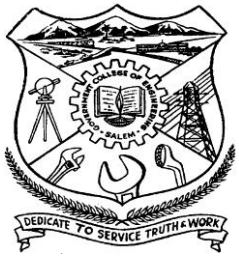

GOVERNMENT COLLEGE OF ENGINEERING, SALEM-11

(An Autonomous Institution Affiliated to Anna University, Chennai)

Curriculum and Syllabus –Regulation 2018

(For Students admitted from 2018-2019)

B.E. MECHANICAL ENGINEERING
(Full TIME)

GOVERNMENT COLLEGE OF ENGINEERING, SALEM-11

DEPARTMENT OF MECHANICAL ENGINEERING

VISION, MISSION, P.E.O, P.O & PSO

Vision:

The department of Mechanical Engineering is committed to blossom into a centre of excellence, dedicated and competent engineers by providing global quality interactive technical education to cater then needs of the industries and nation into a technologically, socially and culturally advanced one.

Mission:

- Constantly updating the departmental resources, faculty and other infrastructure by acquiring state of the art equipment and by imparting constant in-service training to the faculty and supporting staff.
- Promoting skilled and employable graduates to meet the challenges in emerging fields of engineering.
- To prepare the students for prosperous career in entrepreneurship with leader ship qualities, ethics and human values.
- The department executes life-long learning skills and provides engineering services for sustainable development of the society.

Programme Educational Objectives:

- **PEO 1**: To provide students with strong fundamental knowledge in mathematics, science and basic engineering to enable them to solve the mechanical engineering related problems.
- **PEO 2**: To develop expertise in core areas like design, analyze and synthesize data and technical concepts with software skills to create novel products and solutions for the real time problems.
- **PEO 3**: Graduates able to exhibit professionalism in their profession with effective communication, ethical attitude, entrepreneurship skills and knowledge in global economy to meet the social challenges.
- **PEO 4**: To promote the students for continuous learning towards professional growth in contemporary areas of socio-technological issues like energy crisis, environmental pollution, industrial issues and natural disaster.

Programme Outcomes:

- **PO1**: Apply the knowledge of mathematics, science and engineering specialization to solve complex engineering problems.
- **PO2**: Graduates will have the ability to identify, formulate, conduct experiment and analyze engineering problems
- **PO3**: Graduates will demonstrate the ability to design and evaluate a mechanical system (or) process with appropriate consideration for the socio - environmental conditions.
- **PO4**: Graduates will demonstrate the ability to design and conduct experiments, interpretation of data and synthesis of information to provide valid conclusions.
- **PO5**: Graduates will be familiar with modern engineering software tools and equipment to model and predict the Mechanical engineering problems
- **PO6**: Demonstrate knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to engineering practice
- **PO7**: Understand the impact of engineering solution in the environmental context and the need for sustainable development.
- **PO8**: Apply ethical principles and commitment to professional ethics and norms of the practice in the field of Mechanical engineering.
- **PO9**: Obtain the ability to function individually and also as a team member in multi-disciplinary activities.
- **PO10**: Able to communicate effectively in verbal, written and graphical forms.
- **PO11**: Recognize the need and ability to engage in independent and life-long learning in the broadest context of technological change.
- **PO12**: Graduates will have the ability to employ effective project management skills and financial principles to develop project plans in multi-disciplinary environments.

Programme Specific Outcomes:

- **PSO 1**: Ability to identify, analyze and solve engineering problems in the domains of Design, Thermal and Manufacturing systems.
- **PSO 2**: Ability to apply their knowledge in principle of design and analysis, in execution of automation in mechanical system / processes.
- **PSO 3**: Ability to involve professionally in industries or as an entrepreneur by applying manufacturing and management practices.

GOVERNMENT COLLEGE OF ENGINEERING, SALEM-11

CURRICULUM 2018 – 2019 AND ONWARDS

B.E. MECHANICAL ENGINEERING

Course Code	Name of the Course	Hours/Week						Maximum Marks		
		Category	Contact Periods	Lecture	Tutorial/ Demo	Practical	Credits	CA	FE	Total
SEMESTER – I										
THEORY										
18MA101	Matrices and Calculus	BS	60	3	1	0	4	40	60	100
18PH102	Physics – Electromagnetism	BS	60	3	1	0	4	40	60	100
18EE103	Basics of Electrical Engineering	ES	60	3	1	0	4	40	60	100
18ME101	Engineering Graphics & Design	ES	60	1	0	4	3	40	60	100
PRACTICAL										
18PH103	Physics Laboratory	BS	45	0	0	3	1.5	40	60	100
18CY102	Chemistry laboratory	BS	45	0	0	3	1.5	40	60	100
18EE104	Basics of Electrical Engineering Laboratory	ES	30	0	0	2	1	40	60	100
18EN103	Professional Communication Laboratory	HS	30	0	0	2	1	40	60	100
18MC101	Induction Program -21 Days	MC					0			
Total				**10**	**3**	**14**	**20**	**320**	**480**	**800**
SEMESTER –II										
THEORY										
18EN101	Professional English	HS	30	2	0	0	2	40	60	100
18MA201	Differential Equations And Complex Variables	BS	60	3	1	0	4	40	60	100
18CY101	Chemistry	BS	60	3	1	0	4	40	60	100
18CS101	Fundamentals Of Problem Solving And C Programming	ES	45	3	0	0	3	40	60	100
PRACTICAL										
18EN102	Professional English Laboratory	HS	30	0	0	2	1	40	60	100
18CS102	Computer Practice Laboratory	ES	60	0	0	4	2	40	60	100
18ME102	Workshop Manufacturing Practices	ES	60	1	0	4	3	40	60	100
Total				**12**	**2**	**10**	**19**	**280**	**420**	**700**

