KAKATIYA UNIVERSITY
BACHELOR OF TECHNOLOGY First Year
Structure of Curriculum-Common to All Branches

Semester-I (First Year)

Branch/Course Common to all branches of UG Engineering & Technology

Sl. No.	Category/ Code	Course Title	Internal Marks	External Marks	Total marks	Lecture	Tutorial	Practical	No of Credits
1	Basic Sciences Course /BSC 101	Physics	30	70	175	3	1	-	5.5
		Lab.	25	30		-	-	3	
2	Basic Sciences Course /BSC 103	Mathematics-I	30	70	100	3	1	0	4
3	Engineering Science Courses/ESC101	Basic Electrical Engineering	30	70	175	3	1	-	5
		Lab.	25	50				2	
4	Engineering Science Courses/ESC102	Engineering Graphics & Design	30	70	175	1	0	4	3
		Lab.	25	50					
5	Engineering Science Courses	Engineering Mechanics	30	70	100	3	1	0	4
		Total Credits							21.5

In order to balance the load of the some of the subjects which are made in groups (Physics/Chemistry, Engineering Graphics & Design/ Workshop and Manufacturing Practices, Programming for Problem Solving/Engineering Mechanics), the half of the branches of B.Tech course offer one subject of group in odd semester and other half of the branches of B.Tech course offer another subject of same group in odd semester. In the even semester the subjects of the group will be exchanged

MANDATORY INDUCTION PROGRAM

BEFORE BEGINNING OF FIRST SEMESTER

3 Weeks Duration

- Physical Activity
- Creative Arts
- Universal Human Values
- Literay
- Proficiency Modules
- Lectures by Eminent People
- Visits to Local Areas
- Familiarization to Dept./Branch & Innovations

KAKATIYA UNIVERSITY
B.Tech. First Year
SEMESTER – I
(Common to all branches)

PHYSICS
(Theory)

Course code	BSC101				
Category	Basic Science Course				
Course title	**Physics**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	Internal marks = 30
	3	**1**	**-**	**4**	External Marks = 70

Detailed contents:

UNIT-I

SCALARS AND VECTORS

Transformation of scalars and vectors under Rotation transformation; Forces in Nature; Newton's laws and its completeness in describing particle motion; Form invariance of Newton's Second Law; Solving Newton's equations of motion in polar coordinates; Problems including constraints and friction; Extension to cylindrical and spherical coordinates.***(8 lectures)***

UNIT II

POTENTIAL ENERGY FUNCTION

Potential energy function; F = - Grad V, equipotential surfaces and meaning of gradient; Conservative and non-conservative forces, curl of a force field; Central forces; Conservation of Angular Momentum; Energy equation and energy diagrams; Elliptical, parabolic and hyperbolic orbits; Kepler's problem; Application: Satellite manocurves.***(7 lectures)***

SIMPLE HARMONIC MOTION

Harmonic oscillator; Damped harmonic motion – over-damped, critically damped and lightly-damped oscillators; Forced oscillations and resonance.***(6 lectures)***

UNIT- III

RIGID BODY

Definition and motion of a rigid body in the plane; Rotation in the plane; Kinematics in a coordinate system rotating and translating in the plane; Angular momentum about a point of a rigid body in planar motion; Euler's laws of motion, their independence from Newton's laws, and their necessity in describing rigid body motion; Examples.***(5 lectures)***

UNIT-IV

ELECTROSTATICS IN VACUUM

Calculation of electric field and electrostatic potential for a charge distribution; Divergence and curl of electrostatic field; Laplace's and Poisson's equations for electrostatic potential and uniqueness of their solution and connection with steady state diffusion and thermal conduction; Practical examples like Faraday's cage and coffee-ringeffect.Boundary conditions of electric field and electrostatic potential,method of images,energy of a charge distribution and its expression in terms of electric field ***(8 lectures)***

MAGNETOSTATICS

Bio-Savart law, Divergence and curl of static magnetic field; vector potential and calculating it for a given magnetic field using Stokes' theorem; the equation for the vector potential and its solution for given current densities***.(6 lectures)***

UNIT-V

FARADAY'S LAWS

Faraday's law in terms of EMF produced by changing magnetic flux; equivalence of Faraday's law and motional EMF; Lenz's law.***(3 lectures)***

DISPLACEMENT CURRENT, MAGNETIC FIELD DUE TO TIME DEPENDENT ELECTRIC FIELD AND MAXWELL'S EQUATIONS

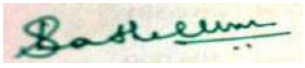
Continuity equation for current densities; Modifying equation for the curl of magnetic field to satisfy continuity equation; displace current and magnetic field arising from time-dependent electric field; calculating magnetic field due to changing electric fields in quasi-static approximation. Maxwell's equation in vacuum and non-conducting medium; Energy in an electromagnetic field; Flow of energy and Poynting vector with examples. ***(5 lectures)***

Suggested Text Books

(i) Introduction to Mechanics — MK Verma
(ii) Introduction to Electrodynamics---David Griffiths
(iii) Engineering Mechanics, 2nd ed. — MK Harbola

Suggested Reference Books:

(i) Halliday and Resnick, Physics
(ii) W. Saslow, Electricity, magnetism and light
(iii) An Introduction to Mechanics — D Kleppner& R Kolenkow
(iv) Principles of Mechanics — JL Synge & BA Griffiths
(v) Mechanics — JP Den Hartog
(vi) Engineering Mechanics - Dynamics, 7th ed. - JL Meriam
(vii) Mechanical Vibrations — JP Den Hartog
(viii) Theory of Vibrations with Applications — WT Thomson



Dr. C.J. Sreelatha
Chairperson Board of Studies in Physics,KU,Wgl
Date:

KAKATIYA UNIVERSITY
B.Tech. First Year
SEMESTER – I
(Common to all branches)

PHYSICS
(Lab.)

Course code	BSC101				
Category	Basic Science Course				
Course title	**Physics-Practical**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	Internal marks = 25
	-	**-**	**3**	**1.5**	External Marks = 50

APPLIED PHYSICS LAB

Choice of experiments from the following:

1. Coupled oscillators.

2. Experiment on moment of inertia measurement.

3. Experiments with gyroscope.

4. Resonance phenomena in mechanical oscillators.

5. LC circuit and CR circuit.

6. Resonance phenomena in LCR circuits.

7. Magnetic'field from Helmholtz coil.

8. Measurement of Lorentz force in a vacuum tube.

KAKATIYA UNIVERSITY
B.Tech. First Year
SEMESTER – I
(Common to all branches)

MATHEMATICS -1

MAXIMUM HOURS:48

Unit 1: Sequences and Series

Sequences , series, general properties of series , series of positive terms, comparison test, integral test, ratio test, Cauchy's root test, D' Alembert's ratio test. Fourier series, Euler's formula, condition for Fourier expansion, Even and odd functions.

(Sections 9.1, 9.2, 9.3, 9.4, 9.5, 9.6, 9.7, 10.1, 10.2, 10.3, 10.6 of Text Book)

Unit 2: Calculus

Fundamental theorems (without proofs) Rolle's Theorem (algebraic and geometrical interpretation, geometrical proof), Legrange's mean value theorem, Cauchy's mean value theorem, Taylors theorem, Maclaurin's series. Asymptote's parallel to axis, curve tracing (simple curves only), radius of curvature for cartesian curves.

(Sections 4.3, 4.10, 4.11, 4.16, 4.17, 9.7 of Text Book)

Unit 3: Multivariable Differential Calculus

Functions of two or more variables, partial derivatives, total derivatives, change of variables, Jacobians, Taylor's theorem (without proof), errors and approximations, maxima and minimum of functions of two variable. Scalar and vector point functions, gradient, divergence, curl, physical interpretation.

(Sections 5.1, 5.2, 5.5, 5.6, 5.7, 5.8, 5.9, 5.10, 5.11, 8.5, 8.6 of Text Book)

Unit 4: Multivariable Integral Calculus

Double integrals, change of order of integration , triple integrals, change of variables, beta and gamma function, line integrals, surface integrals, volume integrals, Greens, Gauss and Stokes theorems (without proof) irrotational fields, solenoidal fields.

(7.1, 7.2, 7.5, 7.7, 7.14, 7.15, 7.16, 8.11, 8.12, 8.13, 8.14, 8.15, 8.16, 8.18 of Text Book)

Unit 5: Differential Equations

Differential equations of first order, formation of differential equations. variable separable form, Bernouli's equation, exact equations, physical applications (Newton's law of cooling, rate of decay) linear differential equations, applications of linear differential equations (simple harmonic motion, oscillating electric circuits). (Sections 11.1, 11.3, 11.4, 11.6, 11.10, 11.11, 12.6, 12,8, 14.1, 14.2, 14.5 of Text Book)

Text Book: B.S. Grewal et.al, Higher Engineering Mathematics, 43rd Edition, Khanna Publicationns.

Reference: Erwin Kreyszig, Aadvanced Engineering Mathematics, 8th Edition, John Wiley & Sons.

KAKATIYA UNIVERSITY
B.Tech. First Year
SEMESTER – I
(Common to all branches)

BASIC ELECTRICAL ENGINEERING

Teaching Scheme				Examination Scheme
L	T	P	C	Internal Marks:30
3	1	0	4	External Marks:70

UNIT – I (7+3)

DC circuits: Introduction, network elements (R, L and C), electric power, electrical energy, Ohm's law, Kirchhoff's laws, resistances in series-voltage divider rule; resistances in parallel-current divider rule, series & parallel circuits, mesh analysis and nodal analysis.

DC network theorems: Introduction, superposition theorem, Thevenin's theorem, Norton's theorem and maximum power transfer theorem. Time-domain analysis of first-order RL and RC circuits.

UNIT – II (7+3)

1-ϕ AC circuits: Phasor representation of sinusoidal quantities, average and R.M.S values of sinusoidal wave form, Form Factor, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), series resonance.

3-ϕ AC circuits: Production of 3-ϕ voltages, voltage & current relationships of line and phase values for balanced star and delta connections.

UNIT – III (7+3)

Transformers : Magnetic materials, BH characteristics, Construction, principle of operation & applications of 1-ϕ transformer, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency, Auto-transformer and 3-ϕ transformer connections.

Three Phase Induction motor: Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, squirrel cage IM, slip-ring IM, Significance of torque-slip characteristic, starting and speed control of induction motor and Applications.

Single-phase induction motor: Construction and principle of operation, Capacitor start & capacitor run motor, applications.

UNIT – IV (7+3)

DC Generators : Constructional features, operating principle, EMF equation, types of DC Generators, magnetization characteristics of DC shunt generator and Applications.

DC Motors: Principle of Operation, Torque Equations, Operating Characteristics of DC Motor, Speed Control Methods and Applications.

Synchronous Generators : Construction and principle of operation of Synchronous generators.

UNIT –V (6+2)

Power Converters : DC-DC buck and boost converters, duty ratio control. Single-phase voltage source inverters and sinusoidal modulation.

Electrical Installaiton: Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries. Elementary calculations for energy consumption, power factor improvement and battery backup.

Text Books:

1. B.L.Thereja, A.K.Thereja, "Electrical Technology Vol. I & II"**,** *S.Chand & Company Ltd*, edn , 2005.
2. Edward Hughes, "Electrical & Electronics Technology", *Pearson Education,* 10/e., 2010.
3. D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", *Tata McGraw Hill*, edn , 2010.

Reference Books:

1. K. Uma Rao, "Basic Electrical Engineering", *Pearson Education,* edn, 2011.
2. Chakravarthy A, Sudhipanath and Chandan Kumar, "Basic Electrical Engineering", *Tata McGraw Hill Ltd*, edn, 2009.

KAKATIYA UNIVERSITY
B.Tech. First Year
SEMESTER – I
(Common to all branches)

BASIC ELECTRICAL ENGINEERING LAB

Class: I/IV B.Tech., I Semester **Branch: Common to all**

Teaching Scheme				Examination Scheme
L	T	P	C	Internal Marks:25
0	0	2	1	External Marks:50

1. Verification of KVL, KCL
2. Transient response of R-L, R-C, R-L-C circuits with DC excitation
3. Verification of Thevenin's Theorem
4. Verification of Norton's Theorem
5. Verification of Maximum Power Transfer Theorem
6. Determination of internal resistance and internal inductance of choke coil
7. Resonance in RLC series circuit
8. Speed control of DC Shunt motor
9. Open Circuit and Short Circuit Test on single phase Transformer.
10. Performance characteristics of 3 phase squirrel cage induction motor
11. Demonstration of components of LT switchgear

KAKATIYA UNIVERSITY
B.Tech. First Year
SEMESTER – I
(Common to all branches)

ENGINEERING GRAPHICS

Teaching Scheme				Examination Scheme
L	T	P	c	Internal Evaluation -30
1	0	4	3	External Evaluation -70

UNIT – I

Introduction to Engineering Drawing: Principles of Engineering Graphics and their ignificance, Usage of Drawing Instruments, Lettering. Conic Sections including the Rectangular Hyperbola – General method only Cycloid,Epicycloid and Hypocycloid, Scales – Plain, Diagonal and vernier.

UNIT- II

Orthographic Projections: Principles of Orthographic Projections – Conventions, Projections of Points and Lines, Projections of Plane regular geometric figures.—Auxiliary Planes.

UNIT – III

Projections of Regular Solids – Auxiliary Views - Sections and Sectional views of Right Regular Solids – Prism, Cylinder, Pyramid, Cone – Auxiliary views – Sections of Sphere.

UNIT – IV

Isometric Projections: Principles of Isometric Projection – Isometric Scale , Isometric Views ,Conventions , Isometric Views of Lines, Plane Figures, Simple and Compound Solids – Isometric Projection of objects having non- isometric lines. Isometric Projection of Spherical Parts. Conversion of Isometric Views to Orthographic Views and Vice-versa – Conventions.

UNIT – V

Development of Surfaces: Right Regular Solids – Prism, Cylinder, Pyramid and Cone.

Introduction to CAD: (For Internal Evaluation Weightage only)

Introduction to Auto CAD Commands, Draw Tools,Modify Tools, Text, Dimension Properties, DIMENSION, PROPERTIES tool bar, Standard Tool bar, LAYERS.

TEXTBOOKS:

1. Engineering Drawing N.D. Bhatt / Charotar
2. Engineering Drawing / N. S. Parthasarathy and Vela Murali/ Oxford

REFERENCE BOOKS:

1. Engineering Drawing / Basant Agrawal and McAgrawal/ McGraw Hill
2. Engineering Drawing / M. B. Shah, B.C. Rane / Pearson.
3. Computer Aided Engineering Drawing – K Balaveera Reddy et al – CBS Publishers

Note: Syllabus must be complete in 48 theory hours, however theory hours may be converted in to equal practical hours as per credits

KAKATIYA UNIVERSITY
B.Tech. First Year
SEMESTER – I
(Common to all branches)

ENGINEERING MECHANICS

Teaching Scheme :					Examination Scheme :	
L	**T**	**P**	**C**		Internal Evaluation :	30 marks
3	1	-	4		End Semester Exam :	70 marks

Course Learning Objectives (LOs):

LO1: develop concept of force, reactions, principles of force and their application on engineering structures and machines
LO2: introduce various kinds of statically determinate pin jointed structures and methods of analysing the trusses
LO3: understand the importance of geometric centre, cross sectional areas of plane lamina and moment of inertia
LO4: understand the behavior of particles in motion subjected to system of forces.

UNIT – I (6+2)

Laws of Mechanics: Parallelogram law of forces, triangle law of forces, Newton's law of gravitation, law of superposition and transmissibility of forces.

Force Systems: Types of forces, co-planar, concurrent and parallel forces, moment and couple, free body diagram, resultant of force systems, resolution of forces, composition of forces, equilibrium equations of forces, Lami's theorem, Varignon's theorem, moment equilibrium equations, types of supports, beams and loadings, statically determinate structures, resultant and equilibrium of general force system.

UNIT –II (8+2)

Friction: Introduction, classification, laws of friction, coefficient of friction, angle of friction, ladder friction and wedge friction.

Plane Trusses: Rigid truss, stability and determinacy conditions, basic assumptions for a perfect truss, analysis of trusses by method of joints and method of sections of a cantilever and simply supported statically determinate pin-jointed trusses.

UNIT– III (8+2)

Centroid: Centroid of one dimensional figures, centroid of simple figures from first principles, centroid of composite sections.

Moment of Inertia: Moment of inertia of plane sections from first principles, theorems of moment of inertia – parallel axis theorem and perpendicular axis theorem, moment of inertia of standard sections and composite sections.

UNIT - IV **(8+2)**

Kinematics: Introduction to dynamics, rectilinear motion of a particle – displacement, velocity and acceleration, motion with uniform acceleration and motion with variable acceleration, curvilinear motion- rectangular components, components, acceleration of normal and tangential acceleration, projectile motion.

UNIT - V (8+2)

Kinetics: Rectilinear motion-equations of rectilinear motion, equations of dynamic equilibrium, D'Alembert's principle, curvilinear motion-equations of motion in rectangular components, tangential and normal components, equations of dynamic equilibrium, applications of work-energy, impulse –momentum principles of rectilinear motion and curvilinear motion.

Text Books:

- Tayal A.K., "Engineering Mechanics: Statics and Dynamics", *Umesh Publishers,* New Delhi, 14th edn., 2014.

Reference Books:

- Timoshenko S., Young D.H., Rao J.V., and Sukumar Pati, "Engineering Mechanics in SI units", *McGraw Hill Education Pvt. Ltd.,* New Delhi, 5th edn., 2013.

- Bhavikatti S.S., "Engineering Mechanics", *New Age International,* New Delhi, 4th edn., 2013 (reprint).

- Basudeb Bhattacharyya, "Engineering Mechanics", *Oxford University Press,* 9th edn., 2013.

- Vijay HYPERLINK "https://www.alibris.com/search/books/author/K-Vijay-Kumar-Reddy?aid=6776440" HYPERLINK "https://www.alibris.com/search/books/author/K-Vijay-Kumar-Reddy?aid=6776440" HYPERLINK "https://www.alibris.com/search/books/author/K-Vijay-Kumar-Reddy?aid=6776440" HYPERLINK "https://www.alibris.com/search/books/author/K-Vijay-Kumar-Reddy?aid=6776440" HYPERLINK "https://www.alibris.com/search/books/author/K-Vijay-Kumar-Reddy?aid=6776440" HYPERLINK "https://www.alibris.com/search/books/author/K-Vijay-Kumar-Reddy?aid=6776440" HYPERLINK "https://www.alibris.com/search/books/author/K-Vijay-Kumar-Reddy?aid=6776440" HYPERLINK "https://www.alibris.com/search/books/author/K-Vijay-Kumar-Reddy?aid=6776440" Kumar Reddy K., Suresh Kumar J. "Singer's Engineering Mechanics Statics and Dynamics" *BS Publications / BSP Books*, 3rd edn. (SI Units), 8th Reprint, 2014

KAKATIYA UNIVERSITY
BACHELOR OF TECHNOLOGY
FIRST YEAR SYLLABUS
Structure of Curriculum-Common to All Branches

Semester –II (First Year)

Branch/Course: Common to all branches of UG Engineering & Technology

Sl. No.	Category/ Code	Course Title	Internal Marks	External Marks	Total Marks	Lecture	Tutorial	Practical	No of Credits
1	Basic Sciences Course /BSC 102	Chemistry	30	70	175	3	1	-	5.5
		Lab.	25	50		-	-	3	
2	Basic Sciences Course /BSC 104	Mathematics-II	30	70	100	3	1	0	4
3	Engineering Science Courses/ESC103	Programming for Problem Solving	30	70	175	3	0	-	5
		Lab.	25	50				4	
4	Engineering Science Courses/ESC104	Workshop and Manufacturing Practices	30	70	175	1	0	-	3
		Lab.	25	50		-	-	4	
5	Humanities and Social Sciences including Management courses/HSMC101	English	30	70	175	2	0	-	3
		Lab.	25	50				2	
		Total Credits							20.5

In order to balance the load of the some of the subjects which are made in groups (Physics/Chemistry, Engineering Graphics & Design/ Workshop and Manufacturing Practices, Programming for Problem Solving/Engineering Mechanics), the half of the branches of B.Tech course offer one subject of group in odd semester and other half of the branches of B.Tech course offer another subject of same group in odd semester. In the even semester the subjects of the group will be exchanged

MANDATORY INDUCTION PROGRAM

BEFORE BEGINNING OF FIRST SEMESTER

3 Weeks Duration

- Physical Activity
- Creative Arts
- Universal Human Values
- Literay
- Proficiency Modules
- Lectures by Eminent People
- Visits to Local Areas
- Familiarization to Dept./Branch & Innovations

KAKATIYA UNIVERSITY
B.Tech. First Year
SEMESTER – II
(Common to all branches)

CHEMISTRY
(Theory)

***Class*: B.Tech. I Year** | ***Internal Marks*: 30**
***Lectures*: 3 Hrs/Week** | ***External Marks*: 70**

UNIT-I

1. ELECTROCHEMISTRY **(08 Hrs)**

Electrode potential, standard electrode potential, Nernst equation (No derivation); Electro chemical series. Types of electrodes - Hydrogen, Quinhydrone, Calomel, and Ion selective electrode (Glass electrode); Galvanic cell, EMF; Determination of pH using Quinhydrone and Glass electrodes; Potentiometric titrations (Acid-base and Redox). Numerical problems.

Batteries: Primary and secondary batteries - Zinc-Carbon battery & Lead-acid battery.

UNIT-II

1. **CORROSION** **(07Hrs)**

Introduction – causes and effects of corrosion. Dry and wet corrosion. Electrochemical theory of corrosion. Galvanic and differential aeration corrosion. Factors affecting rate of corrosion, Corrosion control methods- Cathodic protection – Sacrificial anode and impressed current cathodic protection. Surface coatings – metallic coatings – methods of application.

2. **WATER ANALYSIS AND TREATMENT** **(07Hrs)**

Hardness of water - Causes of hardness - Types of hardness: temporary and permanent – expression and units of hardness. Determination of hardness of water using EDTA method. Potable water and its specifications. Steps involved in treatment of water – Disinfection of water by chlorination and ozonization. Brief review of methods of softening of water - Zeolite process and Ion-exchange process. Desalination of water- Reverse osmosis.

UNIT-III

1 **Organic reactions, synthesis of a drug molecule & Stereochemistry** **(11 Hrs)**

Substitution reactions: Nucleophilic substitution reactions: Mechanism of S_N^1, S_N^2 reactions. *Electrophilic and Nucleophilic addition reactions*: Addition of HBr to propene. Markownikoff's and anti-Markownikoff's additions; Grignard additions on carbonyl compounds; *Elimination reactions*: Dehydrohalogenation of alkylhalides. Saytzeff rule. *Oxidation reactions*: Oxidation of alcohols using $KMnO_4$ and chromic acid. *Reduction reactions*: reduction of carbonyl compounds using $LiAlH_4$ & $NaBH_4$. Hydroboration of olefins. *Synthesis and applications of commonly used drug molecules*: Aspirin and Paracetamol.

Stereochemistry: Introduction to representation of 3-dimensional structures, Structural and stereoisomers, configurations, symmetry and chirality. Enantiomers, diastereomers, optical activity and Absolute configuration. Conformation analysis of n- Butane.

UNIT-IV

1. **Molecular structure and Theories of Bonding**: **(08 Hrs)**

   Atomic and Molecular orbitals: Linear Combination of Atomic Orbitals (LCAO), molecular orbitals of diatomic molecules. Molecular orbital energy level diagrams (MOED) of N_2, O_2 and F_2 molecules.

   Crystal Field Theory (CFT): Salient Features of CFT – Crystal Field Splitting of transition metal ion d- orbitals in Tetrahedral, Octahedral and square planar geometries. Band structure of solids and effect of doping on conductance.

UNIT-V

2 **Spectroscopic techniques and applications**: **(07Hrs)**

Interaction of radiation with matter, spectrum of electromagnetic radiation, Principles of spectroscopy, selection rules and applications of Electronic spectroscopy, Vibrational and Rotational spectroscopy of diatomic molecules. Applications. Numerical problems.

TEXT BOOKS:

1. Text Book of Physical Chemistry by *PL Soni and OP Dharmarha*, Sulthan Chand & Sons.
2. Engineering Chemistry by *PC Jain & M Jain*, Dhanapathi Rai publishing Co.
3. Text Book of Engineering Chemistry by *Shashi Chawla*, Dhanapathi Rai publishing Co.

REFERENCE BOOKS:

1. Principles of Physical Chemistry by *Maron and Prutton*.
2. Applied Chemistry- A Text Book of Engineers & Technologists by *HD Gesser*.
3. Chemistry in Engineering & Technology by *Kuriacose and Rajaram.*
4. Text Book of Engineering Chemistry by *CP Murthy, Agarwal and A Naidu.*
5. A Text Book of Engineering Chemistry by *SS Dara.*
6. Engineering Chemistry by *RP Mani, KN Mishra and B Ramadevi.*
7. Engineering Chemistry by *OP Agarwal.*
8. Fundamentals of Molecular Spectroscopy, by C.N. Banwell

Details about Question Paper of External Examination (Model)

Time: **3 Hrs** Marks: **70**

The question paper consists of TWO sections. (section-A & section-B)

SECTION-A (10X01=10 Marks)

Attempt **all** Questions. Each Question carries 01 Mark.

Q I: About **10** short answer type Questions from all the units. (02 Questions from each unit)

SECTION-B (05X12=60 Marks)

Attempt any **five** (**05)** Questions. Each Question carries 12 Marks.

Q II to **Q VIII**: Should be given **one** question from each unit and set to **07** Questions.

