

FACULTY OF ENGINEERING

Scheme of Instruction & Examination
(AICTE Model Curriculum for the Academic Year 2018-2019)

and

Syllabi

B.E. I and II Semesters (Group-A)

of

Four Year Degree Programme

in

B.E. (Common to All Branches)
(With effect from the Academic Year 2018– 2019)
(As approved in the Faculty Meeting held on 26th June 2018)



Issued by
Dean, Faculty of Engineering
Osmania University, Hyderabad
2018

SCHEME OF INSTRUCTION & EXAMINATION
B.E. (All Branches) I - Semester
(Group - A)

S. No.	Course Code	Course Title	Scheme of Instructions				Scheme of Examination			Credits
			L	T	P/D	Contact Hours/Week	CIE	SEE	Duration in Hours	
Three Week Induction Programme										
Theory Course										
1	BS102MT	Mathematics-I	3	1	-	4	30	70	3	4
2	BS104PH	Physics	3	1	-	4	30	70	3	4
3	ES106EE	Basic Electrical Engineering	3	1	-	4	30	70	3	4
Practical / Laboratory Course										
4	BS152PH	Physics Lab	-	-	3	3	25	50	3	1.5
5	ES154EE	Basic Electrical Engineering Lab	-	-	2	2	25	50	3	1
6	ES156CE	Engineering Graphics & Design	1	-	4	5	50	50	3	3
Total			10	03	09	22	190	360		17.5

BS: Basic Science**ES:** Engineering Science**L:** Lecture**T:** Tutorial**P:** Practical**D:** Drawing**CIE:** Continuous Internal Evaluation**SEE:** Semester End Examination (Univ. Exam)**Note:** Each contact hour is a Clock Hour.

Course Code	Course Title					Core / Elective	
BS102MT	Mathematics - I (Common to All Branches)					Core	
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	1	-	-	30	70	4
Course Objectives <ul style="list-style-type: none"> ➤ To introduce the concepts of sequences, series and their properties ➤ To introduce the concepts of functions of several variables and multiple integrals ➤ To study vector differential and integral calculus Course Outcomes The students will able to <ul style="list-style-type: none"> ➤ Find the nature of sequences and series ➤ Evaluate multiple integrals ➤ Apply this knowledge to solve the curriculum problems 							

Unit-I

Sequences and Series: Sequences, Series, General properties of series, Series of positive terms, Comparison tests, tests of Convergence D'Alembert's ratio test, Cauchy's n^{th} root test, Raabe's test, Logarithmic test, Alternating series, Series of positive and negative terms, Absolute convergence and Conditional convergence.

Unit-II:

Calculus of one variable: Rolle's theorem, Lagrange's, Cauchy's mean value theorems, Taylor's series, Curvature, Radius of curvature, Circle of curvature, Envelope of a family of curves, Evolutes and Involutives.

Unit-III

Multivariable Calculus (Differentiation): Functions of two variables, Limits and continuity, Partial derivatives, Total differential and differentiability, Derivatives of composite and implicit functions (Chain rule), Change of variables, Jacobian, Higher order partial derivatives, Taylor's series of functions of two variables, Maximum and minimum values of functions of two variables, Lagrange's method of undetermined multipliers.

Unit-IV

Multivariable Calculus (Integration): Double integrals, Change of order of integration, Change of Variables from Cartesian to plane polar coordinates, Triple integrals.

Unit-V

Vector Calculus: Scalar and vector fields, Gradient of a scalar field, Directional derivative, Divergence and Curl of a vector field, Line, Surface and Volume integrals, Green's theorem in a plane, Gauss's divergence theorem, Stoke's theorem (without proofs) and their verification.

Suggested Readings:

1. R.K.Jain & S.R.K Iyengar, *Advanced Engineering Mathematics*, Narosa Publications, 2014.
2. Erwin Kreyszig, *Advanced Engineering Mathematics*, John Wiley, 9th Edition, , 2012.
3. B.S.Grewal, *Higher Engineering Mathematics*, Khanna Publications, 43rd Edition, 2014.
4. G.B.Thomas, Maurice Weir and Joel Hass, *Thomas' Calculus*, Peterson, 12th Edition, 2010.
5. B.V. Ramana, *Higher Engineering Mathematics*, 23rd reprint, 2015.

Course Code	Course Title					Core / Elective	
BS104PH	Physics (Common to All Branches)					Core	
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	1	-	-	30	70	4
Course Objectives <ul style="list-style-type: none"> ➤ Aware of limits of classical free electron free theory and to apply band theory of solids ➤ Acquire knowledge on various properties of semiconductors. ➤ Grasp the intricacies in semiconductor-optical interaction Course Outcomes <ul style="list-style-type: none"> ➤ Distinguish materials based on band theory of solids ➤ Classify semiconductors on the basis doping and to estimate conductivity and learn transport phenomenon in semiconductors ➤ Appreciate use of optical absorption by semiconductors. 							

Unit – I

Crystallography: Introduction, Types of crystal systems, Bravais lattices, Lattice planes and Miller Indices (Cubic system), Inter planar spacing (Cubic system), Bragg's law, Powder diffraction method.

Crystal Defects: Classification of point defects, Concentration of Schottky defects in metals and ionic crystals, Concentration of Frankel defects, Line defects, Screw and Edge dislocations, Burger's vector

Unit – II

Band Theory of Solids & Semiconductors: Classical free electron theory (qualitative), Kronig Penney model (qualitative treatment), Energy band formation in solids, Intrinsic and Extrinsic semiconductors, Concept of a hole, Carrier concentration and conductivity in intrinsic semiconductors, Formation of P-N junction diode and its I – V characteristics, Thermistor and its characteristics, Hall effect and its applications.

Dielectric Materials: Dielectrics, Types of polarizations, Electronic, Ionic, Orientational and Space charge polarizations, Expression for Electronic polarizability, Frequency and temperature dependence of dielectric polarizations, Determination of dielectric constant by capacitance Bridge method, Ferro electricity, Barium titanate, Applications of Ferroelectrics.

Unit – III

Wave Mechanics: Matter waves –de-Broglie wavelength, properties of wave function, Physical significance, Schrodinger time dependent and time in-dependent wave equation. Particle in a 1-D box.

Electromagnetic theory: Basic laws of electricity and magnetism, Maxwell's equations in integral and differential forms, Conduction and displacement current, Relation between D, E and P – **Electromagnetic waves:** Equation of plane wave in free space, Poynting theorem.

Unit – IV

Magnetic Materials: Classification of magnetic materials: dia, para, ferro, antiferro and ferrimagnetic materials, Weiss molecular field theory of ferromagnetism, Magnetic domains, Hysteresis curve, soft and hard magnetic materials, Ferrites: Applications of ferrites.

Superconductivity: Introduction, General properties of super conductors, Meissner effect, Type I and Type II superconductors, BCS theory (qualitative), Introduction to High T_c superconductors, Applications of superconductors.

Unit – V

Lasers: Characteristics of Lasers, spontaneous and stimulated emission of radiation, Einstein's Coefficients, population inversion, Ruby Laser, Helium Neon Laser, Semi Conductor Laser and applications of lasers.

Fiber Optics: Introduction, Propagation of light through an optical fiber, Acceptance angle, Numerical aperture (NA), Types of Optical fibers and Refractive index profiles, Fiber drawing process (double Crucible Method), Losses in optical fibers, applications of optical fibers.

Suggested Reading:

1. B.K. Pandey and S. Chaturvedi Engineering Physics Cengage Learning 2012
2. A.K. Bhandhopadhya, Nano Materials, New Age International, 1st Edition, 2007
3. M.S. Avadhanulu and P.G. Kshirusagar, Engg. Physics, S. Chand & Co. 1st Edition, 1992.
4. C.M. Srivastava and C. Srinivasan – Science of Engg Materials, New Age International.
5. R.K Gaur and S.L Gupta- Engineering Physics, Dhanpathrai Publications, New edition.
6. Sanjay D Jain & Girish G Sahasrabudhe -Engineering Physics, University Press

Course Code	Course Title					Core / Elective	
ES106EE	Basic Electrical Engineering (Common to All Branches)					Core	
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	1	-	-	30	70	4
<p>Course Objectives</p> <ul style="list-style-type: none"> ➤ To provide an understanding of basics in Electrical circuits. ➤ To explain the working principles of Electrical Machines and single phase transformers. <p>Course Outcomes</p> <ul style="list-style-type: none"> ➤ To analyze Electrical circuits to compute and measure the parameters of Electrical Energy. ➤ To comprehend the working principles of Electrical DC Machines. ➤ To Identify and test various Electrical switchgear, single phase transformers and assess the ratings needed in given application. ➤ To comprehend the working principles of electrical AC machines. 							

Unit-I

DC Circuits: Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff current and voltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenin and Norton Theorems.

Unit-II

AC Circuits: Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, and RL, RC, RLC combinations (series only). Three phase balanced circuits, voltage and current relations in star and delta connections.

Unit-III

Transformers and 3-ph Induction Motors: Transformers: Electromagnetic induction, Faradays laws, statically induced emf, Lenz law, BH characteristics, ideal and practical transformer, losses and efficiency, Auto-transformer and three-phase 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, Applications.

Unit-IV

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

DC Generators: Dynamically induced emf, Flemming's Right hand and Left hand rules, Construction and principle of operation of DC generator, EMF equation, Types of DC Generators, OCC characteristics, applications

DC Motors: principle of operation of DC Motor, Types of DC motors, applications.

Unit-V

Electrical Installations: 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.

Suggested Reading:

1. N.K. De, "Basic Electrical Engineering", Universities Press, 2015.
2. J.B.Gupta, "Fundamentals of Electrical Engineering and Electronics" S.K.Kataria & Sons Publications, 2002.
3. J.B.Gupta, "Utilization of Electric Power and Electric Traction" S.K.Kataria & Sons Publications, 2010
4. Abhijit Chakrabarti, Sudipta Nath, Chandan Kumar Chanda, " Basic Electrical Engineering" Tata McGraw Hill, Publications,2009
5. Hughes, "Electrical Technology", VII Edition, International Student -on, Addison Welsey Longman Inc., 1995.

Course Code	Course Title					Core / Elective	
BS152PH	Physics Lab (Common to All Branches)					Core	
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	3	25	50	1.5
<p>Course Objectives</p> <ul style="list-style-type: none"> ➤ Make precise measurements using basic physical principles and acquire skills to handle the instruments ➤ Relates the theoretical Knowledge to the behavior of Practical Physical world. ➤ Analyze errors in the experimental data. ➤ Plot graphs between various physical parameters. <p>Course Outcomes</p> <ul style="list-style-type: none"> ➤ Conduct experiments, take measurements independently. ➤ Write appropriate laboratory reports. ➤ Compute and compare the experimental results and draw relevant conclusions. ➤ Use the graphical representation of data and estimate results from graphs 							

List of Experiments:

1. To determine the Dielectric constant and Phase transition temperature of Lead Zirconium Titanate (PZT).
2. To draw the I - V Characteristics of P-N Junction diode and to evaluate the resistance.
3. To find the values of Electrical conductivity and energy gap of Ge crystal .
4. Determination of rigidity of modulus of Torsion pendulum.
5. Determination of carrier concentration, Mobility and Hall Coefficient of Ge crystal using Hall Effect Experiment.
6. To determine the constants of A, B and α using Thermistor characteristics.
7. To draw the curve between the magnetizing field and the intensity of magnetization of the specimen (soft iron rod) and to find out
 - i) Coercivity ii) Retentivity and iii) Hysteresis loss.
8. To draw the I - V Characteristics of a solar cell and to calculate the
 - i) Fill factor Efficiency and ii) Series resistance.
9. To Determine the Numerical aperture (NA) of Optical fiber.
10. To determine the wave length of the given Laser source.

Note: Minimum eight experiments should be conducted in the semester

Suggested Reading:

1. N.K. De, "Basic Electrical Engineering", Universities Press, 2015.
2. J.B.Gupta, "Fundamentals of Electrical Engineering and Electronics" S.K.Kataria & Sons Publications, 2002.
3. J.B.Gupta, "Utilization of Electric Power and Electric Traction" S.K.Kataria & Sons Publications, 2010

Course Code	Course Title					Core / Elective	
ES154EE	Basic Electrical Engineering Lab (Common to All Branches)					Core	
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	2	25	50	1
Course Objectives <ul style="list-style-type: none"> ➤ To impart the practical knowledge on testing of DC and AC Machines and the usage of common electrical measuring instruments Course Outcomes <ul style="list-style-type: none"> ➤ Get an exposure to common electrical components and their ratings. ➤ Analyze the performance of DC and AC Machines. ➤ Comprehend the usage of common electrical measuring instruments. ➤ Test the basic characteristics of transformers and electrical machines. 							

Suggested List of Laboratory Experiments/Demonstrations:

- Dem1. Basic safety precautions. Introduction and use of measuring instruments – voltmeter, ammeter, multi-meter, oscilloscope. Real-life resistors, capacitors and inductors.
- Exp 1. Verification of KVL and KCL, superposition theorem (with DC excitation)
- Exp 2 Verification of Thevenins and Nortons theorems (with DC excitation)
- Exp 3. Sinusoidal steady state response of R-L, and R-C circuits – impedance calculation and verification. Observation of phase differences between current and voltage. Power factor calculation
- Exp 4. Transformers: Observation of the no-load current waveform on an oscilloscope (nonsinusoidal wave-shape due to B-H curve nonlinearity should be shown along with a discussion about harmonics).
- Exp 5. Loading of a transformer: measurement of primary and secondary voltages and currents, and power.
- Exp 6. Three-phase transformers: Star and Delta connections. Voltage and Current relationships (line-line voltage, phase-to-neutral voltage, line and phase currents).
- Exp 7. Measurement of phase voltage/current, line voltage/current and power in a balanced three-phase circuit connected in star and delta
- Dem2. Demonstration of cut-out sections of machines: dc machine (commutator-brush arrangement), induction machine (squirrel cage rotor), synchronous machine (field winding - slip ring arrangement) and single-phase induction machine.
- Exp 8. OCC characteristics of DC Generator
- Exp 9. Synchronous speed of two and four-pole, three-phase induction motors. Direction reversal by change of phase-sequence of connections.
- Exp 10. Power factor improvement of Induction Motor using static capacitors
- Exp 11. Load Test of DC Motor

Note - 1:

- (i) List of Experiments and Demonstrations suggested above are already available in the Laboratory of the electrical department. No need to purchase any extra equipment except Demonstration2 equipments
- (ii) Procurement of Demonstration 2 equipments can be done during the course work of that semester. It can be included in the laboratory.

Note - 2:

- (i) Experiments 9, 10 and Demonstration 3 can be incorporated in the Lab syllabus if the topics concerned to the above experiments are considered in new BEE syllabus .

Suggested Reading:

1. J.B.Gupta, "Fundamentals of Electrical Engineering and Electronics" S.K.Kataria & Sons Publications, 2002.
2. J.B.Gupta, "Utilization of Electric Power and Electric Traction" S.K.Kataria & Sons Publications, 2010
3. Abhijit Chakrabarti, Sudipta Nath, Chandan Kumar Chanda, " Basic Electrical Engineering" Tata McGraw Hill, Publications, 2009
4. Hughes, "Electrical Technology", VII Edition, International Student -on, Addison Welsey Longman Inc., 1995.

Course Code	Course Title					Core / Elective	
ES156CE	Engineering Graphics & Design (Common to All Branches)					Core	
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	1	-	4	-	50	50	3
<p>Course Objectives</p> <ul style="list-style-type: none"> ➤ To prepare you to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability ➤ To prepare you to communicate effectively ➤ To prepare you to use the techniques, skills, and modern engineering tools necessary for engineering practice. <p>Course Outcomes The students will able to</p> <ul style="list-style-type: none"> ➤ Introduction to engineering design and its place in society ➤ Exposure to the visual aspects of engineering design ➤ Exposure to engineering graphics standards ➤ Exposure to solid modeling ➤ Exposure to computer-aided geometric design ➤ Exposure to creating working drawings ➤ Exposure to engineering communication 							

Sheet No	Description of the Topic	Contact Hours	
		Lecture	Drawing
1	Principles of Engineering Graphics and their significance, usage of drawing instruments.	1	
2	Conic Sections – I Construction of ellipse, parabola and hyperbola given focus and eccentricity.	1	2
3	Conic Sections – II Construction of ellipse (given major and minor axis), parabola (given base and height), rectangular hyperbola.		2
4	Cycloids (cycloid & epicycloid)	1	2
5	Involutes (involute of triangle, square & circle)		2
6	Scales (plain & diagonal scales)	1	2 + 2
7	Introduction to AutoCAD Basic commands and simple drawings.		2 + 2
8	Orthographic Projection Projections of points situated in different quadrants.	1	2
9	Projections of straight lines – I Line parallel to both the reference planes, line perpendicular or inclined to one reference plane.	1	2
10	Projections of straight lines – II Line inclined to both the reference planes.	1	2

11	Projections of planes – I Perpendicular planes	1	2
12	Projections of planes – II Oblique planes		2
13	Projections of solids – I Polyhedra and solids of revolution, Projections of solids in simple position.	1	2
14	Projection of solids – II Projections of solids when the axes inclined to one or both the reference planes.	1	2 + 2
15	Section of solids – I When the sectional plane is parallel or perpendicular to one reference plane.	1	2
16	Section of solids – II When the sectional plane is inclined to one reference plane.		2
17	Development of surfaces – I Prisms and Cylinders	1	2
18	Development of surfaces – II Pyramids and Cones		2
19	Intersection of surfaces – I Intersection of cylinder and cylinder	1	2
20	Intersection of surfaces – II Intersection of cylinder and cone		2
21	Isometric projection – I planes and simple solids	1	2
22	Isometric projection – II combination of two or three solids		2
23	Conversion of Isometric Views to Orthographic Views	1	2
24	Floor plans of 2 or 3 rooms including windows, doors, and fixtures such as WC, bath, sink, shower, etc.	1	2

Suggested Text:

1. Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House
2. Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education
3. S.N Lal, Engineering Drawing with Introduction to Auto CAD, CengageLearning India Pvt Lid, New Delhi, 2018.
4. Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication
5. Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers
6. (Corresponding set of) CAD Software Theory and User Manuals

NOTE:

1. At least 20 sheets must be covered.
2. Sheet number 1 to 6 (Graph sheets / drawing sheets)
3. Sheet number 7 to 24 (AutoCAD drawings)

SCHEME OF INSTRUCTION & EXAMINATION
B.E. (All Branches) II - Semester
(Group - A)

S. No.	Course Code	Course Title	Scheme of Instructions				Scheme of Examination			Credits
			L	T	P / D	Contact Hours/Week	CIE	SEE	Duration in Hours	
Theory Course										
1	HS101EG	English	2	-	-	2	30	70	3	2
2	BS103MT	Mathematics-II	3	1	-	4	30	70	3	4
3	BS105CH	Chemistry	3	1	-	4	30	70	3	4
4	ES107CS	Programming for Problem Solving	3	-	-	3	30	70	3	3
Practical / Laboratory Course										
5	HS151EG	English Lab			2	2	25	50	3	1
6	BS153CH	Chemistry Lab			3	3	25	50	3	1.5
7	ES155CS	Programming for Problem Solving Lab			4	4	25	50	3	2
8	ES157ME	Workshop / Manufacturing Process	1	-	4	5	50	50	3	3
		Total	12	02	13	27	245	480		20.5

HS: Humanities and Social Sciences **BS:** Basic Science **ES:** Engineering Science
L: Lectures **T:** Tutorials **P:** Practical **D:** Drawing
CIE: Continuous Internal Evaluation **SEE:** Semester End Examination (Univ. Exam)

Note:

1. Each contact hour is a Clock Hour
2. The students have to undergo a Summer Internship of 1 week duration after II-Semester.

Course Code	Course Title					Core / Elective	
HS101EG	English (Common to All Branches)					Core	
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	2	-	-	-	30	70	2
<p>Course Objectives To enable the students to</p> <ul style="list-style-type: none"> ➤ Communicate clearly, accurately and appropriately ➤ Learn different models of interpersonal communication ➤ Learn to communicate grammatically ➤ Learn to write essays, formal letters and technical reports ➤ Comprehend the different types of texts <p>Course Outcomes The students will able to</p> <ul style="list-style-type: none"> ➤ Communicate clearly, accurately and appropriately ➤ Learn different models of interpersonal communication ➤ Learn to communicate grammatically ➤ Learn to write essays, formal letters and technical reports ➤ Comprehend the different types of texts 							

Unit – I

Effective Communication: Role and importance of communication; Features of human communication; Process of communication; Barriers to communication; Oral and Written Communication; Importance of listening, speaking, reading, and writing; Types of communication: Verbal – formal versus informal communication, one-way versus two-way communication, Non-verbal communication.

Unit – II

Personality Development and Interpersonal Communication: Models of interpersonal development: Johari window, Knapp's model; Styles of communication; Time management; Emotional Quotient; Teamwork; Persuasion techniques.

Unit – III

Remedial English: Tenses, Subject-verb agreement, Noun-pronoun agreement, Misplaced modifiers, Articles, Prepositions, Redundancies, Clichés. (Note: The focus is on appropriate usage).

Unit – IV

Vocabulary Building and Written Communication: Roots and affixes; Words often confused: Homonyms, Homophones, Homographs; One-word substitutes; Idiomatic usage: Idioms, Phrases, Phrasal Verbs; Synonyms; Antonyms; Paragraph writing; Précis writing; Essay writing; Official letters; E-mail etiquette; Technical report writing: Feasibility and Progress reports.

Unit – V

Reading Comprehension: Unseen Passages, A.P.J. Abdul Kalam, Azim Premji, Sachin Tendulkar, Sathya Nadella, Sam Pitroda (Note: No descriptive questions to be set from this

unit and only Reading Comprehension/s from unseen passages should be set in the Examination Question Papers).

