analysis of automated transfer lines without buffer, automated flow lines with storage buffer, analysis of a two-stage line. Line balancing of assembly systems. (Problems on line balancing only). **10Hrs**

UNIT - 3

GROUP TECHNOLOGY: Part families, part classification and coding systems, machine cell design, application consideration in group technology.

COMPUTERIZED MANUFACTURING PLANNING SYSTEMS: Introduction, computer aided process planning, retrieval and generative type of process planning, benefits of computer aided process planning. **6Hrs**

UNIT – 4

FLEXIBLE MANUFACTURING SYSTEMS: Introduction to FMS, components of FMS, types of FMS, Layout configurations, computer control system, application and benefits of FMS. FMS planning and implementation issues.

COMPUTER NETWORKS FOR MANUFACTURING: Introduction, hierarchy of computers in manufacturing, local area networks, manufacturing automation control.
8Hrs

UNIT - 5

AUTOMATED INSPECTION AND TESTING: Introduction, contact and non-contact inspection techniques, Types of coordinate measuring machines, applications and benefits, machine vision.

THE FUTURE AUTOMATED FACTORY: Introduction, trends in manufacturing, the future automated factory, the social impact of automated systems, Industry 4.0 **6Hrs**

SCHEME OF EXAMINATION:
To set two questions from units 1 & 2 and one question from units 3, 4 & 5.

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

TEXT BOOKS:

1. **Automation, Production Systems and Computer Integrated Manufacturing** - Mikell P. Groover, Pearson – Education, New Delhi, 5th Printing, 1996, ISBN-812030618X, 2003e, ISBN-81-7808-511-9
2. **Computer control of manufacturing systems –**Yorem Koren, 2005e, ISBN-0-07-Y66379-3

REFERENCE BOOKS:

1. **CAD/CAM**, Mikell P. Groover and Emory W.Zimmers, PHI, New Delhi , 22nd printing - 2003, ISBN-81-203-0402-0
2. **An Introduction to Automated Process Planning System** – Tiess Chieu Chang and Richard A Wysk PHI , 1985e,

ONLINE: www.nptel.ac.in

Course Out comes:

CO1	Is able to acquire the knowledge of fundamentals of automation, the types of automation and the need to go in for automation. Learn about the concepts of production automation, strategies in automation.
CO2	Is able to learn about the transfer mechanisms, analysis of production and assembly automated flow lines and balancing of flow lines.
CO3	Is able to understand the philosophy of Group technology and learn about computerized process planning system, types of computer aided process planning, and benefits of CAPP.
CO4	Is able to acquire the knowledge ofFlexible manufacturing systems, Layout configurations, and implementation of FMS. Isable to understand about computer networks for production automation,hierarchy, network topology, manufacturing automation protocol.
CO5	Is able to understand the concept of computerized measuring systems, types of equipment used in the automated systems. Is also able to acquire the knowledge of trends in manufacturing, and the future automated factory.

ASSESSMENT

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Semester End Examination (SEE)-a written examination for theory courses and practical/ design examination with built-in-oral part (Viva voice)

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B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

Course Title	SIX SIGMA	Course Code	17IE7IESS
Credits	03	L-T-P	3-0-0

Prerequisites: Nil

UNIT – 1

INTRODUCTION: Six Sigma Introductory Overview, Project Selection, Process and Financial Metrics, Project Reporting Expectations **7 Hrs**

UNIT – 2

PROJECT DEFINITION: Project Charters, Estimating Financial Metrics, Definition of process outputs (characteristics, defects, and defectives), Process Mapping **7 Hrs**

UNIT – 3

MEASUREMENT SYSTEM ANALYSIS: Fundamental Statistical Measures, Control Charts, Common and Special Cause Improvement Strategies, Introduction to Minitab, Variable Gage R&R, Attribute Agreement Analysis, Variables Data Capability Analysis, Attribute Agreement Analysis **8 Hrs**

UNIT – 4

QUALITY TOOLS/HYPOTHESIS TESTING: Quality Tools, Introduction to Hypothesis Testing, one proportion Tests, Two proportion Tests, Chi Square Testing, t Tests, ANOVA, Correlation Analysis, Single Regression, Multiple Regression **8 Hrs**

UNIT – 5

DESIGN OF EXPERIMENTS (DOE): Introduction to Design of Experiments, Non Parametric tests and analysis, General Full Factorial Designs, Two-Level Factorial Designs, Three-Level Factorial Designs, Post-hoc Analysis, Fractional Factorials,
Improve and Control: Solution Selection and Prioritization, Pilot Studies (assessing counter measures), Final Capability Analysis, Process Controls, Wrap-Up , Demonstration on Catapault Experiment **9Hrs**