KAKATIYA UNIVERSITY
B. Tech. First Year
SEMESTER – II
(Common to all branches)

CHEMISTRY LABORATORY

(Common to all branches)

(Credits: 1.5)

***Class*: B.Tech. I Year** ***Internal Marks*: 25**

***Practical*: 3 Hrs/week** ***External Marks*: 50**

LIST OF EXPERIMENTS:

1. Determination of Hardness (Total, Temparary and Permanent) of water using EDTA method.
2. Determination of chloride content of water by Argentometry.
3. Determination of rate constant of acid catalysed hydrolysis of methyl acetate.
4. Colorimetric analysis-verification of Lambert-Beer's law using $KMnO_4$ solution.
5. Conductometric titration of HCl with NaOH
6. Conductometric titration of CH_3COOH with NaOH
7. Potentiometric titration of HCl with NaOH
8. Potentiometric titration of Fe^{2+} with $KMnO_4$
9. Verification of Freundlich adsorption isotherm-adsorption of acetic acid on charcoal.
10. Determination of viscosity of castor oil and ground nut oil by using Ostwald's viscometer.
11. Determination of surface tension of a given liquid using stalagmometer.
12. Synthesis of Urea-Formaldehyde resin polymer / Synthesis of Aspirin.

TEXT BOOKS:

1. *Vogel's* Inorganic Quantitative analysis (2007).
2. College Practical Chemistry by *VK Ahluwalia* (2007)
3. Senior Practical Physical Chemistry by *BD Khosla, A Gulati and VC Garg* (2001)
4. Practical Physical Chemistry by *B Vishwanathan, PS Raghavan.*
5. Text book on Experiments and calculations in Engineering chemistry – *S.S. Dara*
6. *Vogel*'s text book of practical organic chemistry *5th edition*

KAKATIYA UNIVERSITY
B.Tech. First Year
SEMESTER – II
(Common to all branches)

MATHEMATICS -2

(MAXIMUM HOURS: 48)

Unit 1: Integral Transforms

Laplace Transforms: Laplace transforms of elementary functions, properties, transform of derivatives, transform of integrals, multiplication by t, division by t, evaluation of integrals, inverse transforms, convolution theorem, and application to differential equations.

(21.1, 21.2, 21.3, 21.7, 21.8, 21.9, 21.10, 21.11, 21.12, 21.13, 21.14, 21.15 of Text Book)

Unit 2: Linear Algebra

Rank of a matrix, solution of linear system of equations, consistency of linear system of equations, linear independence vectors and linear dependence vectors, Eigen values and Eigen vectors, Caley Hamilton theorem, reduction to diagonal form, complex matrices, Hermition matrix and conjugate matrix.

(Sections 2.7(1), 2.9, 2.10, 2.12, 2.13, 2.14, 2.15, 2.16, 2.19 of Text Book)

Unit 3: Partial Differential Equations

Formation of partial differential equations, linear equations of first order, non-linear equations of first order, Charpit's method, homogenous equations with constant coefficients , applications (one dimensional wave equation, one dimensional heat flow, two dimensional heat flow).

(Sections 17.1, 17.2, 17.3, 17.5, 17.6, 17.7, 17.8, 18.1, 18.3, 18.4, 18.5, 18.6 of Text Book)

Unit 4: Complex Variable - Differentiation

Limit of complex functions, derivative of a complex function, analytic function, Cauchy-Reimann equations, Harmonic functions, applications to flow problems, some standard transformations.

(Sections 20.1, 20.2, 20.3, 20.4, 20.5, 20.6, 20.7, 20.8 of Text Book)

Unit 5: Complex Variables - Integration

Complex integration, Cauchy's theorem, Cauchy's integral formula, Caucly's inequality, Liouvile's theorem, Taylors series, Laurent's series, Singularities of function, residues, residue theorem, evaluation of real definite integrals (integration of trigonometric functions around unit circle, integral of functions around a semi-circle).

(Sections 20.12, 20.13, 20.14, 20.15(2,3), 20.16, 20.17, 20.18, 20.20(a, b) of Text Book)

Text Book: B.S. Grewal et.al. Higher Engineering Mathematics, 43rd Edition, Khanna Publicationns.

Reference: Erwin Kreyszig, Aadvanced Engineering Mathematics, 8th Edition , John Wiley & Sons.

KAKATIYA UNIVERSITY
B.Tech. First Year
SEMESTER – II
(Common to all branches)

Programming for Problem Solving

Teaching Scheme				Examination Scheme
L	**T**	**P**	**C**	**Internal marks: 30**
3	**-**	**4**	**5**	**External marks:70**

UNIT-I: (6+2)

Introduction:
Block Diagram of Computer, Number system (Binary, Octal and Hexa decimal), Input-Output devices.
Operating system definition goals and services, compliers and interpreter, Problem solving steps, Algorithms, Flow chart, Types of programming languages, Introduction to C –language.

Unit-II: (7+3)

Fundamentals of C-language:
Token of C-languages: Identifiers, key words, Constants, Data types, Declaration and initialization statements, compound statements, Operators, Expressions and evaluation, Type conversion, Input-output statements, Structure of C-program.

Unit-III: (7+3)

Control structures/statements:
Decision statements: if, if-else, if-else-if, nested-if and switch-case
Iterative statements: while, do-while and for
Unconditional branching statements: break, continue, goto and exit .

Unit-IV: (7+3)

Arrays and Pointers:
Arrays: Definition of Arrays, 1-Dimensional arrays, 2-Dimensional arrays and multi dimensional arrays, Strings, String handling functions.
Pointers: Definition and declaration of pointer, operation on pointers, pointer and arrays, pointer to functions

Unit-V: (7+3)

Structure-Union: Definition and syntax of structure, union, Comparison between union & structure, nested structures, array of structures, pointer to structures.
Functions: Definition, function prototype, library and user define functions, types of functions, storage classes, parameter passing methods (call by value and call by address), recursion and macros.
Files: Introduction, File modes, Input and out operations on files.

TEXT BOOKS:

1. Let Us C, 14th Edition, Yashavant P. Kanetkar, BPB Publications, ISBN 13: 9788183331630.
   Herbert Schildt, "C: The complete reference", Osbourne Mcgraw Hill, 4th Edition, 2002.

2. C Programming Language, Brian W. Kernighan and Dennis M. Ritchie, Prentice-Hall, ISBN 0-13-110362-8

TEXT/REFERENCE BOOKS:

1. Programming in ANSI C, SIXTH edition, E.Balaguru Swamy, Tata McGraw Hill Pvt Ltd, ISBN-10: 1259004619.
2. Computer Science: A Structured Programming Approach Using C, B.A.Forouzan and R.F. Gilberg, Third Edition, Cengage Learning.
3. Programming in C. Second Edition, Reema Thareja, ISBN: 9780199456147, Oxford University Press.

KAKATIYA UNIVERSITY
B.Tech. First Year
SEMESTER – II
(Common to all branches)

PROGRAMMING FOR PROBLEM SOLVING LAB USING C

Teaching Scheme				Examination Scheme
L	T	P	C	Internal Marks: 25
-	-	4	2	External Marks: 50

LIST OF EXPERIMENTS

1. Programs using input output functions
2. Programs for declaration statement, initialization statement, data type conversions
3. Programs using all operators in C
4. Programs using conditional control structures; if, if-else, nested if, if else if ladder and switch
5. Programs using loop control structures: while, do-while, for,
6. Programs using unconditional statements : break, continue, goto
7. Programs on one dimensional array and two dimensional arrays
8. Programs using functions: different types, parameter passing using call-by-value, call-by-reference
9. Programs using recursion
10. Programs using strings and sharing handling functions
11. Programs using pointers, pointers to arrays, pointer to functions
12. Programs using structures and unions

KAKATIYA UNIVERSITY
B.Tech. First Year
SEMESTER – II
(Common to all branches)

ENGINEERING WORKSHOP

1. TRADES FOR EXERCISES:

At least two exercises from each trade:

I. Carpentry –

1. Study of Carpentry Tools, Equipment and different joints.
2. Practice of Cross Half lap joint, Half lap Dovetail joint and Mortise Tenon Joint

II. Fitting –

1. Preparation of square-Fit as per the given specifications.
2. Preparation of Dovetail Fit as per the given specifications.
3. Preparation of Semi-circular as per the given specifications.

III. Foundry –

1. Introduction to foundry, Patterns, pattern allowances, ingredients of moulding sand and melting furnaces. Foundry tools and their purposes
2. Demo of mould preparation
3. Practice – Preparation of mould by using split pattern.

IV. Welding Practice –

1. Introduction, Study of Tools and welding Equipment (Gas and Arc welding)
2. Selection of welding electrode and current, Bead practice.
3. Practice of Butt Joint, Lap Joint. VI. House-wiring – (Parallel & Series, Two-way Switch and Tube Light)

V. Plumbing:

1. Practice of Internal threading, external threading, pipe bending, pipe fitting.
2. Pipes with coupling for same diameter and with reducer for different diameters.
3. Practice of T-fitting, Y-fitting, Gate valves fitting.

KAKATIYA UNIVERSITY
B.Tech. First Year
SEMESTER – II
(Common to all branches)

English

Course Code	HSMC 101				
Category	Humanities and Social Sciences Including Management Courses				
Course Title	**English**				
Scheme and Credits	L	T	P	Credits	Semester-II
	2	0	2	3	
Exam Pattern	Internal 30 Marks and External: 70 Marks				
Course Completion	Max 48 Hours				

Unit 1. Vocabulary Building

1.1 The concept of Word Formation
1.2 Root words from foreign languages and their use in English
1.3 Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives.
1.4 Synonyms, antonyms, and standard abbreviations.

Unit 2. Basic Writing Skills

2.1 Sentence Structures
2.2 Use of phrases and clauses in sentences
2.3 Importance of proper punctuation
2.4 Creating coherence
2.5 Organizing principles of paragraphs in documents
2.6 Techniques for writing precisely

Unit 3. Identifying Common Errors in Writing

3.1 Subject-verb agreement
3.2 Noun-pronoun agreement
3.3 Misplaced modifiers
3.4 Articles
3.5 Prepositions
3.6 Redundancies
3.7 Clichés

Unit 4. Nature and Style of sensible Writing

4.1 Describing
4.2 Defining
4.3 Classifying
4.4 Providing examples or evidence
4.5 Writing introduction and conclusion

Unit 5. Writing Practices

5.1 Comprehension
5.2 Précis Writing
5.3 Essay Writing

PRACTICALS/LAB: Oral Communication
(This unit involves interactive practice sessions in Language Lab)

- Listening Comprehension
- Pronunciation, Intonation, Stress and Rhythm
- Common Everyday Situations: Conversations and Dialogues
- Communication at Workplace
- Interviews
- Formal Presentations

Prescribed Text Book
Language and Life: A Skills Approach, Orient Blackswan 2018

Suggested Readings:
(i) Practical English Usage. Michael Swan. OUP. 1995.
(ii) Remedial English Grammar. F.T. Wood. Macmillan.2007
(iii) On Writing Well. William Zinsser. Harper Resource Book. 2001
(iv) Study Writing. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.
(v) Communication Skills. Sanjay Kumar and PushpLata. Oxford University Press. 2011.
(vi) Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press

Faculty of Engineering &Technology
KAKATIYA UNIVERSITY, WARANGAL-506009
Department of Mechanical Engineering

B. Tech. (ME) III SEMISTER

Sl. No	Category/ Code	Course Title	L	T	P	Credits
1	BSC-105	Mathematics - III	3	0	0	3
2	MC-210	Environmental Science	2	0	0	0
3	ME-211	Thermodynamics	3	0	0	3
4	ME-212	Mechanics of Solids	3	0	0	3
5	ME-213	Material Science and Metallurgy	3	0	0	3
6	ME-214	Manufacturing Science	3	0	0	3
7	ME-215L	Material Testing and Metallurgy Lab	0	0	3	1.5
8	ME-216L	Manufacturing Science Lab	0	0	3	1.5
9	ESC-106	Applied Electronics	3	0	0	3
10	ESC-106L	Applied Electronics Lab	0	0	3	1.5
		Total Contact Hours	29			22.5

Faculty of Engineering &Technology
KAKATIYA UNIVERSITY, WARANGAL-506009
Department of Mechanical Engineering

B. Tech. (ME) III SEMISTER
BSC-105
Mathematics - III

Statistics, Probability, and Numerical Techniques

Teaching Scheme				Examination Scheme
L	T	P	C	Internal Marks: 30
3	0	0	3	External Marks: 70

Module1: Statistical Methods

Introduction, Collection of Data, Graphical Representation, Measures of Dispersion, Moments, Skewness, Kurtosis, Correlation, Coefficient of Correlation, Lines of Regression.

(Sections 25.1, 25.2, 25.3, 25.6, 25.9, 25.10, 25.11, 25.12, 25.13, 25.14 of Text Book)

Module2: Probability & Distributions

Probability, Addition Law of Probability, Independent Events, Baye's Theorem , Random Variable, Continuous Probability Distribution, Expectation, Moment Generating Function, Binomial Distribution , Poisson Distribution, Normal Distribution, Exponential Distribution. (Sections26.1,26.4,26.5,26.6,26.7,26.9,26.10,26.11,26.14,26.15,26.16,26.19(6) of Text Book)

Module3: Numerical Techniques-I

Solution of Algebraic and Transcendental Equations, Principle of Least Squares, Method of Least Squares, Fitting of Other Curves, Finite Differences, Forward Differences, Backward Differences. (Sections 28.2, 24.4, 24.5, 24.6, 30.2, 30.2(1), 30.2(2) Of Text Book)

Module4: Numerical Techniques-II

Central Differences, Other Difference Operators, Newton's Interpolation Formulae, Gauss's Forward Interpolation Formula, Interpolation with Unequal Intervals, Numerical Differentiation. Sections 29.7, 29.4, 29.6, 29.7(1), 29.9, 30.1.of Text Book)

Module5: Numerical Techniques-III

Numerical Integration, Trapezoidal Rule, Simpson's one –third Rule, Simpson's three-eight Rule, Weddle's Rule, Solution of Simultaneous Linear Equations (Iterative Methods)

(Sections 30.4, 30.6, 30.7, 30.8, 30.10, 28.5 of Text Book)

Text Book:

B.S Grewal, Higher Engineering Mathematics, 43rd Edition, Khanna Publications.

References

1. Erwin Kreyszig, Advanced Engineering Mathematics, 8th Edition, John Wiley & Sons

2. S.C. Gupta, V.K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand &Sons

3. S.S. Sastry, Introductory Methods of Numerical Analysis, PHI Learning Pvt. Ltd.

Faculty of Engineering & Technology
KAKATIYA UNIVERSITY, WARANGAL-506 009
Department of Mechanical Engineering

B. Tech. (ME) III SEMISTER
MC 210
ENVIRONMENTAL SCIENCES

Teaching Scheme				Examination Scheme	
L	**T**	**P**	**C**	CIE	ESE
2	0	0	0	30 Marks	70 Marks

UNIT–I (8)

Introduction to Environmental Science: Environment and society, major environmental issues: Ozone layer depletion, Acid rains, global climate change etc, sustainable development,
Environmental impact assessment, environmental management

Natural Resources Utilization and its Impacts: Energy, minerals, water and land resources, Resource consumption, population dynamics, urbanization..

UNIT–II (8)

Ecology and Biodiversity: Energy flow in ecosystem, food chain, nutrient cycles, eutrofication value of biodiversity, biodiversity at global, national and local levels, threats for biodiversity, conservation of biodiversity.

UNIT–III (8)

Water Pollution: Sources, types of pollutants and their effects, water quality issues, contaminanttransport, self-purification capacity of streams and water bodies, water quality standards, principles of water and wastewater treatment.

UNIT–IV (8)

Air Pollution: Sources, classification and their effects, Air quality standards, dispersion of pollutants, control of air pollution, automobile pollution and its control.

UNIT–V (8)

Solid Waste Management: Sources and characteristics of solid waste, effects, Collection and transfer system, disposal methods.

Text Books:

1. M. Chandrasekhar, Environmental science, Hi Tech Publishers, 2009.
2. P.N. Modi (2006), Water supply Engineering – Environmental Engineering (Vol. I) – Standard Book House.
3. Gerard Kiely, Environmental Engineering, McGraw Hill Education Pvt Ltd, Special Indian Edition, 2007.

References:

1. W P Cunningham, M A Cunningham, Principles of Environmental Science, Inquiry and Applications, Tata McGraw Hill, Eighth Edition, 2016.

Faculty of Engineering &Technology
KAKATIYA UNIVERSITY, WARANGAL-506009
Department of Mechanical Engineering

B. Tech. (ME) III SEMISTER
ME - 211
THERMODYNAMICS

Course code	PCC				
Category	Professional Core Course				
Course title	**Thermodynamics**				
Scheme and Credits	L	T	P	Credits	Internal marks = 30
	3	0	-	3	External Marks = 70

UNIT-I

Concepts of System, **Surroundings and Universe**. Types of systems. Classification of Properties- fundamental and secondary, intensive and extensive. Basic laws of Thermodynamics. Thermodynamic equilibrium. Types of thermodynamic processes and their representation on P-V and T-s plots. Types of cycles- Open and Closed. Ideal Gases- Equation of State. Specific Heats, Enthalpy, Internal energy, & Entropy. Real Gases-vander Waals Equation of State, Compressibility Factor.

UNIT-II

First Law analysis of Closed Systems: First law of thermodynamics. Heat and work transfers. Energy conservation equation for a closed system. Calculation of Work Transfer, Heat Transfer, and Internal Energy changes.

First Law analysis of Open Systems: Derivation of Unsteady Flow Energy Equation (UFEE) and Steady Flow Energy Equation (SFEE). Calculation of Work Transfer, Heat Transfer, and Enthalpy changes. Thermodynamic analysis of flow through Nozzles, Diffusers, Turbines, Compressors, Throttling devices and Heat Exchangers.

Application of Unsteady Flow Energy Equation (UFEE) : Calculation of Heat transfer during charging /evacuation of a Cylinder.

UNIT-III

Carnot Cycle- Thermodynamic analysis of Carnot Cycle. Applications of Carnot cycle -Heat Engine, Heat Pump and Refrigerator.

Second Law of Thermodynamics: Statements of Second Law of thermodynamics. Equivalence of Kelvin-Planck and Clausius Statements. Clausius Inequality, Carnot Theorems, Thermodynamic Temperature Scale.
Concept of Entropy: Reversible and Irreversible processes. Calculation of Entropy change during various thermodynamic processes. Principle of Increase of Entropy. Second law analysis of a control Volume.

Concepts of Exergy and Anergy: Loss in available energy. Second law efficiency of Turbines and Compressors.

UNIT-IV

Pure Substances. Concept of Phase Change. Graphical representation of thermodynamic processes on P-V, P-T, T-V, T-s, h-s, P-h and P-V-T diagrams. Thermodynamic relations involving Entropy, Enthalpy and Internal Energy. Derivation of Maxwell's relations. Clapeyron equation.

Properties of Steam- Use of Steam Tables and Mollier diagram. Power Plant Cycles-Carnot and Rankine Cycles and their representation on P-V, T-s and h-s diagrams. Evaluation of performance parameters–Efficiency, Work ratio, Specific Steam Consumption and Heat Rate.

UNIT-V

Non reactive Ideal homogenous gas Mixtures: Determination of properties of Mixture in terms of properties of individual components of the mixture. Gibbs Phase Rule.

Psychrometry : Moist Air Properties. Use of Psychrometric Chart and Tables.

Concept of Air-Conditioning: Heating, Cooling, Humidification and De-humidification and other psychrometric processes. Adiabatic Mixing of two Streams of Moist Air. Sensible heat factor and Bypass factor for heaters/coolers. Introduction to summer and winter air-conditioning processes with a brief overview on devices used in Air Conditioning.

TEXT BOOKS

1. Yunus Cengel, Michael Boles "*Thermodynamics: An Engineering Approach"*, McGraw-Hill Education; 8 edition, 2017
2. Nag P.K, "*Engineering Thermodynamics'*: Tata McGraw Hill Publishing, 6th Edn, 2017.

REFERENCE BOOKS:

1. Richard E.Sonntag, C.Borgnakke, G.J Van Wylen, *"Fundamentals of Thermodynamics':* John Wiley & Sons, 7th Edn., 2009.
2. Rajput R K, " *Engineering Thermodynamics*" Laxmi Publications, 4th Edition, 2016
3. Fundamentals of Classical Thermodynamics by G. Van Wylan& R.E. Sonntag, John Wiley Pub.6. Thermodynamics by Achutan, PHI.

Faculty of Engineering &Technology
KAKATIYA UNIVERSITY, WARANGAL-506009
Department of Mechanical Engineering

B. Tech. (ME) III SEMISTER
ME - 212
MECHANICS OF SOLIDS

Course code	PCC				
Category	Professional Core Course				
Course title	**Mechanics of Solids**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	Internal marks = 30
	3	**0**	**-**	**3**	External Marks = 70

UNIT-I:

SIMPLE STRESSES AND STRAINS: Elasticity and plasticity – Types of stresses and strains – Hooke's law –stress – strain diagram for mild steel – Working stress – Factor of safety – Lateral strain, Poisson's ratio and volumetric strain – Elastic moduli and the relationship between them – Bars of varying section – composite bars –Temperature stresses. Strain energy – Resilience – Gradual, sudden, impact and shock loadings. Principal stresses, principal planes, the Mohr Diagram, Plane-Stress and Plane-Strain conditions.

UNIT-II:

SHEAR FORCE AND BENDING MOMENT: Definition of beam – Types of beams – Concept of shear force and bending moment – S.F and B.M diagrams for cantilever, simply supported and overhanging beams subjected to point loads , U.D.L, uniformly varying loads and combination of these loads – Point of contra flexure – Relation between S.F., B.M and rate of loading at a section of a beam.

UNIT-III:

FLEXURAL STRESSES:
Theory of simple bending – Assumptions Derivation of bending equation: $M/I=\sigma/y=E/R$ Neutral axis – Determination bending stresses – section modules of rectangular and circular sections (Solid and Hollow),I, T, Angle and Channel sections – Design of simple beam sections. Shear Stresses: Derivation of formula – Shear stress distribution across various beams sections like rectangular, circular, triangular, I, T angle sections.

UNIT-IV:

DEFLECTION OF BEAMS: Bending into a circular arc – slope, deflection and radius of curvature – Differential equation for the elastic line of a beam – Double integration and Macaulay's methods – Determination of slope and deflection for cantilever and simply supported beams subjected to point loads, - U.D.L. uniformly varying load. Mohr's theorems – Moment area method – application to simple cases including overhanging beams.

TORSION OF CIRCULAR SHAFTS: Theory of pure torsion in solid and hollow circular shafts, torsional shear stresses and angle of twist, transmission of power, compound shafts, torsion of tapered shafts.

UNIT-V:

THIN CYLINDERS: Thin seamless cylindrical shells – Derivation of formula for longitudinal and circumferential stresses – hoop, longitudinal and volumetric strains – changes in diameter, and volume of thin cylinders – Riveted boiler shells – Thin spherical shells.

THICK CYLINDERS : Lame's equation – cylinders subjected to inside and outside pressures – compound cylinders.

TEXT BOOKS:

1. Strength of Materials by Andrew Pytel and Ferdinond L. Singer: Longman Publications
2. Strength of Materials by Jondar :Galgotia Publications

REFERENCE BOOKS:

1. Strength of Materials by Bansal, Lakshmi Publications
2. Strength of Materials by S. Tumoshenko
3. Strength of Materials by R.S. Khurmi; S. Chand & Co. 2005

Faculty of Engineering &Technology
KAKATIYA UNIVERSITY, WARANGAL-506009
Department of Mechanical Engineering

B. Tech. (ME) III SEMISTER
ME - 213
MATERIAL SCIENCE & METALLURGY

Course code	PCC				
Category	Professional Core Course				
Course title	**Material Science and Metallurgy**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	Internal marks = 30
	3	**0**	**-**	**3**	External Marks = 70

UNIT–I

Crystal Structure: Unit cells, Metallic crystal structures. Imperfection in solids: Point, line, interfacial and volume defects;

Fracture: Types of fracture in metals, modes of fracture, Ductile and brittle failure mechanisms, Griffith criterion for brittle materials.

Creep: Creep strength, Creep curve, Creep Test.

Fatigue: SN curve, endurance limit, Experimental determination of Fatigue strength.

UNIT-II

Plain Carbon Steels ,Alloying of steel, properties of stainless steel and tool steels, maraging steels; cast irons: grey, white, malleable and spheroidal cast irons;

Non-ferrous metals: Copper and copper alloys, Aluminium and Al-Cu–Mg alloys, Nickel based super alloys and Titanium alloys

UNIT-III

Ceramics - Crystalline ceramics, Glasses, Properties and applications of ceramics;

Polymers - Polymerization, Thermoplastics and thermosetting plastics, Properties and applications of polymers; Methods of processing of plastics;

Composites - Concept of composites, Matrix and reinforcement, Rule of mixtures, Classification of composites, Applications of composites.

UNIT-IV

Phase diagrams: Substitutional and interstitial solid solutions. Interpretation of binary phase diagrams and microstructure development; eutectic, peritectic, peritectoid and monotectic reactions. Iron Iron-carbide phase diagram and microstrctural aspects of ledeburite, austenite, ferrite and cementite, cast iron.

UNIT-V

Heat Treatment of steel: Annealing, Normalizing, Hardening, Tempering. isothermal transformation diagrams for Fe-C alloys and microstructure development. Continuous cooling curves and interpretation of final microstructures and properties. Austempering and Martempering. Case Hardening: Carburizing, Nitriding, Carbo-nitriding, Flame Hardening, Induction Hardening.