Suggested Readings:

1. E. Suresh Kumar, *Engineering English*, Orient Black Swan, 2014
2. *Language and Life A Skills Approach*, Orient Black Swan, 2018
3. Michael Swan, *Practical English Usage*. OUP, 1995
4. Ashraf Rizvi, M, *Effective Technical Communication*, Tata McGraw Hill, 2009.
5. Meenakshi Raman and Sangeeta Sharma. *Technical Communication: Principles and Practice*. OUP, 2011.

Course Code	Course Title					Core / Elective	
BS103MT	Mathematics – II (Common to All Branches)					Core	
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	1	-	-	30	70	4
Course Objectives <ul style="list-style-type: none"> ➤ To study matrix algebra and its use in solving system of linear equations and in solving eigen value problems ➤ To provide an overview of ordinary differential equations ➤ To study special functions like Legendre and Beta Gamma functions ➤ To learn Laplace Transforms and its properties Course Outcomes <i>The students will able to</i> <ul style="list-style-type: none"> ➤ Solve system of linear equations and eigen value problems ➤ Solve certain first order and higher order differential equations ➤ Solve basic problems of Beta Gamma and Legendre's Function. ➤ Apply Laplace Transforms; solve ordinary Differential Equations by using it. 							

Unit-I

Matrices: Rank of a matrix, Echelon form, System of linear equations, Linearly dependence and independence of vectors, Linear transformation, Orthogonal transformation, Eigen values, Eigenvectors, Properties of eigen values, Cayley - Hamilton theorem, Quadratic forms, Reduction of quadratic form to canonical form by orthogonal transformation, Nature of quadratic forms.

Unit-II

Differential Equations of First Order: Exact differential equations, Integrating factors, Linear differential equations, Bernoulli's, Riccati's and Clairaut's differential equations, Orthogonal trajectories of a given family of curves.

Unit-III

Differential Equations of Higher Orders: Solutions of second and higher order linear homogeneous equations with constants coefficients, Method of reduction of order for the linear homogeneous second order differential equations with variable coefficients, Solutions of non-homogeneous linear differential equations, Method of variation of parameters, solution of Euler-Cauchy equation.

Unit-IV

Special Function: Gamma Functions, Beta Functions, Relation Between Beta and Gamma Function, Error Functions. Power Series Method, Legendre's Differential Equations and Legendre's Polynomial $P_n(x)$, Rodrigue's Formula (without proof).

Unit-V

Laplace Transforms: Laplace Transforms, Inverse Laplace Transforms, Properties of Laplace Transforms and inverse Laplace Transforms, Convolution Theorem (without proof). Solution of ordinary Differential Equations using Laplace Transforms.

Suggested Readings:

1. R.K. Jain & S.R.K. Iyengar, *Advanced Engineering Mathematics*, Narosa Publications, 4th Edition, 2014.
2. Erwin Kreyszig, *Advanced Engineering Mathematics*, John Wiley, 9th Edition, , 2012.
3. Dr.B.S.Grewal, *Higher Engineering Mathematics*, Khanna Publications, 43rd Edition, 2014.
4. B.V. Ramana, *Higher Engineering Mathematics*, 23rd reprint, 2015.
5. N. Bali, M.Goyal, A text book of *Engineering Mathematics*, Laxmi publications, 2010
6. H.K. Dass, Er. Rajnish Varma, *Higher Engineering Mathematics*, Schand Technical Third Edition.

Course Code	Course Title					Core / Elective	
BS105CH	Chemistry (Common to All Branches)					Core	
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	1	-	-	30	70	4
<p>Course Objectives</p> <ul style="list-style-type: none"> ➤ Correlate the properties of materials with their internal structure and use the for Engineering applications ➤ Apply the principals of electrochemistry in storage of electrical energy in batteries. ➤ Gains knowledge in causes of corrosion and its prevention. ➤ Attains knowledge about the disadvantages of hard water for domestic and industrial purposes. Also learns the techniques of softening of hard water and treatment of water for drinking purpose. ➤ Exposed to qualitative and quantitative parameters of chemical fuels. ➤ Aware eco friendly materials and processes. <p>Course Outcomes On successful completion of this course, students will be able to:</p> <ul style="list-style-type: none"> ➤ Apply concept of electrode potential in identifying feasibility of electrochemical reaction; illustrate electro analytical techniques and working of batteries. ➤ Identify the mechanism of corrosion of materials on basis of electrochemical approach and devise corrosion control methods. ➤ Estimate the physical & chemical parameters of quality of water and explain the process of water treatment. ➤ Explain the influence of chemical structure on properties of materials and their choice in engineering applications. ➤ Classify chemical fuels and grade them through qualitative analysis. ➤ Relate the concept of green chemistry to modify engineering processes and materials. 							

UNIT-I

Electrochemistry and Battery Chemistry: Electrochemistry: Electrochemical cells, Electrolytic and Galvanic cells-notation, cell reaction and cell potentials. Types of electrodes, Calomel Quinhydrone and Glass electrodes. Determination of pH of a solution by using Quinhydrone electrode. Thermodynamics of emf of cells, Nernst equation and its derivation. Applications of Nernst equation to electrode potential and emf of cells. Numerical problems.

Batteries: Primary batteries: Zn - Carbon battery. **Secondary batteries:** Pb-Acid battery and Li-Ion battery, Applications. **Flow batteries (Fuel cells):** Methanol-Oxygen fuel cells, Construction, Applications.

UNIT-II

Water Chemistry and Corrosion: Water Chemistry: Hardness of water-Types and units of hardness, estimation of temporary and permanent hardness of water by EDTA method. Alkalinity of water and its determination. Water softening by Ion exchange and Reverse Osmosis methods. Numerical problems. Specifications of potable water. Sterilization by Chlorination. Break Point Chlorination.

Corrosion: Causes and its effects. Types of corrosion-Dry or Chemical corrosion and Wet or Electrochemical corrosion and their mechanism. Electrochemical corrosion –Waterline and Pitting Corrosion. Factors influencing rate of corrosion.

Corrosion control methods: Cathodic protection methods - Sacrificial anodic and impressed current methods. Surface coating methods: Hot dipping-Galvanizing.

UNIT-III

Engineering Materials: Polymers: Basics of terms polymers: Monomer and its functionality, Polymers and degree of polymerization. Classification of polymers - Thermoplastics & Thermosetting resins. Types of Polymerization (i) Addition (ii) Condensation (iii) Co-Polymerization. Mechanism of free radical polymerization **Preparation, Properties & Uses of the following polymers:** Plastics - PVC and Bakelite, Fibres - Nylon 6:6, and Kevlar, Elastomers - Buna-S, Butyl and Silicone Rubbers.

Conducting polymers: Introduction, Classification and Mechanism of conduction in Polyacetylene, Applications of conducting polymers.

Biodegradable polymers: Introduction preparation, properties and applications of polylactic acid

UNIT-IV

Chemical Fuels: Classification of fuels: Introduction, definition and classification of chemical fuels- Primary and secondary fuels. Solid, liquid and gaseous fuels. Requirements of a good fuel. Calorific Value – HCV and LCV. Theoretical calculations of calorific value by Dulong's formula – Numerical problems.

Solid Fuels: Coal and its Ranking. Analysis of coal - Proximate and Ultimate analysis.

Liquid Fuels: Fractionation of Petroleum. Composition and uses of Gasoline, Diesel and Kerosene. Cracking & its Significance- Catalytic cracking by moving bed method, Knocking. Fuel rating – Octane and Cetane numbers.

Gaseous Fuels: LPG, CNG -Composition and Uses.

Combustion: Ignition temperature of a fuel, calculation of air quantities by weight and volume required for combustion of a fuel- Numerical problems.

UNIT-V

Green Chemistry and Composites: Green Chemistry: Concept, Principles of green chemistry – Atom Economy, Catalysis. and examples of clean technology.

Biodiesel: Sources, Concept of Trans esterification and carbon neutrality. Properties and significance

Composites: Introduction to composites, composition and characteristic properties of composites. Classification of composites based on matrix, reinforcement and ply. Applications of composites.

Suggested Readings:

1. Principles of Physical Chemistry by Puri, Sharma and Pathania S.N. Chand & Co. New Delhi (Latest edition).
2. Engineering Chemistry by P C Jain and M Jain Dhanpat Rai & Sons (15th Edn), New Delhi.
3. Chemistry in Engineering and Technology by J C Kuriacose and J Rajaram, TMH, New Delhi.
4. Engineering Chemistry by O G Palanna, TMH, and New Delhi.
5. Engineering Chemistry by S S Dara, S Chand & Sons, New Delhi.
6. Engineering Chemistry by Sashi Chawla. Dhanpat Rai & Sons, New Delhi.
7. Engineering Chemistry by Shikha Agrawal, Cambridge, New Delhi.
8. Engineering Chemistry by Prasanta Rath, Cengage Learning India Pvt. Ltd.

Course Code	Course Title					Core / Elective	
ES107CS	Programming for Problem Solving (Common to All Branches)					Core	
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3
Course Objectives <ul style="list-style-type: none"> ➤ To introduce the basic concepts of Computing environment, number systems and flowcharts ➤ To familiarize the basic constructs of C language – data types , operators and expressions ➤ To understand modular and structured programming constructs in C ➤ To learn the usage of structured data types and memory management using pointers ➤ To learn the concepts of data handling using pointers Course Outcomes <i>The students will able to</i> <ul style="list-style-type: none"> ➤ Formulate simple algorithms for arithmetic and logical problems. ➤ Translate the algorithms to programs (in c language). ➤ Test and execute the programs and correct syntax and logical errors. ➤ Implement conditional branching, iteration and recursion. ➤ Decompose a problem into functions and synthesize a complete program using divide and conquer approach. ➤ Use arrays, pointers and structures to formulate algorithms and programs. ➤ Apply programming to solve matrix addition and multiplication problems and searching and sorting problems. ➤ Apply programming to solve simple numerical method problems, namely root finding of function, differentiation of function and simple integration. 							

Unit - I

Introduction to Programming: Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.).

Idea of Algorithm: steps to solve logical and numerical problems.

Representation of Algorithm: Flowchart / Pseudocode with examples. From algorithms to programs; source code, variables (with data types) variables and memory locations, Syntax and Logical Errors in compilation, object and executable code.

Unit - II

Control Structures: Arithmetic expressions and precedence, Conditional Branching and Loops, Writing and evaluation of conditionals and consequent branching.

Arrays: Arrays (1-D, 2-D), Character arrays and Strings

Unit - III

Basic Algorithms: Searching, Basic Sorting Algorithms (Bubble and Selection), Finding roots of Equations. **Functions:** Functions (including using built in libraries), Parameter passing in functions, call by value. **Passing arrays to functions:** idea of call by reference

Unit - IV

Recursion: Recursion, as a different way of solving problems. Example programs, such as Finding Factorial, Fibonacci series. **Structure:** Structures, Defining structures and Array of Structures

Unit - V

Pointers - Idea of pointers, Defining pointers, Use of Pointers in self-referential structures, notion of linked list (no implementation), **Introduction to File Handling.**

Suggested Readings:

1. Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
2. A.K. Sharma, Computer Fundamentals and Programming in C, Universities Press, 2nd Edition, 2018.
3. E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill
4. Brian W. Kernighan and Dennis M. Ritchie, the C Programming Language, Prentice Hall of India.

Course Code	Course Title					Core / Elective	
HS151EG	English Lab (Common to All Branches)					Core	
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	2	25	50	1
<p>Course Objectives To enable the students to</p> <ul style="list-style-type: none"> ➤ Learn IPA ➤ Learn minimal pairs and types of syllables ➤ Overcome the difficulties with sounds of English ➤ Learn to participate well in gds, Debates and Presentations ➤ Communicate with appropriate body language and expressions <p>Course Outcomes The students will able to</p> <ul style="list-style-type: none"> ➤ Learn IPA ➤ Learn minimal pairs and types of syllables ➤ Overcome the difficulties with sounds of English ➤ Learn to participate well in gds, Debates and Presentations ➤ Communicate with appropriate body language, expressions 							

1. **Introduction to English Phonetics: Organs of Speech:** respiratory, articulatory and phonatory systems; **Sounds of English:** Introduction to International Phonetic Alphabet; Minimal pairs; Syllable; Word Stress; Introduction of rhythm and intonation; Difficulties of Indians speakers with stress and intonation.
2. **Speaking Activities:** Self Introduction, Picture perception, JAM.
3. Group discussion, Debate, Presentation skills
4. **Listening Activities:** Listening to different types of materials for effective comprehension
5. **Role play:** Use of dialogues in a variety of situations and settings

Suggested Readings:

1. E. Suresh Kumar, a Handbook for English Language Laboratories (with CD).
2. Revised edition, Cambridge University Press India Pvt. Ltd. 2014
3. T. Balasubramanian. A Textbook of English Phonetics for Indian Students. Macmillan, 2008.
4. J. Sethi et al., A Practical Course in English Pronunciation (with CD). Prentice Hall of India, 2005.
5. Hari Mohan Prasad. How to Prepare for Group Discussions and Interviews. Tata McGraw Hill, 2006.

Course Code	Course Title					Core / Elective	
BS 153 CH	Chemistry Lab (Common to All Branches)					Core	
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	3	25	50	1.5
<p>Course Objectives</p> <ul style="list-style-type: none"> ➤ Conduct experiments, take measurements and analyze the data through hands-on experience in order to demonstrate understanding of the theoretical concepts of quantitative Analysis while working in small group. ➤ Interpret the electro analytical principles with experimental results graphically ➤ Demonstrate writing skills through clear laboratory reports <p>Course Outcomes</p> <p>On successful completion of this course, students will be able to :</p> <ul style="list-style-type: none"> ➤ Apply the principles of Colourimetry and Electrochemistry in quantitative estimations. ➤ Estimate the rate constants of reactions from concentration of reactants/ products as a function of time. ➤ Synthesize small drug molecules. 							

List of Experiments:

1. Introduction to Chemical Analysis.
2. Techniques of Weighing.
3. **Volumetric Analysis:** Preparation of Standard Mohr's salt solution, Standardization of KMnO_4 and estimation ferrous ion.
4. Estimation Iron(II) by Dichromatometry
5. **Water Analysis:** Preparation of Standard Magnesium sulphate solution, standardization of EDTA and Estimation of Total Hardness.
6. Preparation of Standard Sodium Carbonate Solution, Standardization of HCl and Estimation of Carbonate and Bicarbonate Alkalinity.
7. **Conductometry :** Estimation of HCl
8. Estimation of CH_3COOH and mixture of acids
9. **Potentiometry** Estimation of HCl
10. Estimation of Iron
11. **pH Metry:** Estimation of HCl
12. Estimation of HCl
13. **Colorimetry:** Verification of Beer-Lambert's law and estimation of Manganese.
14. **Chemical Kinetics:** Determination of rate constant of acid catalyzed hydrolysis of methyl acetate.
15. **Drug Synthesis** Preparation of Aspirin

Note: Minimum ten experiments should be conducted in the semester

Suggested Readings:

1. Senior Practical Physical Chemistry, B.D. Khosla, A. Gulati and V.Garg (R. Chand & Co., Delhi)
2. An Introduction to Practical Chemistry, K. K. Sharma and D.S. Sharma (Vikas publishing, N. Delhi)

Course Code	Course Title					Core / Elective	
ES 155 CS	Programming for Problem Solving Lab (Common to All Branches)					Core	
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	4	25	50	2
Course Objectives <ul style="list-style-type: none"> ➤ Understand the fundamentals of programming in C Language. ➤ Write, compile and debug programs in C. ➤ Formulate solution to problems and implement in C. ➤ Effectively choose programming components to solve computing problems Course Outcomes <i>The students will able to</i> <ul style="list-style-type: none"> ➤ Choose appropriate data type for implementing programs in C language. ➤ Design and implement modular programs involving input output operations, decision making and looping constructs. ➤ Implement search and sort operations on arrays. ➤ Apply the concept of pointers for implementing programs on dynamic memory management and string handling. ➤ Design and implement programs to store data in structures and files. 							

Programming Exercise:

1. Finding maximum and minimum of given set of numbers, finding roots of quadratic equation.
2. Sin x and Cos x values using series expansion.
3. Conversion of binary to decimal, octal, hexadecimal and vice versa.
4. Generating Pascal triangle, pyramid of numbers.
5. Recursion: factorial, Fibonacci, GCD.
6. Matrix addition and multiplication using arrays, linear search and binary search using recursive and non-recursive procedures.
7. Bubble sort and selection sort.
8. Programs on pointers: pointer to arrays, pointer to functions.
9. Functions for string manipulations.
10. Programs on structures and unions.
11. Finding the number of characters, words and lines of given text file.
12. File handling programs

Suggested Readings:

1. Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
2. A.K. Sharma, Computer Fundamentals and Programming in C, Universities Press, 2018.
3. E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill
4. Brian W. Kernighan and Dennis M. Ritchie, the C Programming Language, Prentice Hall of India.

Course Code	Course Title					Core / Elective	
ES 157 ME	Workshop/ Manufacturing Process (Common to All Branches)					Core	
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	1	-	-	4	50	50	3
<p>Course Objectives</p> <ul style="list-style-type: none"> ➤ Identify and use marking out tools, hand tools, measuring equipment and to work to prescribed tolerances. ➤ To provide hands on experience about use of different engineering materials, tools, equipments and processes those are common in the engineering field. ➤ To gain a good basic working knowledge required for the production of various engineering products. ➤ To Study different hand operated power tools, uses and their demonstration. ➤ Adopt safety practices while working with various tools <p>Course Outcomes <i>The students will able to</i></p> <ul style="list-style-type: none"> ➤ Demonstrate an understanding of and comply with workshop safety regulations. ➤ Identify and apply suitable tools for different trades of Engineering processes including drilling, material removing, measuring, chiseling. ➤ Study and practice on machine tools and their operations ➤ Undertake jobs connected with Engineering Workshop trades including fitting, carpentry, sheet metal, house wiring, welding, smithy and foundry. ➤ Apply basic electrical engineering knowledge for house wiring practice 							

A. TRADE FOR EXERCISES:

1. Carpentry
2. Fitting
3. House wiring
4. Sheet metal working
5. Smithy
6. Welding
7. Plumbing

B. TRADES FOR DEMONSTRATION AND EXPOSURE:

1. Machining (Lathe & Drilling)
2. Injection molding
3. Mould making and casting
4. Basic Electronics lab instruments

C. PRESENTATIONS AND VIDEO LECTURES

1. Manufacturing Methods
2. Rapid Prototyping
3. Glass Cutting
4. 3D printing
5. CNC LATHE

D. IT WORKSHOP: Computer hardware, identification of parts, Disassembly, Assembly of computer to working condition, operating system installation.**Suggested Reading:**

1. Venugopal,K, "Workshop manual", Anuradha Publications, Kumbakonam, TN, 2012
2. K.C. John, "Mechanical Workshop" 2nd Edn., PHI, 2010.
3. Hajra Choudary, "Elements of Workshop Technology" Vol. 1, Asian Publishers, Edn., 1993.
4. G.S. Sawhney, "Mechanical Experiments and Workshop Practice", I.K. International Publishing House, New Delhi, 2009.

Note: At least two exercises from each trade.

FACULTY OF ENGINEERING
Scheme of Instruction & Examination
(AICTE Model Curriculum for the Academic Year 2019-2020)

and

Syllabi

B.E. III and IV Semester

of

Four Year Degree Programme

in

Mechanical Engineering

(With effect from the academic year 2019– 2020)
(As approved in the faculty meeting held on 25-06-2019)



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Osmania University, Hyderabad – 500 007
2019

**SCHEME OF INSTRUCTION & EXAMINATION
B.E. (Mechanical Engineering) III – SEMESTER**

S. No.	Course Code	Course Title	Scheme of Instruction				Scheme of Examination			Credits
			L	T	P/D	Contact Hrs/Wk	CIE	SEE	Duration in Hrs	
Theory Courses										
1	MC111PO	Indian Constitution	2	-	-	2	30	70	3	-
2	HS201EG	Effective Technical Communication in English	3	-	-	3	30	70	3	3
3	HS202CM	Finance and Accounting	3	-	-	3	30	70	3	3
4	BS205MT	Mathematics-III (PDE, Probability & Statistics)	3	-	-	3	30	70	3	3
5	ES211CE	Engineering Mechanics	2	1	-	3	30	70	3	3
6	ES214EC	Basic Electronics	3	-	-	3	30	70	3	3
7	PC221ME	Metallurgy and Material Science	3	-	-	3	30	70	3	3
8	PC222ME	Thermodynamics	3	-	-	3	30	70	3	3
Practical/ Laboratory Courses										
9	PC251ME	Metallurgy and Material Testing Lab	-	-	2	2	25	50	3	1
10	PC252ME	Machine Drawing and Modelling Lab	-	-	2	2	25	50	3	1
			22	01	04	27	290	660		23

HS: Humanities and Social Sciences BS: Basic Science ES: Engineering Science
 MC: Mandatory Course PC: Professional Core
 L: Lecture T: Tutorial P: Practical D: Drawing
 CIE: Continuous Internal Evaluation SEE: Semester End Evaluation (Univ. Exam)
 PO: Political Science, EG: English, CM: Commerce, MT: Mathematics, CE: Civil Engineering,
 EC: Electronics and Communication Engineering, ME: Mechanical Engineering.

Note:

- Each contact hour is a clock hour
- The duration of the practical class is two hours, however it can be extended wherever necessary, to enable the student to complete the experiment.
- All the mentioned **Mandatory Courses** should be offered either in I–Semester or II–Semester only **from the academic year 2019-2020**.
- For those of the students admitted during the academic year 2018-2019, since the Mandatory Courses were not offered during the I–Semester or II–Semester, they should be offered either in III–Semester or IV–Semester of the **academic year 2019-2020**.

Course Code	Course Title				Core/Elective		
MC111PO	Indian Constitution				Mandatory		
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	2	-	-	-	30	70	-

Course Objectives

- To create awareness among students about the Indian Constitution.
- To acquaint the working conditions of union, state, local levels, their powers and functions.
- To create consciousness in the students on democratic values and principles articulated in the constitution.
- To expose the students on the relations between federal and provincial units.
- To divulge the students about the statutory institutions.