TEXTBOOKS:

1. Design for Six Sigma, Gerg Brue, TMH 2003, ISBN 0-07-058120
2. Six Sigma for Managers, Greg Brue, TMH 2002; ISBN - 0-07-048639-5

SCHEME FOR EXAMINATION: Five questions choosing one each from each unit and Unit 2 and 3 with choice questions

ASSESSMENT

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Semester End Examination (SEE)-a written examination for theory courses and practical/ design examination with built-in-oral part (Viva voice)

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B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF INDUSTRIAL ENGINEERING & MANAGEMENT

Course	SIMULATION MODELING AND ANALYSIS	Course Code	17IE7IESMA
Credits	03	L-T-P-S	3-0-0-0

Prerequisites: Nil

UNIT-1

INTRODUCTION TO SIMULATION: Simulation, advantages, Disadvantages, Areas of application, System environment, components of a system, Model of a system, types of models, steps in a simulation study.

SIMULATION EXAMPLES: Simulation of Queuing systems, Simulation of Inventory System, Simulation of Project Management and Other simulation examples **10Hrs**

UNIT - 2

GENERAL PRINCIPLES: Concepts in discrete - events simulation, event scheduling *I* Time advance algorithm

RANDOM NUMBERS: Properties, Generations methods, Tests for Random number- Frequency test, Runs test, Autocorrelation test, Gap test, Poker test. 0**8Hrs**

UNIT –3

RANDOM VARIATE GENERATION: Inverse Transform Technique- Exponential, Uniform, Weibull, Triangular distributions, Direct transformation for Normal and log normal Distributions, Acceptance - Rejection Techniques – Poisson Distribution. **08Hrs**

UNIT - 4

ANALYSIS OF SIMULATION DATA: Input Modeling: Data collection, Identification and distribution with data, parameter, Goodness of fit tests, Selection of input models without data

Verification and Validation of Model- Model Building, Verification, Calibration and Validation of Simulation Models. **08Hrs**

UNIT - 5

STATISTICAL ANALYSIS OF SIMULATION DATA -Estimation Methods, Simulation Run Statistics, Replication of Runs, Batch Means, Spectral Analysis.

Output Analysis -Stochastic Nature of output data, Measures of Performance and their estimation. **05Hrs**

TEXT BOOKS:

1. **Discrete Event system Simulation -** Jerry Banks, John S Carson, II, Berry L Nelson, Prentice Hall, 1996
2. **Discrete-event System Simulation**, David M Nicol, 5th Edition, Pearson Education, Asia, 2010
3. **Systems Simulation with Digital Computer**, Narsingh Deo,, PHI Publication (EEE).1978
4. **Simulation Modeling & Analysis Averill**, M Law, W David Kelton, - ; McGraw Hill, International Editions – Industrial Engineering series, 1991
5. **Systems Simulation**, Gordan. G. "", Prentice Hall India Ltd, 1991.

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REFERENCE BOOKS:

1. **Simulation -- Business & Economics** Sheldon M. Ross, Academic Press, 31-Dec-2012
2. **Simulation Modeling and Analysis with Arena**, Tayfur Altiok, Benjamin Melamed, 2010

ONLINE COURSES

1. http://nptel.ac.in/courses.php?disciplineId=110
2. http://informs-sim.org/
3. E-learning: http://vtu.ac.in
4. http://ocw.mit.edu/
5. http:// youtube.com/ Discrete Event simulation

SOFTWARE PACKAGES

1. Simulation Packages : Arena, Quest, Witness,
2. MS Excel, Minitab

SCHEME OF EXAMINATION

Each question from each unit and internal choice from **Unit 1 & Unit 2**

COURSE OUTCOMES

CO1	Understand concepts, steps and different types of simulation and its models.
CO2	Explain the simulation applications with analytical problems
CO3	Explain & Solve random number generators and its testing
CO4	Apply & Solve inverse transformation techniques in simulation modeling
CO5	Evaluate input data and output by means of statistical tests

ASSESSMENT

Continuous Internal Evaluation (CIE) includes periodic class tests, quizzes or Alternative Assessment Tools (AAT) prescribed by the faculty handling a course prior to beginning of the classes like assignments, problem solving, case studies, group discussion, seminar, mini-project etc.

Semester End Examination (SEE)-a written examination for theory courses and practical/design examination with built-in-oral part (Viva voice)
Both CIE and SEE have equal (50:50) weightages. The student's performance in a course shall be judged individually and together based on the results of CIE and SEE.