TEXT BOOKS:

1. W. D. Callister, 2007, adapted by R.Balasubramaniam, “Materials Science and Engineering”, 7th Edition, Wiley India.
2. Kodgire V.D, Kodgire S.V., “Material Science and Metallurgy For Engineers” Everest Publishing House, 42nd Edition, 2018

REFERENCE BOOKS:

1. Kenneth G. Budinski and Michael K. Budinski, “Engineering Materials”, Prentice Hall of India Private Limited, 4th Indian Reprint, 2002.
2. Avner S.H, "Introduction to Physical Metallurgy", McGraw Hill Publishing Co. Ltd., 2nd Edition, 1974.
3. Nayak S.P, "Engineering Metallurgy And Material Science”: Charotar Publishing House, 6th Edn., 1995.
4. Raghavan V, "Material Science and Engineering", Prentice Hall of India Ltd., 4th Edition, 199

Faculty of Engineering &Technology
KAKATIYA UNIVERSITY, WARANGAL-506009
Department of Mechanical Engineering

B. Tech. (ME) III SEMISTER
ME - 214
MANUFACTURING SCIENCE

Course code	PCC				
Category	Professional Core Course				
Course title	**Manufacturing Science**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	Internal marks = 30
	3	**0**	**-**	**3**	External Marks = 70

UNIT-I

Introduction to Casting: Molding Sands, Properties of sands, Testing of Sand properties and their improvements. Types of patterns and pattern materials, Pattern allowances. Core sands, core sand properties and core making processes. Machine Moulding techniques. Riser and Riser size estimation Chvorinov and Caine's rules. Types gates and components of gating system. Theory of solidification. Introduction to Furnaces: Cupola, Arc and Induction.

UNIT-II

Special Casting Processes: Shell Mould Casting, Co2 Casting, Investment Casting, Gravity and Pressure Die Casting, Centrifugal Casting and Continuous Casting. Cleaning of Castings, Casting defects and their Causes. Processing of Plastics: Blow molding, Injection molding, Reaction injection molding, Rotational molding and Extrusion. Manufacturing of Composites: Hand lay-up, Filament winding, Compression molding, Resin infusion molding

UNIT-III

Sheet Metal Working: Geometry of Punch and Die for Blanking/Piercing operations, Cup Drawing, Strip Layout, Force Calculations. Metal spinning. High Energy Rate Forming: Explosive forming, Magnetic forming, Electro-hydraulic forming and Rubber pad forming.

UNIT - IV

Bulk Deformation Processes: Simple Estimation of Forces in Forging, Rolling, Rod Drawing and Extrusion. Hydrostatic Extrusion. Powder Metallurgy: Powder production methods, steps in powder metallurgy processes, cold and hot isostatic pressing, typical industrial applications.

UNIT-V

Gas Welding: Oxy-Acetylene Welding-Basic set up, Welding and Cutting Torches, Types of Flames. Arc Welding: Schematics of SMAW, GTAW, GMAW, PAW, SAW, LBW and EBW, Electrode Coatings and Electrode Specifications. Resistance Welding: Spot, Seam, Projection and butt welding, Flash welding. Solid State Welding: Pressure Welding, Ultrasonic Welding, Friction welding and Explosive welding. Basics of soldering and brazing.

TEXT BOOKS:

1. P.N.Rao, "Manufacturing Technology," Vol. 1, Tata McGraw Hill Publ., 3nd Ed., 2011.
2. Amitabh Ghosh & Mallick, "Manufacturing Science", Assoc. East west Press Pvt. Ltd. 4th Ed., 2011.

REFERENCE BOOKS:

1. Serope Kalpakjian, "Manufacturing Engineering and Technology", Addison, Wesley Publishing Company, 2006
2. Kaushish J.P, "Manufacturing Processes", PHI Learning Pvt. Ltd., 2nd, 2010

Faculty of Engineering &Technology
KAKATIYA UNIVERSITY, WARANGAL-506009
Department of Mechanical Engineering

B. Tech. (ME) III SEMISTER
ME – 215L
MATERIAL TESTING AND METALLURGY LAB

Course code	PCC				
Category	Professional Core Course				
Course title	Material Testing and Metallurgy Lab				
Scheme and Credits	L	T	P	Credits	Internal marks = 25
	-	-	3	1.5	External Marks = 50

List of Experiments in Mechanics of solids lab:

1. Preparation and study of Crystal models.
2. To study the stress -strain characteristics of (a) Mild Steel and (b) Tor steel by conducting tension test on U.T.M
3. Impact testing- Izod and Charpy
4. Hardness testing on various materials (a) Steel (b) Brass (c) Aluminium (d) Copper
5. Determination of Young's modulus by deflection method
6. To find the Modulus of rigidity of the material of a spring by conducting Compression and Tension test.

List of Experiments in Metallurgy lab:

1. Study of Crystal Structures, Metallurgical Microscope, Iron-Iron Carbide diagram
2. Sample Preparation techniques for Metallographic Analysis
3. Grain size measurement
4. Metallographic Study of Pure Iron, Low carbon steel
5. Metallographic Study of Medium carbon steel
6. Metallographic Study of Hyper Eutectoid steel
7. Metallographic Study of Wrought iron
8. Metallographic Study of Grey cast iron
9. Metallographic Study of White cast iron
10. Metallographic Study of Black heart/ White heart Malleable cast iron
11. Metallographic Study of Copper alloy
12. Metallographic Study of Aluminium alloy
13. Determination of hardenability by Jominy Quench Test
14. Study of microstructure after hardening, normalizing and annealing of steel specimen.

Note: Any ten experiments can be conducted

Faculty of Engineering &Technology
KAKATIYA UNIVERSITY, WARANGAL-506009
Department of Mechanical Engineering

B. Tech. (ME) III SEMISTER
ME – 216L
MANUFACTURING SCIENCE LAB

Course code	PCC				
Category	Professional Core Course				
Course title	**MANUFACTURING SCIENCE LAB**				
Scheme and Credits	L	T	P	Credits	Internal marks = 25
	-	-	3	1.5	External Marks = 50

LIST OF EXPERIMENTS:

Foundry:

1. Study of foundry setup, equipment and the displayed charts with particular attention to moulding machines, sand muller, shell moulding machine & centrifugal casting machine.
2. Mixing and preparation of molding sand samples, Testing of greensand properties.
3. Preparation of molding sand aggregate and simple moulds of greensand complete with sprues,
4. gates and risers.
5. Exercise of melting and casting involving prepared moulds, aluminium metal and crucible furnace. Cleaning of castings, study of the features of the final casting, its features and any visible defects.
6. Experimental Study of blow moulding.
7. Experimental study of centrifugal casting

Welding:

1. Study of the welding equipment and tools related to Arc, gas and resistance welding & displayed charts.
2. Practice of Arc, Resistance Spot, Resistance Butt and Gas welding. Identification of different types of gas flames.

3. Experimental study of
   (a) Electrode characteristics of SMAW.
   (b) Arc length and welding speed on bead characteristics.
   (c) Welding current on bead penetration.
4. Determination of weld characteristics using DC and AC power sources.
5. TIG and MIG welding process - study and exercises.

Forming:

1. Study of the forming equipment: Different types of mechanical presses and hammers, Metal spinning Lathe.
2. Conventional extrusion of metals.
3. Study of sheet metalworking dies and sheet metal working with existing dies.
4. Testing of metals: Fatigue tests. Testing of sheet metals for formability by using Erichson cupping test.
5. Study of HERF processes. Sheet metal forming with water hammer forming equipment

Faculty of Engineering &Technology
KAKATIYA UNIVERSITY, WARANGAL-506009
Department of Mechanical Engineering

B. Tech. (ME) III SEMISTER
ESC – 106
APPLIED ELECTRONICS

Course code	ESC				
Category	Engineering Science Course				
Course title	**APPLIED ELECTRONICS**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	Internal marks = 30
	3	**0**	**-**	**3**	External Marks = 70

UNIT-I

Characteristics of PN Junction: Half wave rectifier, Full wave rectifier, filters, ripple, regulation, TIF and efficiency, Zener diode and Zener diode regulators. CRT construction and CRO applications

UNIT-II

Bipolar and Field Effect Transistors : Biasing FET , small signal model, h-parameter equivalent circuits, basic amplifier circuits-CB,CE,CC configurations of BJT and CG,CS and CD configurations of FETs, RC-coupled amplifier and its frequency response.

UNIT-III

Feedback Concepts: Types of negative feedback-modification of gain, bandwidth, input and output impedances-applications; Oscillators: RC phase shift, Wien bridge, LC and Crystal Oscillators.

UNIT-IV

Operational Amplifier: Characteristics, applications, Differential amplifiers, logic gate circuits-Introduction to Digital Systems-AND,NAND,NOR,XOR gates, Binary half wave adder, full adder, Multi-vibrators-Bi-stable, Mono-stable and Astable Multi-vibrators (Qualitative treatment only),Schmitt trigger.

UNIT-V

Data Acquisition Systems: Construction and Operation of transducers-Strain gauge LVDT, Thermocouple, Instrumentation Systems, Magnetic tape recorders, FM recording, Digital recording, Digital to Analog and Analog to Digital conversions.

TEXT BOOKS:

1. Robert Boylestad L. and Louis Nashelsky, *Electronic Devices and Circuit Theory*, Prentice Hall of India, 2007.

2. Helfrick D and David Cooper, *Modern Electronic Instrumentation and Measurements Techniques*, 1st edition, Prentice Hall of India, 2006.

3. Salivahanan, Suresh Kumar and Vallavaraj, *Electronic Devices and Circuits*, 2nd edition, Tata McGraw-Hill, 2010.

Faculty of Engineering &Technology
KAKATIYA UNIVERSITY, WARANGAL-506009
Department of Mechanical Engineering

B. Tech. (ME) III SEMISTER
ESC – 106L
APPLIED ELECTRONICS LAB

Course code	ESC				
Category	Engineering Science Course				
Course title	**APPLIED ELECTRONICS LAB**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	Internal marks = 25
	0	**0**	**3**	**1.5**	External Marks = 50

List of Experiments:

1. CRO-Applications, Measurements of R, L and C using LCR meter, Color code method and soldering practice.
2. Characteristics of Semiconductors diode (Ge, Si and Zener)
3. Static Characteristics of BJT-Common Emitter
4. Static Characteristics of BJT-Common Base
5. Static Characteristics of FET
6. RC-Phase Shift Oscillator
7. Hartley and Colpitts Oscillators
8. Common Emitter Amplifier
9. Astable Multivibrator
10. Full-wave rectifier with and without filters using BJT
11. Operational Amplifier Applications
12. Strain Guage Measurement
13. Analog-to-Digital and Digital to Analog Converters

Faculty of Engineering &Technology
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B. Tech. (ME) IV SEMISTER

Sl. No	Category / Code	Course Title	L	T	P	Credits
1	ME-220	Thermal Engineering	3	0	0	3
2	ME-220L	Thermal Engineering Lab- I	0	0	2	1
3	MC-220	Constitution of India	2	0	0	0
4	ME-221	Machine Tools &Metrology	3	0	0	3
5	ME-222	Design of Machine Elements-I	3	0	0	3
6	ME-223	Instrumentation and Control system	3	0	0	3
7	ME-224	Kinematics of Machinery	3	0	0	3
8	ME-221L	Machine Tools &Metrology Lab	0	0	3	1.5
9	ME-225L	Machine Drawing	0	0	3	1.5
		Total Contact Hours			25	19

Faculty of Engineering &Technology
KAKATIYA UNIVERSITY, WARANGAL-506009
Department of Mechanical Engineering

B. Tech. (ME) IV SEMISTER
ME-220
THERMAL ENGINEERING

Course code	PCC				
Category	Professional Core Course				
Course title	**THERMAL ENGINEERING**				
Scheme and Credits	L	T	P	Credits	Internal marks = 30
	3	0	-	3	External Marks = 70

UNIT-I

Reciprocating Air Compressors: Classification and applications. Ideal and actual P-V diagrams, work input and efficiency relations for single and multi stage compressors. Effect of clearance volume on work input and efficiency. Inter cooling and after cooling concepts.

UNIT-II

Internal Combustion Engines: Classification and applications. Working principles of four stroke and two stroke engines, Spark Ignition and Compression ignition engines. Deviation of actual cycles from Air Standard cycles. Performance parameters of I.C. Engines. Heat balance sheet of I. C. Engine. Overview of Engine supporting systems- Cooling Systems, Lubrication systems- Wet sump, Dry sump and Mist Systems. Working principles of S.I. Engine fuel systems- Carburetors, Battery and Magneto Ignition systems. Working principles of C.I. Engine fuel systems- Fuel pump and Fuel injector.

UNIT-III

I.C. Engine Combustion phenomena: Stages of combustion in S.I. Engines- Ignition delay, Flame front propagation and After burning. Abnormal combustion- Pre-ignition and Knocking. Factors affecting Knocking. Stages of combustion in C.I. Engines, Delay period, Period of Uncontrolled Combustion, Period of Controlled Combustion and after burning. Abnormal Combustion-Knocking. Factors affecting Knocking. Octane and Cetane rating of fuels. Design considerations for combustion chamber and cylinder head. Type of combustion chambers of S.I. engines and C.I. engines.

UNIT-IV

Steam Boilers: Classification and Working Principles. Water tube boilers- Babcok & Wilcox and Stirling boilers. Fire tube boilers- Cornish, Cochran, Locomotive and Lancashire boilers. High Pressure boilers / Supercritical boilers: La mont, Benson boiler, Loeffler boiler and Velox boiler. Boiler Mountings and Accessories: Working Principles of Water level indicator, Pressure gauge,

Steam stop valve, Feed check valve, Blow-off cock, Fusible plug, Safety valves, Economizers, Superheaters and Steam separator. Steam Condensers: Jet and Surface condensers, Principle of Operation and Applications.

UNIT-V

Steam power plant cycles: Carnot and Rankine cycles of operation and their efficiencies. Analysis of Rankine cycle with superheating, reheating and regeneration (Direct and Indirect types). Steam Nozzles: Flow of steam through convergent - divergent nozzles, velocity of steam flowing through the nozzle, mass of steam discharge through the nozzle, condition for maximum discharge, critical pressure ratio and nozzle efficiency. Super saturated expansion of steam through nozzles. General relationship between area, velocity and pressure in Nozzle flow.

Text books:

1. R.K. Rajput, *"Thermal Engineering"*, Laxmi Publications, 10th Edn. 2018
2. V. Ganesan, *"Internal Combustion Engines"*, Tata McGraw Hill Publishing, 4th Edn, 2017

References Books:

1. P.L. Ballaney, " *Thermal Engineering: Engineering Thermodynamics & Energy Conversion Techniques*" Khanna Publishers, 19th Edn, 2005.
2. Richard Stone, "*Introduction to I.C. Engines*", Palgrave Mac Millan, 4th Edn., 2012

Faculty of Engineering &Technology
KAKATIYA UNIVERSITY, WARANGAL-506009
Department of Mechanical Engineering

B. Tech. (ME) IV SEMISTER
ME-220L
THERMAL ENGINEERING Lab-I

Course code	PCC				
Category	Professional Core Course				
Course title	**THERMAL ENGINEERING Lab-I**				
Scheme and Credits	L	T	P	Credits	Internal marks = 25
	0	0	2	1	External Marks = 50

LIST OF EXPERIMENTS:

1. To determine valve / port timing diagram of a diesel/ petrol engine
2. To conduct performance test on diesel engine
3. To conduct heat balance test on diesel engine
4. To conduct performance test on petrol engine
5. To conduct heat balance test on petrol engine
6. To determine the viscosities of lubricating oils
7. To determine the flash point and fire points of fuels
8. To conduct Performance test on VCR engine
9. To conduct Heat balance test on VCR engine
10. To conduct the Morse test on multi cylinder Petrol Engine.
11. To determine volumetric efficiency and mass flow rates of a two stage reciprocating air compressor.

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B. Tech. (ME) IV SEMISTER
MC 220
CONSTITUTION OF INDIA

Course code	MC				
Category	Mandatory Course				
Course title	CONSTITUTION OF INDIA				
Scheme and Credits	L	T	P	Credits	Internal marks =30
	2	0	0	0	External Marks = 70

UNIT -1: 1. Making of Indian Constitution - Constituent Assembly
2. Historical Perspective of the Constitution of India
3. Salient Features and characteristics of the Constitution of India

UNIT -2: 1. The Fundamental Rights
2. The Fundamental Duties and their Legal Status
3. The Directive Principles of State Policy – Their Importance and Implementation

UNIT -3: 1. Federal Structure and Distribution of Administrative, Legislative and Financial Powers between the Union and the States
2. Parliamentary Form of Government in India – The Constitutional Powers and Status of the President of India
3. Amendment of the Constitutional Provisions and Procedure

UNIT -4: 1.The Judiciary
2. Constitutional and Legal Frame Work for Protection of Environmental in Global and National Level
3. Corporate Social Responsibility (CSR) International and National Scenario.

Text books:

1. D.D. Basu: An Introduction of Indian Constitution
2. Greanvile Austin: The Indian Constitution
3. Paras Diwan: Studies on Environmental cases

References Books:

1. Khannna Justice.H.R: Making of India's Constitution, Eastern Book Companies.
2. Rajani Kothari: Indian Politics
3. Ghosh Pratap Kumar: The Constitution of India. How it has been Formed, World Press.
4. A.Agrawal (Ed): Legal Control of Environmental Pollution.

Faculty of Engineering &Technology
KAKATIYA UNIVERSITY, WARANGAL-506009
Department of Mechanical Engineering

B. Tech. (ME) IV SEMISTER
ME-221
MACHINE TOOLS & METROLOGY

Course code	PCC				
Category	Professional Core Course				
Course title	**Machine Tools & Metrology**				
Scheme and Credits	L	T	P	Credits	Internal marks = 30
	3	0	0	3	External Marks = 70

UNIT–I:

Metal cutting: Introduction, elements of cutting process – Geometry of single point tools. Chip formation and types of chips, chip breakers, mechanism of orthogonal cutting, merchant force diagram, cutting force, cutting speed , feed ,depth of cut ,tool life, coolant.

Engine lathe – Principle of working, types of lathe, specifications. Taper turning– Lathe attachments. Capstan and Turret lathe – Single spindle and multi-spindle automatic lathes – tool layouts.

UNIT–II:

Drilling and Boring Machines – Principles of working, specifications, types, operations performed; twist drill. Types of Boring machines and applications. Shaping, slotting and planning machines - Principles of working –machining time calculations.

UNIT–III:

Milling machines – Principles of working – Types of milling machines – Geometry of milling cutters – methods of indexing.

Grinding – theory of grinding – classification of grinding machines. Types of abrasives, bonds. Selection of a
grinding wheel. Lapping, honing and broaching machines, comparison and Constructional features, machining time calculations

UNIT–IV:

Limits, fits and tolerances- Unilateral and bilateral tolerance system, hole and shaft basis system. Interchange ability and selective assembly.

Limit Gauges: Taylor's principle, Design of GO and NO GO gauges Measurement of angles, Bevel protractor, Sine bar. Measurement of flat surfaces, straight edges, surface plates, optical flat and auto collimator.

UNIT–V:

Surface Roughness Measurement-Roughness, Waviness. CLA, RMS, Rz Values. Methods of measurement of

Surface finish- Talysurf. Screw thread measurement, Gear measurement; Machine Tool Alignment Tests on lathe, milling and drilling machines. Coordinate Measuring Machines: Types and Applications of CMM.

TEXT BOOKS:

1. Engineering Metrology by I C Gupta., Danpath Rai
2. Engineering Metrology by R.K. Jain, Khanna Publishers

References Books:

1. Principles of Machine Toolsby Bhattacharya A and Sen.G.C, New Central Book Agency.
2. Production Technology by R.K. Jain and S.C. Gupta.

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Department of Mechanical Engineering

B. Tech. (ME) IV SEMISTER
ME-222
DESIGN OF MACHINE ELEMENTS – I

Course code	PCC				
Category	Professional Core Course				
Course title	**Design of Machine Elements I**				
Scheme and Credits	L	T	P	Credits	Internal marks = 30
	3	0	-	3	External Marks = 70

NOTE:
Design Data books are not permitted in the Examinations. The design must not only satisfy strength criteria but also rigidity criteria.

UNIT-I

Introduction: General considerations in the design of Engineering Materials and their properties – selection –Manufacturing consideration in design. Tolerances and fits –BIS codes of steels.

Design for static strength: Simple stresses – Combined stresses – Torsional and Bending stresses – Impact stresses – Stress strain relation – Various theories of failure – Factor of safety – Design for strength and rigidity – preferred numbers. The concept of stiffness in tension, bending, torsion and combined situations.

UNIT – II:

Design for fatigue strength: Stress concentration – Theoretical stress Concentration factor – Fatigue stress concentration factor- Notch Sensitivity – Design for fluctuating stresses – Endurance limit – Estimation of Endurance strength – Gerber's curve– Modified Goodman's line–Soderbergs line.

Eccentric loading: Design of Machine Frames and Brackets under eccentric and flexural loads, Circular bars under axial, torsion and bending loads, equivalent bending and twisting moments.

UNIT – III:
Riveted, welded joints: Riveted joints- methods of failure of riveted joints-strength equations-efficiency of riveted joints-eccentrically loaded riveted joints.

Welded joints: Design of fillet welds-axial loads-circular fillet welds under bending, torsion. Welded joints under eccentric loading.

UNIT – IV:

Keys, cotters and knuckle joints: Design of keys-stresses in keys-cotter joints-spigot and socket, sleeve and cotter, gib and cotter joints-Knuckle joints.

Bolted joints: Design of bolts with pre-stresses – Design of joints under eccentric loading – locking devices – bolts of uniform strength.

UNIT – V:

Shafts: Design of solid and hollow shafts for strength and rigidity – Design of shafts for combined bending and axial loads – Shaft sizes – BIS code. Use of internal and external circlips, Gaskets and seals (stationary & rotary).

Shaft couplings: Rigid couplings – Muff, Split muff and Flange couplings. Flexible couplings – Flange coupling (Modified).

Mechanical springs: Stresses and deflections of helical springs-Extension-compression springs-springs for static and fatigue loading – natural frequency of helical springs-energy storage capacity-helical tension springs- co-axial springs.

TEXT BOOKS:

1. Machine Designby V. Bhandari, TMH Publishers

REFERENCE BOOKS:

1. Design of Machine Elements by V.M. Faires, Mcmillan Company New York

2. Mechanical Engineering Design by JE ShigleyMcGrawHill Publications

3. A Text book of Machine Design by RS Khurmi and Guptha, S. Chand & Co. New Delhi

4. Elements of Machine Design byPandya& Shah, Chartor publications

Faculty of Engineering &Technology
KAKATIYA UNIVERSITY, WARANGAL-506009
Department of Mechanical Engineering

B. Tech. (ME) IV SEMISTER
ME-223
INSTRUMENTATION AND CONTROL SYSTEMS

Course code	PCC				
Category	Professional Core Course				
Course title	**Instrumentation and Control Systems**				
Scheme and Credits	L	T	P	Credits	Internal marks = 30
	3	0	-	3	External Marks = 70

UNIT–I:

Definition – Basic principles of measurement – Measurement systems, generalized configuration and functional description of measuring instruments –examples. Static and Dynamic performance characteristics – sources of errors, Classification and elimination of errors.

Measurement of Displacement: Theory and construction of various transducers to measure displacement – Piezoelectric, Inductive, capacitance, resistance, ionization and Photo electric transducers, Calibration procedures.

UNIT–II:

Measurement of Temperature: Various Principles of measurement-Classification: Expansion Type: Bimetallic Strip- Liquid in glass Thermometer; Electrical Resistance Type: Thermistor, Thermocouple, RTD; Radiation

Pyrometry: Optical Pyrometer; Changes in Chemical Phase: Fusible Indicators and Liquid crystals. Measurement of Pressure: Different principles used- Classification: Manometers, Dead weight pressure gauge. Tester (Piston gauge), Bourdon pressure gauges, Bulk modulus pressure gauges; Bellows – Diaphragm gauges. Low-pressure measurement – Thermal conductivity gauges, ionization pressure gauges, Mcleod pressure gauge.

UNIT–III:

Measurement of Level: Direct methods – Indirect methods – Capacitive, Radioactive, Ultrasonic, Magnetic, Cryogenic Fuel level indicators – Bubbler level indicators.

Flow measurement: Rotameter, magnetic, Ultrasonic, Turbine flow meter, Hot – wire anemometer, Laser Doppler Anemometer (LDA).

Measurement of Speed: Mechanical Tachometers, Electrical tachometers, Non- contact type- Stroboscope

Measurement of Acceleration and Vibration: Different simple instruments – Principles of Seismic instruments –Vibrometer and accelerometer using this principle- Piezo electric accelerometer.

UNIT–IV:

Stress-Strain measurements: Various types of stress and strain measurements –Selection and installation of metallic strain gauges- electrical strain gauge – gauge factor – method of usage of resistance strain gauge for bending compressive and tensile strains – Temperature compensation techniques, Use of strain gauges for measuring torque, Strain gauge Rosettes.

Measurement of Humidity: Moisture content of gases, Sling Psychrometer, Absorption Psychrometer, Dew pointmeter.

UNIT-V:

Measurement of Force, Torque And Power- Elastic force meters, load cells, Torsion meters, Dynamometers.

Elements of Control Systems: Introduction, Importance – Classification – Open and closed systems Servomechanisms– Examples with block diagrams–Temperature, speed & position control systems.