Course Outcomes

After completing this course, the student will

1. Know the background of the present constitution of India.
2. Understand the working of the union, state and local levels.
3. Gain consciousness on the fundamental rights and duties.
4. Be able to understand the functioning and distribution of financial resources between the centre and states.
5. Be exposed to the reality of hierarchical Indian social structure and the ways the grievances of the deprived sections can be addressed to raise human dignity in a democratic way.

UNIT-I

Evolution of the Indian Constitution: 1909 Act, 1919 Act and 1935 Act. Constituent Assembly: Composition and Functions; Fundamental features of the Indian Constitution.

UNIT-II

Union Government: Executive-President, Prime Minister, Council of Minister

State Government: Executive: Governor, Chief Minister, Council of Minister

Local Government: Panchayat Raj Institutions, Urban Government

UNIT-III

Rights and Duties: Fundamental Rights, Directive principles, Fundamental Duties

UNIT-IV

Relation between Federal and Provincial units: Union-State relations, Administrative, legislative and Financial, Inter State council, NITI Ayog, Finance Commission of India

UNIT-V

Statutory Institutions: Elections-Election Commission of India, National Human Rights Commission, National Commission for Women

Suggested Readings:

1. Abhay Prasad Singh & Krishna Murari, Constitutional Government and Democracy in India, Pearson Education, New Delhi, 2019
2. D.D. Basu, Introduction to the constitution of India, Lexis Nexis, New Delhi
3. Subhash Kashyap, Our Parliament, National Book Trust, New Delhi
4. Peu Ghosh, Indian Government & Politics, Prentice Hall of India, New Delhi
5. B.Z. Fadia & Kuldeep Fadia, Indian Government & Politics, Lexis Nexis, New Delhi

Course Code	Course Title				Core/Elective		
HS201EG	Effective Technical Communication in English				Core		
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives

To expose the students to:

- Features of technical communication
- Types of professional correspondence
- Techniques of report writing
- Basics of manual writing
- Aspects of data transfer and presentations.

Course Outcomes

On successful completion of the course, the students would be able to:

1. Handle technical communication effectively
2. Use different types of professional correspondence
3. Use various techniques of report writing
4. Acquire adequate skills of manual writing
5. Enhance their skills of information transfer and presentations

UNIT I

Definition and Features of Technical communication: Definition and features of technical communication (precision, relevance, format, style, use of visual aids), Differences between general writing and technical writing, Types of technical communication (oral and written)

UNIT II

Technical Writing-I (Official correspondence): Emails, IOM, Business letters, Business proposals.

UNIT III

Technical writing-II (Reports): Project report, Feasibility report, Progress report, Evaluation report.

UNIT IV

Technical writing- III (Manuals): Types of manuals, User manual, Product manual, Operations manual.

UNIT V

Information Transfer and Presentations: Non-verbal (bar diagram, flow chart, pie chart, tree diagram) to verbal (writing), Verbal (written) to non-verbal, Important aspects of oral and visual presentations.

Suggested Readings:

1. Raman, Meenakshi & Sharma, Sangeeta. (2015). *Technical Communication: Principles and Practice*(3rd ed.). New Delhi.
2. Rizvi, Ashraf, M. (2017). *Effective Technical Communication*(2nd ed.). New Delhi, Tata McGraw Hill Education.
3. Sharma, R. C., & Mohan, Krishna. (2017). *Business Correspondence and Report Writing: A Practical Approach to Business & Technical Communication* (4th ed.). New Delhi, Tata McGraw Hill Education.
4. Tyagi, Kavita & Misra, Padma. (2011). *Advanced Technical Communication*. New Delhi, PHI Learning.
5. Jungk, Dale. (2004). *Applied Writing for Technicians*. New York, McGraw-Hill Higher Education.

Course Code	Course Title				Core/Elective		
HS202CM	Finance and Accounting				Core		
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3
<p>Course Objectives The course will introduce the students</p> <ul style="list-style-type: none"> ➤ To provide basic understanding of Financial and Accounting aspects of a business unit ➤ To provide understanding of the accounting aspects of business ➤ To provide understanding of financial statements ➤ To provide the understanding of financial system ➤ To provide inputs necessary to evaluate the viability of projects ➤ To provide the skills necessary to analyse the financial statements <p>Course Outcomes After successful completion of the course the students will be able to</p> <ol style="list-style-type: none"> 1. Evaluate the financial performance of the business unit. 2. Take decisions on selection of projects. 3. Take decisions on procurement of finances. 4. Analyse the liquidity, solvency and profitability of the business unit. 5. Evaluate the overall financial functioning of an enterprise. 							

UNIT-I

Basics of Accounting: Financial Accounting–Definition- Accounting Cycle – Journal - Ledger and Trial Balance-Cash Book-Bank Reconciliation Statement (including Problems)

UNIT-II

Final Accounts: Trading Account-Concept of Gross Profit- Profit and Loss Account-Concept of Net Profit- Balance Sheet (including problems with minor adjustments)

UNIT-III

Financial System and Markets: Financial System-Components-Role-Considerations of the investors and issuers- Role of Financial Intermediaries. Financial Markets-Players- Regulators and instruments - Money Markets Credit Market- Capital Market (Basics only)

UNIT-IV

Basics of Capital Budgeting techniques: Time Value of money- Compounding- Discounting- Future Value of single and multiple flows- Present Value of single and multiple Flows- Present Value of annuities- Financial Appraisal of Projects– Payback Period, ARR- NPV, Benefit Cost Ratio, IRR (simple ratios).

UNIT-V

Financial statement Analysis: Financial Statement Analysis- Importance-Users-Ratio Analysis-liquidity, solvency, turnover and profitability ratios.

Suggested Readings:

1. Satyanarayana. S.V. and Satish. D., Finance and Accounting for Engineering, Pearson Education
2. Rajasekharan, Financial Accounting, Pearson Education
3. Sharma.S.K. and Rachan Sareen, Financial Management, Sultan Chand
4. Jonathan Berk, Fundamentals of Corporate Finance, Pearson Education
5. Sharan, Fundamentals of Financial Management, Pearson Education

Course Code	Course Title				Core/Elective		
BS205MT	Mathematics – III (PDE, Probability & Statistics)				Core		
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3
<p>Course Objectives</p> <ul style="list-style-type: none"> ➤ To introduce the solution methodologies for second order Partial Differential Equations with applications in engineering ➤ To provide an overview of probability and statistics to engineers <p>Course Outcomes</p> <p>After completing this course, the student will be able to:</p> <ol style="list-style-type: none"> 1. Solve field problems in engineering involving PDEs. 2. They can also formulate and solve problems involving random variables and apply statistical methods for analysing experimental data. 							

UNIT-I: Formation of Partial Differential Equations, First order partial differential equations, solutions of first order linear Partial Differentiation Equations, Lagranges’s equation, Non-linear First Order equations, Charpit’s method.

UNIT-II: Second-order linear equations and their classification, Method of separation of variables, vibration of stretched string wave equation, one dimensional heat equation, two dimensional heat equation, solution of Laplace’s equation.

UNIT-III: Probability distributions: Poisson, Uniform and Normal distributions, Mean, variance, moment generating function and evaluation of statistical parameters for these distributions, Moments, Skewness and Kurtosis.

UNIT-IV: Curve fitting by the method of least squares: Fitting of straight lines, second degree parabolas and more general curves, Correlation, regression and Rank correlation. Test of significance: Large sample test for single proportion, difference of proportions, single mean, difference of means, and difference of standard deviations.

UNIT-V : Test for single mean, difference of means and correlation coefficients, test for ratio of variances , Chi-square test for goodness of fit and independence of attributes.

Suggested Readings:

1. R.K.Jain & Iyengar, “Advanced Engineering Mathematics”, Narosa Publications.
2. B.S. Grewal, “Higher Engineering Mathematics”, Khanna Publishers, 2000.
3. P.Sivaramakrishna Das & C.Vijaya Kumar, “Engineering Mathematics” , Pearson India Education Services Pvt. Ltd.
4. N.P. Bali & M. Goyal, “A Text Book of Engineering Mathematics”, Laxmi Publications, 2010.
5. S.C.Gupta & V.K.Kapoor, “Fundamentals of Mathematical Statistics” , S.Chand Pub.
6. P. G. Hoel, S. C. Port & C. J. Stone, “Introduction to Probability Theory”, Universal Book Stall, 2003.
7. W. Feller, “An Introduction to Probability Theory and its Applications”, Vol. 1, Wiley, 1968.

Course Code	Course Title				Core/Elective		
ES211CE	Engineering Mechanics				Core		
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	2	1	-	-	30	70	3

Course Objectives

The objectives of this course is to impart knowledge of

- Resolution of forces, equilibrium of force systems consisting of static loads
- Obtaining centroids and moments of inertia for various regular and irregular areas.
- Various forces in the axial force members, and to analyse the trusses using various methods,
- Concept of friction for single and connected bodies.
- Basic concepts of dynamics, their behaviour, analysis and motion bodies
- Work energy principles and impulse momentum theory and applications to problem solving

Course Outcomes

After completing this course, the student will be able to:

1. Apply the fundamental concepts of forces, equilibrium conditions for static loads.
2. Determine the centroid and moment of inertia for various sections.
3. Analyse forces in members of a truss using method of joints and method of sections, analyse friction for single and connected bodies.
4. Apply the basic concepts of dynamics, their behaviour, analysis and motion bodies.
5. Solve problems involving work energy principles and impulse momentum theory.

UNIT – I

Introduction to Engineering Mechanics: Basic Concepts

System of Forces: Coplanar Concurrent Forces, Components in Space – Resultant of coplanar and spatial systems, Moment of Force and Couple and its Application to coplanar system

Equilibrium of Systems of Forces: Free Body Diagrams, Equations of Equilibrium and applications to Coplanar System.

UNIT – II

Centroid: Centroid of simple areas (from basic principles), Centroid of Composite areas.

Area Moment of Inertia: Definition, Moment of inertia of simple areas (from basic principles), Polar Moment of Inertia, Transfer formula, Moment of Inertia of Composite areas.

Centre of Gravity & Mass moment of Inertia: Centre of gravity and Mass moment of inertia of simple bodies (from basic principles).

UNIT-III

Friction: Theory of friction, Laws of friction, Friction connected to single and connected bodies. Wedge friction.

Analysis of Perfect Frames: (Analytical Method) Types of Frames, Assumptions for forces in members of perfect frame, Method of joints and Method of sections for Cantilever Trusses, simply supported Trusses.

UNIT –IV

Kinematics: Introduction, Motion of particle, Rectilinear and Curvilinear motions, Velocity and Acceleration, Types of Rigid body, Angular motion, Fixed axis rotation.

Kinetics: Introduction, fundamental equation of kinetics for a particle, D' Alembert's principle for particle motion, connected system and Fixed Axis Rotation.

UNIT – V

Work - Energy Method: Introduction, Equations for Translation, Work-Energy Applications to Particle Motion, Connected System and Fixed Axis Rotation.

Impulse Momentum Method: Linear impulse momentum, law of conservation of momentum, coefficient of restitution, Elastic impact.

Suggested Readings:

1. Ferdinand L. Singer, *Engineering Mechanics*, Collins, Singapore, 1975.
2. Reddy Vijay Kumar K. and K. Suresh Kumar, *Singer's Engineering Mechanics*, 2010.
3. S.S Bhavakatti, *Engineering Mechanics*, New age International publishers.
4. Rajeshakharam, S. and Sankarasubrahmanyam, G., *Mechanics*, Vikas Publications, 2002.
5. Junarkar, S.B. and H.J. Shah., *Applied Mechanics*, Publishers, 2001.

Course Code	Course Title				Core/Elective		
ES214EC	Basic Electronics				Core		
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives

The objectives of this course is to impart knowledge of

- To understand the characteristics of diodes and transistor configurations
- To understand the design concepts of biasing of BJT and FET
- To understand the design concepts of feedback amplifiers and oscillators
- To study the design concepts of OP Amp and data converters

Course Outcomes

After completing this course, the student will be able to:

1. Study and analyse the rectifiers and regulator circuits.
2. Study and analyse the performance of BJTs, FETs on the basis of their operation and working.
3. Ability to analyse & design oscillator circuits.
4. Ability to analyse different logic gates & multi-vibrator circuits.
5. Ability to analyse different data acquisition systems

UNIT-I

PN Junction Diode: Characteristics, 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

Transistors: BJT construction and working, modes of operation, configurations of BJT (CB, CE, CC), small signal h-parameter model of CE, CE amplifier analysis. Construction and working of JFET, V-I characteristics of JFET.

UNIT-III

Feedback concepts: Types of negative feedback – modification of gain, bandwidth, input and output impedances, applications.

Oscillators: RC Phase shift, Wein bridge, LC and crystal Oscillators (Qualitative treatment only).

UNIT-IV

Operational Amplifier: OP-AMP Block diagram, Ideal OP-AMP, DC and AC Characteristics, Inverting and Non-Inverting Amplifiers, Adder/Subtractor, Integrator, Differentiator.

Logic gate circuits - Introduction to Digital systems- AND, NAND, NOR, XOR gates, Binary half adder, full adder.

UNIT-V

Data Acquisition Systems: Construction and Operation of transducers- Strain gauge LVDT, Thermocouple, Instrumentation systems.

Data Converters: R-2R Ladder DAC, Successive approximation and Flash ADC.

Suggested Readings:

1. Robert Boylestad L. and Louis Nashelsky, *Electronic Devices and Circuit Theory*, PHI, 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.

Course Code	Course Title				Core/Elective		
PC221ME	Metallurgy and Material Science				Core		
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives

- Enable to understand structure property relations, analyse the failures of metals and their prevention.
- To broad understanding of phase diagrams.
- Acquire basic knowledge in various heat treatment operations, their purpose and applications.
- Expose to various methods of extractive metallurgy techniques.
- Understand various modes of failure and suggest mechanisms for preventions of failures.
- Understand applications of conventional metals and alloys.

Course Outcomes

1. Know the fundamental science and engineering principles relevant to material.
2. Suggest appropriate physical metallurgical methods (phase diagrams).
3. The type of heat treatment operation to be given to any metal in order to improve desired Mechanical properties.
4. Basic ability to plan an extraction process for given ore.
5. Suggest the appropriate methods for prevention of failures.
6. Analyse the applications of conventional metals and alloys.

UNIT-I

Introduction to Materials engineering, classification of materials- metals and alloys, ceramics, polymers and composites,

Space lattice, unit cell, crystal structure, crystal directions and planes, crystal imperfections- point defects, line defects, surface defects, volume defects. Types of dislocations, Effect of slip and twinning on the plastic deformation, Jogs and its effect on yield phenomenon, Hall-Petch equation, Orange peel effect, cold and hot working, strain hardening and Bauchinger effect. Recovery, Recrystallisation, Grain growth and its effect on mechanical properties of metals.

Mechanical properties of materials- Tensile properties, stress-strain diagrams, elasticity, plasticity, ductility, toughness, modulus of elasticity, resolved shear stress, tensile and compression test, hardness and its measurement

UNIT-II

Fracture: Ductile and Brittle fracture, modes of fracture, ductile to brittle transition, crack initiation and propagation.

Fatigue: S-N curve, Structure of fatigue fracture specimen, Fatigue crack propagation, Effect of metallurgical variables on fatigue of metal, Experimental determination of fatigue strength (RR-Moore Test).

Creep: Creep strength, Creep curve, Creep deformation mechanisms, Creep Test, Differences between creep curve and stress rupture curve.

UNIT-III

Structure of Alloys: Types of solid solution, Substitutional and Hume Rothery's rules for solid solution, Construction and interpretation of Binary equilibrium diagram, Isomorphous, Eutectic and Peritectic diagrams, Intermediate phases and phase rule, Iron-Iron Carbide equilibrium diagram, construction and interpretation. Types of Plain Carbon Steels, Cast Iron and their properties and Characteristics.

UNIT-IV

Alloy Steels: Effects of alloying elements like Nickel, Chromium, Manganese, Silicon and Tungsten. Titanium. Study about Stainless steels, HSS, Maraging steels, Brass, Bronze, Muntz Metal, Invar, Duralumin and Ti Alloy (Ti-6Al-4V) – their composition and Properties.

Heat Treatment: Annealing, Normalising, Hardening, Tempering, Construction and interpretation of T.T.T Curve. Austempering and Martempering. Case Hardening: Carburising, Nitriding, Carbo-nitriding, Flame Hardening, Induction Hardening. Brief introduction of Age Hardening.

UNIT-V

Non-ferrous metals and alloys: Properties and applications of –Cu and its alloys, Al and its alloys, Age hardening, Ti and its alloys, Ni- based alloys

Ceramics, Polymers and Composites: Ceramics, crystalline ceramics, glasses, properties and applications of ceramics, polymers-polymerization, thermoplastics and thermosetting plastics, properties and applications of polymers. Composites: concept of composites, matrix and reinforcement, rule of mixtures, classification of composites, applications of composites.

Suggested Readings:

1. V.Raghavan, Material Science and Engineering, Prentice Hall of India Ltd., 4th Edition, 1994.
2. S.H. Avner, Introduction to Physical Metallurgy, Tata McGraw Hill, 2nd Edn.1997.
3. S.P. Nayak, Engineering Metallurgy and Material Science, Charotar Publishing House, 6th Edition, 1995.
4. E. Dieter, Mechanical Metallurgy, Metric Editions, Tata McGraw Hill, 3rd Edn,1997.
5. Robert M Jones, Mechanics of Composite Materials, Taylor and Francis.

Course Code	Course Title				Core/Elective		
PC222ME	Thermodynamics				Core		
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives

- Basic definitions of thermodynamics and significance of Zeroth law of thermodynamics.
- The importance and application of first law of thermodynamics.
- The various laws associated with second law of thermodynamics.
- Properties of pure substances and use of Mollier diagram.
- Various air standard cycles, their importance and their comparison.
- Calculation procedures of the air-fuel ratio.

Course Outcomes

1. Correlate the study of thermodynamics with the fundamental conceptual terminologies and Distinguish the different forms of energy
2. Analyse the Laws of Thermodynamics and correlate them for real life problem solving.
3. Read data from the chart of Mollier diagram and its applications.
4. Assess the importance of entropy and recognize the various curves of phase transformation
5. Identify the various air standard cycles, gas cycles and gas laws toward solving practical applications.

UNIT-I

Introduction: Definition and Concept of Thermodynamics, Microscopic and Macroscopic approach of thermodynamics, system, surroundings and property, intensive and extensive properties, Measurement of temperature, Zeroth law of thermodynamics, Temperature Scales, ideal gas and ideal gas thermometer, Reversibility and irreversibility quasi-static process, Specific heats for ideal gases, Thermodynamic Equilibrium, Mole fraction and mass fraction, Partial pressure and Dalton's Law, Amagat-Leduc Law of Partial volumes.

UNIT-II

First law of Thermodynamics: Statement of First Law, Heat and work interactions, Thermodynamics work and Internal energy, Energy as property of system, First Law applicable to Closed system, Thermodynamic processes and calculation of work, Heat transfer, and internal energy, Heat as Path Function, first law analysis of flow processes and limitation, Calculation of work done during flow processes.

UNIT-III

Second Law of Thermodynamics: Physical description of second law, Kelvin- Planck and Clausius statement of Second Law of thermodynamics, Equivalence of Kelvin- Planck and Clausius statement, Reversible and irreversible processes, Carnot Theorem, Clausius Inequality, Calculation of entropy change during various thermodynamic processes, principle of Entropy increase, T- S diagram, Available and Unavailable energies in steady flow, Second Law Analysis of Control Volume, Helmholtz and Gibb's functions, Available function for flow and non-flow processes and applications.

UNIT-IV

Thermodynamic properties of Fluids: Properties of pure substances, Concept of phase change, Graphical representation of pressure, Volume and Temperature, (PVT)– T and H diagrams, Properties of steam, Use of steam Tables and Mollier diagram, Thermodynamic relations involving entropy, Enthalpy, Internal Energy, Maxwell relations and Clapeyron equation.

UNIT-V

Analysis of Thermodynamic Cycles: Air standard cycles: Otto, Diesel, Dual Combustion Cycle, Joule/Brayton cycle. Vapour Power cycles: Rankine cycle and Modified Rankine cycle. Refrigeration cycles: Reversed Carnot cycle, Bell Coleman cycle, Vapour compression refrigeration cycle.

Suggested Readings:

1. P.K. Nag, Basic & Applied Thermodynamics, Tata McGraw Hill, 2ndEdn., 2008.
2. Yunus A Cengel & Michael A Boles, Thermodynamics- An Engineering Approach, Tata McGraw-Hill, 7th Edition in SI Units (Special Indian Edition),2011
3. Y.V.C.Rao, An Introduction to Thermodynamics, Universities Press, 2nd Edn., 2010.
4. P.L Ballaney, Thermal Engineering, Khanna Publishers 2004.
5. E. Rathakrishnan, Fundamentals of Engineering Thermodynamics, PHI Learning Pvt. Ltd, 2005.

Course Code	Course Title				Core/Elective		
PC251ME	Metallurgy and Material Testing Lab				Core		
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	2	25	50	1

Course Objectives

- Acquire basic knowledge by understanding iron-carbide diagram and its application in engineering.
- Expose to Metallographic study and analysis of various metals.
- Acquire knowledge in determining the hardness of metals before and after various Heat treatment operations.
- Understand differences between different heat treatment methods.
- Expose to T-T-T curve and its application in engineering metallurgy.
- Understand the relation between micro structure and properties.