TEXT BOOKS:

1. Principles of Industrial Instrumentation & Control Systems by Alavala, Cengage Learning

2. Instrumentation, Measurement & Analysis by B.C.Nakra & K.K.Choudhary, TMH

3. Mechanical Measurements & Controls by D.S. Kumar

REFERENCE BOOKS:

1. Measurement Systems: Applications & design by E.O. Doebelin, TMH

2. Experimental Methods for Engineers by Holman

3. Mechanical and Industrial Measurements by R.K. Jain, Khanna Publishers.

4. Mechanical Measurements by Sirohi and Radhakrishna, New Age International.

Faculty of Engineering &Technology
KAKATIYA UNIVERSITY, WARANGAL-506009
Department of Mechanical Engineering

B. Tech. (ME) IV SEMISTER
ME-224
KINEMATICS OF MACHINERY

Course code	PCC				
Category	Professional Core Course				
Course title	**Kinematics of Machinery**				
Scheme and Credits	L	T	P	Credits	Internal marks = 30
	3	0	-	3	External Marks = 70

UNIT – I:

Mechanisms: Elements or Links – Classification – Rigid Link, flexible and fluid link – Types of kinematics pairs –sliding, turning, rolling, screw and spherical pairs – lower and higher pairs – closed and open pairs – constrained motion – completely, partially or successfully and incompletely constrained .

Mechanism and Machines: Mobility of Mechanisms: Grublers criterion, classification of machines – kinematics chain – inversions of mechanism – inversions of quadric cycle chain, single and double slider crank chains, Mechanical Advantage, Intermittent motion Mechanism, Rutchet & Paul Generca Mechanicsm.

UNIT – II:

Kinematics: Velocity and acceleration – Motion of link in machine – Determination of Velocity and acceleration –Graphical method – Application of relative velocity method.

Plane motion of body: Instantaneous center of rotation- centrodes and axodes– Three centers in line theorem –Graphical determination of instantaneous center, determination of angular velocity of points and links by instantaneous center method.
Kliens construction - Coriolis acceleration - determination of Coriolis component of acceleration

Analysis of Mechanisms: Analysis of slider crank chain for displacement- velocity and acceleration of slider –Acceleration diagram for a given mechanism.

UNIT – III:

Straight-line motion mechanisms: Exact and approximate copied and generated types –Peaucellier - Hart - Scott Russel– Grasshopper – Watt -Tchebicheffs and Robert Mechanism -

Pantographs Steering gears: Conditions for correct steering – Davis Steering gear, Ackerman's steering gear.

Hooke's Joint: Single and double Hooke's joint –velocity ratio – application – problems.

UNIT – IV:

Cams: Definitions of cam and followers – their uses – Types of followers and cams – Terminology – Types of follower motion - Uniform velocity, Simple harmonic motion and uniform acceleration and retardation. Maximum velocity and maximum acceleration during outward and return strokes in the above 3 cases.

Analysis of motion of followers: Tangent cam with Roller follower – circular arc cam with straight, concave and convex flanks.

UNIT – V:

Higher pair: Friction wheels and toothed gears – types – law of gearing, condition for constant velocity ratio for transmission of motion – velocity of sliding. Forms of teeth, cycloidal and involutes profiles – phenomena of interferences – Methods of interference. Condition for minimum number of teeth to avoid interference – expressions for arc of contact and path of contact of Pinion & Gear and Pinion & Rack Arrangements– Introduction to Helical –Bevel and worm gearing

Gear Trains: Introduction: Types – Simple – compound and reverted gear trains –Epicyclic gear train. Methods of finding train value or velocity ratio of Epicyclic gear trains. Selection of gear box - Differential gear for an automobile

TEXT BOOKS:

1. Theory of Machines by S.S.Rattan, Tata McGraw Hill Publishers.
2. Kinematics & Dynamics Of machinerybyNorton, TMH

REFERENCE BOOKS:

1. Theory of Machines by Thomas Bevan, CBS
2. Theory of Machines by Sadhu Singh, Pearson.
3. Theory of Machines by Shigley, Oxford
4. Mechanism and Machine Theory by JS Rao and RV Duggipati, New Age
5. Theory of Machines by R.K. Bansal, LakshmiPublications.

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B. Tech. (ME) IV SEMISTER
ME-221L
MACHINE TOOLS & METROLOGY LAB

Course code	PCC				
Category	Professional Core Course				
Course title	**Machine Tools &Metrology Lab**				
Scheme and Credits	L	T	P	Credits	Internal marks = 25
	0	0	3	1.5	External Marks = 50

MACHINE TOOLS LAB

1. Study of general purpose machines - Lathe, Drilling machine, Milling machine, Shaper, Planning machine, slotting machine, Cylindrical Grinder, surface grinder and tool and cutter grinder.
2. Step turning, taper turning (swelling compound rest), grooving on lathe machine.
3. Taper turning by taper turning attachment.
4. Thread cutting and knurling using lathe machine.
5. Make a hole using lathe machine.
6. Drilling and Tapping using Radial drilling machine.
7. Cutting 'V' groove using shaping machine.
8. Cutting slots on circular shaft using slotting machine.
9. Cutting key ways using milling machines.
10. Surface Grinding using surface grinding machine.
11. Setting tool angles using tool & cutter grinder.
12. Cutting grooves/Plain surface using planning machine.
13. Cylindrical grinding by cylindrical grinding machine.

METROLOGY LAB

1. Measurement of lengths, heights, diameters by vernier caliper and micrometer etc.
2. Measurement of bores by internal micrometer and dial bore indicator.
3. Use of gear teeth vernier caliper and checking the chordal addendum and chordal height of spur gear.
4. Machine tool - alignment test on the lathe.
5. Measurement of screw thread and cutting tool profiles using Tool maker's microscope.
6. Angle and taper measurements by Bevel protractor and Sine bar.
7. Measurement of effective diameter of screw thread by two wire / three wire method.
8. Measurement of surface roughness.

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B. Tech. (ME) IV SEMISTER
ME-225L
MACHINE DRAWING

Course code	PCC				
Category	Professional Core Course				
Course title	**Machine Drawing**				
Scheme and Credits	L	T	P	Credits	Internal marks = 30
	-	-	3	1.5	External Marks = 70

The following contents are to be drawn using conventional method

UNIT-I

Standard Drawing Practices: Format of drawing sheet, title block, conventions of drawing lines and dimensions. conventional representation of materials and parts (Screwed joint, Welded joints, Springs, Gears, machine tool elements). Abbreviated indication of standard parts in assembly drawings. First and third angle projections, conventions for sectional views, views of simple machine elements from the given pictorial and orthographic views.

UNIT II

Machine Elements: sketching of the following standard machine elements Screwed Fastenings: Screw thread nomenclature, thread series, designation, thread profiles, multi start threads, representation of threads, bolted joints, studded joint, eye bolt.

Keys, Cotters and Pin Joints: Introduction, saddle keys, sunk keys, cotter joint with sleeve, cotter joint with socket and Spigot ends, cotter joint with a Gib and knuckle joint.

Shaft Couplings: Rigid couplings, flexible couplings, disengaging couplings and non-aligned couplings.

Riveted Joints: Introduction, classification of riveted joints, terminology of riveted joints, rivet heads.

Welded Joints: Introduction, types of welded joints, representation of welds on drawings.

UNIT-III

Assembly Drawings:
Assembly drawings from given details of component drawings and working description of the assembly. Ability to supply additional views. The exercises will be drawings of typical machine parts, assemblies e.g., Connecting rod, Eccentric, Cross head, Machine vice, pipe vice, Screw jack, Plummer block, Pedestal Bearing, Tail stock, Gate valve, Universal coupling, Geneva cam etc. These are only examples and actual exercise or examination may include any assembly.

Limits and fits: Introduction, fundamental deviations for Hole based and Shaft based systems, alpha numeric designation of limits & fits. Types of Fits. Form and positional tolerances. Conventional practices of indicating limits and fits, geometrical form and position tolerances, surface finish and surface treatments requirements. Study of Examples involving selection of fits and calculation of limits. Suggestion of suitable fits for mating parts.

The following contents are to be drawn using software package

UNIT-IV

Sectional views Creating solid models of complex machine parts and creating sectional views **Assembly drawing:** Lathe tool post, Connecting rod, Eccentric, Cross head, Machine vice, pipe vice, Screw jack, Plummer block, Pedestal Bearing, Tail stock, Gate valve, Universal coupling, Geneva cam.

UNIT - V

Manufacturing drawing: Representation of limits fits and tolerances for mating parts. Use any four parts of above assembly drawings and prepare manufacturing drawing with dimensional and geometric tolerances.

Pattern of Exam: Internals: Conventional and CAD Software Externals: Conventional N.B. Tolerance charts to be provided in the examination Hall for calculation of limits.

TEXT BOOKS:

1. Siddeshwar N, Kannaiah P and Sastry VVS, "*Machine Drawing*", Tata McGraw Hill Publishing Co. Ltd., 5th Edition, 1994.
2. Bhatt N.D, "*Machine Drawing*", Charotar Publishing House, Anand, New Delhi, 28th Edition, 1993.

REFERENCE BOOKS:

1. Narayan K.L, Kannaiah P, Venkat Reddy K, "*Machine Drawing*", New Age International (P) Ltd., 2nd Edition, 1999.
2. K. C. John, "*Text book of Machine Drawing*", PHI Learning, 2010.

3. P. Narsimha Reddy, T.A. Janardhan Reddy, C.S. Rao, *Production Drawing Practice*, High Tech Publishers, 2001.
4. R.K. Jain, *Engineering Metrology*, Khanna Publishers, 8th Ed. 1985.
5. K.L. Narayana, P. Kannayya and K. Venkat Reddy, *Production Drawing*, New Age International (p) Ltd. Revised edition, 1997.
6. The Solid Works software manual

Faculty of Engineering & Technology
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B. Tech. (Mechanical) V SEMESTER

S. No.	Course Code	Course Title	Scheme of Instruction			Lecture Hrs/ week	Scheme of Examination		Credits
			L	T	P		CIE	SEE	
Theory									
1.	PC3101ME	Fluid Mechanics & Hydraulic Machines	3	1	-	4	30	70	4
2.	PC3102ME	Dynamics of Machines	3	1	-	4	30	70	4
3.	PC3103ME	Machine Design	3	1	-	4	30	70	4
4.	PC3104ME	Production Planning and Control	3	-	-	3	30	70	3
5.	PE-I*	Professional Elective-I*	3	-	-	3	30	70	3
6.	HS 3108LW	Law and Engineering	2	-	-	2	30	70	2
PRACTICALS									
7.	PC3109ME	Fluid Mechanics & Hydraulic Machines Lab	-	-	3	3	25	50	1.5
8.	PC3110ME	Dynamics of Machines Lab	-	-	3	3	25	50	1.5
		Total	17	3	6	26	230	520	23

* (PE-I)**PROFESSIONAL ELECTIVE COURSE -I**	
PE3105 ME	Design of Thermal Systems
PE3106 ME	Non-conventional Energy Sources
PE3107 ME	Power Plant Engineering

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B. Tech. (ME) V SEMISTER

PC3101ME

FLUID MECHANICS AND HYDRAULIC MACHINES

Course code	PCC				
Category	Professional Core Course				
Course title	**Fluid Mechanics and Hydraulic Machines**				
Scheme and Credits	L	T	P	Credits	Internal marks = 30
	3	1	-	4	External Marks = 70

UNIT-I

Fluid Properties: Viscosity of liquids. Newtonian and non-Newtonian fluids. Surface tension, capillary effect, vapour pressure and cavitation. Ideal and real fluids, Incompressible and Compressible flows. Stream lines, Path lines.

Pressures and pressure head: Types of pressures, Pascal's law of pressure at a point, variation of pressure vertically in a fluid under gravity.

Static Forces on Surface and Buoyancy:

Fluid statics, action of fluid pressure on surface, resultant force and centre of pressure on a plane surface under uniform pressure. Equilibrium of floating bodies, stability of a submerged body, stability of floating bodies, determination of metacentric height, position of the metacentre and centre of buoyancy.

UNIT-II

Laws of fluid flow – Continuity equation. Derivation of Euler's and Bernoulli's equations. Application of Bernoulli's equations. Flow measuring devices-Venturimeter, Orifice meter and Pitot static tube.

Viscous Flow: Reynolds number and Reynolds experiment, flow of viscous fluid through circular pipe- Hagen Poiseuille formula.

Flow through pipes: Head losses in pipes, bends and fittings. Major energy losses, Minor energy losses, Hydraulic gradient and total energy lines, Pipes in series and parallel, Equivalent pipes.

Unit-III

Hydraulic Turbines: Classification and comparison of impulse and reaction turbines. Impulse turbines: Salient features and working details of Pelton wheel installation. Velocity diagrams. Calculation of number of buckets, bucket sizes and power developed. Overall efficiency, speed regulation methods.

Reaction turbines: Constructional details and working of Francis and Kaplan turbines. Draft tube. Theory, types and efficiency of draft tubes. Velocity diagrams. Power developed and efficiencies, pressure head at inlet of the runner.

Principles of similarity applied to hydraulic turbines. Unit quantities, specific speed and its significance for turbine selection. Performance and characteristic curves for Pelton wheel, Francis and Kaplan turbines. Governing of turbines. Cavitation effects in reaction turbines and remedial measures. Surge tanks.

Unit-IV

Centrifugal pumps: Working and constructional details of single stage centrifugal pump. Priming – significance and methods of priming. Basic classification of CF pumps. Types of impellers, casings and vane shapes . Simple and multistage pumps and their applications. Series and parallel operation of CF pumps. Manometric head and its importance. Manometric efficiency and other efficiencies. Losses in CF pumps. Velocity diagrams. Cavitation. Unit quantities, specific speed. Performance and characteristic curves.

Unit-V

Reciprocating pumps: Classification, working details, theory and terms used for single and double acting pumps. Effect of acceleration head and friction. Indicator diagrams. Effect of cavitation and limiting suction head on pump speed. Variation of pressure inside pump cylinder during suction and delivery strokes. Work done, power required and efficiency. Functions of air vessels. Work saved and rate of flow from air vessels. Losses and performance curves for reciprocating pumps. Industrial applications. Types of Positive displacement pumps.

Suggested Reading:

1. Modi, P.N. & Seth, S.M., "Hydraulics & Fluid Mechanics Including Hydraulics Machines", Standard Book House, 2017
2. A.K.Mohanty. "Fluid Mechanics" , PHI Learning Pvt. Ltd, 1994
3. S.K.Som, GautamBiswas, S Chakraborty. "Introduction to Fluid Mechanics and Fluid Machines", McGraw Hill Education, 2017
4. Bansal, R. K., "Textbook of fluid mechanics and hydraulic machine" Laxmi Publication, 2011
5. Gupta, V., & Gupta, S. K., "Fluid mechanics and its applications", Tunbridge Wells: New Academic Science, 2012
6. JagdishLal, "Hydraulic Machines", Metropolitan Book Co., 1994.
7. N.S. GovindRao, "Fluid Flow Machines, Tata McGraw Hill", 1983.
8. K. Subramanya, "Theory and Applications of Fluid Mechanics", Tata McGraw-Hill Publishing Company Ltd.,1993
9. Vijay Gupta and Santosh K. Gupta, "Fluid Mechanics and its applications", Wiley Eastern Ltd.,1984K.L. Kumar, "Engineering Fluid Mechanics", Eurasia Publishing House Pvt Ltd., New Delhi, 2009

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Department of Mechanical Engineering

B. Tech. (ME) V SEMISTER

PC3102ME

DYNAMICS OF MACHINES

Course code	PCC				
Category	Professional Core Course				
Course title	**Dynamics of Machines**				
Scheme and Credits	L	T	P	Credits	Internal marks = 30
	3	1	-	4	External Marks = 70

Unit-I

Static and Dynamic Force Analysis in Mechanisms: Four link mechanism, slider-crank mechanism, effect of friction, piston effort, crank effort, turning moment on crank shaft, inertia forces in reciprocating engines, turning moment diagrams, fluctuation of speed and energy- Principle of flywheel. Static and Dynamic analysis of planar mechanisms: Graphical and analytical methods, Free body diagrams, Method of superposition, Equivalent offset inertia force.

Unit-II

Force analysis of space mechanisms, inertia matrix, Lagrangian and Newton-Euler formulation.
Gyroscope: Gyroscopic couple, gyroscopic reaction and gyroscopic effect in shafts, aeroplanes, ships, two and four wheelers and gyroscopic stabilization.

Unit-III

Forces on bearings due to rotating shaft carrying several eccentric rotors, balancing of shafts carrying several rotors, determination of balancing masses from the forces on the bearings shaking forces in a single cylinders engine, partial balancing of reciprocating engine. Balancing of a two cylinder locomotive engine, determination of unbalanced forces and couples.

Unit-IV

Governors: Function of governor, centrifugal governors, working principles of Watt, Porter, Proel, Hartnell governor with auxiliary spring, Wilson-Hartnell type, sensitiveness, isochronism, hunting, effect of friction, coefficient of insensitiveness, controlling force diagrams, stability criteria, effort and power of a governor.

Unit-V

Vibrations: Free and forced vibrations of a spring mass system with damping, vibration isolation and transmissibility, transverse vibrations of shafts- point load, UDL and several point loads, Energy method, Whirling of shafts, torsional vibrations of rotating shafts-two rotor and three rotor systems and geared system. Natural frequencies of two degree freedom linear systems. Nodes in three rotor systems. Modes of vibration, determining natural frequencies by Holzer's method for multi-rotor systems. Dunkerley's method , Raleigh's method.

Suggested Reading:

1. S.S. Rathan, "Theory of Machines", Tata-McGraw Hill, 1995.
2. Thomas Bevan, "Theory of Machines", 3rd edition, Pearson Education, 2005
3. A. Ghosh and Mallick, "Theory of mechanisms and machines", Affiliated to E-W Press, 1988.
4. John.J.Vicker, Gordon R. Pennock, Joseph E. Shigley, "Theory of Machines & Mechanisms", Oxford University Press, 2003.
5. Robert L. Norton, "Design of Machinery", Tata McGraw Hill, 2005.

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B. Tech. (ME) V SEMISTER

PC3103ME

MACHINE DESIGN

Course code	PCC				
Category	Professional Core Course				
Course title	**Machine Design**				
Scheme and Credits	L	T	P	Credits	Internal marks = 30
	3	1	-	4	External Marks = 70

Unit-I

Belts: Flat belts-velocity ratio, effect of slip, ratio of tensions, open and cross belts, centrifugal tension, initial tension, condition for maximum power transmission, design of belt dimensions. V-belts, ratio of tensions, belt size and number of belts.

Unit-II

Gears: Introduction of gear drives, different types of gears, Materials used for gears. Standards for gears and specifications. Spur Gear Design: Basic analysis of gear tooth-Bending stress-Lewis equation, refined analysis of gear tooth -bending strength-procedure, gear tooth surface fatigue analysis-procedure, spur gear design procedures, Design of Helical, Bevel and Worm gears. Concepts of Design for manufacturability.

Unit-III

Bearings: Introduction. Materials used for Bearings. Classification of bearings and mounting of bearings.
Design of sliding contact bearings: Properties and types of Lubricants, Design of Hydrostatic and Hydro dynamic sliding contact bearings. Design of Rolling Contact Bearings: Different types of rolling element bearings and their constructional details, static load carrying capacity. Dynamic load carrying capacity. Load-life relationship, selection of bearing life. Design for cyclic loads and speeds. Selection of Ball and Roller bearings.

Unit-IV

Analysis of Column And Struts : Column and strut, Types of columns, end conditions, Euler's column Theory, different cases in Euler's Theory, Limitations of Euler's Theory, Rankine's formula.
I.C. Engine parts: Introduction. Materials used. Connecting rod for I.C. Engines, Loads on connecting rod, cross-sections, materials, Design of connecting rod. Design of piston.

Unit-V

Fly wheels: Introduction, Design of solid disk type and rimmed fly wheels.
Design of Brakes: Block brake with short shoe & long shoe, Pivoted block brake with long shoe, band brakes, internal expanding shoe, and thermal considerations.
Clutches: Single and multiple disc clutches, cone clutch, friction materials.

Suggested Reading:

1. Bhandari V.B. “Machine Design”, Tata McGraw Hill Publications, 1994.
2. Robert C. Juvinall, Kurt M. Marshek, “Fundamentals of Machine Component Design”, Wiley publications, 5th edition, 2012.
3. J.E. Shigley , C.R. Misckhe, “Mechanical Engineering Design”, Tata McGraw Hill Publication, 2003.
4. P. Kannaiah, “Machine Design”, Science-Tech Publications, 2003.
5. M.F. Spotts, “Design of Machine Elements”, Prentice Hall, 1964.
6. Robert L. Norton, “Machine Design: An Integrated Approach”,2/e PearsonEducation, 2000.
7. NitinGhokale, “Practical Finite Element Techniques”, Altair Publications.

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B. Tech. (ME) V SEMISTER

PC3104ME

PRODUCTION PLANNING & CONTROL

Course code	PCC				
Category	Professional Core Course				
Course title	**Production Planning & Control**				
Scheme and Credits	L	T	P	Credits	Internal marks = 30
	3	-	-	3	External Marks = 70

Unit I

Introduction:
Definition – Objectives of production Planning and Control – Functions of production planning and control – Elements of production control – Types of production – Organization of production planning and control department – Internal organization of department. Forecasting**:** Importance of forecasting –Types of forecasting, their uses –General principles of Forecasting –Forecasting techniques– qualitative methods- Jury/Expert Method , Survey of Expert opinion method , Sales force composite method, Survey of buyers intention method and quantitative methods-Simple average, moving average, smoothing coefficient, Least Square method.

Unit II

Inventory Management: Functions of inventories – relevant inventory costs – ABC analysis – VED analysis – EOQ model – Inventory control systems – P–Systems and Q-Systems Introduction to MRP-I, MRP-II & ERP, JIT inventory, Kanban system

Unit III

Routing & Scheduling: Definition of Routing – Routing procedure –Route sheets – Bill of material – Factors affecting routing procedure. Definition of Scheduling – Activities-Difference with loading, Scheduling types: Forward, Backward scheduling, Job shop scheduling methods – Arrival pattern, processing pattern, number of workers available, machine varieties available, Priority rules for job sequencing FIFO, SPT,SOT, EDD, STR, CR, LISO, Random Orders. Scheduling Techniques Gantt Charts, LOB, Johnson's job sequencing rules- n jobs on 2machines, n jobs on 3 machines, n jobs on m machines.

Unit IV

Line Balancing and Aggregate Planning:
Introduction to line balancing, objectives, terms related to line balancing, procedures, simple problems; Introduction to Aggregate Planning, Inputs to aggregate planning, strategies- Line strategy, chase strategy, capacity options, demand options.

Unit V

Dispatching: Centralized and Decentralized Dispatching- Activities of dispatcher – Dispatching procedure – follow-up – definition – Reason for existence of functions – types of follow up, applications of computer in production planning and control.

Suggested Readings:

1. Samuel Eilon, "Elements of Production Planning and Control", Universal Publishing Corporation, 1991.
2. Buffa&RakeshSarin , "Modern Production & Operations management", 8th edition,Wiley india Pvt. Ltd, 2009.
3. S.N. Chary, "Production & Operations Management", 6th Edition, McGraw-Hill Education, 2019.
4. Krajewski, L.J., and Ritzman, L. P., "Operations management – strategy and analysis", 6th Edition, Prentice-Hall of India Pvt. Ltd, 2003.
5. S.K Sharma, savita Sharma, "Industrial Engineering and Operations Management", SkKataria& Sons, 2002.

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B. Tech. (ME) V SEMISTER

PE3105ME
DESIGN OF THERMAL SYSTEMS
(Professional Elective-I)

Course code	PEC				
Category	Professional Elective Course				
Course title	**Design of Thermal System**				
Scheme and Credits	L	T	P	Credits	Internal marks = 30
	2	1	-	3	External Marks = 70

Unit-I

Solar radiation: Properties of sunlight. Sun-Earth Relationships, Absorption by the atmosphere. Peak sun hours, the declination of the Sun, Determination of Solar time, solar angle, solar window. solar radiation is measuring devices: Pyrheliometers, Pyranometers. Pyrgeometer, Net radiometer, Sunshine recorder, Estimation of Average Solar radiation. Solar irradiance at surfaces

Unit-II

Solar cells and modules: The function of solar cells from semiconductor physics. Different solar cell technologies and fabrication methods. Concepts for increasing efficiency based on loss analysis. Wavelength sensitivity. Series connection and parallel connection of solar cells to modules. Module function and characteristics. Shading of cells and modules.

Unit-III

Solar cell systems: System components and their functions. Calculating output and dimensioning of solar cell systems. Concentrated sunlight and solar power (CSP).Properties of optical concentration systems. Solar cells in concentrated sunlight. Overview of the different components in a CSP system and their functions. Design of Photovoltaic Systems

Unit-IV

Solar thermal: Thermodynamic description of solar collectors. Optical properties of solar collectors and technologies for fabrication. ***Solar thermal systems for different applications***: Solar Water Heating (Active and Passive), Solar Industrial Process Heat, Solar Thermal Power Systems in India and abroad. Storage of solar generated heat. Design of Active Systems by Utilizability Methods, Design of Passive and Hybrid Heating Systems.

Unit-V

Performance Testing of Solar Collectors*:*
Governing equations for evaluation of performance. Methods of testing, testing procedures, testing of liquid and air flat plate collectors. Cylindrical, parabolic concentrators. Overall performance of heating panels. Selection of materials - Absorbing heat transfer fluids.
Hybrid systems: Combinations of solar thermal and solar cell systems. Overview of different applications.

Suggested Reading:

1. Magal B.S. "Solar Power Engineering", Tata McGraw Hill Publishing Co. Ltd., 1994.
2. Sukhatme S.P.," Solar Energy", 2 Edition, Tata McGraw Hill Publishing Co. Ltd., 2nd ed, 1996.
3. Garg H.P. and Prakash J., "Solar Energy", Tata McGraw Hill Publishing Co. Ltd., 1997.
4. John A. Duffie, William A. Beckman, "Solar Engineering of Thermal Processes", 4th Edition, John Wiley & Sons Inc., 2013.
5. MertensKonrad, "Photovoltaics :Fundamentals, Technology and Practice", John Wiley & Sons Inc., 2014.

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B. Tech. (ME) V SEMISTER

PE3106 ME
NON CONVENTIONAL ENERGY SOURCES
(Professional Elective-I)

Course code	PEC				
Category	Professional Elective Course				
Course title	**Non-Conventional Energy Sources**				
Scheme and Credits	L	T	P	Credits	Internal marks = 30
	3	-	-	3	External Marks = 70

UNIT-I

Introduction: Distinction between Conventional and Non-conventional sources of energy-Brief description of the different sources.
Wind Energy: Brief History of wind power-Principles of wind power-Operation of a wind turbine-Site Characteristics.

UNIT-II

Solar Energy: Solar energy option-Solar radiation-Solar flat Plate Collectors-Air heaters-Collectors with booster mirrors-Concentric collectors-Thermal storage systems. Solar Photovoltaic (SPV) Systems: Introduction. Prospects of SPV systems. Principle of a PV cell. Large scale SPV systems. Economic considerations of SPV Systems. PV Cell Technology. Merits and limitations of SPV Systems. Applications of SPV Systems-street lighting, domestic lighting, Battery charging, SPV pumping systems. Concept of Satellite solar power systems (SSPS).

UNIT-III

Geothermal Energy: Origin and Types of geothermal energy-Operational difficulties-Vapor dominated systems-Liquid dominated systems-Petro-thermal systems-Hybrid geothermal systems.
Magneto Hydro Dynamic (MHD) Power Generation: MHD systems-Open and closed systems-MHD design problems and Developments-Advantages of MHD Systems.

UNIT-IV

Energy from Oceans: Ocean temperature differences-the open and closed cycle analysis-Modification of the Open cycle Analysis-closed or the Anderson cycle Analysis-Ocean Waves-Wave motions and tides-Energy from the Waves.

UNIT-V

Bio Energy: Introduction-Biomass conversion-Technologies-Wet processes-Dry processes-Photosynthesis-Biogas generation-Biogas from plant wastes-methods of maintaining Biogas production-Utilization of biogas. Biomass gasification- Applications of gassifiers.

TEXT BOOKS:

1. Bansel N.K., M.Kaleeman, and M.Miller, *Renewable Energy Sources and Conversion Technology*, Tata McGraw-Hill, New Delhi.
2. Rai G.D., *Non-conventional Energy Sources*, Khanna Publishers, New Delhi.

REFERENCE BOOKS:

1. EL-Wakil M.M., *Power Plant Technology*, McGraw-Hill, New York.
2. Duffie and Beckman, *Solar Energy Thermal Processes*, John Wiley & Sons, New York.

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B. Tech. (ME) V SEMISTER
PE3107 ME
POWER PLANT ENGINEERING
(Professional Elective-I)

Course code	PEC				
Category	Professional Elective Course				
Course title	**Power Plant Engineering**				
Scheme and Credits	L	T	P	Credits	Internal marks = 30
	3	-	-	3	External Marks = 70

UNIT – I:

Introduction to the Sources of Energy – Resources and Development of Power in India. Steam Power Plant: Plant Layout, Working of different Circuits, Fuel and handling equipments, types of coals, coal handling, choice of handling equipment, coal storage, Ash handling systems. Combustion Process: Properties of coal – overfeed and underfeed fuel beds, traveling grate stokers, spreader stokers, retort stokers, pulverized fuel burning system and its components, combustion needs and draught system, cyclone furnace, design and construction, Dust collectors, cooling towers and heat rejection. Corrosion and feed water treatment.

UNIT – II:

Internal Combustion Engine Plant: Diesel Power Plant: Introduction – IC Engines, types, construction– Plant layout with auxiliaries – fuel supply system, air starting equipment, lubrication and cooling system – super charging. Gas Turbine Plant: Introduction – classification - construction – Layout with auxiliaries – Principles of working of closed and open cycle gas turbines. Combined Cycle Power Plants and comparison. Direct Energy Conversion: Solar energy, Fuel cells, Thermo electric and Thermo ionic, MHD generation.

UNIT – III:

Hydro Electric Power Plant: Water power – Hydrological cycle / flow measurement – drainage area characteristics – Hydrographs – storage and Pondage – classification of dams and spill ways. Hydro Projects And Plant: Classification – Typical layouts – plant auxiliaries – plant operation pumped storage plants. Power From Non-Conventional Sources: Utilization of Solar- Collectors-Principle of Working, Wind Energy – types – HAWT, VAWT -Tidal Energy.

UNIT – IV:

Nuclear Power Station: Nuclear fuel – breeding and fertile materials – Nuclear reactor – reactor operation. Types of Reactors: Pressurized water reactor, Boiling water reactor, sodium-graphite reactor, fast Breeder Reactor, Homogeneous Reactor, Gas cooled Reactor, Radiation hazards and shielding – radioactive waste disposal.

UNIT – V:

Power Plant Economics and Environmental Considerations: Capital cost, investment of fixed charges, operating costs, general arrangement of power distribution, Load curves, load duration curve. Definitions of connected load, Maximum demand, demand factor, average load, load factor, diversity factor – related exercises. Effluents from power plants and Impact on environment – pollutants and pollution standards – Methods of Pollution control.

TEXT BOOKS:

1. Power Plant Engineering/ P. K. Nag / McGraw Hill
2. Power Plant Engineering / Hegde / Pearson.

REFERENCES BOOKS:

1. Power Plant Engineering / Gupta / PHI
2. Power Plant Engineering / A K Raja / New ag

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B. Tech. (ME) V SEMISTER

PC3109 ME
FLUID MECHANICS AND HYDRAULIC MACHINERY LABORATORY

Course code	PCC				
Category	Professional Core Course				
Course title	Fluid Mechanics and Hydraulic Machinery Lab				
Scheme and Credits	L	T	P	Credits	Internal marks = 25
	-	-	3	1.5	External Marks = 50

List of Experiments:

1. Determination of C_d and C_v of an orifice meter
2. Calibration of a mouth piece
3. Calibration of a Venturi meter
4. Verification of Bernoulli's principle
5. Performance test on Pelton wheel turbine
6. Characteristic curves test on Pelton wheel turbine
7. Performance test on Turbo wheel
8. Characteristic curves test on Turbo wheel
9. Performance test on Francis turbine
10. Characteristic curves test on Francis turbine
11. Performance test on reciprocating pump
12. Study of positive displacement and Rotodynamic pumps with the help of models.
13. Study of the working of Kaplan turbine

Any ten (10) experiments can be conducted

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B. Tech. (ME) V SEMISTER

PC3110 ME
DYNAMICS OF MACHINERY LABORATORY

Course code	PCC				
Category	Professional Core Course				
Course title	Dynamics of Machinery Lab				
Scheme and Credits	L	T	P	Credits	Internal marks = 25
	-	-	3	1.5	External Marks = 50

List of Experiments:

1. To verify the relations of gyroscopic effect.
2. Static and dynamic balancing of rotating mass system.
3. To study the whirling phenomenon in shafts.
4. To draw the controlling force diagrams of governors (Watt, Porter, Proell and Hartnell governors).
5. To draw the curves for displacement vs angle of rotation for different cam-follower combinations. (Cams-circular arc cam, tangent cam, eccentric circular arc cam; followers- flat face follower, roller follower.)
6. To determine the radius of gyration of given bar using bi-filar suspension.
7. To study the longitudinal vibrations of a given spring.
8. To study the undamped free vibrations of equivalent spring mass system.
9. To study the forced vibrations of equivalent spring mass system.
10. To study the free vibrations of a two rotor system.
11. To verify Dunkerley's equation.

Any ten (10) experiments can be conducted

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B. Tech. (ME) V SEMISTER

HS3108ELW
LAW AND ENGINEERING

Course code	HS				
Category	Humanity Sciences				
Course title	LAW AND ENGINEERING				
Scheme and Credits	L	T	P	Credits	Internal marks = 30
	2	-	-	2	External Marks = 70

Unit-I

The Legal System - Meaning, nature and definition of jurisprudence -Schools of jurisprudence- Analytical, Historical, Philosophical and Sociological Schools of jurisprudence - Meaning and Definition of Law - The Nature and functions of Law - Sources of Law - Legal and Historical sources –Precedent/Case Law as Source of Law - Definition of Precedent, Kinds of Precedent - Legislation as Source of Law- Definition of Legislation -Classification of Legislation – Supreme and Subordinate Legislation – Court System and Hierarchy of Judiciary in India - Concept of Alternative Dispute Resolution System (ADR) – History and Reasons for the growth of ADR–Important forms of ADR – Mediation - Negotiation – Arbitration - Definition of Arbitration and Essentials - Online Dispute Resolution (ODR).

Unit-II

Society and Constitutional law - Social Change: Definition, nature and characteristics of Social change – Social Transformation - Factors of Social Change - Law and social Change - State, Law and Society, their interrelationship and interdependence - Identification of Goals of Social Changes in Indian Constitution - Constitution-Meaning and Significance - Nature and Salient Features of Indian Constitution - Preamble to Indian Constitution –Fundamental Rights - Right to Equality(Art.14-18) – Freedoms and Restrictions under Art.19 - Right to Life and Personal Liberty - Directive Principles of State Policy – Significance – Nature –Classification.

Unit-III

Contract law - Definition and essentials of a Valid Contract – Meaning and Definition of Consideration - Capacity of the parties to enter into contract -Concepts of Free Consent - Lawful Object - Illegal agreements - Void and Voidable contracts - Discharge of Contracts - Remedies for breach of contract -Kinds of damages - Contract of sale of Goods – Formation of contract of sale -Sale and Agreement to Sell -Conditions and Warranties - Express and implied Conditions and Warranties - Caveat Emptor - Rights and duties of seller and buyer before and after sale – Rights of Unpaid Seller - Remedies of breach.

Unit-IV

Business Organizations - Corporate Personality - General Principles of Company Law – Companies Act, 2013 - Nature and Definition of Company -Characteristics of a Company - Different kinds of Company - Private Company and Public Company – Registration & Incorporation of Company –Advantages and Disadvantages of Incorporation - Lifting of the Corporate Veil – Company distinguished from Partnership and Limited Liability Partnership - Shares &Stock - Kinds of shares – Share Capital - Directors – Different kinds of Directors -Appointment, position , qualifications and disqualifications - Powers of Directors - Rights and Duties of Directors – Corporate Governance and Role of Directors – Meetings of Company - Winding up of Companies- Modes of Winding up of Companies.

Unit-V

Meaning, Definition and Concept of Environment - Types of Environment - Concept of Pollution – Sources of Pollution, Types of Pollution, and Effects of Pollution – Ozone Depletion – Global Warming – Climate Change -The Environment Protection Act of 1986 - Main Aims and Objectives of the Act -Meaning, Nature, Classification and significance of Intellectual Property – The main forms of Intellectual Property - Patents - Concept of Patent - Kinds of Patents - The Patents Act, 1970 - Rights and obligations of a patentee - The notion of 'abuse' of patent rights - Infringement of patent rights and remedies available - Meaning, Definition and Nature of Cyber crimes– Information Technology Act, 2000 - Specific Cyber crimes - Cyber Stalking – Hacking – Child Pornography - Phishing – Cyber Crimes and Issues of Privacy - Investigation and Jurisdiction over Cyber crimes.

References:

1. Salmond: Jurisprudence, Universal Publishers.
2. Mahajan V.D. :Legal Theory and Jurisprudence, Eastern Book Company, Lucknow.
3. M.P.Jain, Indian Constitutional Law, Wadhwa & Co, Nagpur
4.H.M. Seervai, Constitutional Law of India(in3Volumes), N.M. Tripathi, Bombay
5. J.N.Pandey, Constitutional Law of India, Central Law Agency, Allahabad
6. Anson: Law of Contract, Clarendon Press, Oxford, 1998.
7. Avtar Singh: Law of Contract, Eastern Book Company,Lucknow,1998.
8. P.S. Atiyah: Sale of Goods Act, Universal Book Traders, Delhi.
9. Acharya N.K.: Law relating to Arbitration and ADR, Asia Law House, Hyderabad
10.TripathiS.C.:Arbitration,Conciliation and ADR, Central Law Agency, Allahabad.
11. Avatar Singh: Arbitration and Conciliation, Eastern Law Book House, Lucknow
12. V.K. KrishnaIyer : Environment Pollution and Law
13. Paras Diwan: Environmental Law and Policy in India,1991
14. Dr. N. Maheshwara Swamy, Environmental Law, Asia Law House, Hyderabad.
15. Avtar Sing: Company Law, Eastern Book Company.
16. Ramaiah: Company Law, Wadhwa &Co.
17. P.Narayanan: Patent Law, Eastern LawHouse,1995.
18. Roy Chowdhary, S.K. & Other: Law of Trademark, Copyrights, Patents and Designs, Kamal Law House,
19.Dr.G.B.Reddy, Intellectual Property Rights and the Law Gogia Law Agency.
20.Dr Jyoti Rattan, Dr Vijay Rattan, Cyber Laws & InformationTechnology,2019,BharatLawHouse,NewDelhi

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B. Tech. (Mechanical) VI SEMESTER

S. No.	Course Code	Course Title	Scheme of Instruction			Lecture Hrs/ week	Scheme of Examination		Credits
			L	T	P		CIE	SEE	
Theory									
1	PC3201ME	Metal Cutting Science &Unconventional Machining process	3	-	-	3	30	70	3
2	PC3202ME	Heat Transfer	3	1	-	4	30	70	4
3	PC3203ME	Refrigeration and Air conditioning	3	-	-	3	30	70	3
4	PE-II*	Professional Elective-II	3	-	-	3	30	70	3
5	OE-I*	Open Elective -I	3	-	-	3	30	70	3
6.	HS3208	Managerial Economics and Accountancy	3	-	-	3	30	70	3
PRACTICALS									
7.	PC3209ME	Metal Cutting science Lab	-	-	3	3	25	50	1.5
8.	PC3210ME	Thermal Engineering-II Lab	-	-	3	3	25	50	1.5
	PW3211ME	Summer Internship	-	-	-	-	-	-	-
		Total	18	1	6	25	230	520	22

*(PE-II) **PROFESSIONAL ELECTIVE COURSE-II**	
PE3204ME	Finite Element Analysis
PE3205ME	Fatigue, Creep and Fracture
PE3206ME	Theory of Elasticity

Note: Please refer annexure-I for open elective -I

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B. Tech. (ME) VI SEMISTER

PC3201ME

METAL CUTTING SCIENCE AND UNCONVENTIONAL MACHINING

Course code	PCC				
Category	Professional Core Course				
Course title	**Metal Cutting Science and Unconventional Machining**				
Scheme and Credits	L	T	P	Credits	Internal marks = 30
	3	-	-	3	External Marks = 70

Unit-I

Basic chip formation process. Tool geometry: Nomenclature of single point cutting tool by ASA,ORS and NRS. Geometry of drills, Milling cutters and broaches. Recommended Tool angles.
Chip formation: Types of chips, BUE, Chip breakers. Machining: Orthogonal and oblique cutting, Mechanics of Orthogonal Cutting: Merchant's analysis, Friction. Shear angle: Shear angle Solutions of Merchant and Lee & Shafer. Cutting tool materials: High carbon steel, HSS, Carbides, Ceramics, Coated carbides, Cermets, HPC, CBN & Diamond.

Unit-II

Measurement of Cutting Forces: Lathe tool dynamometers, Drilling, Milling and Grinding Dynamometers .Thermal aspects of metal cutting: Sources of heat and heat distribution, various methods of measurement of temperature, Cutting fluids and applications. Tool wear, Tool life & Machinability: Types of wear, mechanism of tool wear, Tool life & Machinability. Effects of process parameters on Tool life, Taylor's tool life equation. Economics of machining: Tool life for maximum production, minimum cost.

Unit-III

Ultrasonic Machining (USM):Process description, abrasive slurry, Abrasive materials and their characteristics. Functions of liquid medium in slurry .Types of Transducers ,effect of process parameters, applications and limitations.
Abrasive Jet Machining (AJM): Principle of operation, process details, process variables and their effect on MRR and accuracy. Equation for MRR. Advantages, disadvantages and applications.
Water Jet Machining (WJM): Schematic diagram , equipment used, advantages and applications.

Unit- IV

Electro Discharge Machining (EDM):Process description with schematic diagram, process parameters, functions and characteristics of dielectric medium, dielectric fluids, over cut and side taper Flushing, Mechanism of metal removal, crater volume, types of power supply circuits,mathematicalanalysisofmetalremovalrate(MRR),characteristicsofsparkerodedsurfaces,advantages,disadvantagesand applications, wire electro-discharge machining principles and description.
Electro-Chemical Machining(ECM):Schematic of the process, process parameters, function and characteristics of electrolyte, chemistry of the process. Equation for specific MRR and electrode feed rate, advantages, limitations and applications. Rotary Machining, Hot machining, high speed machining, description of each process, process parameters, advantages and applications.

Unit-V

Laser Beam Machining (LBM):Principle of Laser Beam production, materials used, thermal analysis of the process, process parameters, equations for power density and machining rate, advantages, limitations and applications.

Plasma Arc Machining (PAM): Equipment used, process description and parameters, types of plasma arc: Transferred arc and non-transferred arc and process applications.

Electron Beam Machining (EBM): Schematic of the process, process parameters, principle of production of Electron beam, equipment used, Advantages, disadvantages and applications.

Hybrid Machining Processes: Principle of Hybrid machining process; Classification of hybrid machining Processes; Ultrasonic assisted Electro-chemical machining; Electro-chemical Hybrid Machining Processes (ECHMP); Electro-chemical Grinding machining; Electro-chemical Discharge Machining; Electric Discharge Grinding and Abrasive Water Jet Machining

Suggested Reading:

1. David A. Stephenson, Johs S. Agapiou, "Metal Cutting Theory and Practice", CRC Press, 3rdEdition, 2016.
2. B.L. Juneja ,Shekhon G.S. and Seth Nitin, "Fundamentals of Metal Cutting & Machine tools", New Age Publishers, 2003.
3. A. Bhattacharyya, "Metal Cutting Theory and Practice", New Central Book Agency (P) Ltd., 2006.
4. AmitabhaGhosh and Ashok Kumar Mallik, "Manufacturing Science", Affiliated East-West Press Pvt. Ltd., 2ndEdition, 2010.
5. Winston A. Knight and Geoffrey Boothroyd, "Fundamentals of Metal Machining & Machine tools", CRC Press, 3rd Edition, 2005.
6. McGeough JA, "Advanced Methods of Machining", Chapman & Hall, 1988.
7. Pandey PC. and Shah H.S., "Modern Machining Process", Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1980
8. Bhattacharya A., "New Technology", the Institution of Engineers, India, 1984.
9. Davies and Austin, "Developments in High Speed Metal Forming". The Machinery Publishing Co. Ltd., 1985
10. Mikell. P. Groover "Principles of Modern Manufacturing" Wiley India Pvt. Ltd., New Delhi, 2014.

Hassan Abdel-Gawad El-Hofy, Advanced Machining Processes, Nontraditional and Hybrid Machining Processes, McGraw Hill Publishing Co. Ltd.

Faculty of Engineering & Technology
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B. Tech. (ME) VI SEMISTER

PC3202ME

HEAT TRANSFER

Course code	PCC				
Category	Professional Core Course				
Course title	**Heat Transfer**				
Scheme and Credits	L	T	P	Credits	Internal marks = 30
	3	1	-	4	External Marks = 70

Unit-I

Heat transfer fundamentals: Basic heat transfer mechanisms (conduction, convection and radiation), Conduction: General conduction equation on plane wall, Cylinders and spheres.

One dimensional steady state conduction through plane walls, hollow cylinders and spheres with and without heat generation .Thermal resistance network, Boundary Conditions, Effect of variable thermal conductivity for one-dimensional steady-state conduction in a plane wall .The critical radius of insulation.

Unit-II

Fins: Heat transfer analysis of a body with negligible internal temperature gradients, fins efficiency and effectiveness.

Lumped system analysis within the body with negligible internal temperature gradients. Transient heat transfer analysis of an infinite slab with specified temperature and connective boundary conditions. Use of Grover &Heisler charts for solving problems of infinite slabs, cylinders, spheres.

Unit-III

Convection: Physical mechanism of convection, Buckingham pi-theorem and use of dimensional analysis in free and forced convection, Physical significance of different dimensionless numbers. Concept of velocity boundary layer, thermal boundary layer.

Reynolds analogy, Chilton-Colburn analogy for turbulent flow over flat surfaces. Calculation of heat transfer for flow over plates, cylinders and in pipes in free and forced convection using empirical formulae.

Unit-IV

Radiation: Absorptivity, Reflectivity, and Transmissivity, Concept of a blackbody, Emissivity, the Planck Distribution law, Wien's Displacement Law, Stefan-Boltzmann, Kirchhoff's Law. The View factor, View factor relations, View Factors between Infinitely Long Surfaces: The Crossed-Strings Method Radiation exchange between Opaque, Diffuse, Gray Surfaces in an enclosure: Blackbody radiation exchange, the two-surface enclosure, radiation shields.

Unit-V

Heat Exchangers: Heat exchanger types, overall heat transfer coefficient. Heat exchanger analysis: Use of the Log Mean Temperature Difference (Parallel-Flow, Counter-Flow), the Effectiveness–NTU Method. Heat Exchanger Design and Performance Calculations (LMTD, ε-NTU methods), Selection of heat exchangers.

Boiling: Pool boiling regimes, nucleate pool boiling, and critical heat flux for nucleate pool boiling, minimum heat flux.
Condensation: Physical Mechanisms, Laminar Film Condensation on a Vertical Plate, Turbulent Film Condensation, drop wise condensation.

Suggested Reading:

1. John H Lienhard IV, John H LienhardV,A"Heat Transfer" Textbook, Fifth Edition, Phlogiston Press, 2019.
2. Theodore L. Bergman, Adrienne S. Lavine, Frank P. Incropera, David P. DeWitt "Fundamentals of Heat and Mass Transfer", 8th Edition, John willey& Sons, 2018.
3. J.P. Holman, "Heat Transfer", Tenth Edition, McGraw Hill Companies Inc., 2010.
4. Yunus A Cengel, "Heat Transfer A Practical Approach", Second Edition, McGraw-Hill, 2002
5. James R. Welty, Charles Wicks, Robert Wilson, Gregory Rorrer, "Fundamentals of Momentum, Heat and Mass Transfer", 4th Edition, John Wiley and Sons Ltd, 2001

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B. Tech. (ME) VI SEMISTER

PC3203ME

REFRIGERATION AND AIR CONDITIONING

Course code	PCC				
Category	Professional Core Course				
Course title	**Refrigeration and Air conditioning**				
Scheme and Credits	L	T	P	Credits	Internal marks = 30
	3	-	-	3	External Marks = 70

Unit-I

Definition of Refrigeration & Air Conditioning: Necessity of refrigeration. Applications of refrigeration and air conditioning. Units of refrigeration. Refrigerants classification and desirable properties of refrigerants. Air refrigeration: Carnot refrigeration cycle and its limitation. Air refrigeration cycle operating on Brayton cycle and analysis. Aircraft refrigeration: Necessity. Advantages of using air cycles for aircraft refrigeration. Refrigeration systems for low and high speed aircrafts.

Unit-II

Vapour compression system: Simple vapour compression cycle: COP, representation of cycle on T- S, P-H and H-S diagrams. Actual vapour compression cycle. Effect of superheating and sub cooling– problems.

Vapour absorption refrigeration systems: Ammonia –water, Lithium Bromide – water systems. Improvements using analyzer and rectifier. Desirable properties of combinations. Electrolux refrigerator – It's working.

Unit-III

Steam jet refrigeration systems: Analysis using T-S and H-S diagrams. Quantity of motive steam required. Use of barometric and evaporative condensers. Limitations and advantages of steam jet systems.

Thermoelectric refrigeration systems: Seebeck effect, Peltier effect and Thompson effect. Analysis of the thermoelectric refrigeration systems using Peltier effect. Expression for COP. Criterion for selecting thermoelectric effects. Vortex tube refrigeration – principle and working.

Unit-IV

Psychrometric properties of air: Psychrometric chart and psychrometric processes and combination of processes. By pass factor. SHR and Room conditioning using SHR with and without recirculation .Design and classification of Air conditioning systems, RSHF, GSHF, ERSF. Human comfort and tolerances. ASHRAE comfort charts. Effective temperature.

Unit-V

Cryogenics: Limitations of single stage vapour compression systems applied to low temperature applications. Multistage compression and cascade systems for production of low temperature .Joule Thompson effect and coefficient. Inversion curve. Liquification of air using Linde and cloud systems. Liquification of hydrogen and helium. Application of cryogenics in metallurgy, cryobiology and cryosurgery.

Suggested Reading:

1. Arora& Domkundwar, " A Course in Refrigeration and Air conditioning", 8th Edition, Dhanpatrai & Co, 2008.
2. Roy J. Dossat, "Principles of Refrigeration", 5th edition, Pearson Education, 2001
3. R.S. Khurmi& J.K. Gupta, "Refrigeration and air conditioning", 5th revised edition, S Chand & Co, 2008.
4. ordon &Priester, "Principles of Refrigeration and Air Conditioning", Prentice Hall, India,1988 Arora C.P., "Refrigeration and Air Conditioning", Tata McGraw Hill, New Delhi, 1988.