Course Outcomes

After completing this course, the student will be able to:

1. Prepare specimen for metallographic observation
2. Analyse and identify low, medium and high carbon steels, different types of cast irons, non-ferrous alloys, from the study of their microstructure
3. Underlines the importance of grain size in evaluating the desired mechanical properties.
4. Correlate the heat treatment methods and the mechanical properties obtained.
5. Analyse and identify microstructures after annealing, normalizing, hardening and tempering Relate the properties of the materials using image analyser

List of Experiments:

A: Metallurgy Experiments:

1. Study of: Metallurgical Microscope, Iron-Iron Carbide diagram, Procedure for specimen preparation
2. Metallographic Study of Pure Iron & Low carbon steel
3. Metallographic Study of Medium carbon steel, Eutectoid steel & Hyper Eutectoid steel
4. Metallographic Study of Grey cast-iron, White cast-iron, & Black heart Malleable cast iron
5. Metallographic Study of Aluminium, Brass & Bronze
6. Jominy Quench test or Study of microstructure after heat treatment

B: Materials testing Lab

1. Uni-axial tension test, to draw stress- strain diagram, and estimate modulus of elasticity, % of elongation and toughness.
2. Compression test on bricks and Impact test
3. Hardness test: Brinell & Vickers
4. Shear force & bending moments tests.
5. Bending test on fixed beam, simply supported beam
6. Spring test and torsion test

Note: At least ten experiments should be conducted

Course Code	Course Title				Core/Elective		
PC252ME	Machine Drawing and Modelling Lab				Core		
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	2	25	50	1

Course Objectives

- To understand format of drawing sheet, angle of projections, isometric projections and practice on simple machine elements
- To practice free hand sketching of machine elements
- To understand Modelling of assembly drawings of typical machine parts.

Course Outcomes

At the end of the course, the student

1. Will be able to draw isometric and orthogonal projections and sectional views of various mechanical components.
2. Will be able to draw free hand sketches of various mechanical components
3. Will be able to understand the shape and structure of different types of joints, screws, keys and Couplings
4. Will be sufficiently knowledgeable to use both the software and drafter to produce assembly views of various mechanical components from part drawings.

List of Experiments:

I. Machine Drawing (AutoCAD):

1. Format of drawing sheet & title block,
2. Conventions of drawing lines and dimensions,
3. Convention for sectional views.
4. Simple machine elements.
5. Riveted and screwed fastenings.
6. Joints and coupling.

II. Assembly drawing (SOLIDWORKS/ CATIA/ PRO-E):

7. Connecting rod.
8. Eccentric.
9. Cross head.
10. Stuffing box.
11. Lathe Tool Post.
12. Revolving centre.
13. Pedestal bearing (Plummer block).
14. Screw Jack.

Note: The test is for the ability of the student to read and interpret drawing. The drawing should include part list in standard format.

Suggested Readings:

1. N.D. Bhatt, Machine Drawing, Charotar Publishing house, Anand, New Delhi, 28th edition, 1994.
2. K.L. Narayana, P. Kanniah, K. Venkat Reddy, Machine Drawing, New Age International (P) Ltd., 2nd edition 1999.
3. N. Siddeshwar, Machine Drawing, Tata McGraw Hill Publishing Co. Ltd., 5th edition, 1994
4. K. C. John, Text book of Machine Drawing, PHI Learning,

**SCHEME OF INSTRUCTION & EXAMINATION
B.E. (Mechanical Engineering) IV – SEMESTER**

S. No.	Course Code	Course Title	Scheme of Instruction				Scheme of Examination			Credits
			L	T	P/D	Contact Hrs/Wk	CIE	SEE	Duration in Hrs	
Theory Courses										
1	MC112CE	Environmental Science	2	-	-	2	30	70	3	-
2	MC113PY	Essence of Indian Traditional Knowledge	2	-	-	2	30	70	3	-
3	HS213MP	Industrial Psychology	3	-	-	3	30	70	3	3
4	BS206BZ	Biology for Engineers	3	-	-	3	30	70	3	3
5	ES213ME	Energy Sciences and Engineering	2	-	-	2	30	70	3	2
6	PC231ME	Mechanics of Materials	3	-	-	3	30	70	3	3
7	PC232ME	Applied Thermodynamics	3	-	-	3	30	70	3	3
8	PC233ME	Kinematics of Machinery	3	-	-	3	30	70	3	3
9	PC234ME	Manufacturing Processes	3	-	-	3	30	70	3	3
Practical/ Laboratory Courses										
10	PC261ME	Thermal Engineering Lab – I	-	-	2	2	25	50	3	1
11	PC262ME	Manufacturing Processes Lab	-	-	2	2	25	50	3	1
			24	-	04	28	320	730		22

HS: Humanities and Social Sciences BS: Basic Science ES: Engineering Science
 MC: Mandatory Course PC: Professional Core
 L: Lecture T: Tutorial P: Practical D: Drawing
 CIE: Continuous Internal Evaluation SEE: Semester End Evaluation (Univ. Exam)
 PY: Philosophy, BZ: Biology/ Life Sciences, CE: Civil Engineering
 MP: Mechanical / Production Engineering, ME: Mechanical Engineering.

Note:

- Each contact hour is a clock hour
- The duration of the practical class is two hours, however it can be extended wherever necessary, to enable the student to complete the experiment.
- All the mentioned **Mandatory Courses** should be offered either in I–Semester or II–Semester only **from the academic year 2019-2020**.
- For those of the students admitted during the academic year 2018-2019, since the Mandatory Courses were not offered during the I–Semester or II–Semester, they should be offered either in III–Semester or IV–Semester of the **academic year 2019-2020**.
- The students have to undergo a Summer Internship of two-week duration after IV – Semester and credits will be awarded in V – Semester after evaluation.

Course Code	Course Title				Core/Elective		
MC112CE	Environmental Science				Mandatory		
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	2	-	-	-	30	70	-

Course Objectives

- To create awareness and impart basic knowledge about the environment and its allied problems.
- To know the functions of ecosystems.
- To understand importance of biological diversity.
- To study different pollutions and their impact on environment.
- To know social and environment related issues and their preventive measures.

Course Outcomes

After completing this course, the student will be able to:

1. Adopt environmental ethics to attain sustainable development.
2. Develop an attitude of concern for the environment.
3. Conservation of natural resources and biological diversity.
4. Creating awareness of Green technologies for nation's security.
5. Imparts awareness for environmental laws and regulations.

UNIT-I

The Multidisciplinary Nature of Environmental Studies: Definition, scope and importance, need for public awareness.

Natural Resources: Water Resources – Use and over utilization of surface and ground water, flood, drought, conflicts over water, Dams: Benefits and Problems. Food Resources –World Food Problems, effects of modern agriculture, fertilizer-pesticides problems, water logging, salinity, Forest Resources –Use and over exploitation, deforestation & its effect on tribal people. Land Resources –Land Degradation, environmental effect of mining, man induced landslides, soil erosion and desertification. Energy Resources –Growing energy needs, Renewable and Non-renewable energy resources.

UNIT-II

Ecosystems: Concept of an ecosystem, Structure and function of an ecosystem, Producers, consumers and decomposers, Energy flow in ecosystem, food chains, ecological pyramids, ecological succession, types of ecosystems (marine, pond, river, forest, grassland, desert)

UNIT-III

Biodiversity: Levels of Biodiversity, Bio-geographical classification of India, Value of biodiversity, Threats to biodiversity, endangered and endemic species of India, Conservation of biodiversity, global and national efforts.

UNIT-IV

Environmental Pollution: Definition, Causes, effects and control measures of air pollution, water pollution, soil pollution, noise pollution, thermal pollution, solid waste management.

Environment Protection Act: Air, water, forest and wildlife Acts, issues in the enforcement of environmental legislation.

UNIT-V

Social Issues and the Environment: Watershed management and environmental ethics. Climate change, global warming, acid rain, ozone layer depletion.

Environmental Disaster Management: Types of disasters, impact of disasters on environment, infrastructure, and development. Basic principles of disaster mitigation, disaster management, and methodology. Disaster management cycle and disaster management in India.

Field Work:

- Visit to a local area to document environmental issues- agricultural area/ pond/lake/terrestrial ecosystem
- Visit to a local polluted area- market/slum area/Industrial area/traffic area

Suggested Readings:

1. A.K. De, *Environmental Chemistry*, Wiley Eastern Ltd.
2. E.P. Odum, *Fundamentals of Ecology*, W.B. Saunders Co., USA.
3. M.N. Rao and A.K. Datta, *Waste Water Treatment*, Oxford and IBK Publications.
4. Benny Joseph, *Environmental Studies*, Tata McGraw Hill, 2005.
5. V.K. Sharma, *Disaster Management*, National Centre for Disaster Management, IPE, 1999.

Course Code	Course Title				Core/Elective		
MC113PY	Essence of Indian Traditional Knowledge				Mandatory		
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	2	-	-	-	30	70	-
<p>Course Objectives The course will introduce the students to</p> <ul style="list-style-type: none"> ➤ To get a knowledge in Indian Philosophical Foundations. ➤ To Know Indian Languages and Literature and the fine arts in India & Their Philosophy. ➤ To explore the Science and Scientists of Medieval and Modern India <p>Course Outcomes After successful completion of the course the students will be able to</p> <ol style="list-style-type: none"> 1. Understand philosophy of Indian culture. 2. Distinguish the Indian languages and literature among difference traditions. 3. Learn the philosophy of ancient, medieval and modern India. 4. Acquire the information about the fine arts in India. 5. Know the contribution of scientists of different eras. 6. The essence of Yogic Science for Inclusiveness of society. 							

UNIT – I

Introduction to Indian Philosophy: Basics of Indian Philosophy, culture, civilization, culture and heritage, general characteristics of culture, importance of culture in human literature, Indian culture, Ancient Indian, Medieval India, Modern India.

UNIT – II

Indian Philosophy & Literature: Vedas Upanishads, schools of Vedanta, and other religion Philosophical Literature. Philosophical Ideas the role of Sanskrit, significance of scriptures to current society, Indian Philosophies, literature of south India.

Indian languages and Literature-II: Northern Indian languages & Philosophical & cultural & literature.

UNIT – III

Religion and Philosophy: Religion and Philosophy in ancient India, Religion and Philosophy in Medieval India, Religious Reform Movements in Modern India (selected movements only)

UNIT – IV

Indian Fine Arts & Its Philosophy (Art, Technology & Engineering): Indian Painting, Indian handicrafts, Music, divisions of Indian classic music, modern Indian music, Dance and Drama, Indian Architecture (ancient, medieval and modern), Science and Technology in Indian, development of science in ancient, medieval and modern Indian.

UNIT – V

Education System in India: Education in ancient, medieval and modern India, aims of education, subjects, languages, Science and Scientists of Ancient India, Scientists of Medieval India, Scientists of Modern India. The role Gurukulas in Education System, Value based Education.

Suggested Readings:

1. Kapil Kapoor, "Text and Interpretation: The India Tradition", ISBN: 81246033375, 2005
2. "Science in Samskrit", Samskrita Bharti Publisher, ISBN-13:978-8187276333,2007
3. NCERT, "Position paper on Arts, Music, Dance and Theatre", ISBN 81-7450-494-X, 2006
4. S. Narain, "Examination in Ancient India", Arya Book Depot, 1993
5. Satya Prakash, "Founders of Sciences in Ancient India", Vijay Kumar Publisher, 1989
6. M.Hiriyanna, "Essentials of Indian Philosophy", Motilal Banarsidass Publishers, ISBN-13: 978-8120810990,2014
7. Chatterjee. S & Dutta "An Introduction to Indian Philosophy"

Course Code	Course Title				Core/Elective		
HS213MP	Industrial Psychology				Core		
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives
 The course will introduce the students to

- To Know Industry Structures and functions.
- Develop an awareness of the major perspectives underlying the field of Industrial Psychology
- Understanding for the potential Industrial Psychology has for society and organizations now and in the future.

Course Outcomes
 After completing this course, the student will be able to:

1. Understanding of key concepts, theoretical perspectives, and trends in industrial psychology.
2. Evaluate the problems thorough and systematic competency model.
3. Analyse the problems present in environment and design a job analysis method.
4. Create a better work environment for better performance.
5. Design a performance appraisal process and form for the human behaviour.

UNIT-I

Industrial Engineering: Meaning, Definition, Objective, Need, Scope, Evolution and developments. Concept of Industrial Engineering, Historical development of Industrial Engineering, main departments of Industry.

Organization Structure: Introduction, Principles of Organization, Organizational theories, Departmentalism, Authority, power, Organizational effectiveness, structuring the Organization, Organizational change, Organization charts.

UNIT-II

Motivation, Morale and Behavioural Science: Motivation, Characteristics, Kinds of motivation, Thoughts of motivational philosophy, Human needs, Incentive as motivators, Managing Dissatisfaction and frustration, Morale, Absenteeism, Behavioural Science.

Social environment: Group dynamics in Industry Personal psychology, Selection, training, placement, promotion, counselling, job motivations, job satisfaction. Special study of problem of fatigue, boredom and accidents.

UNIT-III

Understanding Consumer Behaviour: Consumer behaviour, study of consumer preference, effects of advertising, Industrial morale: The nature and scope of engineering psychology, its application to industry

UNIT-IV

Work Methods: Efficiency at work, the concept of efficiency, the work curve, its characteristics, the work methods; hours of work, nature of work, fatigue and boredom, rest pauses. The personal factors; age abilities, interest, job satisfaction, the working environment, noise, illumination, atmospheric conditions, increasing efficiency at work; improving the work methods, Time and motion study, its contribution and failure resistance to time and motion studies, need for allowances in time and motion study.

UNIT-V

Work and Equipment Design: Criteria in evaluation of job-related factor, job design, human factors, Engineering information, input processes, mediation processes, action processes, methods design, work space and its arrangement, human factors in job design. Accident and Safety: The human and economic costs of accidents, accident record and statistics, the causes of accidents situational and individual factors related to accident reduction.

Suggested Readings:

1. TR Banga and SC Sharma, *Industrial Engineering and Management*, Khanna Publishers, 11th Edn., 2014.
2. Tiffin, J and McCormic E.J., *Industrial Psychology*, Prentice Hall, 6th Edn., 1975.
3. McCormic E.J., *Human Factors Engineering and Design*, McGraw Hill, 4th Edn., 1976.
4. Mair, N.R.F., *Principles of Human relations*
5. Gilmer, *Industrial Psychology*
6. Ghiselli & Brown, *Personnel and Industrial Psychology*.
7. Myer, *Industrial Psychology*.
8. Dunnette, M.D., *Handbook of Industrial and Organizational Psychology*.
9. Blum & Taylor, *Industrial Psychology*

Course Code	Course Title				Core/Elective		
BS206BZ	Biology for Engineers				Core		
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives

Gain vivid knowledge in the fundamentals and uses of biology, human system and plant system.

Course Outcomes

After completing this course, the student will be able to:

1. Apply biological engineering principles, procedures needed to solve real-world problems.
2. Understand the fundamentals of living things, their classification, cell structure and biochemical constituents.
3. Apply the concept of plant, animal and microbial systems and growth in real life situations.
4. Comprehend genetics and the immune system.
5. Know the cause, symptoms, diagnosis and treatment of common diseases.
6. Apply basic knowledge of the applications of biological systems in relevant industries.

UNIT-I

Introduction to Life: Characteristics of living organisms, Basic classification, cell theory, structure of prokaryotic and eukaryotic cell, Introduction to Biomolecules: definition, general classification and important functions of carbohydrates, lipids, proteins, vitamins and enzymes.

UNIT-II

Biodiversity: Plant System: basic concepts of plant growth, nutrition, photosynthesis and nitrogen fixation. Animal System: Elementary study of digestive, respiratory, circulatory, excretory systems and their functions. Microbial System: History, types of microbes, economic importance and control of microbes.

UNIT-III

Genetics and Evolution: Theories of evolution and Evidences; cell division–mitosis and meiosis; evidence of laws of inheritance; variation and speciation; nucleic acids as a genetic material; central dogma; Mendel laws, gene and chromosomes.

UNIT-IV

Human Diseases: Definition, causes, symptoms, diagnosis, treatment and prevention of diabetes, cancer, hypertension, influenza, AIDS and Hepatitis. Immunity immunization, antigen – antibody immune response.

UNIT-V

Biology and its Industrial Applications: Transgenic plants and animals, stem cell and tissue engineering, bioreactors, bio pharming, recombinant vaccines, cloning, drug discovery, biological neural networks, bioremediation, biofertilizer, biocontrol, biofilters, biosensors, biopolymers, bioenergy, biomaterials, biochips, basic biomedical instrumentation.

Suggested Readings:

1. A Text book of Biotechnology, R.C.Dubey, S. Chand Higher Academic Publications, 2013
2. Diseases of the Human Body, Carol D. Tamparo and Marcia A. Lewis, F.A. Davis Company, 2011.
3. Biomedical instrumentation, Technology and applications, R. Khandpur, McGraw Hill Professional, 2004
4. Biology for Engineers, Arthur T. Johnson, CRC Press, Taylor and Francis, 2011
5. Cell Biology and Genetics (Biology: The unity and diversity of life Volume I), Cecie Starr, Ralph Taggart, Christine Evers and Lisa Starr, Cengage Learning, 2008
6. Biotechnology Expanding horizon, B.D. Singh, Kalyani Publishers, 2012.

Course Code	Course Title				Core/Elective		
ES213ME	Energy Sciences and Engineering				Core		
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	2	-	-	-	30	70	2

Course Objectives

The objectives of this course is to impart knowledge of

- Able to identify various sources of energy.
- Understand the difference between Conventional and renewable energy sources.
- Identify various storage devices of Energy.
- Able to estimate the costing of power plant.

Course Outcomes

After completing this course, the student will be able to:

1. Understand the basics of various sources of energy
2. Analyse the present status of conventional energy sources.
3. Understand the working principles of Renewable Energy systems
4. Design and develop waste heat recovery systems.
5. Relate energy economics, standards and future challenges.

UNIT-I

Introduction: Various sources of energy, relative merits and demerits, Statistics and prospects of conventional and Renewable energy sources.

UNIT-II

Conventional Energy Sources: Fossil Fuels: Power generation using steam turbine and gas turbine power plants, Nuclear Fuels: Parts of reactor core, Nuclear power plant outline, Methods to dispose radioactive waste. Hydro Energy: Spillways, Hydroelectric power plant outline.

UNIT-III

Renewable Energy Systems: Solar Energy – Types of collectors and concentrators, Solar Photo Voltaic Cell. Wind Energy – Types of Wind Turbines and their working, geothermal power plant, Biomass conversion, Wave Energy power plant, Tidal Energy power plant, Ocean thermal energy power plant.

UNIT-IV

Storage: Methods to store Mechanical Energy, Electrical Energy, Chemical Energy and Thermal Energy. Co-generation & Tri-generation: Definition, application, advantages, classification, saving Potential. Energy waste, waste heat recovery classification, advantages and applications, commercially viable waste heat recovery devices.

UNIT-V

Power Plant Economics and Environmental Considerations: Costing, Estimation of power production - Pollutants and Pollution Standards -Methods of pollution control. Energy Efficiency rating and BEE standards, Future energy needs and challenges.

Suggested Readings:

1. Wakil MM, *Power Plant Technology*, McGraw Hill
2. P.K. Nag, *Power Plant Engineering*, McGraw-Hill
3. G.D. Rai, *Non-Conventional Energy Sources*, Khanna Publishers
4. Mili Majumdar, *Energy Efficient Buildings in India*, Ministry of Non-Conventional Energy Sources.

Course Code	Course Title					Core/Elective	
PC231ME	Mechanics of Materials					Core	
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3
Course Objectives <ul style="list-style-type: none"> ➤ To understand the basic concept of stress and strains for different materials. ➤ To know the mechanism of the development of shear force and bending moment in beams and the stresses in thin cylinders & spheres. ➤ To know the theory of simple bending, direct & bending stress and distribution of shear stress. ➤ To analyse and understand shear stress, torsional stress and spring applications. ➤ To study the deflections and its applications. Course Outcomes <ol style="list-style-type: none"> 1. To understand the theory of elasticity and Hooke's law 2. To analyse beams to determine shear force and bending moments 3. Analyse shear stress distribution in different sections of beams. 4. To analyse and design structural members subjected to combined stresses 5. To solve problems on bars and to determine deflections at any point of the beams 							

UNIT – I

Simple Stresses & Strains: Types of stresses & strains, Stress-Strain relations (Hooke's law), Relation between elastic constants, Volumetric strain, Composite bars, Temperature stresses. **Strain energy:** Gradual, Sudden, Impact and Shock loading.

Compound Stresses: Stresses on oblique planes, Principal stresses and Principal planes. Mohr's circle and ellipse of stresses & strains.

UNIT – II

Shear Force and Bending Moment: Construction of S.F and B.M diagrams for cantilever, simply supported and overhanging beams subjected to point loads, uniformly distributed loads, uniformly varying loads and combination of these loads, Point of contra flexure and Relation between S.F & B.M.

Thin Cylinders & Spheres: Derivation of formulae for longitudinal stress, Circumferential (hoop) stress, Volumetric strains, Changes in diameter and volume.

UNIT – III

Bending stresses in Beams: Assumptions made in pure bending, Derivation of bending moment equation, Modulus of section, Moment of resistance, Determination of bending stresses. Direct and Bending Stresses: Basic concepts, Core of sections for square, rectangular, solid and hollow circular.

Distribution of shear stress: Equation of shear stress, Distribution across rectangular section.

UNIT – IV

Torsion of Circular Shafts: Theory of pure torsion, Assumptions made, Derivation of basic torsion equation, Torsional moment of resistance, Polar section modulus, Power transmitted by shafts, Combined bending and torsion.

Helical Springs: Close and open coiled helical springs subjected to axial loads, axial couples, Strain energy in springs.

UNIT - V

Deflection of Beams: Deflections of cantilever and simply supported beams including overhanging beams for point loads and uniformly distributed loads by Double integration method, Macaulay's method, Strain energy method, Moment area method, Conjugate beam method and Maxwell reciprocal theorem.

Suggested Readings:

1. S. Ramamrutham, Strength of Materials, Dhanpat Rai & Sons, 1993.B.C. Punmia, Strength of Materials and Theory of Structures, Laxmi Publishers, Delhi, 2000.
2. R.K. Rajput, Strength of Materials, S. Chand & Co., 2003.
3. EgorP.Popov,EngineeringMechanicsofSolids,PrenticeHallofIndia,NewDelhi,2001.
4. Gere & Timoshenko, Mechanics of Materials, 2nd Edition, CBS Publishers and Distributors Pvt. Ltd.
5. Ferdinand P. Beer et.al., Mechanics of Materials, Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 2005.

Course Code	Course Title					Core/Elective	
PC232ME	Applied Thermodynamics					Core	
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives

- To study the application of thermal science in mechanical engineering, consisting of the fundamental laws and processes for energy conversion.
- To understand thermal design aspects of reciprocating machinery-reciprocating compressors and IC Engines.
- To analyse Rankine cycle applied to thermal power plants and its improvements.
- To gain the knowledge on the power plant thermal Devices-Boilers, Condensers, Pumps & Nozzles.

Course Outcomes

1. Expected to be able to quantify the behaviour of reciprocating compressors.
2. Expected to be able to explain thermal design and working principles of IC Engines, their supporting systems and Combustion chambers.
3. Expected to be able to quantify the behaviour of power plants based on the Rankine cycle, including the effect of enhancements such as superheat, reheat and regeneration.
4. Expected to be able to explain the thermal design and working principles of Power plant devices.
5. Expected to be able to explain working principles of Boilers, Condensers, Pumps & Nozzles.

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- Carburettors, 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- Babcock & 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. Boiler Draught. Calculation of Chimney height.

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.

Suggested Reading:

1. R.K. Rajput, "Thermal Engineering", Laxmi Publications, 9th Edn., 2013
2. V. Ganesan, "Internal Combustion Engines", Tata McGraw Hill Publishing, 2007
3. P.L. Ballaney, "Thermal Engineering", Khanna Publishers, 19th Edn., 1993.
4. Richard Stone, "Introduction to I.C. Engines", Mac Millan, 2nd Edn., 1997

Course Code	Course Title					Core/Elective	
MC233ME	Kinematics of Machinery					Core	
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives

The objectives of this course is to impart knowledge of

- Analysis of mechanisms.
- Drawing displacement diagrams for followers with various types of motions.
- Cam profile drawing for various followers.
- Estimation of transmission of power by belts and application of various gears and gear trains.

Course Outcomes

After completing this course, the student will be able to:

1. Understand the principles of kinematic pairs, chains and their classification, DOF, inversions, equivalent chains and planar mechanisms.
2. Analyse the planar mechanisms for position, velocity and acceleration.
3. Design frictional systems like belt drives, rope drives, clutches, bearings and screw threads
4. Design cams and followers for specified motion profiles.
5. Evaluate gear tooth geometry and select appropriate gears for the required applications.

UNIT-I

Definition of link, pair, kinematic chain, mechanism and machine, Kutzbach and Grubler criterion, Grashoff's law, inversions of quadratic cycle chain, inversions of single and double slider crank chains. Fundamentals of coupler curves, Robert's law, Pantograph, Geneva mechanism, Hooke's joint, Davis and Ackerman's Steering gear mechanisms.

Introduction to Type, Number and Dimensional synthesis of four bar planar mechanisms

UNIT-II

Analysis of Mechanisms: Instantaneous centre, body centrode and space centrode, Kennedy's theorem, Graphical methods (relative velocity method, instantaneous center method) to find velocities and accelerations including Coriolis component of acceleration of planar mechanisms. Angular velocity theorem.

UNIT-III

Laws of Friction: Friction in screw threads, pivots, collars and clutches, friction axis of link and friction circle

Belts and Rope drives: Open and closed belt drives, length of belt, ratio of tensions, effect of centrifugal tension and initial tension on power transmission, condition for maximum power transmission

Brakes: Block or shoe brake, internal expanding shoe brake, disc brake, belt brakes

Dynamometers: Rope brake, belt transmission and Torsion type dynamometers

UNIT-IV

Cams: Types of cams and followers, Displacement, velocity, acceleration and jerk (SVAJ) diagrams for follower motion, Analysis of uniform motion, parabolic motion, simple harmonic motion and cycloidal motion profiles. Graphical synthesis of planar cams with knife edge, roller and flat face followers. Eccentric circle cam with translating roller follower.

UNIT-V

Gears: Classification of gears. Spur gears- Nomenclature, law of gear tooth action, involute as gear tooth profile, interference of involute gears, minimum number of teeth to avoid interference, contact ratio, cycloidal tooth profile, comparison of involute and cycloidal tooth profile.

Helical gears: Helical gear tooth relations, contact of helical gear teeth.

Gear trains- Simple, compound, reverted, and epi cyclic gear trains.

Suggested Readings:

1. S.S. Rattan, Theory of Machines, Tata McGraw-Hill, 3rd Edition,2009.
2. J. E. Shigley, Theory of Machines and Mechanisms, McGraw-Hill Publications,2005.
3. Thomas Bevan, Theory of Machines, Pearson Education
4. Norton RL, Kinematics and Dynamics of Machinery, McGraw-Hill Publications
5. Amitabha Ghosh and Ashok Kumar Mallik, Theory of Mechanisms and Machines, East West Press Pvt. Ltd,2008

Course Code	Course Title					Core/Elective	
MC234ME	Manufacturing Process					Core	
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives

- To understand the basic principles of major manufacturing processes such as metal casting, welding and forming of engineering materials.
- To know the advantages and limitations of each process.
- To be able to select the optimal process to produce a product.
- To know the basic principle of advanced forming processes.

Course Outcomes

1. Describe the concepts of Foundry Technologies consisting of pattern making, mould making, gating design and solidification.
2. Discuss the importance of special casting processes, categorize various casting defects and describe the processing of plastics.
3. Classify and differentiate various Arc welding, Gas welding and Advanced welding processes, discuss their advantages, applications and limitations.
4. Differentiate various Solid State welding and Resistance welding processes, discuss their applications, and identify various welding defects.
5. Describe various forming processes, sheet metal operations and discuss the importance of unconventional forming processes.

UNIT-I

Casting Process : Casting terms, pattern materials, types of patterns, pattern allowances, colour code for patterns, Moulding sands, core sands, properties of moulding sand and its ingredients, different types of moulding machines, Directional solidification, use of chaplets, chills, riser and gating design.

UNIT-II

Special Casting Processes: Shell moulding, Co₂ moulding, die casting, centrifugal casting, investment or lost wax process; Casting defects, causes and remedies, Inspection and testing of castings.

Processing of Plastics - Extrusion, Injection moulding, Blow moulding and Thermoforming.

Introduction to Powder Metallurgy- Process, Production of powders, blending, mixing, compaction techniques and finishing operations employed in powder metallurgy processes.

UNIT-III

Welding Processes: Introduction, Classification of welding processes, principle of gas welding, equipment and techniques, types of flames and applications, advantages, limitations and applications of Gas welding; Arc welding equipment electrode materials and specifications, polarity, types of arc welding.- SMAW, SAW, GMAW, GTAW, PAW, Atomic hydrogen welding, principle of Electro slag welding, Soldering and Brazing, Gas cutting.

UNIT-IV

Solid State Welding Process: Forge Welding, Friction Welding, Friction Stir Welding, and Explosive Welding.

Resistance welding processes - Spot welding, Projection welding, Percussion welding, Seam welding, Butt welding, weldability, Welding defects

UNIT-V

Forming Processes: Cold & Hot working, Yield criteria, Process description of Forging, Rolling, Extrusion, Wire drawing.

Sheet Metal Operations: Blanking, Piercing, Bending, Deep drawing, Stretch forming, Spinning.

Advance Forming Processes- High energy rate forming processes such as Explosive forming, Electro-magnetic forming and Electro-hydraulic forming; Rubber pad forming

Suggested Readings:

1. P.N. Rao, "Manufacturing Technology," Vol. 1, Tata McGraw Hill Publ., 3rd Ed., 2011
2. Amitabh Ghosh & Mallick, "Manufacturing Science", Assoc. East west Press Pvt. Ltd. 4th Ed., 2011
3. Roy A. Lindberg, "Processes and Materials of Manufacture", 3rd Edition, Pearson Education, 2015.
4. Serope Kalpakjian, "Manufacturing Engineering and Technology", Pearson Education, 2018
5. George. E. Dieter, "Mechanical Metallurgy", SI Metric Edition McGraw-Hill Book Company
6. J.P.Kaushish, "Manufacturing Processes", PHI Learning Pvt. Ltd., 2nd, 2010

Course Code	Course Title					Core/Elective	
MC261ME	Thermal Engineering Lab - I					Core	
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	2	25	50	1
<p>Course Objectives</p> <ul style="list-style-type: none"> ➤ To understand applications of thermal engineering concepts through experimentation. ➤ To provide knowledge in testing of properties of fuels and lubricating oils ➤ To demonstrate and conduct experiments, Interpret and analyse data and report results of IC engine testing <p>Course Outcomes</p> <ol style="list-style-type: none"> 1. Perform experiments to find the efficiency of Petrol and Diesel engines. 2. Find the properties of unknown fuels/lubricants. 3. Perform experiments on CI and SI engines. 4. Perform experiments on Reciprocating Air Compressor. 							

List of Experiments:

1. To determine volumetric efficiency, isothermal efficiency and mass flow rate of a two stage reciprocating air compressor.
2. To determine valve timing diagram of a Petrol/Diesel engine.
3. To determine port timing diagram of a Petrol/Diesel engine.
4. To conduct performance test on single cylinder Diesel engine.
5. To conduct heat balance test on a Diesel engine.
6. To conduct Morse test on multi cylinder Petrol engine.
7. To conduct performance test on multi cylinder Petrol engine.
8. To conduct performance test on a two-stroke Petrol engine.
9. To conduct performance test on multi cylinder Diesel engine.
10. To study the performance of a Petrol engine under different compression ratios.
11. Exhaust gas analysis of Petrol engine for carbon-monoxide and unburnt hydrocarbons.
12. Exhaust gas analysis of Diesel engine for carbon deposits using smoke meter.
13. Determination of viscosity of lubricating oil.
14. Determination of flash and fire points of a fuel
15. Study of Boiler Models

Note: At least ten experiments should be conducted in the Semester

Course Code	Course Title					Core/Elective	
PC262ME	Manufacturing Processes Lab					Core	
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	2	25	50	1

Course Objectives

- To gain knowledge and skill in various manufacturing processes such as casting, welding and forming.
- To understand and perform operations like pattern making, sand testing and casting.
- To join metal pieces by various welding techniques and gain hands on experience.
- To understand the working principle and produce some components by various metal forming techniques.

Course Outcomes

1. Conduct experiments and put hands-on experience on various processes in foundry, welding, forging, forming and plastic manufacturing technologies.
2. Demonstrate the understanding of the theoretical concepts of above technologies while working in small groups.
3. Demonstrate writing skills through clear laboratory reports
4. Identity the defects / imperfections and discuss their causes and suggest remedies to eliminate them.
5. Transfer group experience to individual performance of exercises and demonstrate effective oral communication skills.

List of Experiments:

Foundry

1. Single piece pattern making with wood as material considering allowances (Draft, Shrinkage and Machining)
2. Green sand mould making processes with complete sprues, gates, riser design.
3. Testing of green sand properties
4. Melting and casting of aluminium metal.

Welding

- I. Evaluation of strength and hardness of a
 1. Butt Joint prepared by gas welding using different types of flames
 2. Lap joint by resistance welding process
 3. V-Joint by Arc welding process
- II. Exercises using TIG and MIG welding processes.

Forming:

1. Evaluation of formability using Erichsen cupping test
2. Performing wire drawing operation on different materials (ex. Cu, Al, etc)
3. Performing blanking and piercing operations using hydraulic/fly presses.
4. Manufacturing of a simple component using Plastic Injection moulding machine

Note: Minimum ten experiments should be conducted in the semester

FACULTY OF ENGINEERING
Scheme of Instruction & Examination
(AICTE Model Curriculum for the Academic Year 2020-2021)

and

Syllabi

B.E. V and VI Semester

of

Four Year Degree Programme

in

Mechanical Engineering

(With effect from the academic year 2020– 2021)
(As approved in the faculty meeting held on - -2020)



Issued by

Dean, Faculty of Engineering
Osmania University, Hyderabad – 500 007
2020

**SCHEME OF INSTRUCTION & EXAMINATION
B.E. (Mechanical Engineering) V – SEMESTER**

S.No.	Course Code	Course Title	Scheme of Instructions				Scheme of Examination			Credits
			L	T	P/D	Contact Hours/ Week	CIE	SEE	Duration in Hours	
Theory Course										
1	PC501ME	Fluid Mechanics and Hydraulic Machinery	3	-	-	3	30	70	3	3
2	PC502ME	Design of Machine Elements	3	-	-	3	30	70	3	3
3	PC503ME	Dynamics of Machines	3	-	-	3	30	70	3	3
4	PC504ME	Metal Cutting and Machine Tools	3	-	-	3	30	70	3	3
5	PC505ME	Heat Transfer	3	-	-	3	30	70	3	3
Laboratory Course										
6	PC591ME	Thermal Engineering Lab-2	-	-	2	2	25	50	3	1
7	PC592ME	Dynamics of Machines Lab	-	-	2	2	25	50	3	1
8	PC593ME	Fluid Mechanics and Hydraulic Machinery Lab	-	-	2	2	25	50	3	1
		Total	15	-	06	21				18

PC: Professional Core

PE: Professional Elective

OE: Open Elective

L: Lecture T: Tutorial

P: Practical

D: Drawing

CIE: Continuous Internal Evaluation

SEE: Semester End Evaluation (Univ. Exam)

**SCHEME OF INSTRUCTION & EXAMINATION
B.E. (Mechanical Engineering) VI – SEMESTER**

S.No.	Course Code	Course Title	Scheme of Instructions				Scheme of Examination			Credits
			L	T	P/D	Contact Hours/Week	CIE	SEE	Duration in Hours	
Theory Course										
1	PC601ME	Machine Design	3	-	-	3	30	70	3	3
2	PC602ME	Metrology and Instrumentation	3	-	-	3	30	70	3	3
3	PC603ME	Finite Element Analysis	3	-	-	3	30	70	3	3
4	PEME - 1	Professional Elective – I	3	-	-	3	30	70	3	3
5	PEME - 2	Professional Elective – II	3	-	-	3	30	70	3	3
6	OEME - 1	Open Elective – 1	3	-	-	3	30	70	3	3
Laboratory Course										
7	PC691ME	Metrology and Machine Tools Lab	-	-	2	2	25	50	3	1
8	PC692ME	Computer Aided Engineering Lab	-	-	2	2	25	50	3	1
9		Summer Internship*								2
		Total	18	00	04	22				22

Open Elective - 1 (OE611ME) : Industrial Robotics (Not for Mechanical / Prod. / Automobile)

PROFESSIONAL ELECTIVE - I	
PE611ME	CAD/CAM
PE612ME	Automobile Engineering
PE613ME	Modern Machining and Forming Methods

Professional Elective-II		
S. No.	Course Code	Course Title
1.	PE621ME	Thermal Turbo Machines
2.	PE622ME	Production and Operations management
3.	PE623ME	Design For Manufacture

PC: Professional Core PE: Professional Elective OE: Open Elective
 L: Lecture T: Tutorial P: Practical D: Drawing
 CIE: Continuous Internal Evaluation SEE: Semester End Evaluation (Univ. Exam)

* At the end of VI semester students should undergo summer Internship - Credits for Summer Internship will be awarded in VII semester

FACULTY OF ENGINEERING
Scheme of Instruction & Examination

(AICTE Model Curriculum for the Academic Years **2018-22**)

B.E.VII and VIII Semesters

Of

Four Year Degree Programme in
B.E.(Mechanical Engineering)

14.09.2021

SCHEME OF INSTRUCTION & EXAMINATION
B.E. (Mechanical Engineering) VII – SEMESTER
(wef: 2021-2022)

S. No.	Course Code	Course Title	Scheme of Instructions				Scheme of Examination			Credits
			L	T	P/D	Contact Hours/Wee	CIE	SEE	Duration in Hours	
Theory Course:										
1	PC701ME	Operations Research	3	-	-	3	30	70	3	3
2	PC702ME	Refrigeration & Air Conditioning	3	-	-	3	30	70	3	3
3	PE-III	Professional Elective-III	3	-	-	3	30	70	3	3
4	PE-IV	Professional Elective-IV	3	-	-	3	30	70	3	3
5	OE-II	Open Elective-II	3	-	-	3	30	70	3	3
Practical / Laboratory Course:										
6	PW702ME	Project -I	-	-	6	6	50	-	-	3
Total			15	-	6	21	200	350	-	18

Professional Elective-III		
S. No.	Course Code	Course Title
1	PE711ME	Industrial Engineering
2	PE712ME	Modern Control Engineering
3	PE713ME	Basics of Electric & Hybrid vehicles

Professional Elective-IV		
S. No.	Course Code	Course Title
1	PE721ME	Additive Manufacturing Technology
2	PE722ME	Robotics Engineering
3	PE723ME	Computational Fluid Dynamics

Open Elective-II		
S. No.	Course Code	Course Title
1	OE901ME	Start-up Entrepreneurship

MC: Mandatory Course

CIE: Continuous Internal Evaluation

SEE: Semester End Examination (Univ. Exam)

BS: Basic Science

L: Lecture

P: Practical

ES: Engineering Science

T: Tutorial

D: Drawing

Note:

- Each contact hour is a clock hour
- The duration of the practical class is two hours, however it can be extended wherever necessary, to enable the student to complete the experiment.

Code: PC701ME

**OPERATION RESEARCH
(Professional Core Course)**

Credits: 3

*Instruction: 3 periods per week
CIE: 30 marks*

*Duration of SEE: 3 hours
SEE: 70 marks*

Course Objectives:

1. To use variables for formulating complex mathematical models in management science, industrial engineering and transportation models.
2. To use the basic methodology for the solution of linear programming problems.
3. To understand the mathematical tools that are needed to solve optimization problems like Transportation models and Assignment models.
4. To understand the replacement models with change in money value considering with time and without time.
5. To Model a system as a queuing model and compute important performance measures.

Course Outcomes:

After completing this course, the student will be able to:

1. To prepare the students to have the knowledge of Linear Programming Problem in operations Research at the end students would be able to understand the concept and develop the models for different applications.
2. To make students understand the concept Replacement models at the end students would able to explain various features and applications of replacement models in real time scenario.
3. To prepare the students to understand theory of Game in operations research at the end students would able to explain application of Game theory in decision making for a conflict.
4. To prepare the students to have the knowledge of Sequencing model at the end student would able to develop optimum model for job scheduling.
5. To prepare students to understand Queuing theory concepts and various optimization techniques at the end students would able to develop models for waiting line cases.

Unit-I

Introduction: Definition and Scope of Operations Research.

Linear Programming: Introduction, Formulation of linear programming problems, graphical method of solving LP problem, simplex method, maximization and minimization, Degeneracy in LPP, Unbounded and, Infeasible solutions.

Unit-II:

Duality: Definition, Relationship between primal and dual solutions, Economic Interpretation, Post optimal of sensitivity analysis, Dual Simplex Method.

Unit-III

Transportation Models: Finding an initial feasible solution - North West corner method, least cost method, Vogel's Approximation method, Finding the optimal solution, optimal solution by stepping stone and MODI methods, Special cases in Transportation problems - Unbalanced Transportation problem.

Assignment Problems: Hungarian method of Assignment problem, Maximization in Assignment problem, unbalanced problem, problems with restrictions, travelling salesman problems.

Unit-IV

Game Theory: Introduction, 2 person zero sum games, Maximin - Minimax principle, Principle of Dominance, Solution for mixed strategy problems, Graphical method for $2 \times n$ and $m \times 2$ games.

Sequencing Models: Introduction, General assumptions, processing n jobs through 2 machines, processing 'n' jobs through m machines, Processing 2 jobs through m machines

Queuing Theory: Introduction, single channel - Poisson arrivals - exponential service times with infinite population & finite population, Multi channel - poisson arrivals - Exponential service times with infinite population.

Unit-V

Introduction to Optimization Techniques: Single objective & Multi objective optimization Techniques like G.A, NSGA, P.Q.O& MPSO Techniques.

Project Management: Project management: Network fundamentals, difference between PERT/CPM Scheduling the activities. Fulkerson's rule. Earliest and latest times. Determination of ES and EF in the forward path. LS and LF in backward path. Determination of critical path.

Suggested Reading:

1. Hamdy, A. Taha, "*Operations Research-An Introduction*", Sixth Edition, Prentice Hall of India Pvt. Ltd., 1997.
2. S.D. Sharma, "*Operations Research*", Kedarnath, Ramnath & Co., Meerut, 2009.
3. Hrvey M. Wagner, "*Principles of Operations Research*", Second Edition, Prentice Hall of India Ltd., 1980.
4. V.K. Kapoor, "*Operations Research*", S. Chand Publishers, New Delhi, 2004.
5. R. Paneer Selvam, "*Operations Research*", Second Edition, PHI Learning Pvt. Ltd., New Delhi, 2008.
6. Data Reconciliation & Gross Error Detection by Prof. Shankar Narasimha and Cornelius Jordache, Gulf Publishing House, Huston, Texas,2008.

Code: PC702ME

**REFRIGERATION & AIR CONDITIONING
(Professional Core Course)**

Credits : 3

Instruction: 3 periods per week

CIE: 30 marks

Duration of SEE: 3 hours

SEE: 70 marks

Course Objectives:

1. To understand the basic concepts of refrigeration and air conditioning systems.
2. To study the methods of refrigeration for commercial and industrial applications.
3. To study the lower temperature applications: cryogenics by using cascade systems.
4. Solving the problems related to cooling and heating system (HVAC).