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B. Tech. (ME) VI SEMISTER

PE3204ME

FINITE ELEMENT ANALYSIS

(Professional Elective-II)

Course code	PEC				
Category	Professional Elective Course				
Course title	**Finite Element Analysis**				
Scheme and Credits	L	T	P	Credits	Internal marks = 30
	2	1	-	3	External Marks = 70

Unit-I

Introduction: Introduction to Finite Element Method ,solution method using FEM, discretization ,Boundary conditions, load application, types of elements comparison, Stress and Equilibrium, Boundary conditions. Strain-Displacement relations. Stress-strain relations. Types of elements used. Convergence requirements and geometric isotropy. Local, natural and global coordinates.
One Dimensional problems :Finite element modeling, coordinates and shape functions.
Potential Energy approach: Assembly of Global stiffness matrix and load vector. Finite element equations, Treatment of boundary conditions. Quadratic shape functions.

Unit-II

Analysis of trusses and frames: Element stiffness matrix for a truss member. Analysis of plane truss with number of unknowns not exceeding two at each node. Analysis of frames with two translations and a rotational degree of freedom at each node.
Analysis of Beams: Element stiffness matrix for two nodded, two degrees of freedom per node beam element.

Unit-III

Finite element modeling of two dimensional stress analysis with constant strain triangles and treatment of boundary conditions.
Finite element modeling of Axisymmetirc solids subjected to Axisymmetric loading with triangular elements.

Unit-IV

Two dimensional four nodded isoperimetric elements and numerical integration.
Steady state heat transfer analysis: One dimensional analysis of a find and two dimensional analysis of thin plate. Analysis of uniform shaft subjected to torsion.

Unit-V

Dynamic Analysis: Formulation of finite element mode, element matrices, evaluation of Eigen values and Eigen vectors for a stepped bar and a beam.
Time dependent field problems: Application to one dimensional heat flow in a rod. Finite element formation to three dimensional problems in stress analysis. Introduction to Finite Element Analysis Software.

Suggested Reading:

1. Tirupathi R. Chandraputla and Ashok, D. Belgundu" Introduction to Finite Elements in Engineering", Pearson Education, 2002, 3rd Edition.
2. Rao S.S., "The Finite Element Methods in Engineering", pergamonPress, 1989.
3. Segerlind, L.J. "Applied Finite Element Analysis", Wiley Publication, 1984.
4. Reddy J.N., "An Introduction to Finite Element Method", McGraw-Hill Company, 1984.

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B. Tech. (ME) VI SEMISTER

PE3205ME
FATIGUE CREEP AND FRACTURE
(Professional Elective-II)

Course code	PEC				
Category	Professional Elective Course				
Course title	**Fatigue Creep and Fracture**				
Scheme and Credits	L	T	P	Credits	Internal marks = 30
	2	1	-	3	External Marks = 70

Unit I:

Design philosophy : Infinite life, Safe life, Fail safe and Damage tolerant design concepts.
Fatigue Design : Cyclic stress and stress reversals, Fatigue and progressive fracture, Endurance limit, Fatigue Tests : Cantilever and Beam type of Fatigue Tests, Axial Fatigue Tests. Influence of mean stress on fatigue : Gerber, Goodman and Soderberg's criteria. Effect of compressive cyclic stress on fatigue. Fatigue design formula for axial, bending, torsional and combined loading.

Unit II:

Fatigue controlling factors: Effect of frequency, Temperature, size, form, stress concentration factors, Notch, sensitivity & surface conditions, residual stresses. Improvement of fatigue strength by chemical/metallurgical processes such as nitriding, flame hardening, case carburizing. Fatigue strength enhancement by mechanical work : cold rolling, peening, shot peening.

Unit III:

Effect of environment : Corrosion Fatigue, Concept of cumulative fatigue damage
Fracture Mechanics : Ductile and brittle fracture Theoretical cohesive strength of metals, Griffith Theory of brittle Fracture, Oruron's modification to Griffith Theory.

Unit IV:

Modes of fracture :Mode-I, -II and -III, fatigue crack growth, Behavior of metals, Linear Elastic Fracture Mechanics (LEFM), Stress Intensity Factor(SIF), Stress field near the crack tip, Critical SIF and Fracture Toughness, Experimental determination of fracture toughness KIC , COD gauge sand standard ASTM Tests.
Strain Energy Release Rates (SERR), Elasto-Plastic Fracture Mechanics (EPFM), Plastic zone size and its evaluation, J-Integral Method.

Unit V:

Creep Analysis :Definition, Constant stress and constant, strain creep tests. Uniaxial creep tests : Baily's Power Law, Creep relaxation : strain hardening and time hardening creep relaxation. Introduction to Creep bending and deflection of simple problems.

Suggested Reading

1. George E. Dieter, Mechanical Metallurgy, - McGraw Hill, NY,1988
2. Joseph Marin,Mechanical Behaviour of Engg.Materials,-PrenticeHallofIndia,1966
3. Stephens, R.I. and Fuchs,H.O.,Metal Fatigue in Engg.,-Wiley, NY2001
4. Finnie, I. and Heller, W.R., Creep of Engg. Materials, - McGraw Hill BookCo.,1959
5. Prasant Kumar, Fracture Mechanics

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B. Tech. (ME) VI SEMISTER

PE3206ME

THEORY OF ELASTICITY

(Professional Elective-II)

Course code	PEC				
Category	Professional Elective Course				
Course title	**Theory of Elasticity**				
Scheme and Credits	L	T	P	Credits	Internal marks = 30
	2	1	-	3	External Marks = 70

Unit-I

Analysis of Stress: Stress tensor, Equilibrium equations in Cartesian coordinates, Two dimensional stress at a point and principal stresses. Three dimensional stress at a point and principal stresses. Stresses on an oblique plane in terms of principal stresses.

Unit-II

Analysis of Strain: Strains in terms of displacements in Cartesian coordinates, Equations of compatibility, Generalized Hook's Law and Lame's constants, Strain energy, Dilatational and distortional energy, St. Venant's principle.

Unit-III

Two dimensional problems: Plane stress, Plane strain problems: Stress function, Bi-harmonic equation, Equilibrium equations, Strain displacement relations and compatibility equations in polar coordinates, Stress concentration.

Unit-IV

Bending of straight beams and curved beams, stresses in curved beams, expression for radius of curvature of neutral axis for rectangular, circular, trapezoidal and T-sections .Design of crane Hook, C-clamp. Design of chain drives: Power rating of roller chains. Strength of roller chains. Torsion of shafts, Membrane analogy. Bending of plates.

Unit-V

Axi-symmetric problems, Thick walled cylinders subjected to internal and external pressures, Stresses in composite tubes, Rotating disks of uniform and variable thickness. General treatment of column stability problems.

Suggested Reading:

1. L.S. Srinath, "Advanced Mechanics of Solids", Tata McGraw Hill Publ. Co., 1970.
2. S. Timeshenko& J.N. Goodier, "Theory of Elasticity", Tata McGraw Hill, 1970.
3. A.C. Uguaral, "Advanced Strength and Theory of Elasticity", Elsevier Publication, 1965.
4. S. Singh, "Theory of Elasticity", Khanna Publishers, 1979.

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B. Tech. (ME) VI SEMISTER

HS3208

Managerial Economics and Accountancy

(Humanity Sciences)

Course code	HS				
Category	Humanity Sciences				
Course title	Managerial Economics and Accountancy				
Scheme and Credits	L	T	P	Credits	Internal marks = 30
	3	-	-	3	External Marks = 70

UNIT-I

Meaning and Nature of Managerial Economics: Managerial Economics and its usefulness to Engineers, Fundamental Concepts of Managerial Economics-Scarcity, Marginalism, Equimarginalism, Opportunity costs, Discounting, Time Perspective, Risk and Uncertainty, Profits, Case study method.

UNIT-II

Consumer Behavior: Law of Demand, Determinants, Types of Demand; Elasticity of Demand (Price, Income and Cross-Elasticity); Demand Forecasting, Law of Supply and Concept of Equilibrium.

UNIT-III

Theory of Production and Markets: Production Function, Law of Variable Proportion, ISO quants, Economics of Scale, Cost of Production (Types and their measurement), Concept of Opportunity Cost, Concept of Revenue, Cost-Output relationship, Break-Even Analysis, Price - Output determination under Perfect Competition and Monopoly.

UNIT-IV

Capital Management: Significance, determination and estimation of fixed and working capital requirements, sources of capital, Introduction to capital budgeting, methods of payback and discounted cash flow methods with problems.

UNIT-V

Book-keeping: Principles and significance of double entry book keeping, Journal, Subsidiary books, Ledger accounts, Trial Balance, concept and preparation of Final Accounts with simple adjustments, Analysis and interpretation of Financial Statements through Ratios.

Suggested Reading:

1. Mehta P.L., Managerial Economics - Analysis, Problems and Cases,Sulthan Chand & Sons Educational Publishers, 2011
2. Maheswari S.N., Introduction to Accountancy, Vikas Publishing House, 2005
3.Pandey I.M., Financial Management, Vikas Publishing House, 2009

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B. Tech. (ME) VI SEMISTER

PC3210ME
METAL CUTTING SCIENCE LAB

Course code	PCC				
Category	Professional Core Course				
Course title	Metal Cutting science Lab				
Scheme and Credits	L	T	P	Credits	Internal marks = 25
	-	-	3	1.5	External Marks = 50

List of Experiments:

1. Grinding of a single point cutting tool.
2. Determination of shear angle in turning process.
3. Determination of shear angle in shaping process.
4. Study of chip formation in machining Ferrous and Non-Ferrous materials.
5. Determination of average chip-tool interface temperature by natural work-
6. Tool thermocouple method.
7. Determination of cutting forces in turning operation using a lathe-tool dynamometer
8. Tool wear measurement
9. Demonstration of Machinability of Mild Steel using Abrasive Water Jet
10. Demonstration of wire cut EDM for making slots in Tool Industry

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B. Tech. (ME) VI SEMISTER

PC3211ME
THERMAL ENGINEERING-II LAB

Course code	PCC				
Category	Professional Core Course				
Course title	Thermal Engineering-II Lab				
Scheme and Credits	L	T	P	Credits	Internal marks = 25
	-	-	3	1.5	External Marks = 50

List of Experiments:

1. Thermal Conductivity of Insulating Powder.
2. Heat Transfer from vertical tube by Natural Convection.
3. Heat Transfer through pin fin by natural and forced convection.
4. Heat Transfer by forced convection.
5. Heat Transfer through composite walls.
6. Emissivity of test plate.
7. Heat Transfer through metal rod.
8. Parallel and counter flow heat exchangers.
9. Heat transfer through two slab gaurded apparatus.
10. Heat transfer through heat pipe.
11. Estimation of Stefan Boltzman's constant.
12. Calibration of thermocouple.
13. C.O.P. of vapor compression refrigeration system.
14. Performance of Vapor Absorption Refrigeration System.
15. Performance testing of window air-conditioner
16. Separating and throttling calorimeter

Any ten (10) experiments can be conducted

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B. Tech. (ME) VI SEMISTER

PW3211ME SUMMER INTERNSHIP

Course code	PW3211				
Category	Project Work				
Course title	Summer Internship				
Scheme and Credits	L	T	P	Credits	Internal marks = --
	-	-	-	-	External Marks = --

Course Objectives:

- To give an experience to the students in solving real life practical problems with all its constraints.
- To give an opportunity to integrate different aspects of learning with reference to real life problems.
- To enhance the confidence of the students while communicating with industry engineers and give an opportunity for useful interaction with them and familiarize with work culture and ethics of the industry.
- Course Outcomes: Student will be
- Able to design/develop a small and simple product in hardware or software.
- Able to complete the task or realize a prespecified target, with limited scope, rather than taking up a complex task and leave it.
- Able to learn to find alternate viable solutions for a given problem and evaluate these alternatives with reference to prespecified criteria.
- Able to implement the selected solution and document the same.

Summer Internship is introduced as part of the curricula for encouraging students to work on problems of interest to industries. A batch of two or three students will be attached to a person from anMechanical Industry / R & D Organization / National Laboratory for a period of 8 weeks. This will be during the summer vacation following the completion of the VI semester course. One faculty member will act as an internal guide for each batch to monitor the progress and interacts with the Industry guide.

After the completion of the project, students will submit a brief technical report on the project executed and present the work through a seminar talk to be organized by the department. After the completion of the project, students will submit a brief technical report on the project executed and present the work through a seminar talk to be organized by the department. Award of sessional are to be based on the performance of the student at the work place to be judged by industry guide and internal guide (25 Marks) followed by presentation before the committee constituted by the department (25 Marks). One faculty member will coordinate the overall activity of Summer Internship.

*Students have to undergo summer internship of 6 Weeks duration at the end of semester VI

Annexure

- ✓ Students can select any one of the following subjects as an Open elective subject.

Open Elective subjects offered from different department

Sl. No	Course Code	Name of the subject	Branch
1	OE3213EC	Microprocessor and Interfacing	ECE
2	OE3207CS	Fundamentals of Data Structures	CSE

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B. Tech. (MECH) VI SEMESTER

OPEN ELECTIVE-I

OE3113EC MICROPROCESSORS AND INTERFACING

Course code	OE3113EC				
Category	Open Elective Course				
Course title	**Microprocessors And Interfacing**				
Scheme and Credits	L	T	P	Credits	Internal marks = 30
	3	-	-	3	External Marks = 70

UNIT I
Evolution of microprocessors, 8085 microprocessor architecture, addressing modes and instruction sets. Basic assembly language programming, pin configuration, timing diagram of read and write operation.

UNIT II
8086 architecture-functional block diagram, register organization, memory segmentation, programming model, pins description in maximum mode and minimum mode, timing diagrams.

UNIT III
Instruction formats, addressing modes, classification of instruction set, assembler directives, macros, 8086 microprocessor assembly language programs: simple programs involving data transfer operation, arithmetic operation, logical operation, branch operation, machine control operation, string manipulations, stack and subroutine operations.

UNIT IV
8255 Programmable peripheral interface block diagram and various modes of operation. Interfacing of ADC, DAC, keyboard, seven segment display, stepper motor interfacing and 8254 (8253) programmable interval timers.

UNIT V
Interrupt structure of 8086, interfacing programmable interrupt controller 8259 and DMA Controller 8257 to 8086 microprocessor. Serial communication standards, RS 232 ,Serial data transfer schemes and block diagram of 8251 USART.

Suggested Readings:
1. Ramesh Gaonkar, "Microprocessor architecture, programming and applications with the 8085", Penram International Publication (India) Pvt. Ltd.
2. Douglas V. Hall, "Microprocessors and Interfacing", Tata McGraw Hill Publication.
3. Sivarama P. Dandamudi, "Introduction to Assembly Language Programing From 8086 to Pentium Processors", Springer Publication.
4. Walter A. Triebel and Avtar Singh, "The 8088 and 8086 Microprocessors: Programming, Interfacing Software, Hardware and Applications", Pearson Publication.
5. A. K. Ray and K. M. Bhurchandi, "Advance microprocessors and Peripherals" Tata McGraw Hill Publication.
6. Lyla B. Das, "The X86 Microprocessors, Architecture, Programming and Interfacing (8086 to Pentium)", Pearson Publication.

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B. Tech. (ECE) VI SEMESTER

OPEN ELECTIVE – I

OE3207CS FUNDAMENTALS OF DATA STRUCTURES

Course code	OE3207CS				
Category	Open Elective Course				
Course title	Fundamentals Of Data Structures				
Scheme and Credits	L	T	P	Credits	Internal marks = 30
	3	-	-	3	External Marks = 70

UNIT-I

Introduction: Introduction to data structure, types of data structures, revision of arrays, memory representation of arrays, operations on arrays, static versus dynamic memory allocation, pointers, self-referential Structure Time complexity.

UNIT-II

Stack-Queue (Linear Data structures): Definition of stack, operations on stack, implementation of stack. Applications of Stack.

UNIT-III

Definition of queue, operations on queue, implementation of queue using arrays
Applications of queue, Circular queue and priority queue.

UNIT-IV

Trees-Graphs (Nonlinear Data structures): definition of trees, Terminology on trees, binary tree, binary search tree and its operations, tree traversal techniques. Applications of Trees.

UNIT-V

Graph: definition, terminology on graphs, representation of graphs, graph traversal techniques, spanning tree, minimum cost spanning tree algorithms. Applications of Graphs.

Text Books:

1. Sahni Horowitz, "Fundamentals of data structures in C", Universities Press, second edition, 2008, ISBN No- 978-8173716058.
2. R Venkatesan,S Lovelyn Rose,"Data structures",Wiley, second edition, 2019, ISBN No-978-8126577149.

References:

1.Narasimha Karumanchi, "Data Structures and Algorithms Made Easy: Data Structures and Algorithmic Puzzles", Careermonk Publications, 2016, ISBN-No: 978-8193245279.

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B. Tech. (Mechanical) VII SEMESTER

S.No	Course Code	Course Title	Scheme of Instruction			Lecture Hrs/ week	Scheme of Examination		Credits
			L	T	P		CIE	SEE	
Theory									
1.	PC4101ME	CAD/CAM	3	-	-	3	30	70	3
2.	PC4102ME	Industrial Automation	3	-	-	3	30	70	3
3.	PC4103ME	Advanced Material Science and Engineering	3	-	-	3	30	70	3
4.	PE III*	Professional Elective -III	3	-	-	3	30	70	3
5.	PEC IV*	Professional Elective -IV	3	-	-	3	30	70	3
6.	OE II	Open Elective II	3			3	30	70	3
PRACTICALS									
7.	PC4113ME	Product Design by CAD Lab	-	-	2	2	25	50	1
8.	PW4114ME	PROJECT WORK-I	-	-	3	3	50	00	1.5
		Total	18	-	5	23	255	470	20.5

* (PE-III) **PROFESSIONAL ELECTIVE COURSE -III**	
PE4104 ME	Computational Fluid Dynamics
PE4105 ME	Mechatronics
PE4106 ME	Tool Design

* (PE-IV) **PROFESSIONAL ELECTIVE COURSE -IV**	
PE4107 ME	Additive Manufacturing
PE4108ME	Design for Manufacturing
PE4109ME	Fuel Cell Technology

* (OE-II) **OPEN ELECTIVE COURSE -II**	
OE4110 EE	Energy Storage Systems
OE4111 EC	Optimization Techniques
OE4112 EC	Fundamentals of IoT

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B. Tech. (ME) VII SEMISTER
PC4101ME CAD/CAM
(Professional Core Course)

Course code	PC4101ME				
Category	Professional Core Course				
Course title	CAD/CAM				
Scheme and Credits	L	T	P	Credits	Internal marks = 30
	3	-	-	3	External Marks = 70

UNIT – I

Fundamentals of CAD/ CAM, Application of computers for Design and Manufacturing, Benefits of CAD/ CAM - Computer peripherals for CAD/ CAM, Design workstation, Graphic terminal, CAD/ CAM software- definition of system software and application software, CAD/ CAM database and structure.

Geometric Modeling: Wire frame modeling, wire frame entities, Interpolation and approximation of curves, Concept of parametric and non-parametric representation of curves, Curve fitting techniques, definitions of cubic spline, Bezier, and B-spline.

UNIT – II

Surface Modeling: Algebraic and geometric form, Parametric space of surface, Blending functions, parameterization of surface patch, Subdividing, Cylindrical surface, Ruled surface, Surface of revolution Spherical surface, Composite surface, Bezier surface. B-spline surface, Regenerative surface and pathological conditions.

Solid Modeling: Definition of cell composition and spatial occupancy enumeration, Sweep representation, Constructive solid geometry, Boundary representations.

UNIT – III

NC Control Production Systems: Numerical control, Elements of NC system, NC part programming: Methods of NC part programming, manual part programming, Computer assisted part programming, Post Processor, Computerized part program, SPPL (A Simple Programming Language). CNC, DNC and Adaptive Control Systems.

UNIT – IV

Group Technology: Part families, Parts classification and coding. Production flow analysis, Machine cell design. Computer aided process planning: Difficulties in traditional process planning, Computer aided process planning: retrieval type and generative type, Machinability data systems.

Computer Aided Manufacturing Resource Planning: Material resource planning, inputs to MRP, MRP output records, Benefits of MRP, Enterprise resource planning, Capacity requirements planning

UNIT – V

Flexible Manufacturing System: F.M.S equipment, FMS layouts, Analysis methods for FMS benefits of FMS.

Computer Aided Quality Control: Automated inspection- Off-line, On-line, contact, Non-contact; Coordinate measuring machines, Machine vision.

Computer Integrated Manufacturing: CIM system, Benefits of CIM

Suggested Readings:

1. CAD/CAM Concepts and Applications / Alavala / PHI
2. CAD/CAM Principles and Applications / P. N. Rao / McGraw Hill
3. CAD/CAM/ Groover M.P/ Pearson
4. CAD/CAM/CIM/ Radha krishnan and Subramanian / New Age

Faculty of Engineering & Technology
KAKATIYA UNIVERSITY, WARANGAL-506 009
Department of Mechanical Engineering

B. Tech. (ME) VII SEMISTER
PC4102ME INDUSTRIAL AUTOMATION
(Professional Core Course)

Course code	PC4102ME				
Category	Professional Core Course				
Course title	Industrial Automation				
Scheme and Credits	L	T	P	Credits	Internal marks = 30
	3	-	-	3	External Marks = 70

UNIT – I

CIM – Definition, scope and elements of CIM system-benefits, Production system facilities – low-medium-high-Manufacturing support systems-Automation in production systems, Automated manufacturing systems, Computerized Manufacturing Support Systems-Reasons for Automating.

UNIT – II

Automation: Automation –definition- Basic elements of an automated system - Levels of automation, Types and strategies of automation, Automation principles and strategies-USA Principle-Ten Strategies for Automation and Production Systems, Automation in machine tools. Mechanical feeding and tool changing and machine tool control transfer of automation.

UNIT-III

Automated Flow Lines: Methods or work part transport transfer Mechanical buffer storage control function, design and fabrication consideration.

Analysis of Automated Flow Lines: General terminology and analysis of transfer lines without and with buffer storage, partial automation, implementation of automated flow lines.

Assembly System and Line Balancing: Assembly process and systems assembly line, line balancing methods, ways of improving line balance, flexible assembly lines.

UNIT - IV

Material Handling: Types of equipment, functions, analysis and design of material handling systems, conveyor systems, automated guided vehicle systems. Automated storage systems, automated storage and retrieval systems, work in process storage, interfacing handling and storage with manufacturing.

Adaptive Control Systems: Introduction, adaptive control with optimization, Adaptive control with constraints, Application of A.C. in machining operations. Use of various parameters such as cutting force, Temperatures, vibration and acoustic emission.

UNIT-V

Business Process Re-engineering: Introduction to BPE logistics, ERP, Software configuration of BPE, Industry 4.0, concurrent Engineering, Techniques of Rapid Proto typing.

Suggested Readings:

1. Automation, Production Systems and Computer Integrated Manufacturing/M.P. Groover. / Pearson
2. Computer control of Manufacturing Systems by Yoram Coreom / McGraw Hill
3. CAD / CAM/ CIM / Radha krishnan / New Age Advanced Manufacturing Technology/ K Vara Prasada Rao / Kanna Publications

Faculty of Engineering & Technology
KAKATIYA UNIVERSITY, WARANGAL-506 009
Department of Mechanical Engineering

B. Tech. (ME) VII SEMISTER
PC4103ME Advanced Material Science
(Professional Core Course)

Course code	PC4103ME				
Category	Professional Core Course				
Course title	Advanced Material Science				
Scheme and Credits	L	T	P	Credits	Internal marks = 30
	3	-	-	3	External Marks = 70

UNIT – I

Nanotechnology: There's Plenty of Room at the Bottom: History of Nano science, Nanometer, Nano materials and Nanotechnology, Importance of Nano-technology, Nano materials-classification, applications.

Mechanical Behavior of Nano Materials: Effect of Nano scale on mechanical properties. Strength and deformation of Nano Materials, Inverse Hall petch effect, Super Plastic Deformation of Nano Materials. Physical, Electrical and Magnetic Behavior of Nano Materials.

UNIT – II

Nano Materials Synthesis: Methods for creating Nanostructures; Bottom-up and Top-down approaches, **Vapor Phase Processing***:* Physical Vapor Deposition, Chemical Vapor Deposition, Inert Gas Condensation, **Liquid Phase Processing:** Rapid Solidification Process, Atomization, Sonication of Immiscible Liquids, **Solid State Processing***:* Mechanical Alloying, Severe Plastic Deformation, Annealing of Amorphous Precursors. Effect of Process Parameters

UNIT – III

Structural Characterization: Sample preparation, Working Principle and Result Analysis : X-ray diffraction, Small angle X-ray Scattering (GI XRD), Scanning Electron Microscopy (SEM), Scanning Probe Microscopy (SPM), TEM and EDAX analysis, Scanning Tunneling Microscopy (STM), Atomic force Microscopy (AFM).

UNIT – IV

Special Nano Materials: Nano Composites: Introduction: Definition - characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Classification of Composites Based on Matrix and Reinforcement. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

Manufacturing of Metal Matrix Composites*:* Stir Casting - Solid State diffusion technique, Cladding - Hot isostatic pressing. **Powder Metallurgy process:** steps in powder metallurgy

process, process variables, SWOT analysis of Powder Metallurgy Process. Properties and Applications.

Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering.

UNIT – V

Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs hand layup method Autoclave method - Filament winding method Compression moulding - Reaction injection moulding. Properties and applications.

Special Nano Materials: Carbon Nano Tubes: SWCNT, MWCNT: properties and applications
Nano Biomaterials: Introduction, Biocompatibility, anti-bacterial activity, targeted drug delivery.

Suggested Readings:

1. Kulkarni Sulabha K, Nanotechnology: Principles and Practices, Capital Publishing Company, 2007
2. B. S. Murty, P. Shankar, Baldev Raj et al., Textbook on Nano science and Nanotechnology, 1st ed., Springer-Verlag Berlin Heidelberg, 2013Stuart M. Lindsay, Introduction to Nano science, Oxford University Press, 2009
3. Material Science and Technology- Vol 13- Composites by R.W. Cahn-VCH, West Germany.
4. Materials Science and Engineering, An Introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.