Course Outcomes:

1. Identify various natural and artificial methods of refrigeration. State the importance of refrigerant selection and the environmental issues related to the use of CFCs
2. Formulate equations for different types of refrigerants used in vapour compression refrigeration system. Justify the selection of single or multi stage system based on operating temperature range
3. Explain the working principles of vapour absorption, thermoelectric and steam-jet refrigeration systems. Select a suitable refrigerant absorbent mixture for vapour absorption refrigeration system
4. Define Psychrometry and its properties. Analyze various problems on psychrometric processes, know the construction and application of Psychrometric chart
5. Able to design an air conditioning system based on given inside and outside conditions. Evaluate cooling and heating loads in an air-conditioning system
6. List typical conditions required for various food product processes and List applications of refrigeration and air conditioning

Unit-I

Introduction to Refrigeration: Definition of Refrigeration and Air-conditioning, Necessity of Refrigeration, Methods of Refrigeration, Unit of Refrigeration and C.O.P. Reversed Carnot cycle.

Properties of Refrigerants: Survey, Designation, Desirable properties of refrigerants, Thermodynamic, Chemical and Physical properties, Classification of Refrigerants, Ozone depletion & Global warming, Green House Effect and Future of Refrigerants.

Air Refrigeration Systems: Analysis of Bell-Coleman Cycle, Open and Dense air system, Application to aircraft refrigeration, Simple cooling system and Bootstrap refrigeration system, Regenerative cooling system and Reduced ambient cooling system.

Unit-II:

Vapour compression system: Working principle and essential components of Simple vapor compression Refrigeration cycle, Compressor, condenser, evaporator, and expansion devices, Analysis of cycle, C.O.P, Representation of the cycle on T-S, P-H and H-S charts. Performance improvement of simple vapour compression refrigeration cycle by means of flash chamber and accumulator Dry and wet compression, Effect of operating conditions like evaporating pressure, condenser pressure, Liquid sub-cooling and Vapor super heating, Performance of the system. Low temperature refrigeration system (with single load system), Compound compression with water inter cooler and Flash intercooler, Cascade refrigeration system-Analysis and advantages

Unit-III

Vapour Absorption Refrigeration System: Simple absorption systems, COP, Practical ammonia absorption refrigeration system, Lithium bromide absorption system, Electrolux refrigerator, Common refrigerants and absorbents properties, Comparison with vapor compression refrigeration system

Steam Jet Refrigeration: Principle of working, Analysis of the system, Advantages, limitations and applications.

Non-Conventional Refrigeration Systems: Principle and operation of Thermoelectric Refrigeration Systems, Seebeck effect - Peltier effect - Thomson effect, Analysis, Pulse tube refrigeration system.

Unit-IV

Psychrometry: Psychrometric properties, Psychrometric chart, construction, Representation of Psychrometric processes on the chart.

Introduction to Air Conditioning: Requirements of comfort air conditioning, Thermodynamics of human body, Body temperature, Metabolism, Body defense and Human tolerance, Effect of heat on performance, ASHRE comfort chart and Effective temperature.

Unit-V

Cooling Load Calculations in Air Conditioning: Concept of bypass factor, Sensible heat factor, Apparatus Dew Point, Room Sensible Heat Factor (RSHF), Gross Sensible Heat Factor (GSHF), Different heating and cooling loads, Problems.

Design of air conditioning systems: All fresh air, Re-circulated air with bypassed air, Design of Summer, winter and Year-round air-conditioning systems, Energy conservation in air conditioned building.

Air Conditioning Systems: Types, Components of air conditioner equipment's, Humidifier, Dehumidifier, Filter, Grills, Fans and Blowers, Duct material, Function of Dampers, Diffusers.

Applications of Refrigeration and Air conditioning Food Preservation, Transport air conditioning, and Industrial applications.

Suggested Reading:

1. Arora C.P., "Refrigeration and Air conditioning", Tata McGraw Hill, New Delhi, 2009.
2. Arora, S.C. and Domkundwar, S., "A Course in Refrigeration and Air conditioning", Dhanpat Rai & Sons, New Delhi, 2010.
3. Jain, V.K., "Refrigeration and Air Conditioning", S Chand & Company, New Delhi, 2010.
4. Stocker, W.S., "Refrigeration and Air conditioning", McGraw Hill, New Delhi, 2009.
5. RK Rajput, "Refrigeration & Air conditioning", SK Kataria & Sons New Delhi, Third Edition 2015.

Code: PE711ME

**INDUSTRIAL ENGINEERING
(Professional Elective-III)**

Credits: 3

*Instruction: 3 periods per week
CIE: 30 marks*

*Duration of SEE: 3 hours
SEE: 70 marks*

Course Objectives:

1. To learn the concept of Management.
2. To understand role of Production Planning and Control in Industry.
3. To learn various material procurement policies.
4. To understand importance of quality control and various methods.
5. To interpret the role of Decision theory in Industry.

Course Outcomes:

After completing this course, the student will be able to

1. Explain various approaches for industrial management. Able to infer concept of management in human resource domain
2. Apply Philosophy of Production Planning and Control in Industry and control the activities in delivering the products in time
3. Determine the optimum requirement of inventory by developing the various quantitative models.
4. Develop various models or methods for ensuring the required quality of the products or processes.
5. Elaborate the role of Decision theory and apply various approaches under Uncertainty and Risk conditions

Unit-I

Management: Introduction to Management, Scientific Management, Systems approach to Management, MBO, and Decision-Making Process.

Personnel Management: Functions of personnel management, types of training, Job evaluation and Merit rating, Collective bargaining and labour participation in management.

Unit-II:

Production Planning & Control: Definition, Objectives, Importance and Functions of Production Planning & Control.

Production Control: Routing, Scheduling, Dispatching, Follow-up and progress Report.

Unit-III

Inventory Control: Importance of inventory control, types of inventory models Inventory costs deterministic inventory models Basic EOQ models, production model without shortages, Purchase model with instantaneous replenishment and with shortages production model with shortages Inventory model with price breaks, Fixed order quality system, periodic review system Inventory model with probabilistic demand.

Unit-IV

Quality Control: Concept of quality, evolution of quality control, assignable and chance causes of variation, Variable Control charts (X and R charts)

Attributes control charts: P chart and C chart

Acceptance Sampling – Single Sampling, Double Sampling and Multi sampling plans
– OC curves of single

Unit-V

Decision Theory: Introduction, Decision, Decision Making & Decision Theory, Types of Decisions, decision making process, Types of Decision making Environment:

Decision making under Uncertainty- Criterion of Optimism or Maximax, Criterion of Pessimism or Maximin, Minimax decision criteria

Decision making under Risk: Expected Monetary Value(EMV), Expected Opportunity Loss (EOL) Criterion & Expected Value of Perfect Information(EVPI) Criterion, Decision Trees.

Suggested Reading:

1. M. Mahajan, "Industrial Engineering and Production Management", Dhanpatrai & sons, New Delhi
2. S.K. Sharma and Savitasarma, "Industrial Engineering and Organization Management", SK Kataria & Sons, New Delhi.
3. S.D. Sharma, "Operations Research", Kedarnath, Ramnath & Co., Meerut, 2009
4. S Kalavathi, "Operations Research", Vikas Publishing House Pvt. Ltd, 2009
5. V. K. Kapoor, "Operations Research", S. Chand, New Delhi.
6. SK Sharma & Savita Sharma," A course in Industrial Engineering & Operations Management", S K Kataria & Sons, 2008

Code: PE712ME

**MODERN CONTROL ENGINEERING
(Professional Elective-III)**

Credits : 3

*Instruction: 3 periods per week
CIE: 30 marks*

*Duration of SEE: 3 hours
SEE: 70 marks*

Course Objectives:

1. To explain the concepts of basic and modern control system for the real time analysis and design of control systems.
2. To explain the concepts of state variables analysis.
3. To study and analyze nonlinear systems.

Course Outcomes

1. Various terms of basic and modern control system for the real time analysis and design of control systems.
2. To perform state variables analysis for any real time system.
3. Apply the concept of optimal control to any system.
4. Able to examine a system for its stability, controllability, and observability.
5. Implement basic principles and techniques in designing linear control systems.

Unit-I Mathematical Preliminaries and State Variable Analysis:

Fields, Vectors and Vector Spaces – Linear combinations and Bases – Linear Transformations and Matrices – Scalar Product and Norms – Eigen values, Eigen Vectors and a Canonical form representation of Linear systems – The concept of state – State space model of Dynamic systems – Time invariance and Linearity – Non uniqueness of state model – State diagrams for Continuous-Time State models – Existence and Uniqueness of Solutions to Continuous-Time State Equations – Solutions of Linear Time Invariant Continuous-Time State Equations – State transition matrix and its properties. Complete solution of state space model due to zero input and due to zero state.

Unit-II: Controllability and Observability:

General concept of controllability – Controllability tests, different state transformations such as diagonalization, Jordan canonical forms and Controllability canonical forms for Continuous-Time Invariant Systems – General concept of Observability – Observability tests for Continuous-Time Invariant Systems – Observability of different State transformation forms.

Unit-III: State Feedback Controllers and Observers:

State feedback controller design through Pole Assignment, using Ackerman's formula– State observers: Full order and Reduced order observers.

Unit-IV: Non-Linear Systems:

Introduction – Non-Linear Systems – Types of Non-Linearities – Saturation – Dead-Zone – Backlash – Jump Phenomenon etc; Linearization of nonlinear systems, Singular Points and its types– Describing function–describing function of different types of nonlinear elements, – Stability analysis of Non-Linear systems through describing functions. Introduction to phase-plane analysis, Method of Isoclines for Constructing Trajectories, Stability analysis of nonlinear systems based on phase-plane method.

Unit-V: Stability Analysis

Stability in the sense of Lyapunov, Lyapunov's stability, and Lyapunov's instability theorems – Stability Analysis of the Linear continuous time invariant systems by Lyapunov second method – Generation of Lyapunov functions – Variable gradient method – Krasoviski's method.

Suggested Reading:

1. Dorf, R.C., *Modern Control Systems*, Addison-Wesley 1989.
2. M. Gopal, *Control Systems*, Tata McGraw Hill, 2004.
3. Ogata, K., *Modern Control Engineering*, Prentice Hall, 2004.
4. Norman S. Nise, *Control Systems Engineering*, John Wiley & Sons, Inc., 2001.

Code: PE713ME

**BASICS OF ELECTRIC AND HYBRID VEHICLES
(Professional Elective-III)**

Credits: 3

Instruction: 3 periods per week

CIE: 30 marks

Duration of SEE: 3 hours

SEE: 70 marks

Objectives:

1. To present a comprehensive overview of Electric and Hybrid Electric Vehicles
2. To introduce the basic elements of Electric and Hybrid vehicles.
3. To understand the energy storage requirements in Electric and Hybrid vehicles.
4. To learn the energy management strategies.

Outcomes: Upon completion of this course the student will be able to

1. Choose a suitable drive scheme for developing an electric hybrid vehicle depending on resources
2. Design and develop basic schemes of electric vehicles and hybrid electric vehicles.
3. Choose proper energy storage systems for vehicle applications
4. Identify various communication protocols and technologies used in vehicle networks
5. Choose a suitable drive scheme for developing an electric hybrid vehicle depending on resources

Unit - I

Introduction to Hybrid Electric Vehicles: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies. Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, transmission characteristics, mathematical models to describe vehicle performance.

Unit - II

Hybrid Electric Drive-Trains: Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.

Electric Drive-Trains: Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis.

Unit - III

Electric Propulsion Unit: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration, and control of Induction Motor drives

Unit - IV

Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Hybridization of different energy storage devices.

Unit - V

Sizing The Drive System: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power, electronics, selecting the energy storage technology Communications, supporting subsystems: In vehicle networks- CAN, Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies.

Suggested Reading:

- 1 Iqbal Hussein, *“Electric and Hybrid Vehicles”*: Design Fundamentals, CRC Press, 2003
- 2 James Larminie, John Lowry, *“Electric Vehicle Technology Explained,”* Wiley, 2003.
- 3 Mehrdad Ehsani, YimiGao, Sebastian E. Gay, Ali Emadi, *“Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design”*, CRC Press, 2004

Code: PE721ME

**ADDITIVE MANUFACTURING TECHNOLOGY
(Professional Elective-IV)**

Credits: 3

*Instruction: 3 periods per week
CIE: 30 marks*

*Duration of SEE: 3 hours
SEE: 70 marks*

Course Objectives:

1. To understand the fundamental concepts of additive manufacturing, its advantages and limitations.
2. To know the working principle, advantages, disadvantages, and applications of liquid, solid and Powder based Technologies.
3. To know the various types of STL file errors and other data formats used in additive manufacturing Technology.
4. To know the features of various software's used in additive manufacturing.
5. To know diversified applications of additive manufacturing Technologies.

Course Outcomes:

On successful completion of this course, the student will be able to

1. Interpret the features of additive manufacturing and compare it with conventional methods.
2. Illustrate the working principle of liquid, solid and powder based additive manufacturing Technologies. additive manufacturing
Identify various types of errors in STL file and other data formats used additive manufacturing Technology.
3. Select suitable software used in additive manufacturing Technology.
4. Apply the knowledge of various additive manufacturing technologies for developing Innovative applications.

Unit-I

Introduction: Prototyping fundamentals: Need for time compression in product development, Historical development, Fundamentals of Rapid Prototyping, rapid prototyping process chain, Advantages and Limitations of rapid prototyping, rapid prototyping wheel, commonly used Terms, Classification of processes.

Unit-II:

Liquid-based Systems: Stereo Lithography Apparatus (SLA): Models and specifications, Process, working principle, photopolymers, photo polymerization, Layering technology, laser and laser scanning, Applications, Advantages and Disadvantages, Case studies. Polyjet: Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies

Solid-based System: Laminated Object Manufacturing (LOM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Fused Deposition Modeling (FDM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies.

Unit-III

Powder Based Systems: Working principle, Specifications, Materials used, Process, Applications, Advantages and Disadvantages, Case studies of the following Technologies like Selective laser sintering (SLS), Selective Laser Melting (SLM) and Direct Metal Laser

Sintering (DMLS), Laser Engineered Net Shaping (LENS), Electron Beam Melting (EBM).

Unit-IV

Data Formats & Software: STL Format, STL File Problems, Consequence of Building Valid and Invalid Tessellated Models, STL file Repairs, Newly Proposed Formats.

Software's Features: 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

Applications of Additive Manufacturing: Application in Design, Application in Engineering, Analysis and Planning, Aerospace Industry, Automotive Industry, Electronic Industry, Jewellery Industry, Coin Industry, GIS application, Arts and Architecture. RP Medical and Bioengineering Applications: Planning and simulation of complex surgery, Customized Implants & Prosthesis, Design and Production of Medical Devices, Forensic Science and Anthropology, Visualization of Biomolecules. Biopolymers, Packaging, Disaster Management, Entertainment and Sports industry.

Suggested Reading:

1. Chee Kai Chua and Kah Fai Leong, "*3D Printing and Additive Manufacturing Principles and Applications*" Fifth Edition, World scientific
2. Ian Gibson, David W Rosen, Brent Stucker, "*Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing*" Springer, Second Edition, 2010.
3. "*Rapid Prototyping & Engineering Applications*"- Frank W. Liou, 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/>

Code: PE722ME

**ROBOTIC ENGINEERING
(Professional Elective-IV)**

Credits: 3

*Instruction: 3 periods per week
CIE: 30 marks*

*Duration of SEE: 3 hours
SEE: 70 marks*

Course Objectives:

Students will understand

1. The configuration, work envelop and motion controls and applications
2. Familiarities with the kinematics of robots.
3. Robot end effectors and their design.
4. Familiarities with the dynamics of robots.
5. Robot Programming methods & Languages of robot.
6. Various Sensors and drives and their applications in robots

Course Outcomes:

At the end of the course, the students will be able to

1. Identify and classify various robot configurations with their workspaces, recognize and find suitable robot for a particular Industrial application considering their degrees of freedom, type of end effector and other Specifications.
2. Able to use rotation matrices and perform forward kinematic operations. Find Jacobean in velocity domain.
3. Able to perform inverse kinematics and convert a world space problem to joint space problem. Develop dynamical equations for control of robots.
4. Perform trajectory planning and implement independent joint control. Identify suitability of various control methods.
5. Interface various hardware and software components to develop robotic systems for industry & evaluate their performance

Unit-I

Brief History, Types of robots, Overview of robot subsystems, Robot Joints and its Links, Degrees of freedom of robots, Work space of Robots, accuracy, precision, resolution and repeatability, Robot classification: Based on kinematic configurations, control methods, workspace. Different types of Wrists used in industrial robots. Different types of Robot Drives. End effectors and Grippers, Mechanical, Electrical, vacuum and other methods of gripping.

Robots used in various Industrial operations like Material handling, Assembly, Inspection, Welding and Painting. Description and Specifications in each case.

Unit-II:

Rotation matrices, Representation of location and orientation. Euler angle and RPY representation, Homogeneous transformation matrices Denavit-Hartenberg notation, representation of Translation and rotation in terms of joint parameters, Forward kinematics. Velocity Kinematics and Jacobian in Velocity domain.

Unit-III

Inverse Kinematics, inverse location, inverse orientation, inverse velocity, Singular Configuration of robots, Static force analysis of RP type and RR type planar robots, Dynamic analysis using Lagrange and Newton-Euler formulations of RR and RP type planar robots.

Unit-IV

Trajectory Planning: Joint interpolation, task space interpolation, executing user specified tasks, Independent joint control, PD and PID feedback, actuator models, nonlinearity of manipulator models, Computed torque control, force control, hybrid control, neural network-based control of manipulator, fuzzy control of manipulator, CNN based control of manipulator.

Unit-V

Sensors: types of sensors, tactile & non tactile sensors, sensors to measure Position, velocity & acceleration, Optical encoders. Range and Proximity sensing, acoustic, pneumatic, Hall effect sensor, Eddy current sensors, Force and Torque sensors.

Vision: Image acquisition, types & components of vision system, Image representation, digitization, binary, gray scale, RGB representation, Image processing, Image segmentation, image smoothening, object descriptors, object recognition.

Suggested Reading:

1. Spong and Vidyasagar, "Robot Dynamics & Control", John Wiley and Sons, Ed.,1990
2. Mittal and Nagrath, "Industrial Robotics", Tata McGraw Hill Publications, 2004.
3. Saha & Subir Kumar Saha, 'Robotics', TMH, India.
4. Asada and Sllotine , 'Robot analysis and intelligence' BS Publications , India.
5. Fu. K.S., GonZalez R.C., Lee C.S.G. "Robotics, Control-sensing vision and Intelligence", McGraw Hill, Int. Ed., 1987.
6. Groover M.P., "Industrial Robotics", McGraw Hill Publications, 1999.
7. Robotics toolbox in MAT LAB.

Code: PE723ME

**COMPUTATIONAL FLUID DYNAMICS
(Professional Elective-IV)**

Credits: 3

*Instruction: 3 periods per week
CIE: 30 marks*

*Duration of SEE: 3 hours
SEE: 70 marks*

Course Objectives

1. To convert the conservation equations of fluid flow in differential form into algebraic equations and apply numerical methods to obtain solutions
2. To learn the finite difference method.
3. To learn finite volume method and solution methodology for fluid flow problems

Course Outcomes

1. Understand the concepts of turbulence and fluid dynamics
2. Determine and develop the partial differential equations for various conditions
3. Design the grid for different applications
4. Determine the finite difference solutions
5. Analyse the systems using finite volume method

UNIT-I

Review of basic equations of fluid dynamics: Continuity, Momentum and Energy equations, Navier Stokes equations, Reynolds and Favre averaged N – S equations. Differential equations for steady and unsteady state heat conduction. Differential equations for diffusion. Introduction to turbulence, Turbulence models-mixing length model, K- turbulence Model.

UNIT-II

Classification of PDEs – Elliptic, parabolic and hyperbolic equations. Initial and boundary value problems. Concepts of Finite difference methods – forward, backward and central difference. Errors, Consistency, Stability analysis by von Neumann. Convergence criteria.

UNIT-III

Grid Generation- Types of grid O,H,C. Coordinate transformation, algebraic methods. Unstructured grid generation.

UNIT-IV

Finite difference Solutions-Parabolic PDEs – Euler, Crank Nicholson, Implicit methods, Elliptic PDEs – Jacobi, Gauss Seidel, ADI, methods. FD- solution for Viscous incompressible flow using Stream function – Vorticity method & MAC method.

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. Use of Staggered grids SIMPLE Algorithm.

Suggested Reading:

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

Code: PW702ME

PROJECT-I
(Project Work-I)
Credits: 3

Instruction: 6 periods per week
CIE: 50 marks

Duration of SEE: --
SEE: 70 marks

Objectives:

1. To enhance practical and professional skills.
2. To familiarize tools and techniques of systematic literature survey and documentation
3. To expose the students to industry practices and team work.
4. To encourage students to work with innovative and entrepreneurial ideas

Outcomes:

1. Demonstrate the ability to synthesize and apply the knowledge and skills acquired in the academic program to the real-world problems.
2. Evaluate different solutions based on economic and technical feasibility
3. Effectively plan a project and confidently perform all aspects of project management
4. Demonstrate effective written and oral communication skills

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 3 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.

1. 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:

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

SCHEME OF INSTRUCTION & EXAMINATION
B.E. (Mechanical Engineering) VIII - SEMESTER
(Proposed for the Academic year 2021-2022)

S. No	Course Code	Course Title	Scheme of Instruction				Scheme of Examination			Credits
			L	T	P/D	Contact Hours/Week	CIE	SEE	Duration in	
Theory Course										
1	PE-V	Professional Elective-V	3	-	-	3	30	70	3	3
2	PE-VI	Professional Elective-VI	3	-	-	3	30	70	3	3
3	OE-III	Open Elective-III	3	-	-	3	30	70	3	3
Practical / Laboratory Course										
4	PW703ME	Project-II	-	-	16	16	50	150		8
Total										17

Professional Elective-V		
S. No.	Course Code	Course Title
1	PE811ME	Mechanical Vibrations
2	PE812ME	Composite Materials
3	PE813ME	Power Plant Engineering

Professional Elective-VI		
S. No.	Course Code	Course Title
1	PE821ME	Energy Conservation & Management
2	PE822ME	Non-Destructive Testing
3	PE823ME	Entrepreneurship Development

Open Elective - III		
1	OE801 CE	Road Safety Engineering (Not for Civil Engg. Students)
2	OE801CS	Fundamentals of AI & ML (Not for CSE & IT students)
3	OE801 EE	Smart Building Systems (Not for EEE & EIE Students)
4	OE802 EE	Programmable Logic Controllers (Not for EEE & EIE Students)
5	OE801EC	Principles of Electronic Communications (Not for ECE students)
6	OE801IT	Software Engineering (Not for IT Students)
7	OE801ME	3D Printing Technologies (Not for Mechanical and Production students)
8	OE801AE	Elements of Electrical and Hybrid Vehicle Technology

MC: Mandatory Course

CIE: Continuous Internal Evaluation

SEE: Semester End Examination (Univ. Exam)

BS: Basic Science

L: Lecture

P: Practical

ES: Engineering Science

T: Tutorial

D: Drawing

Note:

1. Each contact hour is a clock hour
2. The duration of the practical class is two hours, however it can be extended wherever

necessary, to enable the student to complete the experiment.

Introduction

The purpose of this experiment is to determine the effect of temperature on the rate of reaction between hydrogen peroxide and potassium iodide.

Objectives

To determine the effect of temperature on the rate of reaction between hydrogen peroxide and potassium iodide.

To determine the effect of temperature on the rate of reaction between hydrogen peroxide and potassium iodide.

To determine the effect of temperature on the rate of reaction between hydrogen peroxide and potassium iodide.

Apparatus

1. Conical flask

2. Measuring cylinder

3. Stopwatch

4. Thermometer

Procedure

1. Preparation of standard solution of potassium iodide

2. Preparation of standard solution of hydrogen peroxide

3. Preparation of standard solution of sodium acetate

4. Preparation of standard solution of sodium sulphate

5. Preparation of standard solution of sodium chloride

6. Preparation of standard solution of sodium bromide

7. Preparation of standard solution of sodium nitrate

8. Preparation of standard solution of sodium carbonate

9. Preparation of standard solution of sodium bicarbonate

10. Preparation of standard solution of sodium phosphate

11. Preparation of standard solution of sodium sulphate

12. Preparation of standard solution of sodium chloride

13. Preparation of standard solution of sodium bromide

14. Preparation of standard solution of sodium nitrate

15. Preparation of standard solution of sodium carbonate

16. Preparation of standard solution of sodium bicarbonate

17. Preparation of standard solution of sodium phosphate

18. Preparation of standard solution of sodium sulphate

19. Preparation of standard solution of sodium chloride

**MECHANICAL VIBRATIONS
(Professional Elective-V)**

Credits :3

Instruction: 3 periods per week
CIE:30marks

Duration of SEE: 3 hours
SEE: 70marks

Objectives:

Student has to understand the

1. Explain the concept of vibrations, with single degree of freedom systems
2. Discuss the numerical methods involved in vibrations
3. Demonstrate the concept of Transient vibrations

Outcomes:

At the end of the course, the students will be able to

1. Find the Natural frequencies of SDOF Systems.
2. Draw the mode shapes.
3. Solve the MDOF Systems
4. Do the Model analysis.
5. Apply the numerical methods to vibration Problems.

Unit-I

Free Vibration of Single Degree of Freedom Systems: Introduction, causes and effects of vibration. Free Vibration of an Undamped Translational System, Equation of Motion using Newton's second law of motion, Equation of motion using other methods, Equation of motion of a spring, mass system in vertical position, solution, Harmonic Motion Free Vibration of an Undamped Torsional System - Equation of motion. Free Vibration with Viscous Damping - Equation of motion.

Unit-II:

Forced Vibration of Single Degree of Freedom Systems: Introduction, Beating Phenomenon. Response of a Damped system under the Harmonic Motion of the base, Force Transmitted, Relative Motion.

Unit-III

Two Degree of Freedom Systems: Introduction, Equations of Motion for forced Vibration, Free Vibration Analysis of an undamped system, Torsional system, Coordinate Coupling and Principal Coordinates, forced Vibration Analysis, Semidefinite Systems.

Unit-IV

Multi-degree of Freedom Systems: Introduction Modeling of Continuous systems as Multi-degree of Freedom systems. Equations of motion, Influence Coefficients. Potential and kinetic energy expressions in matrix form, Generalized coordinates and generalized forces, Using Lagrange's equation to derive equations of motion, Equations of motion of undamped systems in matrix form, Eigenvalue problem, solution of the Eigenvalue problems - solution of the characteristic equation, orthogonality of normal modes.

Unit-V

Determination of Natural Frequencies and Mode Shapes: Introduction, Dunkerley's formula, Rayleigh's Method - Properties of Rayleigh's Quotient, Computation of the Fundamental Natural Frequency, Fundamental Frequency of Beams and Shafts. Holzer's

Method-Torsional systems, Spring Mass Systems. Jacobi method, Standard Eigen value Problems.

Suggested Reading:

1. W T Thomson, "Theory of Vibrations with Applications", CBS Publishers
2. S S Rao, "Mechanical Vibrations", Addison-Wesley Publishing Co.
3. Leonard Meirovitch, "Fundamentals of Vibration", McGraw Hill International Edison.
4. J P Den Hartog, "Mechanical Vibrations", McGraw Hill.
5. Srinivasan, "Mechanical Vibration Analysis", McGraw Hill.
6. Nuno Manuel Mendes Maia et al, "Theoretical and Experimental Modal Analysis", Wiley John & sons, 1999

Code: PE812ME

**COMPOSITE MATERIALS
(Professional Elective-V)**

Credits :3

Instruction: 3 periods per week
CIE:30marks

Duration of SEE: 3 hours
SEE: 70marks

Objectives

Student has to understand the

1. Understand the basic structure of composites
2. Manufacturing processes involved in composites
3. Hygro-thermal stresses in composites
4. Behavior and design of composites

Outcomes

At the end of the course, the students will be able to

1. Demonstrate the knowledge of composites and their structures
2. Demonstrate the manufacturing processes involved in composites
3. Analyse and predict the stress and strain relationship in composites.
4. Summarize and apply the design procedures and failure criteria of composites
5. Apply the testing procedures of composites

UNIT-I

Introduction: Fibres, Matrix materials, interfaces, polymer matrix composites, metal matrix composites, ceramic matrix composite, carbon fibre composites, Applications of composites.

UNIT-II

Fabrication processes, open mould processes, hand lay-up composites, spray up composites, prepegging processes, autoclave moulding, sheet moulding compound (SMC), Resin transfer moulding, thermo plastic moulding, Filament winding process, pultrusion process.

UNIT-III

Micromechanics of Composites: Mechanical Properties: Prediction of Elastic constant, micromechanical approach, Halpin-Tsai equations, Transverse stresses. Thermal properties: Hygrothermal stresses, mechanics of load transfer from matrix to fibre.

UNIT-IV

Macromechanics of Composites: Elastic constants of a lamina relations between engineering constants and reduced stiffness and compliances, variation of lamina properties with orientation, analysis of laminated composites, stresses and strains with orientation, inter-laminar stresses and edge effects, Simplified composite beam solutions. Bending of laminated beams.

UNIT-V

Design of composites - Maximum stress theory, maximum strain criteria, Tsai-hill, Tsai-wu criteria, fracture modes in composites.

Testing of composites - Measurement of constituent material properties - fibre test and resin matrix test. Measurement of basic composite properties - Tensile test, compressive test, in-plane shear test, interlaminar shear test, flexural test

Suggested Readings:

1. Jones, R.M., 'Mechanics of Composite Materials', Mc-Graw Hill Co., 1967.
2. Calcote, L.R., 'The Analysis of Laminated Composite Structures', Van Nostrand, 1969.
3. Whitney, I.M., - Daniel, R.B. Pipes, 'Experimental Mechanics of fibre Reinforced Composite Materials', Prentice Hall, 1984.
4. Hyer, M.W., 'Stress Analysis of Fibre-Reinforced Composite Materials', McGraw Hill Co., 1998.
5. Carl.T. Herakovich, 'Mechanics of Fibrous Composites', John Wiley Sons Inc., 1998.

Code: PE813ME

POWER PLANT ENGINEERING
(Professional Elective-V)

Credits :3

Instruction: 3 periods per week
CIE:30marks

Duration of SEE: 3 hours
SEE: 70marks

Objectives:

Student has to understand the

1. Operation of steam turbine and gas turbine power plants
2. About hydraulic power plant, hydrology, dams and spillways
3. Various types of nuclear power plants including Pressurized water reactor, Boiling water reactor, Liquid metal fast breeder reactor and Gas cooled reactor
4. The power plant economics
5. The environmental and safety aspects of power plant operation.

Outcomes:

At the end of the course, the students will be able to demonstrate

1. Select coal and ash handling methods for a coal fired power plant.
2. Comprehend basic working principle of steam and gas turbine power plant
3. Classify Dams and Spillways.
4. Demonstrate the basic principles of thermal-fission and fast-breeder nuclear power plants, such as pressurized-water, boiling-water, and heavy-water reactors.
5. Analyze load factor, capacity factor, average load and peak load on a power plant.
6. Illustrate the control methods of major pollutant emitted from fossil-fuel power plants.

Unit-I

Introduction to Sources of Energy-Resources and Development of Power in India.
Steam Power Plant: Plant layout, working of different Circuits, Fuel and handling equipment, types of coal, coal handling, choice of handling equipment, coal storage, ash handling systems.

Unit-II:

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.

Gas Turbine Power Plant: Introduction -Classification-Layout with Auxiliaries-Principles of working of closed and open cycle gas turbines

Unit-III

Hydro Electric Power Plant: Water Power-Hydrological cycle, flow measurement-drainage area Characteristics-Hydrographs-storage and pondage-classification of dams and spillways

Unit-IV

Nuclear Power Station: Nuclear fuel-breeding and fertile materials - Nuclear reactor - reactor
Operation - 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
offixed charges, operating costs, general arrangement of power distribution, Load
curves, average load and load factor, delivery factor - related exercises Effluents from
power plants and impact on environment - Pollutants and Pollution Standards - Methods
of pollution control

Suggested Reading:

1. Rajput, RK, *A Text Book of Power Plant Engineering*, 3rd Edition. Laxmi Publications, New Delhi.
2. Arora SC, Domkundwar S, *A Course in Power Plant Engineering*, Dhanpat Rai & Sons, New Delhi.
3. Yadav R, *Steam & Gas Turbines and Power Plant Engineering*, 7th Edition, Central Publishing House, Allahabad, 2007.
4. Nag PK, *Power Plant Engineering*, 2nd Edition, Tata McGraw Hills Co. Ltd, New Delhi, 2002.
5. Wakil MM, *Power Plant Technology*, McGraw Hill Publications, New York, 2005.

Code: PE821ME

**ENERGY CONSERVATION AND MANAGEMENT
(Professional Elective-VI)**

Credits :3

Instruction: 3 periods per week
CIE:30 marks

Duration of SEE: 3 hours
SEE: 70 marks

Objectives:

1. To learn about energy conservation.
2. To understand sources of loss of power in energy conversion.
3. To understand Procedure for Comprehensive Energy Conservation Planning.
4. To understand Industrial energy conservation methods.

Outcomes:

On successful completion of this course, the student will be able to

1. Understand different forms of energy.
2. Calculate the amount of heat energy available.
3. Understand the industry energy conservation modeling.
4. Understand methodology for forecasting industrial energy supply and demand.

Unit-I

Definition, Principles of Energy Conservation - Maximum Thermodynamic efficiency. Maximum Cost-effectiveness in energy use. Various forms of energy-Heat Mechanical. Electrical energy and Chemical energy. Identification of potential sources of energy losses-Transportation, operation and conversion from one form to another.

Unit-II:

Heat energy and storage-Media of transport of heat energy-steam, oil and flue gases. Calculation of steam quality. Calculation of amount of heat energy available. Recuperators. Constructional details, Selection of material to store heat energy. Concept of power. Modes of mechanical energy transport-Gears, pulleys, belts, shaft etc., Calculation of power. Sources of loss of power in energy conversion into electricity, potential energy (i.e., pumps).

Unit-III

Chemical energy-combustion of fuels-petrol, diesel and coal. Loss due to quality of fuel, conversion into other form of energy-boilers, I.C. engines. Calculation related to losses. Electrical energy-Working principle of motors and generators. Calculation of efficiency of generators. Losses during transmission and energy conversion - into mechanical energy, thermal energy. Calculation of effecting parameters.

Unit-IV

Procedure for Comprehensive Energy Conservation Planning (CECP) -Specifying targets, identifying energy in-efficient facilities. Synthesize evaluation and optimization of alternative conservation measures in view of organization costs. Flow chart of organization's functions. Collection of accountable data. Application of CECP method. An example.

Unit-V

Industrial energy conservation modeling-Methodology-Definition of production system-Primary copper production system, Model construction-Mathematical Programming.

Market penetration, Structure of energy conservation model. Data preparation - coefficients needed in a model, Unit production cost and unit energy requirements. Model exercise, verification and validation. Methodology for forecasting Industrial Energy Supply and Demand.

Suggested Reading:

1. Gottschalk C.M., "*Industrial Energy Conservation*", John Wiley & Sons, 1996.
2. Chaturvedi P., and Joshi S., "*Strategy for Energy Conservation in India*", Concept Publishing Co., New Delhi, 1997.
3. Sharna and Venkata Sebhaiah, "*Energy management and conservation*".
4. Dr. Sanjeev Singh, Umesh Rathore, "*Energy management*", Edition 2019.
5. Mrs. P. Nagaveni, Dr. A. Amudha, Dr. M. Sivaram Kumar and Mr. N. Prasanna, "*Energy management and Energy conservation*".

Code: PE822ME

**NON-DESTRUCTIVE TESTING
(Professional Elective-VI)**
Credits :3

Instruction: 3 periods per week
CIE:30marks

Duration of SEE: 3 hours
SEE: 70marks

Objectives:

Student has to understand the

1. Need, basic concepts and technologies of Non-Destructive Testing(NDT)
2. Security precautions from Radiography, protection from radiation and measurement of radiation received by personnel.
3. Technology of acoustic emission(AE), the associated instrumentation and applications
4. Technologies like neutron radiography; laser induced ultrasonics, surface analysis and thermography
5. Merits and demerits of the different NDT Technologies
6. Latest research and developments in NDT

Outcomes:

1. The knowledge of different NDT techniques.
2. Clear understanding of liquid penetrate inspection and magnetic particle inspection.
3. The basics of Eddy Current Testing.
4. View and interpret radiographs, utilize the various principles of radiography for different components of different shapes
5. The knowledge of acoustic emission for NDT and the instrumentation used for NDT
6. The knowledge of latest research, developments and trends in NDT

Unit-I

Liquid Penetrate inspection: Principle of penetrate inspection, characteristics of a penetrate, water washable system, post emulsification system, solvent removable system, surface preparation and cleaning, penetrate application, development, advantages, limitations, and applications.

Magnetic Particle Inspection: Principle, magnetization methods, continuous and residual methods, sensitivities, demagnetization, Advantages, Limitations, and Applications.

Unit-II:

Eddy Current Testing: Principle, lift-off factor, and edge effect, skin effect, inspection frequency, coil arrangements, inspection probes, types of circuits, reference pieces, phase analysis, display methods and applications

Unit-III

Ultrasonic Testing: Generation of ultrasound, 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 and calibration. Reference standards, surface conditions, applications

Unit-IV

Radiography: Principle and uses of radiography, limitation principle, radiation sources, production of X-rays, X-ray spectra, attenuation of radiation, shadow formation enlargement and distortion, radiographic film and paper, inspection of simple and complex shapes, radiation hazard, protection against radiation.

Unit-V

Acoustic Emission: physical principles, sources of emission, instrumentation and applications.

Other NDT Techniques: Neutron radiography, laser induced ultrasonics, surface analysis, and thermography.

Suggested Reading:

1. Barry Hull & Vernon John, '*Non-Destructive Testing*', 1988.
2. Non-Destructive examination and quality control, ASM International, Vol.17, 9th edition 1989
3. J. Prasad and C.G.K. Nair, Non-Destructive Test and evaluation of materials, Tata McGraw-Hill Education, 2nd edition 2011
4. B.Raj, T.Jayakumar and M.Thavasimuth, Practical Non-Destructive Testing, Alpha Science International Limited, 3rd edition 2002
5. T.Rangachari, J.Prasad and B.N.S.Murthy, Treatise on Non-Destructive Testing and Evaluation, Navbharath enterprises, Vol.3, 1983.

Code: PE823ME

**ENTREPRENEURSHIP DEVELOPMENT
(Professional Elective-VI)**

Credits :3

Instruction: 3 periods per week
CIE:30marks

Duration of SEE: 3 hours
SEE: 70marks

Objectives:

1. To motivate students to take up entrepreneurship in future.
2. To learn nuances of starting an enterprise & project management.
3. To understand the design principles of solar energy systems, their utilization and performance evaluation.
4. To understand the behavioral aspects of entrepreneurs and time management.

Outcomes:

1. Understand Indian Industrial Environment, Entrepreneurship and Economic growth, Small and Large Scale Industries, Types and forms of enterprises.
2. Identify the characteristics of entrepreneurs, Emergence of first generation entrepreneurs, Conception and evaluation of ideas and their sources.
3. Practice the principles of project formulation, Analysis of market demand, Financial and profitability analysis and Technical analysis.
4. Apply the concepts of Project Management during construction phase, project organization, project planning and control using CPM, PERT techniques.
5. Understand the behavioural aspects of entrepreneurs, Time Management, Various approaches of time management, their strengths and weakness. The urgency addition and time management matrix.

Unit-I

Indian Industrial Environment-competence, Opportunities and Challenges. Entrepreneurship and Economic growth. Small Scale Industry in India, Objectives, Linkage among small, medium and heavy industries. Types of enterprises.

Unit-II:

Identification and characteristics of entrepreneurs. Emergence of First generation entrepreneurs, environmental influence and women entrepreneurs. Conception and evaluation of ideas and their sources. Choice of Technology-Collaborative interaction for Technology development.

Unit-III

Project formulation, Analysis of market demand, Financial and profitability analysis and Technical analysis, project financing in India.

Unit-IV

Project Management during construction phase, project organization, project planning and control using CPM, PERT techniques. Human aspects of project management. Assessment of tax burden.

Unit-V

Behavioural aspects of entrepreneurs: Personality - determinants, attributes and models. Leadership concepts and models. Values and attitudes. Motivation aspects. Change behaviour. Time Management: Various approaches of time management, their strengths

and weaknesses. The urgency addiction and time management matrix.

Suggested Reading:

1. Vasant Desai, "Dynamics of Entrepreneurial Development and Management", Himalaya Publishing House, 1997.
2. Prasanna Chandra, "Project-Planning, Analysis, Selection, Implementation and Review", Tata McGraw-Hill Publishing Company Ltd. 1995.
3. Stephen R. Covey and A. Roger Merrill, "First Things First", Simon and Schuster Publication, 1994.
4. G.S. Sudha, "Organizational Behaviour", 1996.
5. Robert D. Hisrich, Michael P. Peters, "Entrepreneurship", Tata McGraw Hill Publishing Company Ltd., 5th Ed., 2005.

Faculty of Engineering, O.U. AICTE Model Curriculum with effect from Academic

Course Code	Course Title				Core/Elective		
OE801 CE	ROAD SAFETY ENGINEERING				Open Elective-III		
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives:

- Introduction to various factors considered for road safety and management
- Explain the road safety appurtenances and design elements
- Discuss the various traffic management techniques

Course Outcomes:

After completing this course, the student will be able to

1. Understand the fundamentals of traffic safety analysis
2. Analyze Accident data
3. Remember the concepts of road safety in urban transport
4. Apply crash reduction techniques
5. Design of urban Infrastructure considering safety aspects.

UNIT - I

Introduction:

Road Safety scenario in India and World, Road Accident Characteristics.

Traffic Safety Analysis: Fundamentals of Traffic Engineering - Basic Characteristics of Motor-Vehicle Traffic, Highway Capacity, Applications of Traffic Control Devices, Design of Parking Facilities, Traffic Engineering Studies; Statistical Methods in Traffic Safety Analysis - Regression Methods, Poisson Distribution, Chi-Squared Distribution, Statistical Comparisons.

UNIT - II

Accident Analysis: Accident Investigations and Risk Management, Collection and Analysis of Accident Data, Condition and Collision Diagram, Causes and Remedies, Traffic Management Measures and Their Influence on Accident Prevention, Assessment of Road Safety, Methods to Identify and Prioritize Hazardous Locations and Elements, Determine Possible Causes of Crashes, Crash Reduction Capabilities and Countermeasures, Effectiveness of Safety Design Features, Accident Reconstruction. Application of computer analysis of accident data.

UNIT - III

Road Safety in planning and Geometric Design: Vehicle and Human Characteristics, Road Design and Road Equipment's, Redesigning Junctions, Cross Section Improvements, Reconstruction and Rehabilitation of Roads, Road Maintenance, Traffic Control, Vehicle Design and Protective Devices, Post Accident Care.

UNIT - IV

Faculty of Engineering, O.U. AICTE Model Curriculum with effect from Academic Year 2019-20
Traffic Signals & Road Signs: Traffic Signals, Factors affecting signal design, street lighting, Provisions for NMT Vehicles in India, Safety Provisions for Pedestrians & Cyclists, Road Signs and Pavement Markings.
Safety at Construction Site: Safety provisions for workers at construction site, Construction Zone markings, signs.

UNIT - V

Traffic Management safety audit: Traffic Management Systems for Safety, Road Safety Audits and Tools for Safety Management Systems, Road Safety Audit Process, Approach to Safety, Road Safety Improvement Strategies, ITS and Safety.