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Department of Mechanical Engineering

B. Tech. (ME) VII SEMISTER
PE4104 ME Computational Fluid Dynamics
(Professional Elective-IV)

Course code	PE4104ME				
Category	Professional Elective Course				
Course title	Computational Fluid Dynamics				
Scheme and Credits	L	T	P	Credits	Internal marks = 30
	3	-	-	3	External Marks = 70

UNIT-I

Review of Basic Equations of Fluid Dynamics: Continuity, Momentum and Energy equations-Navier Stokes equations, Reynolds and Favre averaged N-S equations. Heat transfer conduction equations for steady and unsteady flows. Steady convection-diffusion equation.

UNIT-II

Introduction to Turbulence: Mixing length model, K-ε turbulence Model. Classification of PDEs-Elliptic, parabolic and hyperbolic equations. Initial and boundary value problems.

UNIT-III

Concepts of Finite Difference Methods: Forward, backward and central difference. Finite difference solutions-Parabolic partial differential equations. Euler, Crank Nicholson, Implicit methods. Higher order difference methods. Errors, consistency. stability analysis- von Neumann analysis. Convergence criteria.

UNIT-IV

Numerical Methods: Jacobi, Gauss Seidel and ADI methods.1D and 2D Elliptic partial differential equations Problems. Viscous incompressible flow, Stream function- Vorticity method. Introduction to Grid Generation- Types of grid- O,H,C.

UNIT- V

Introduction to Finite Volume Method: Finite volume formulations for diffusion equation, convection diffusion equation. Solution algorithm for pressure velocity coupling in steady flows, Staggered grid, SIMPLE Algorithm.

Suggested Reading:

1. Muralidhar K, Sundararjan T, Computational Fluid Flow and Heat transfer, Narosa Publishing House, 2003.
2. Chung, T J, Computational Fluid Dynamics, Cambridge University Press, 2002.
3. Patankar, S V, Numerical Heat transfer and Fluid flow, Hemisphere Publishing Company, New York, 1980.
4. John D Anderson, Computational Fluid Dynamics, McGraw Hill, Inc., 1995.
5. PradipNiyogi, Chakrabartty S K, Laha M K, Introduction to Computational Fluid Dynamics, Pearson Education, 2005

Faculty of Engineering & Technology
KAKATIYA UNIVERSITY, WARANGAL-506 009
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B. Tech. (ME) VII SEMISTER
PE4105ME Mechatronics
(Professional Elective-III)

Course code	PE4105ME				
Category	Professional Elective Course				
Course title	Mechatronics				
Scheme and Credits	L	T	P	Credits	Internal marks = 30
	3	-	-	3	External Marks = 70

UNIT I

Introduction: Definition of Mechatronics, Mechatronics in manufacturing, Product, and design. Measuring systems, control systems, Microprocessor based controllers. Comparison between Traditional and Mechatronics approach.

UNIT II

Review of Fundamentals of Electronics: Data conversion devices, sensors, micro sensors, transducers, signal processing devices, relays, contactors and timers. Performance, terminology, displacement, position, proximity, velocity and motion.
Microprocessors controllers and PLCs.

UNIT III

Electrical Actuation Systems: Electrical system, mechanical switches, solid-state switches solenoids, D.C.motors, AC motors and stepper motors. Drives: stepper motors, servo drives. Ball screws, linear motion bearings, cams, systems controlled by camshafts, electronic cams, indexing mechanisms, tool magazines, transfer systems.

UNIT IV

Hydraulic Systems: Flow, pressure and direction control valves, actuators, and supporting elements, hydraulic power packs, pumps. Design of hydraulic circuits. Pneumatics: production, distribution and conditioning of compressed air, system components and graphic representations, design of systems.

UNIT V

System Models: Engineering system, rotational-translational system, electro- mechanical systems and hydraulic-mechanical system.
System Transfer Functions: Transfer function, first order system, second order system, system in series and systems with feedback loops. Description of PID controllers. CNC machines and part programming. Industrial Robotics.

Suggested Readings:

1. HMT ltd. Mechatronics, Tata Mcgraw-Hill, New Delhi, 1988.
2. G.W. Kurtz, J.K. Schueller, P.W. Claar .II, Machine design for mobile and industrial applications, SAE, 1994.
3. T.O. Boucher, Computer Automation in Manufacturing - an Introduction, Chappman and Hall, 1996.
4. Devdas Shetty, Richard Klok "Mechatronic system design", 2nd edition, Cengage Learning,
5. Boltan, W., "Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering", Longman, Singapore, 1999
6. Krishna Kant; Computer Based Industrial Control ; Prentice Hall of India Pvt. Ltd. 1999.
7. Herbert Taub& Donald Schilling : Digital Integrated Electronics, McGraw Hill International Edition, 1977.
8. David Alciatoare, Michael Histand, "Introduction to Mechatronics and Measurement Systems", McGraw Hill, 2002.
9. Haxkworth, "Programmable Logic Controllers-Programming Methods and its Applications", Pearson India Ltd., 2011.

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Department of Mechanical Engineering

B. Tech. (ME) VII SEMISTER
PE4106ME Tool Design
(Professional Elective-III)

Course code	PE4106ME				
Category	Professional Elective Course				
Course title	Tool Design				
Scheme and Credits	L	T	P	Credits	Internal marks = 30
	3	-	-	3	External Marks = 70

Unit I

Form Fools and Multi Point Cutting Tools: Form tools: Radial and tangential: flat and circular. Form correction and tool holding methods. Drills Geometry: Variation of rake and clearance angles along tips, effect of geometrical parameters on thrust and torque effect of feed rate on rake and clearance, web thinning. Types of drill points, Grinding of drills.

Milling Cutters: Major types, geometry of peripheral, end and face milling cutters. Profile sharpened and form relieved expression for minimum number of teeth. Design features, forces and power estimation, Grinding of milling cutters.
Reamers: Types, geometry, Reaming allowance, design features tolerance disposition.
Broachers: Pull and push types. Internal and External broaches, geometry and design features. Pull force estimation. Keyway, spline, round, square broaches.

Unit II

Press Tools for Sheet Metal Working: Blanking and piercing. Diet set elements. Simple and progressive dies. Estimation of punch load, clearances, centre of pressure, strip layout, methods of reducing punch load. Bending dies: Spring back and bending allowance estimation of punch load. Drawing Dies: Punch load, blank size, number of draws, methods of retaining metal in draw dies. Metal flow during drawing.

Metal Spinning: Configuration and design features of metal spinning, shear forming and flow forming.

Unit III

Jigs & Fixtures: Design principles and construction features. Locating methods associated with flat, cylindrical internal and external surface. Types of locating pins. Requirements and choice of locating systems. Redundant location, fool proofing. Setting blocks, types of clamping devices and their basic elements. Quick action clamps and nuts. Equalising and multiple clamping pneumatics. Hydraulic, magnetic and vacuum clamping. Types of drill jig and their

classification. Types of jig bushes, jig feet. Indexing jigs. Economic analysis of Jigs and Fixtures. Economic tool life for minimum cost maximum production and max profit rate.

Unit IV

Miscellaneous tools: Cam design for single spindle automatics for simple components. Tool layout estimation of cycle time. Gauge design: Taylor's principle, limit gauges for holes and shafts. Estimation of limits on Go and No Go gauges.

Forgoing dies: Draft, parting line, filters. Allowances, sequence in multiple impression forging. Flashing, Trimming.
Tools for Injection Moulding: Basics , Material, Allowances, sequence of operation.

Unit V

Brief Introduction of CNC Machines Work Holding Devices: Tool design for CNC machines- An introduction, Fixture design for CNC Machine, Cutting tools for CNC Machine, Tool holding methods for CNC Machine, ATC and APC for CNC Machine, Tool presetting for CNC Machine

Suggested Readings:

1. Surendra kenav and Umesh Chandra, "Production Engineering Design (Tool Design)",Satya prakashan, New Delhi, 1994.
2. Donaldson, Leain and Goold, "Tool Design", Tata McGraw Hill, New Delhi, 1983.
3. Amitabha Battacharya and Inyong Ham, "Design of Cutting Tools, Use of Metal Cutting Theory", ASTME publication Michigan USA, 1969.
4. F. W. Wilson, "Fundamentals of Tool Design", ASME, PHI, New Delhi,2010.

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B. Tech. (ME) VII SEMISTER
PE4107ME Additive Manufacturing
(Professional Elective-V)

Course code	PE4107ME				
Category	Professional Elective Course				
Course title	Additive Manufacturing				
Scheme and Credits	L	T	P	Credits	Internal marks = 30
	3	-	-	3	External Marks = 70

UNIT – I

Introduction: Additive Manufacturing fundamentals: Need for time compression in product development, Need for Additive Manufacturing, Historical development, Fundamentals of Additive Manufacturing, AM Process Chain, Advantages and Limitations of AM, Commonly used Terms, Classification of AM process, Fundamental Automated Processes: Distinction between AM and CNC, other related technologies. Role of AM in Industry 4.0.

UNIT – II

Working principle, Specifications, Materials used, Process, Applications, Advantages and Disadvantages, Case studies of the following AM Technologies: **Vat Photo polymerization AM Systems:** Photopolymers, photo polymerization Stereo lithography Apparatus (SLA), Direct Light Processing (DLP) and Continuous Direct Light Processing (CDLP).

Material Jetting AM Systems: Material Jetting, Nano particle jetting and Drop-On-Demand (DOD) material jetting, Polyjet.

Binder Jetting AM Systems: Three dimensional Printing (3DP). **Material Extrusion AM Systems:** Fused Deposition Modeling (FDM)

UNIT – III

Working principle, Specifications, Materials used, Process, Applications, Advantages and Disadvantages, Case studies of the following AM Technologies:

Powder Bed Fusion AM Systems: Selective laser sintering (SLS), Selective Laser Melting (SLM) and Direct Metal Laser Sintering (DMLS), Electron Beam Melting (EBM).

Direct Energy Deposition (DED) AM Systems: Laser Engineered Net Shaping (LENS).

Sheet Lamination AM Systems: Laminated Object Manufacturing (LOM) and Ultrasonic Additive Manufacturing (UAM).

UNIT – IV

AM Data Formats: STL Format, STL File Problems, Consequence of Building Valid and Invalid Tessellated Models, STL file Repairs: Generic Solution, Slicing Algorithms: **Design for AM:** Topology optimization and Additive Manufacturing.

AM Software's: Need for AM software, Features of various AM softwar's like Magics, Mimics, Solid View, View Expert, 3 D Rhino, 3 D doctor, Flash Print, Object Studio, Cura, ITK Snap, 3-matic, Simplant, 3-matic, Simplant, MeshLab, Ansys for Additive Manufacturing.

UNIT –V

Additive Manufacturing Applications: AM Applications in Design, Engineering Analysis and Planning, Aerospace, Automotive, Jewelry, Coin, GIS, Arts, Architecture. Medical and Bioengineering Applications, Forensic Science, Anthropology, Visualization of Biomolecules, Electronic industry and Disaster Management.

Suggested Readings:

1. Chee Kai Chua and Kah Fai Leong, "3D Printing and Additive Manufacturing Principles and Applications" Fifth Edition, World Scientific Publications, 2017
2. Ian Gibson, David W Rosen, Brent Stucker, "Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing", Springer, Second Edition, 2010.
3. Frank W.Liou, "Rapid Prototyping & Engineering Applications", CRC Press, Taylor & Francis group, 2011.
4. Rafiq Noorani, "Rapid Prototyping: Principles and Applications in Manufacturing", John Wiley & Sons, 2006.
5. NPTEL Course on Rapid Manufacturing https://nptel.ac.in/courses/112/104/112104265/

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Department of Mechanical Engineering

B. Tech. (ME) VII SEMISTER
PE4108ME Design for Manufacturing
(Professional Elective-V)

Course code	PE4108ME				
Category	Professional Elective Course				
Course title	Design for Manufacturing				
Scheme and Credits	L	T	P	Credits	Internal marks = 30
	3	-	-	3	External Marks = 70

UNIT-I

Introduction: General design principles for manufacturability, strength and mechanical factors, Mechanisms selection, evaluation method, geometrical tolerances, tolerance control and utilization.

Economic Use of Raw Materials: Ferrous steel, hot rolled steel, cold finished steel, stainless steel, non ferrous materials aluminium, copper, brass, non metallic materials, plastics, rubber and composites.

UNIT-II

Metallic Components Design: Metal extrusion, metal stamping, fine blanking, four slide parts, spring and wire forms, spun metal parts, cold headed parts, extruded parts, tube and section bends, rolled formed parts, forging electro forming parts, specialized forming methods, turned parts, machined round holes, drilled parts, milled parts.

UNIT-III

Metallic Components Design: Planned shaped and slotted parts, screw threaded contoured and internal Ground parts, center less ground, electrical discharged, rolled furnished parts, electro chemical and Advanced machine parts. Sand cast, die cast, investment cast and other cast products.

UNIT-IV

Assembled Parts Design: Welded parts, arc, resistance, brazed and soldered parts, gear box assembly, Bearing assembly.

UNIT-V

Assembled Parts Design: Retension, bolted connection, screwed connections, flanged connections, centred connections, press fitted connections, surface finishing, plated parts, heat treated parts.

Case Studies: Identification of economical design and redesign for manufacture.

Suggested Reading:

1. Assembly, Automation and Product Design/Geoffrey Boothroyd/Marceal Dekker INC, NY 1992
2. James G. Bralla, "Hand book of product design for manufacturing" McGraw Hill Co., 1986
3. K.G. Swift “Knowledge based design for Manufacture", Kogan page Limited, 198

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KAKATIYA UNIVERSITY, WARANGAL-506 009
Department of Mechanical Engineering

B. Tech. (ME) VII SEMISTER
PE4109ME FUEL CELL TECHNOLOGY
(Professional Elective-V)

Course code	PE4109ME				
Category	Professional Elective Course				
Course title	FUEL CELL TECHNOLOGY				
Scheme and Credits	L	T	P	Credits	Internal marks = 30
	3	-	-	3	External Marks = 70

UNIT-I

Fundamentals: Brief history, working principles of fuel cell, components, and relative merits and demerits, classifications of fuel cells: low, intermediate and high temperature fuel cells, comparison of fuel cells with battery and heat engines.

UNIT-II

Fuel Cell Types: Polymer Electrolyte Membrane Fuel Cells (PEMFCs), Alkaline Fuel Cells (AFCs), Phosphoric Acid Fuel Cells (PAFCs), Solid Oxide Fuel Cells (SOFCs), Molten-Carbonate Fuel Cells (MCFCs), Direct Methanol Fuel Cells (DMFCs), Zinc Air Fuel Cells (ZAFCs), Protonic Ceramic Fuel Cells (PCFCs), Biological Fuel Cells (BFCs)

UNIT-III

Fuel Cells Applications: Portable Power, Backup Power, Transportation Applications: Automobiles, Buses, Utility vehicles, Scooters and bicycles, Stationary Power Applications, economic and environmental analysis on usage of fuel cell, future trends of fuel cells, and hybrid electric vehicle

UNIT-IV

Fuel Cell Analysis: Fuel cell thermodynamics, and electrochemistry - Nernst equation, Electrochemical kinetics, Butler-Volmer equation, performance evaluation of fuel cells: current/voltage, voltage efficiency and power density, Fuel cell: charge transport, mass transport, energy balance mass. fuel cell stack, fuel cell heat management..

UNIT-V

Fuel Cell System Design: Fuel Subsystem, Electrical Subsystem, System Efficiency. Fuel Types, Delivery, and Processing, Fuel Cell Operating Conditions, Fuel Cell Testing Setup, Verification of the Assembly, Fuel Cell Conditioning, Fuel Cell Hybrid Power Systems.

Suggested Reading:

1. Ryan O'Hayre, Suk-Won Cha, Whitney G.Colella, Fritz B.Prinz, "*Fuel Cell Fundamentals*", John Wiley & Sons, Inc., 2016.
2. Andrei A Kulikovsky, "*Analytical Modelling of Fuel Cells*", Elsevier, 2010, Vladimir S. Bagotsky, ―*Fuel Cells Problems and Solutions"*, John Wiley & Sons, Inc., 2009
3. Michael Gasik,"*Materials for fuel cells*", Woodhead Publishing Limited, 2008
4. Colleen Spiegel, "*Designing and Building Fuel Cells*", The McGraw-Hill Companies, 2007 W.W. Pulkrabek, Intorduction to IC Engines, PHI, 2004.

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B. Tech. (ME) VII SEMISTER
OE4110EE ENERGY STORAGE SYSTEMS
(Open Elective-II)

Course code	OE4110EE				
Category	Open Elective Course				
Course title	Energy Storage Systems				
Scheme and Credits	L	T	P	Credits	Internal marks = 30
	3	-	-	3	External Marks = 70

UNIT - I

Electrical Energy Storage Technologies: Characteristics of electricity, Electricity and the roles of EES, High generation cost during peak-demand periods, Need for continuous and flexible supply, Long distance between generation and consumption, Congestion in power grids, Transmission by cable.

UNIT - II

Needs for Electrical Energy Storage: Emerging needs for EES, More renewable energy, less fossil fuel, Smart Grid uses, The roles of electrical energy storage technologies, The roles from the viewpoint of a utility, The roles from the viewpoint of consumers, The roles from the viewpoint of generators of renewable energy.

UNIT - III

Features of Energy Storage Systems: Classification of EES systems , Mechanical storage systems, Pumped hydro storage (PHS), Compressed air energy storage (CAES), Flywheel energy storage (FES), Electrochemical storage systems, Secondary batteries, Flow batteries, Chemical energy storage, Hydrogen (H2), Synthetic natural gas (SNG).

UNIT - IV

Types of Electrical Energy Storage systems: Electrical storage systems, Double-layer capacitors (DLC) ,Superconducting magnetic energy storage (SMES),Thermal storage systems ,Standards for EES, Technical comparison of EES technologies.

UNIT - V

Applications: Present status of applications, Utility use (conventional power generation, grid operation & service) , Consumer use (uninterruptable power supply for large consumers), New trends in applications ,Renewable energy generation, Smart Grid, Smart Micro grid, Smart House, Electric vehicles, Management and control hierarchy of storage systems, Internal configuration of battery storage systems, External connection of EES systems , Aggregating EES

systems and distributed generation (Virtual Power Plant), Battery SCADA– aggregation of many dispersed batteries.

Suggested Readings:

1. Energy Storage Benefits and Market Analysis' by James M. Eyer, Joseph J. Iannucci and Garth P. Corey.
2. The Electrical Energy Storage by IEC Market Strategy Board.
3. Jim Eyer, Garth Corey: Energy Storage for the Electricity Grid: Benefits and Market Potential Assessment Guide, Report, Sandia National Laboratories, Feb 2010.

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B. Tech. (ME) VII SEMISTER
OE4111EC Optimization Techniques
(Open Elective-II)

Course code	OE4111EC				
Category	Open Elective Course				
Course title	Optimization Techniques				
Scheme and Credits	L	T	P	Credits	Internal marks = 30
	3	-	-	3	External Marks = 70

UNIT – I

Introduction: Definitions, Characteristics, Objective function, Classification of optimization problems, Engineering applications and limitations. Single-Variable Optimization, Multivariable Optimization with No Constraints, Multivariable Optimization with Equality Constraints and Multivariable Optimization with Inequality Constraints: Kuhn–Tucker Condition

UNIT – II

Linear Programming: Definitions and Formulation of the LPP, Construction of L.P. Models, Slack and surplus variables, Standard form, Canonical form and matrix form of LP Problems. Artificial Variables, solution by the Big-M method, Duality principle, Dual problems and numerical problems.

UNIT – III

Random Search Methods concepts: Direct Search Methods – Uni variate Method, Gradient of a Function, Indirect Search Methods - Gradient of a Function, Steepest Descent (Cauchy) Method, Newton‘s Method.

UNIT – IV

Binary Genetic Algorithm: Genetic Algorithms Natural Selection on a Computer, Components of a Binary Genetic Algorithm. Selecting the Variables and the Cost Function. Variable Encoding and Decoding, the Population, Natural Selection, Selection, Mating. Mutations, the Next Generation and Convergence, Components of a Continuous Genetic Algorithm. With effect from the Academic year 2021-22

UNIT – V

Metaheuristics Optimization: Concepts of Simulated Annealing, Theoretical approaches, Advantages and disadvantages, applications, Ant Colony Algorithms - Introduction, Collective behavior of social insects, Formalization and properties of ant colony optimization.

Suggested Readings:

1. Rao, S.S., "Engineering Optimization: Theory and Practice", John Wiley & Sons, Inc., 2009
2. Taha, H.A., "Operations Research, Pearson Education India", New Delhi, India, 2008.
3. Randy L. Haupt and Sue Ellen Haupt, "Practical genetic algorithms" second edition, a John Wiley& sons, inc., publication -2004.
4. Sharma J.K., ―Operation Research: Theory and Applications" Fifth Edition, Macmillan Publishers, New Delhi, India, 2013.
5. J. Dreo A. Petrowski, P. Siarry E. Taillard, "Metaheuristics for Hard Optimization" Springer.

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B. Tech. (EC) VII SEMISTER
OE4112EC Fundamentals of IOT
(Open Elective-II)

Course code	OE4112EC				
Category	Open Elective Course				
Course title	Fundamentals of IOT				
Scheme and Credits	L	T	P	Credits	Internal marks = 30
	3	-	-	3	External Marks = 70

UNIT- I

Introduction to Internet of Things: IoT vision, Strategic research and innovation directions, IOT Applications, Related future technologies, Infrastructure, Networks and communications, Processes, Data Management, Security, Device level energy issues.

UNIT- II

Internet Principles and communication technology: Internet Communications: An Overview – IP, TCP, IP protocol Suite, UDP. IP addresses – DNS, Static and Dynamic IP addresses, MAC Addresses, TCP and UDP Ports, Application Layer Protocols – HTTP, HTTPS, Cost Vs Ease of Production, Prototypes and Production, Open-Source Vs Closed Source.

UNIT- III

Prototyping for IoT: Prototyping Embedded Devices – Sensors, Actuators, Microcontrollers, SoC, Choosing a platform, Prototyping Hardware platforms – Arduino, Raspberry Pi.

UNIT- IV

Cloud computing and Data Analytics: Introduction to Cloud storage models -SAAS, PAAS, and IAAS. Communication APIs, Amazon web services for IOT.

UNIT- V

IoT Product Manufacturing - From prototype to reality: Business model for IoT product manufacturing, Business models canvas, Funding an IoT Startup.

Suggested Readings:

1. *"Internet of Things"* - Converging Technologies for smart environments and Integrated Ecosystems, River Publishers.
1. Adrian McEwen, Hakim Cassimally, "*Designing the Internet of Things",* Wiley India Publishers
2. Daneil W lewies, "*Fundamentals of embedded software: where C meets assembly",* Pearson.
3. Arshdeep Bahga*, "Internet of things -A hands on Approach"* Universities press.

Faculty of Engineering & Technology
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Department of Mechanical Engineering

B. Tech. (ME) VII SEMISTER
PC4113ME Product Design by CAD Lab
(Professional Core Course)

Course code	PC4113ME				
Category	Professional Core Course				
Course title	Product Design by CAD Lab				
Scheme and Credits	L	T	P	Credits	Internal marks = 25
	-	-	2	1	External Marks = 50

Product Design by CAD LAB

List of Experiments

1. To design and implement a program for line drawing using Bresenhams Integer line algorithim.
2. Implementation of general two-dimensional rotation, reflection and scaling in modules, generation of required transformation matrices using the above modules.
3. Curve generation and manipulation program for cubic spline curve.
4. Curve generation and manipulation program for Bezier curve.
5. Orthographic Projections of Standard Mechanical components using AutoCAD.
6. Isometric Projections of Standard Mechanical components using AutoCAD.
7. Solid Part modelling of Simple mechanical components Using CATIA.
8. Assembly of solid models of simple mechanical devices using CATIA
    1. Finite Element Analysis Using ANSYS
    2. Simple 2D Truss problems.
    3. Beam Problems
    4. Plate with Circular Hole.
9. Solid imported from CATIA subjected to simple loads
10. One dimensional Thermal problems
11. Demonistration of 3d Printing
12. To create a Simple Rectangular Box using 3d printer.

Suggested Readings:

1. P. Radha Krishnan, Introduction to CNC Machines, New Age International, New Delhi.
2. Jerry Banks, Introduction to Discrete event simulation, McGraw-Hill, New York
3. James D. Foley, Andries Van Dam, et.al., Computer Graphics-Principles and Practice,2/e, Addison Wesley, 1997.
4. Verification Manual ANSYS

Note: Any ten (10) experiments can be conducted

Faculty of Engineering & Technology
KAKATIYA UNIVERSITY, WARANGAL-506 009
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B. Tech. (ME) VII SEMISTER
PW4114ME PROJECT WORK
(PROJECT WORK)

Course code	PW4114ME				
Category	Professional Core Course				
Course title	PROJECT WORK				
Scheme and Credits	L	T	P	Credits	Internal marks = 50
	-	-	3	1.5	External Marks

The department can initiate the project allotment procedure at the end of VI semester and finalize it in the first two weeks of VII semester.