Suggested Readings:

1. Kadiyali L.R.,
Traffic Engineering and Transport planning, 9th Edition, Khanna Tech Publishers, 2013.
2. C.E.G. Justo, A. Veeraragavan and S. K. Khanna, *Highway Engineering*, 10th Edition, Nem Chand Publishers, 2017.
3. Donald Drew, *Traffic Flow Theory Chapter 14 in Differential Equation Models*, Springer, 1983
4. C. Jotinkhisty and B. Kent Lall, *Transportation Engineering - An Introduction*, 3rd Edition, Pearson publications, 2017
5. Rune Elvik, Alena Høy, Truls Vaa, Michael Sørensen, *Handbook of Road Safety measures*, second Edition, Emerald Publishing, 2009.
6. Highway Research Programme (NCHRP) Synthesis 336.A
synthesis of Highway Research Board, Washington D.C, 2016.

Faculty of Engineering, O.U. AICTE Model Curriculum with effect from Academic

Course Code	Course Title					Core/Elective	
OE801CS	FUNDAMENTALS OF ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING					Open Elective-III	
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives:

- Cover various paradigms that come under the broad umbrella of AI.
- To understand various key paradigms for machine learning approaches
- To familiarize with the mathematical and statistical techniques used in machine learning.
- To understand and differentiate among various machine learning techniques

Course Outcomes:

After completing this course, the student will be able to

1. Develop an understanding of modern concepts in AI and where they can be used
2. Design, implement and apply novel AI techniques based on emerging real-world requirements
3. To formulate a machine learning problem
4. Select an appropriate pattern analysis tool for analyzing data in a given feature space.
5. Apply pattern recognition and machine learning techniques such as classification and feature selection to practical applications and detect patterns in the data.
6. Design and program efficient algorithms related to recent machine learning techniques, train models, conduct experiments, and develop real-world ML-based applications and products

UNIT-I:

INTRODUCTION: Definitions of Artificial Intelligence, Artificial Intelligence Problems, Topics of Artificial Intelligence, Timelines of Artificial Intelligence, Production Systems, State Space Representation, Branches of Artificial Intelligence, Applications of Artificial Intelligence,

UNIT-II:

HEURISTIC SEARCH TECHNIQUES: Generate-and-Test , Hill Climbing, Search Techniques, Problem Reduction, Constraints Satisfaction, Means-ends Analysis

KNOWLEDGE REPRESENTATION: Knowledge Management, Types of Knowledge, Knowledge Representation, Approaches to Knowledge Representation, Issues in Knowledge Representation, Knowledge Base

UNIT-III:

LEARNING: Types of Learning, Machine Learning, Intelligent Agents

CLUSTERING: k-Means Clustering, Fuzzy Clustering, Hierarchical Clustering, Cluster Similarity, Case Studies,

UNIT-IV:

Faculty of Engineering, O.U. AICTE Model Curriculum with effect from Academic

STATISTICAL LEARNING: Hidden Markov Models, Linear Classifiers, Quadratic Classifiers, Decision Trees, Bayesian Networks, Case Studies,

ARTIFICIAL NEURAL NETS: ANN Basics, ANN—Learning Process, Types of Networks, Perceptron, RBF Networks, ANN Summary, Case Studies

UNIT-V:

SUPERVISED LEARNING: Support Vector Machines, Inductive Logic Programming, Case-based Reasoning, Ensemble Classifiers, Nearest Neighbourhood, Fuzzy Network, Case Studies,

UNSUPERVISED LEARNING: Expectation Maximization, Self organizing maps, Adaptive resonance theory, Case studies

Suggested Readings:

1. Vinod Chandra S.S and Anand Hareendran S , "Artificial Intelligence and Machine Learning ", PHI , 2014
2. Prashant Kikani, "Demystifying Artificial intelligence: Simplified AI and Machine Learning concepts for Everyone", January 2021, BPB publication
3. Dr. Nilakshi Jain , "Artificial Intelligence, As per AICTE: Making a System Intelligent" January 2019, WILEY India
4. Lavika Goel , "Artificial Intelligence: Concepts and Applications" January 2021, WILEY India

Faculty of Engineering, O.U. AICTE Model Curriculum with effect from Acade

Course Code	Course Title				Core / Elective		
OE801EE	SMART BUILDING SYSTEMS				OE -III		
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
	3	-		-	30	70	3
Course Objectives: <ul style="list-style-type: none"> To understand the basic blocks of Building Management System. To design various sub systems (or modular system) of building automation To integrate all the sub systems Course Outcomes: Student will be able to <ul style="list-style-type: none"> Describe the basic blocks and systems for building automation Use different subsystems for building automation and integrate them Understand basic blocks and systems for building automation Design different systems for building automation and integrate those systems 							

UNIT - I

Introduction: Concept and application of Building Management System (BMS) and Automation, requirements and design considerations and its effect on functional efficiency of building automation system, architecture and components of BMS.

UNIT - II

Fire Alarm (FA) System: concept of fire, Fire modes, History, Components, and Principles of Operation. Different fire sensors, smoke detectors and their types, Fire control panels, design considerations for the FA system. Field Components, Panel Components, Applications. Types of FAS Architectures, Examples. Classification of FAS loops, Examples. FAS Design procedure in brief, NFPA 72A, BS 5839, IS, Concept of IP enabled fire & alarm system, design aspects and components of PA system.

UNIT - III

Access Control System: Access Components, Access control system Design.
CCTV: Camera Operation & types, Camera Selection Criteria, Camera Applications, DVR Based system, DVM, Network design, Storage design. Components of CCTV system like cameras, types of lenses, typical types of cables, controlling system. CCTV Applications.

UNIT - IV

Security Systems Fundamentals: Introduction to Security Systems, Concepts.
Perimeter Intrusion: Concept, Components, Technology, Advanced Applications. Security system design for verticals. concept of automation in access control system for safety, Physical security system with components, RFID enabled access control with components, Computer system access control -DAC, MAC, RBAC.

EPBX System & BMS subsystem integration: Design consideration of EPBX system and its components, integration of all the above systems to design BMS.

UNIT - V

Energy Management: Energy Savings concept & methods, Lighting control, Building Efficiency improvement, Green Building (LEED) Concept & Examples.

Building Management System: IBMS (HVAC, Fire & Security) project cycle, Project steps BMS, Advantages & Applications of BMS, IBMS Architecture, Normal & Emergency operation, Advantages of BMS.

Faculty of Engineering, O.U. AICTE Model Curriculum with effect from Acade

Suggested Readings:

1. Jim Sinopoli, *Smart Buildings*, Butterworth-Heinemann imprint of Elsevier, 2nd ed., 2010.
2. Reinhold A. Carlson, Robert A. Di Giandomenico, *Understanding Building Automation Systems (Direct Digital Control, Energy Management, Life Safety, Security, Access Control, Lighting, Building Management Programs)*, R.S. Means Company Publishing, 1991.
3. Albert Ting-Pat So, WaiLok Chan, Kluwer, *Intelligent Building Systems*, Academic publisher, 3rd ed., 2012.
4. Robert Gagnon, *Design of Special Hazards and Fire Alarm Systems*, Thomson Delmar Learning; 2nd edition, 2007.
5. Levenhagen, John I. Spethmann, Donald H, *HVAC Controls and Systems*, McGraw-Hill Pub.
6. Hordeski, Michael F, *HVAC Control in the New Millennium*, Fairmont press, 2001.
7. Bela G. Liptak, *Process Control-Instrument Engineers Handbook*, Chilton book co.

Course Code	Course Title						Core/Elective
OE 802EE	PROGRAMMABLE LOGIC CONTROLLERS						Open Elective-III
Prerequisite	Contact Hours per Week				CIE	SEE	
-	L	T	D	P	30	70	3
Course Objectives <ul style="list-style-type: none"> To be able to understand basics of Programmable logic controllers, basic programming of PLC. To make the student to understand the Functions and applications of PLC Course Outcomes At the end of the course students will be able to <ol style="list-style-type: none"> Develop PLC programs for industrial applications. Acquire the knowledge of PLC counter functions and PLC Arithmetic functions and data handling functions. 							

UNIT-I

PLC Basics: Definition and History of PLC - PLC advantages and disadvantages - Over all PLC Systems - CPU and Programmer Monitors - PLC input and output models - Printing PLC Information- Programming Procedures - Programming Equipment - Programming Formats- Proper Construction of PLC Diagrams - Devices to which PLC input and output modules are connected - Input on/off switching devices - Input analog devices - Output analog/off devices and output analog devices.

UNIT-II

Basic PLC Programming: Programming on/off inputs to produce on/off outputs - PLC input instructions - Outputs - Operational procedures - Contact and coil input/output programming examples - Relation of digital gate logic contact / coil logic - PLC programming and conversion examples - Creating ladder diagrams from process control descriptions- Sequencer listings- Large process ladder diagram constructions.

UNIT-III

Basic PLC Functions: General Characteristics of Registers - Module addressing - Holding registers - Input registers - output registers - PLC timer functions - examples of timer functions. Industrial applications - PLC counter functions.

UNIT-IV

Intermediate Functions: PLC Arithmetic functions - PLC additions and subtractions - The PLC repetitive clock - PLC Multiplications, Division and Square Root - PLC trigonometric and log functions - Other PLC arithmetic functions - PLC number comparison functions. PLC basic

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comparison functions and applications - Numbering systems and number
conversion functions - PLC conversion between decimal and BCD-
Hexadecimals numbering systems.

UNIT-V

Data Handling Functions: The PLC skip and master control relay
functions - Jump functions - Jump with nonreturn - Jump with return. PLC
data move Systems - The PLC functions and applications. PLC functions
working with bits-PLC digital bit functions and applications-
PLC sequence functions-PLC matrix functions.

Suggested Reading:

1. John W. Weff, Ronald A. Reis, Programmable Logic Controllers, Prentice
Hall of India Private Limited, Fifth edition, 2003.
2. Frank D. Petruzella, Programmable Logic Controllers, 5th Edition, Mc-
Graw Hill, 2019.

Course Code	Course Title					Core / Elective	
OE 801 EC	PRINCIPLES OF ELECTRONIC COMMUNICATIONS					Open Elective-III	
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3
Course Objectives							
<ul style="list-style-type: none"> • Provide an introduction to fundamental concepts in the understanding of communication systems. • Provide an introduction to network model and some of the network layers including physical layer, data link layer, network layer and transport layer. • Provide an introduction to the evolution of wireless systems and current wireless technologies. 							
Course Outcomes							
<ol style="list-style-type: none"> 1. Understand the working of analog and digital communication systems 2. Understand the OSI network model and the working of data transmission 3. Understand the evolution of communication technologies from traditional telephony systems to modern wireless communication systems. 							

UNIT - I

Introduction to communication systems: Electromagnetic Frequency Spectrum, Signal and its representation, Elements of Electronic Communications System, Types of Communication Channels.

Signal Transmission Concepts: Baseband transmission and Broadband transmission,

Communication Parameters: Transmitted power, Channel bandwidth and Noise, Need for modulation **Signal Radiation and Propagation:** Principle of electromagnetic radiation, Types of Antennas, Antenna Parameters and Mechanisms of Propagation.

UNIT - II

Analog and Digital Communications: Amplitude modulation and demodulation, FM modulation and demodulation, Digital converters, Digital modulation schemes - ASK, FSK, PSK, QPSK, Digital demodulation.

UNIT - III

Data Communication and Networking: Network Models, OSI Model, Data Link Layer - Media Access control, Ethernet, Network Layer - Internet Protocol (IPv4/IPv6), Transport Layer - TCP, UDP.

UNIT - IV

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Telecommunication Systems: Telephones, Telephone system, Paging systems, Internet Telephony.

Optical Communications: Optical Principles, Optical Communication Systems, Fiber -Optic Cables, Optical Transmitters & Receivers, Wavelength Division Multiplexing.

UNIT - V

Wireless Communications: Evolution of Wireless Systems: AMPS, GSM, CDMA, WCDMA, OFDM. Current Wireless Technologies: Wireless LAN, Bluetooth, PAN and ZigBee, Infrared wireless, RFID communication, UWB, Wireless mesh networks, Vehicular adhoc networks.

Suggested Readings:

1. *Principles of Electronic Communication Systems*, Louis E. Frenzel, 3e, McGraw Hill, 2008.
2. *Data Communications and Networking*, Behrouz A. Forouzan, 5e TMH, 2012.
3. Kennady, Davis, *Electronic Communications systems*, 4e, McGraw Hill, 1999.

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Course Code	Course Title					Core/Elective	
OE 801 IT	SOFTWARE ENGINEERING					Open Elective- III	
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	3 0	7 0	3

Course Objectives:

- To introduce the basic concepts of software development processes from defining a product to shipping and maintaining.
- To impart knowledge on various phases, methodologies and practices of software development.
- To understand the importance of testing in software development, study various testing strategies along with its relationship with software quality and metrics.

Course Outcomes:

After completing this course, the student will be able to

1. Acquired working knowledge of alternative approaches and techniques for each phase of software development
2. Judge an appropriate process model(s) assessing software project attributes and analyze necessary requirements for project development eventually composing SRS.
3. Creation of visual model to describe (non-) algorithmic solutions for projects using various design principles.
4. Acquires skills necessary as an independent or as part of a team for architecting a complete software project by identifying solutions for recurring problems exerting knowledge on patterns.

UNIT - I

Introduction to Software Engineering:

A generic view of Process: Software Engineering, Process Framework, CMM Process Patterns, Process Assessment.

Process Models: Prescriptive Models, Waterfall Model, Incremental Process Models, Evolutionary Process Models, Specialized Process Models, The Unified Models, Personal and Team Process Models, Process Technology, Product and Process.

An Agile view of Process: Introduction to Agility and Agile Process, Agile Process Models

UNIT - II

Software Engineering Principles: SE Principles, Communication Principles, Planning Principles, Modeling Principles, Construction Principles, Deployment.

System Engineering: Computer-based Systems, The System Engineering Hierarchy, Business Process Engineering, Product Engineering,

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Requirements Engineering: A Bridge to Design and Construction, Requirements Engineering Tasks, Initiating Requirements Engineering Process, Eliciting Requirements, Developing Use-Cases, Building the Analysis Model, Negotiating Requirements, Validating Requirements.

UNIT - III

Building the Analysis Model: Requirements Analysis Modeling Approaches, Data Modeling Concepts, Object-Oriented Analysis, Scenario-based Modeling, Flow-oriented Modeling, Class-based Modeling, Creating a Behavioral Model.

Design Engineering: Design within the context of SE, Design Process and Design Quality, Design Concepts, The Design Model, Pattern-based Software Design.

UNIT- IV

Creating an Architectural Design: Software Architecture, Data Design, Architectural Styles and Patterns, Architectural Design. **Modeling Component-**

Level Design: Definition of Component, Designing Class-based Components, Conducting Component-level Design, Object Constraint Language, Designing Conventional Components.

Performing User Interface Design: The Golden Rules, User Interface Analysis and Design, Interface Analysis, Interface Design Steps, Design Evaluation.

UNIT - V

Testing: Strategies: A Strategic Approach to Conventional Software Testing, Test Strategies for O-O Software.

Tactics: Software Testing Fundamentals, Black-box and White-box Testing, Basis Path Testing, Control Structure Testing, O-O Testing Methods.

Debugging: Debugging Techniques, The Art of Debugging.

Product Metrics: A Framework for Product Metrics, Metrics for each phase of software development.

Software Quality: Definition, **Quality Assurance:** Basic Elements, Formal Approaches, Statistical Software Quality Assurance, Software Reliability, ISO 9000 Quality Standards, SQAPlan.

Suggested Readings:

1. Roger S. Pressman, *Software Engineering: A Practitioner's Approach*, 7th Edition, McGraw Hill, 2009
2. Ali Behforooz and Frederick J. Hudson, *Software Engineering Fundamentals*, Oxford University Press, 1996
3. Pankaj Jalote, *An Integrated Approach to Software Engineering*, 3rd Edition, Narosa Publishing House, 2008

Faculty of Engineering, O.U. AICTE Model Curriculum with effect from Academic Year 2020-21

Course Code	Course Title	Contact Hours per Week				CIE	SEE	Credits
OE 801 ME	3D PRINTING TECHNOLOGIES							Open Elective-III
Prerequisite		L	T	D	P			
-		3	-	-	-	30	70	3

Course Objectives:

- To understand the fundamental concepts of 3D Printing, its advantages and limitations.
- To know the working principle, advantages, disadvantages and applications of liquid, solid and powder based 3D Printing Technologies.
- To know diversified applications of 3D Printing Technologies.

Course Outcomes:

After completing this course, the student will be able to

1. Interpret the features of 3D Printing and compare it with conventional methods.
2. Illustrate the working principle of liquid, solid and powder-based 3D Printing Technologies.
3. Apply the knowledge of various 3D Printing technologies for developing innovative applications.

Unit-I

Introduction: Prototyping fundamentals, Historical development, Fundamentals of 3D Printing, Advantages and Limitations of 3D Printing, commonly used Terms, 3D Printing Process Chain, 3D Modeling, Data conversion and Transmission, Checking and Preparing, Building, Post-processing, RP Data formats, Classification of 3D printing processes, Fundamental Automated Processes, Distinction between 3D Printing and Conventional Machining Processes.

Unit-II

Liquid-

based Systems: Stereo Lithography Apparatus (SLA): Models and specifications, Process, working principle, photopolymers, photopolymerization, Layering technology, laser and laser scanning, Applications, Advantages and Disadvantages, Case studies. Polyjet: Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Solid ground curing (SGC): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies.

Unit-III

Solid-based System: Laminated Object Manufacturing (LOM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Fused Deposition Modeling (FDM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Multi-Jet Modelling (MJM): Models and specifications, Process, Working principle, Applications, Advantages and Disadvantages, Case studies.

Faculty of Engineering, O.U. AICTE Model Curriculum with effect from Acad
Unit-IV

Powder Based Systems: Selective laser sintering (SLS): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Three-dimensional Printing (3DP): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Laser Engineered Net Shaping (LENS): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies.

Faculty of Engineering, O.U. AICTE Model Curriculum with effect from Academic

Unit-V

Applications of 3D Printing : Application in Design, Application in Engineering, Analysis and Planning, Aerospace Industry, Automotive Industry, Electronic Industry, Jewelry Industry, Coin Industry, GIS application, Arts and Architecture, Pattern for investment and vacuum casting, Medical Models and Bioengineering Applications: Planning and simulation of complex surgery, Customized Implants & Prosthesis, Design and Production of Medical Devices, Forensic Science and Anthropology, and Web Based Rapid Prototyping Systems.

Suggested Reading:

1. Chee Kai Chua and Kah Fai Leong, "3D Printing and Additive Manufacturing Principles and Applications" Fifth Edition, World Scientific
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.

Faculty of Engineering, O.U. AICTE Model Curriculum with effect from Academic

Course Code	Course Title					Core/Elective	
OE 801 AE	ELEMENTS OF ELECTRIC AND HYBRID VEHICLE TECHNOLOGY					Open Elective-III	
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives:

- To understand the hybrid vehicle technology
- To know the energy storage requirements and analyze the hybridization of different storage devices.
- To understand the configuration of various electric propulsion units.
- To know the different hybrid drives and the concept of electric drive trains.

Course Outcomes:

After completing this course, the student will be able to

1. Explain the basics of electric and hybrid electric vehicles, their architecture, technologies and fundamentals.
2. Discuss different energy storage technologies used for hybrid electric vehicles and their control.
3. Analyze various electric drives suitable for hybrid electric vehicles.
4. Explain plug - in hybrid electric vehicle architecture, design and component sizing and the power electronics devices used in hybrid electric vehicles.
5. Demonstrate different configurations of electric vehicles and its components, hybrid vehicle configuration by different techniques, sizing of components and design optimization and energy management.

Unit - I

Introduction: Introduction to Hybrid Electric Vehicles: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies Electric vehicles; configuration of EVs, performance, traction motor characteristics, tractive effort and transmission requirements.

Unit- II

Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Hybridization of different energy storage devices.

Unit - III

Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives

Unit - IV

Hybrid Drives: Introduction, features, functional classification, start/stop system, mild hybrid, full hybrid, plug-in-hybrid, batteries for hybrid vehicles, and optimization of hybrid configurations. Changing modes for conductive charging.

Unit - V

Hybrid Electric Vehicles (HEVs) And Drive Structures: Concept of electric drive train, architecture of hybrid electric drive train, series hybrid drive, parallel hybrid electrical drive train.

Electric and Hybrid Vehicles - Case Studies: Honda Insight, Chevrolet Volt, GM EV1, Toyota RAV 4 EV and Ford; Think City

Suggested Reading

1. Iqbal Husain, "Electric and Hybrid vehicles Design Fundamentals" , CRC Press, second edition 2013
2. James Larminie, John Lowry, "Electric vehicle technology Explained" 2nd Ed., Wiley 2012
3. Vehicular Electrical Power Systems – Emadi, Ehasni, Mercel (Marcel Dekker)
4. Electric and Hybrid vehicles – Pistoia (Elsevier)
5. Fuel cells principles and applications - B.Vishwanath, M. Aulice Scibion (University Press)
6. Electrical vehicle machine and drives – K.T.Chau (Wiley).

**PROJECT-II
(Project Work-II)**

Credits: 3

*Instruction: 6 periods per week
CIE: 50 marks*

*Duration of SEE:--
SEE: 70 marks*

Objectives:

1. To enhance practical and professional skills.
2. To familiarize tools and techniques of systematic literature survey and documentation
3. To expose the students to industry practices and team work.
4. To encourage students to work with innovative and entrepreneurial ideas

Outcomes:

1. Demonstrate the ability to synthesize and apply the knowledge and skills acquired in the academic program to the real-world problems.
2. Evaluate different solutions based on economic and technical feasibility
3. Effectively plan a project and confidently perform all aspects of project management
4. Demonstrate effective written and oral communication skills

The aim of Project Work-II is to implement and evaluate the proposal made as part of I. Students can also be encouraged to do full-time internship as part of 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.

Project Work-
project work-

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

1. Re-grouping of students-deletion of internship candidates from groups made as part of project Work-I
2. Re-Allotment of internship students to project guides
3. Project monitoring at regular intervals

All re-grouping/re-allotment has to be completed by the 1st 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 are 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