The department will appoint a project coordinator who will coordinate the following:

Collection of project topics/ descriptions from faculty members (Problems can also be invited from the industries)
Grouping of students (max 5 in a group) Allotment of project guides

The aim of project work is to develop solutions to realistic problems applying the knowledge and skills obtained in different courses, new technologies and current industry practices. This requires students to understand current problems in their domain and methodologies to solve these problems. To get awareness on current problems and solution techniques, the first 4 weeks of VII semester will be spent on special lectures by faculty members, research scholars, post graduate students of the department and invited lectures by engineers from industries and R&D institutions. After completion of these seminars each group has to formalize the project proposal based on their own ideas or as suggested by the project guide

Seminar schedule will be prepared by the coordinator for all the students from the 5th week to the last week of the semester which should be strictly adhered to.

Each group will be required to:

1. Submit a one page synopsis before the seminar for display on notice board.
2. Give a 30 minutes presentation followed by 10 minutes discussion.
3. Submit a technical write-up on the talk.

At least two teachers will be associated with the Project Seminar to evaluate students for the award of sessional marks which will be on the basis of performance in all the 3 items stated above.

The seminar presentation should include the following components of the project:

1. Problem definition and specification
2. Literature survey
3. Broad knowledge of available techniques to solve a particular problem.
4. Planning of the work, preparation of bar (activity) charts
5. Presentation- oral and written.

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B. Tech. (Mechanical) VIII SEMESTER

S.no.	Course Code	Course Title	Scheme of Instruction			Lecture Hrs/ week	Scheme of Examination		Credits
			L	T	P		CIE	SEE	
Theory									
1.	PC4201ME	Industry 4.0	3	-	-	3	30	70	3
2.	PEC V*	Professional Elective -V	3	-	-	3	30	70	3
3.	PEC VI*	Professional Elective -VI	3	-	-	3	30	70	3
4.	PW4208ME	PROJECT WORK-II	-	-	14	14	150	100	7
5.	MC	Mandatory Non Credit course	2	-	-	2	30	-	-
		Total	11	-	14	25	270	310	16

* (PE-V) **PROFESSIONAL ELECTIVE COURSE -V**	
PE4202 ME	Non Destructive Testing
PE4203 ME	Total Quality Management
PE4204 ME	Tribology

* (PE-VI) **PROFESSIONAL ELECTIVE COURSE -VI**	
PE4205 ME	Automobile Engineering
PE4206 ME	Micro Electro-Mechanical Systems
PE4207 ME	Industrial Robotics

* (HS MC) **Mandatory Non Credit Course**	
MC 42a HS	Yoga Practice
MC 42b HS	NSS

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B. Tech. (ME) VIII SEMISTER
PC4201ME INDUSTRY 4.0
(Professional Core Course)

Course code	PC4201ME				
Category	Professional Core Course				
Course title	Industry 4.0				
Scheme and Credits	L	T	P	Credits	Internal marks = 30
	3	-	-	3	External Marks = 70

UNIT-I

Introduction to Industry 4.0: Industrial revolutions; Industry 4.0-origin concept, characteristics, challenges for transformation, drivers, the value chain, benefits, current state of industry 4.0.

Conceptual Framework for Industry 4.0: Industry 4.0- design principles, supportive technologies, framework of Industry 4.0; lean production system for industry 4.0, automated based lean production applications; Impact of industry 4.0: society, business, government, and people.

UNIT-II

Smart Factories: Smart factory, smart factories in action, importance of smart manufacturing; Real World Smart Factories - GE's brilliant factory, Airbus: smart tools and smart apps, Siemen's Amberg Electronics Plant (EWA); Industry 4.0: The way forward.

Industrial Artificial Intelligence: Artificial Intelligence (AI) -history, environment and societal influences, application, domains and tools, associated technologies, prospects of AI, challenges of industrial artificial intelligence**.**

UNIT-III

Introduction to Robotics: Types of robots, Overview of robot subsystems, Robot specifications, joints and its types, types of links, Degrees of freedom of robots, accuracy, precision, resolution and repeatability, Robot classification: kinematic configurations, actuators, control mechanisms, concept of workspace, End effectors and Grippers, Mechanical, Electrical, vacuum and other methods of gripping. Applications of robots, specifications of different industrial

UNIT – IV

Robotics in the Era of Industry 4.0: Recent technological components of robots-advanced sensor technologies, Internet of Robotic Things (IoRT), cloud robotics, cognitive architecture for cyber physical robotics; Industrial robotic applications- manufacturing, maintenance, and assembly.

Role of Augmented Reality (AR) in Industry 4.0: AR hardware and software technology, industrial applications of AR.

UNIT-V

Introduction to Industrial Internet of Things(IIoT): conceptual frame work, architecture, design principles and needed capabilities, IoT enabling technologies, sensing, actuation, basics of networking, M2M communication, devices and gateways, role of cloud in IoT.

Applications of IIoT: manufacturing, healthcare, education, aerospace, defense, agriculture, transportation, and logistics;

Suggested Readings:

1. Alp Ustundag and Emre Cevikcan, "*Industry 4.0: Managing the Digital Transformation springer series in Advanced Manufacturing*", 1st edn., Springer, 2018. (Chapters 1 to 8)
2. Raj Kamal, "*Internet of Things: Architecture and Design*", 1st edn., McGraw Hill Education (India) Private Limited, Chennai, 2018. (Chapters 1,2,7,8)

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B. Tech. (ME) VIII SEMISTER
PE4202ME Non Destructive Testing
(Professional Elective-IV)

Course code	PE4202ME				
Category	Professional Elective Course				
Course title	Non Destructive Testing				
Scheme and Credits	L	T	P	Credits	Internal marks = 30
	3	-	-	3	External Marks = 70

Unit I

Non Destructive Testing's: Introduction, Objectives, Types Of NDT.

Liquid Penetrant Inspection: Principles of penetrant inspection, characteristics of a penetrant, water –washable system, post-emulsification system, solvent-removable system, surface preparation and cleaning, Penetrant application, Development, Advantages limitations, and applications.

Unit II

Magnetic Particle Inspection: Principle, Magnetization methods, continuous and residual methods, sensitivities, Demagnetization, Magnetic particles, Applications, Advantages and limitations.

Eddy Current Testing: Principle, Lift-off factor, and edge effects, Skin effect, Inspection frequency, coil arrangements, inspection probes, types of circuit, reference pieces, phase analysis, display methods and applications.

Unit III

Ultrasonic Testing: Generation of ultra sound, characteristics of an ultrasonic beam, sound waves at interfaces, sound attenuation, Display systems, Probe construction, type of display, Inspection techniques, Identification of defects, Immersion testing, Sensitivity & calibration. Reference standards. Surface condition, Applications.

Unit IV

Radiography: Principle and uses of Radiography, limitations, Principle, Radiation sources, Production of X-rays, x-ray spectra, Attenuation of radiation, Radiographic equivalence, Shadow formation, enlargement and distortion, Radiographic film and paper, Xeroradiography, fluoroscopy, Exposure factors, Radiographic screens, identification markers and image quality indicators, Inspection of simple shapes, inspection of complex shapes, viewing and interpretation of radiographs, Radiation hazard, Protection against radiation, measurement of radiation received by personnel.

Unit V

Acoustic Emission: Physical Principles, Sources of emission, instrumentation and applications. **Other NDT Techniques:** Neutron radiography, Laser induced Ultrasonics, Surface analysis, Thermography.

Suggested References:

1. Barry Hull & Vernon John, "Non Destructive Testing", 1988.
2. HJ.Frissell (Editorial Co-Ordinator) - "Non-Destructive Evaluation and Quality Control" ASM Hand Book - International Publication, USA, 1989.
3. Dove and Adams, "Experimental stress analysis and motion measurement", Prentice Hall of India, Delhi.

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B. Tech. (ME) VIII SEMISTER
PE4203ME Total Quality Management
(Professional Elective-IV)

Course code	PE4203ME				
Category	Professional Elective Course				
Course title	Total Quality Management				
Scheme and Credits	L	T	P	Credits	Internal marks = 30
	3	-	-	3	External Marks = 70

UNIT-I

Evolution of Quality-Historical Perspective: Basic Concepts of Quality, Vision, Mission and Objectives of an Organization, Corporate Structure in an Organization and Role of Quality. Quality Planning, Quality by Design, Quality Costs and Cost of Failure, Waste Control, How Quality Benefits Business.

UNIT-II

Quality and Competitiveness in Business: Zero Defects and Continuous Improvement, Role of Leadership and Commitment in Quality Deployment, Team Building, Motivation and Rewards, Total Employee Empowerment, Quality Functions-Measurement, Inspection, Testing, Calibration and Assurance.

UNIT-III

Design Control and Conformity: Tolerance and Variability, PDCA Cycle, Edward Demings, Juran, Philip Crosby approaches, Customers Requirements, Customer Supplier and Chain Links, Establishing Customer Focus, Customer Satisfaction, Measurement and Customer Retention

UNIT-IV

Total Quality Concepts: Product Liability, and CWQC, Difference in Western and Japanese Approach of TQM, Basic Philosophy and Fundamental Models of TQM, Total Quality and Ethics

UNIT-V

Internal Policies and Total Quality Management: Quality Culture, Education and Training Implementing Total Quality Management- An Integrated System Approach Total Preventive Maintenance. Self-Assessment, International/National Quality Awards: Malcolm Bal dridge Award, Deming Prize, European Award, Rajeev Gandhi Award, CII Exim Award, Jamna Lal Bajaj Award, Golden Peacock Award

Suggested Reading:

1. Total Quality Management by N.V.RNaidu, G. Rajendra New Age International, First Edition Jan 2006
2. Total Quality Management by R.S Naagarazan, New Age international,3e, 2015
3. Quality Control & Application by B. L.H anson&P. M. Ghare, Prentice Hall of India, 2004.
4. Total Quality Management by V.S Bagad Technical Publications, First Edition, Jan2008
5. Total Quality Management by S. Rajaram Dreamtech Press, First Edition,Jan2008

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B. Tech. (ME) VIII SEMISTER
PE4204ME Tribology
(Professional Elective-IV)

Course code	PE4204ME				
Category	Professional Elective Course				
Course title	Tribology				
Scheme and Credits	L	T	P	Credits	Internal marks = 30
	3	-	-	3	External Marks = 70

UNIT – I

Study of Various Parameters: Viscosity, flow of fluids, viscosity and its variation, absolute and kinematic viscosity, temperature dependent variation, viscosity index, determination of viscosity, different viscometers used.

Hydrostatic Lubrication: Hydrostatic step bearing, application to pivoted pad thrust bearing and other applications, hydrostatic lifts, hydrostatic squeeze films and its application to journal bearing.

UNIT – II

Hydrodynamic Theory of Lubrication: Various theories of lubrication, petroffs equation, Reynold's equation in two dimensions -Effects of side leakage - Reynolds equation in three dimensions, Friction in sliding bearing, hydro-dynamic theory applied to journal bearing, minimum oil film thickness, oil whip and whirl anti -friction bearing.

UNIT – III

Friction and Power Losses in Journal Bearings: Calibration of friction loss, friction in concentric bearings, bearing modulus, Sommer-field number, heat balance, practical considerations of journal bearing design

UNIT – IV

Air Lubricated Bearing: Advantages and disadvantages, application to Hydrodynamic journal bearings, hydrodynamic thrust bearings. Hydrostatic thrust bearings. Hydrostatic bearing Analysis including compressibility effect. Study of current concepts of boundary friction and dry friction.

UNIT- V

Types of Bearing Oil Pads: Hydrostatic bearing wick oiled bearings, oil rings, pressure feed bearing, partial bearings -externally pressurized bearings. Bearing materials: General requirements of bearing materials, types of bearing materials.

Suggested Readings:

1. Engineering Tribology/ Gwidon W. Stachowiak & Andrew W. Batchelor/ Elesevier
2. Engineering Tribology/ Prasanta Sahoo / PHI
3. Tribology – B.C. Majumdar
4. Fundamentals of Tribology, Basu, Sen Gupta and Ahuja/PHI
5. Tribology in Industry: Sushil Kumar Srivatsava, S. Chand &Co

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B. Tech. (ME) VIII SEMISTER
PE4205ME Automobile Engineering
(Professional Elective-VI)

Course code	PE4205ME				
Category	Professional Elective Course				
Course title	Automobile Engineering				
Scheme and Credits	L	T	P	Credits	Internal marks = 30
	3	-	-	3	External Marks = 70

UNIT-I

Automobile Body Construction: Automobile history and development, current scenario in Indian auto/ ancillary industries, Classification, types of chassis layout with reference to power source locations and drive, Vehicle frames, Various types of frames. Constructional details, Unitized frame body construction, Loads acting on vehicle frame, details of chassis material.

UNIT-II

Drive Train & Transmission: Classification of clutches: Single plate & with dual flywheel effect, Multi plate, Cone, diaphragm spring, Centrifugal. Clutch materials, Clutch plate: Electromagnetic, vacuum operated, Necessity of gear box, Manual gear box-Constant mesh, Sliding mesh, Synchromesh, Epicyclic, fluid flywheel, Torque convertor, Continuous variable transmission (CVT) , Propeller Shaft, Universal Joint, Differential and final drive

UNIT-III

Front & Rear Axle, Steering System, Wheel & Tyres Axle: Purpose and requirement of front & rear axle, live and dead axles types & arrangement, types of loads acting on rear axles, full floating, three quarter floating and semi floating rear axles. Steering System: Steering mechanism, steering geometry, cornering force, slip angle, scrub radius, steering characteristic, steering linkages & gearbox, power steering, collapsible steering, reversibility of steering, four wheel steering. Wheel and Tyres: Wheel construction, alloy wheel, wheel alignment and balancing, type of tyres, tyre construction, tyre materials, factors affecting tyre life

UNIT-IV

Suspension & Brakes System: Sprung and unsprung mass, types of suspension linkages, types of suspension springs- leaf, coil, air springs, hydro gas, rubber suspension, interconnected suspension, self leveling suspension (active suspension), damping and shock absorbers Types of brake systems - drum, disc, operation-mechanical, hydraulic, air brakes, servo and power braking, hand brake, ABS.

UNIT-V

Alternative Energy Sources: Use of Natural Gas, Liquefied Petroleum Gas, Bio-diesel, Bio ethanol, Gasohol and Hydrogen in Automobiles- Engine modifications required –Performance, Combustion and Emission Characteristics of SI and CI engines with these alternate fuels - Electric and Hybrid Vehicles. Autonomous vehicles – current status of development

Suggested Reading:

1. Kirpal Singh, "Automobile Engineering, Vol I and II",12th Edition, Standard Publishers, 2011
2. S. Srinivasan, "Automotive Mechanics", 2nd Edition, Tata McGraw Hill, 2003.
3. H. Heisler, "Vehicle and Engine Technology", ELBS, 1965.
4. P.L. Kohli, "Automotive Electrical Equipment, Tata McGraw Hill, 1985.
5. William H. Crouse, Donald L. Anglin, "Automotive Mechanics", 10th Ed., Tata McGraw Hill, 2007

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B. Tech. (ME) VIII SEMISTER
PE4206ME MICRO ELECTRO-MECHANICAL SYSTEMS
(Professional Elective-VI)

Course code	PE4206ME				
Category	Professional Elective Course				
Course title	Micro Electro Mechanical Systems				
Scheme and Credits	L	T	P	Credits	Internal marks = 30
	3	-	-	3	External Marks = 70

UNIT – I

Introduction to MEMS: MEMS and micro system products, evolution of micro-fabrication, micro systems and miniaturization, application of micro systems in industrial products and telecommunications

Working Principles of Microsystems: micro-sensors, micro-actuation, MEMS with micro-actuators, micro-accelerators and micro-fluidics

UNIT –II

Materials for MEMS and Microsystems: Substrates and wafers, active substrate materials, silicon compounds, silicon piezo resistors, gallium arsenide, quartz, piezoelectric crystals, polymers and packaging materials

Scaling Laws in Miniaturization: scaling- geometry, rigid-body dynamics, electrostatic forces, electromagnetic forces, electricity, fluid mechanics and heat transfer

UNIT– III

Micro System Fabrication Processes: photolithography, ion implantation, diffusion, oxidation, chemical vapor deposition, physical vapor deposition-sputtering, deposition by epitaxy, etching;

Micro manufacturing: bulk micro manufacturing, surface micromachining and LIGA (Lithographie, Galvano formung, Abformung) process

UNIT– IV

Microsystems Design: ions and ionization, doping of semiconductors, diffusion process, plasma physics, electrochemistry, and quantum physics, design considerations, design constraints, selection of materials, manufacturing processes, signal transduction, electromechanical system and Computer Aided Design of micro systems

UNIT – V

MEMS Structures and Devices: Pressure sensors-Accelerometers-Gyroscopes-RF MEMS Switch-Temperature sensors Humidity sensors.

Micro Actuators: Electrostatic–piezoelectric–SMA–Thermo electric electromagnetic. Micro pumps –micro valves.

Suggested Readings

1. Tai-Ran Hsu, MEMS and Microsystems: Design, Manufacture and nano scale engineering, 2nd ed., John Wiely & Sons, New Jersey, 2008.
2. MEMS & Microsystems Design and Manufacture/ Tai-Ran Hsu/ Tata McGraw Hill
3. Micro electro mechanical Systems / Bhattacharyya / Cengage

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B. Tech. (ME) VIII SEMISTER
PE4207 ME Industrial Robotics
(Professional Elective-VI)

Course code	PE4207ME				
Category	Professional Elective Course				
Course title	Industrial Robotics				
Scheme and Credits	L	T	P	Credits	Internal marks = 30
	3	-	-	3	External Marks = 70

UNIT-I

Introduction: Automation in robotics, Asimov's laws of robotics

Components of The Robot: Controller/logic function, teach pendant/interface, manipulator, degrees of freedom, and axis numbering, base types.

Classification of Robots: Power source, geometry of the work envelope, drive systems: classification and operation, so classification, **End-of-arm tooling**: multiple tooling, positioning of EOAT,

UNIT-II

Programming and File Management: Planning, subroutines, writing the program, testing and verifying, normal operation, file maintenance, **Automation sensors**: limit switches, proximity switches, tactile and impact sensors, temperature sensors, fluid sensors, position sensors, sound sensors, connection to the robot, sensor selection criteria; **vision systems**: components of a vision system, image analysis, lighting,

UNIT-III

Integration and Networking: Types of networks, communication protocols, integration; **Programmable Logic Controllers (PLCS) and Human-Machine Interfaces (HMIS)**: Basic components of the PLC, operation of the PLC, human-machine interfaces, **Maintenance and Trouble Shooting:** Preventive maintenance, arc flash, troubleshooting, crash recovery, repair tips, parts swapping versus fixing the problem, precautions before running the robot

UNIT-IV

Robot Handling: The handling task, Robot characteristics for handling. **Robot assembly**-case studies Application characteristics. **Robot Welding-** The spot welding process, Robot spot welding, The robot task, The arc welding process , Robot MIG welding.- , **Machining with Robots.** : Application characteristics.-,Spray painting applications. The spray painting process.- Spray painting robot anatomy and characteristics.- , Programming techniques.- Innovative robot applications.in the automation of manufacturing processes., assembly automation.- applications in inspection

UNIT-V

Lean Manufacturing With Robotics for Low Volume: **Small Batch Runs-** Changeover for Small Batches, the Design of a Robotic Work-Cell, Automating the machining process, Automating the welding process and Automating the material removal process for small batch runs, Automating small batch runs for press tending and palletizing, automating the palletizing process for small batch runs, Tools for small batch and high changeover production

Lean Manufacturing with Robotics for High Volume: **Large Batch Runs**- Robotic Machine Tending for High Production, Robotic Cellular Manufacturing

Suggested Reading:

1. Keith Dinwiddie Industrial Robotics / Edition 1 by , Publisher: Cengage Learning
2. Rex Miller, Mark R. Miller Robots and Robotics: Principles, Systems, and Industrial Applications,
3. Groover MP (Author) Industrial Robotics Technology, Programming &Application, TataMcGraw Hill Education
4. Larry T. Ross, Stephen W. Fardo, and Michael F. Walach Industrial Robotics Fundamentals: Theory and Applications, 3rd Edition
5. Andrew Glaser Industrial Robotics Industrial Press publisher

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B. Tech. (ME) VIII SEMISTER
PW4208ME PROJECT WORK II
(Project Work)

Course code	PW4208 ME				
Category	Project Work				
Course title	Project Work II				
Scheme and Credits	L	T	P	Credits	Internal marks = 50
	-	-	14	7	External Marks = 100

The aim of project work -II is to implement and evaluate the proposal made as part of project - I. Students can also be encouraged to do full time internship as part of project work-II based on the common guidelines for all the departments. The students placed in internships need to write the new proposal in consultation with industry coordinator and project guide within two weeks from the commencement of instruction.

The Department will appoint a project coordinator who will coordinate the following:

- Re-grouping of students - deletion of internship candidates from groups made as part of project work-I
- Re-Allotment of internship students to project guides
- Project monitoring at regular intervals

All re-grouping/re-allotment has to be completed by the 2nd week of VIII semester so that students get sufficient time for completion of the project. All projects (internship and departmental) will be monitored at least twice in a semester through student presentation for the award of sessional marks. Sessional marks will be awarded by a monitoring committee comprising of faculty members as well as by the supervisor. The first review of projects for 25 marks can be conducted after completion of five weeks. The second review for another 25 marks can be conducted after 12 weeks of instruction. Common norms will be established for the final documentation of the project report by the respective departments. The students are required to submit draft copies of their project report within one week after completion of instruction.

Note: Three periods of contact load will be assigned to each project guide.

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B. Tech. (ME) VIII SEMISTER
MC 42a HS Yoga Practice
(Humanity Science Course)

Course code	MC 42a HS				
Category	Humanity Science				
Course title	Yoga Practice				
Scheme and Credits	L	T	P	Credits	Internal marks = 30
	2	-	-	-	

UNIT – I

Introduction: Yoga definition, health definition from WHO, yoga versus health, basis of yoga, yoga is beyond science, Gist of eighteen chapters of Bhagavad-Gita, four types of yoga: Karma, Bhakti, Gnyana and Raja yoga, Internal and External yoga, elements of Ashtanga yoga (Yama, Niyama, Asana, Pranayama, Prathyahara, Dharana, Dhyana and Samadhi), Pancha koshas and their purification through Asana, Pranayama and Dhyana.

UNIT – II

Surya namaskaras (Sun Salutations): Definition of sun salutations, seven chakras (Mooladhaar, Swadhishtaan, Manipura, Anahata, Vishuddhi, Agnya and Sahasrar), various manthras (Om Mitraya, Om Ravaye, Om Suryaya, Om Bhanave, Om Marichaye, Om Khagaye, Om Pushne, Om Hiranya Garbhaye, Om Adhityaya, Om Savitre, Om Arkhaya, and Om Bhaskaraya) and their meaning while performing sun salutations, physiology, seven systems of human anatomy, significance of performing sun salutations.

UNIT – III

Asanas (Postures): Pathanjali's definition of asana, sthiram sukham asanam, 3rd limb of Ashtanga yoga, loosening or warming up exercises, sequence of perform in asanas (standing, sitting, prone, supine and inverted), nomenclature of asanas (animals, trees, rishis and so on), asanas versus chakras, asanas versus systems, asanas versus physical health, activation of Annamaya kosha.

UNIT – IV

Pranayama (Breathing Techniques): Definition of Pranayama as per Shankaracharya, 4th limb of Ashtanga yoga, various techniques of breathing, Pranayama techniques versus seasons, bandhas and their significance in Pranayama, mudras and their significance in Pranayama, restrictions of applying bandhas with reference to health disorders, Pranayama versus concentration, pranayama is the bridge between mind and body, pranayam versus mental health, activation of Pranamaya kosha through Pranayama.

UNIT – V

Dhyana (Meditation): Definition of meditation, 7th limb of Ashtanga yoga, types of mind (Conscious and Sub-Conscious), various types of dhyana. Meditation versus spiritual health, Dharana and Dhyana, extention of Dhyana to Samadhi, Dhyana and mental stress, activation of Manomaya kosha through dhyana, silencing the mind.

Suggested Readings:

1. *Light on Yoga* by BKS lyengar.
2. *Yoga Education for Children,* Vol-1 by Swami Satyananda Saraswati.
3. *Light on Pranayama* by BKS lyengar.
4. *Asana Pranayama Mudra and Bandha* by Swami Satyananda Saraswati.
5. *Hatha Yoga Pradipika* by Swami Mukhtibodhananda.
6. *Yoga education for children,* Vol-11 by Swami Niranjanananda Saraswati.
7. *Dynamics of Yoga* by Swami Satyananda Saraswati.

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B. Tech. (ME) VIII SEMISTER
MC 42b HS NSS
(Humanity Science Course)

Course code	MC 42b HS				
Category	Humanity Science				
Course title	NSS				
Scheme and Credits	L	T	P	Credits	Internal marks = 30
	2	-	-	-	

List of Activities:

1. Orientation programme about the role of NSS in societal development.
2. Swachh Bharat Program.
3. Guest lectures from eminent personalities on personality development.
4. Plantation of saplings/Haritha Haram Program.
5. Blood Donation / Blood Grouping Camp.
6. Imparting computer education to school children.
7. Creating Awareness among students on the importance of Digital transactions.
8. Stress management techniques.
9. Health Check-up Activities.
10. Observation of Important days like Voters' day, World Water Day and so on.
11. Road Safety Awareness Programs.
12. Energy Conservation Activities
13. Conducting Programs on effective communication skills.
14. Awareness programs on national integration.
15. Orientation on Improving Entrepreneurial Skills.
16. Developing Effective Leadership skills.
17. Job opportunity awareness programs in various defense, public sector undertakings.
18. Skill Development Program.
19. Creating awareness among students on the Importance of Yoga and other physical activities.
20. Creating awareness among students on various government sponsored social welfare schemes for the people.

Note: At least Ten Activities should be conducted in the Semester**.** Each event conducted under Swachh Bharat, Plantation and important days like Voters' day, world water day may be treated as a separate activity