Course Code	Name of the Course	Hours/Week						Maximum Marks		
		Category	Contact Periods	Lecture	Tutorial/ Demo	Practical	Credits	CA	FE	Total
SEMESTER – III										
THEORY										
18PH202	Physics – Waves & Optics And Quantum Mechanics	BS	60	3	1	0	4	40	60	100
18MA204	Fourier Series and Transforms	BS	60	3	1	0	4	40	60	100
18ME301	Manufacturing Processes	PC	45	2	1	0	3	40	60	100
18ME302	Engineering Mechanics	PC	45	3	0	0	3	40	60	100
18ME303	Thermodynamics	PC	60	3	1	0	4	40	60	100
18EC308	Basic Electronics Engineering	ES	45	3	0	0	**3**	40	60	100
PRACTICAL										
18ME304	Manufacturing Technology Laboratory	PC	45	0	0	3	2	40	60	100
18EC309	Electronics Laboratory	ES	30	0	0	2	1	40	60	100
Total				**17**	**4**	**5**	**24**	**320**	**480**	**800**
SEMESTER –IV										
THEORY										
18ME401	Kinematics of Machinery	PC	60	3	1	0	4	40	60	100
18ME402	Applied Thermodynamics	PC	45	3	0	0	3	40	60	100
18ME403	Fluid Mechanics and Machinery	PC	60	3	1	0	4	40	60	100
18ME404	Strength of Materials	PC	45	3	0	0	3	40	60	100
18ME405	Materials Engineering	PC	45	3	0	0	3	40	60	100
18CYMC01	Environmental Science	MC	14	0	0	1	0	-	-	-
PRACTICAL										
18ME406	Strength of Materials and Fluid Mechanics Laboratory	PC	45	0	0	3	1.5	40	60	100
18ME407	Thermal Engineering Laboratory	PC	45	0	0	3	1.5	40	60	100
Total				**15**	**2**	**7**	**20**	**280**	**420**	**700**

Course Code	Name of the Course	Hours/Week						Maximum Marks		
		Category	Contact Periods	Lecture	Tutorial/ Demo	Practical	Credits	CA	FE	Total
SEMESTER – V										
THEORY										
18ME501	Heat and Mass Transfer	PC	60	3	1	0	4	40	60	100
18ME502	Instrumentation & Control	PC	45	3	0	0	3	40	60	100
18ME503	Metrology and Quality Control	PC	45	3	0	0	3	40	60	100
18ME504	Dynamics of Machinery	PC	45	3	0	0	3	40	60	100
18MEOE1X	Open Elective-I	OE	45	3	0	0	3	40	60	100
18MC301	Indian Constitution	MC	15	3	0	0	0	-	-	-
PRACTICAL										
18ME505	Heat Transfer and Refrigeration Laboratory	PC	45	0	0	3	1.5	40	60	100
18EN501	Communication Skills and Language Laboratory	HS	30	0	0	2	2	40	60	100
18ME506	Dynamics and Metrology Laboratory	PC	45	0	0	3	1.5	40	60	100
Total				**18**	**1**	**8**	**21**	**320**	**480**	**800**
SEMESTER –VI										
THEORY										
18ME601	Computer Integrated Manufacturing	PC	45	3	0	0	3	40	60	100
18ME602	Finite Element Analysis	PC	45	3	0	0	3	40	60	100
18ME603	Design of Machine Elements	PC	60	3	1	0	4	40	60	100
18MEPE1X	Professional Elective –I	PE	45	3	0	0	3	40	60	100
18MEPE2X	Professional Elective – II	PE	45	3	0	0	3	40	60	100
18MEOE2X	Open Elective –II	OE	45	3	0	0	3	40	60	100
PRACTICAL										
18ME604	CAD /CAM Laboratory	PC	45	0	0	3	1.5	40	60	100
18ME605	Mini Project	PRO	30	0	0	6	1	40	60	100
Total				**18**	**1**	**9**	**21.5**	**320**	**480**	**800**

Course Code	Name of the Course	Hours/Week						Maximum Marks		
		Category	Contact Periods	Lecture	Tutorial/ Demo	Practical	Credits	CA	FE	Total
SEMESTER – VII										
THEORY										
18ME701	Mechatronics	PC	45	3	0	0	3	40	60	100
18MEPE3X	Professional Elective – III	PE	45	3	0	0	3	40	60	100
18MEPE4X	Professional Elective – IV	PE	45	3	0	0	3	40	60	100
18MEOE3X	Open Elective – III	OE	45	3	0	0	3	40	60	100
PRACTICAL										
18ME702	Mechatronics & Simulation Laboratory	PC	45	0	0	3	1.5	40	60	100
18ME703	Project – I	PRO	75	0	0	10	4	40	60	100
Total				**12**	**0**	**13**	**17.5**	**240**	**360**	**600**
SEMESTER –VIII										
THEORY										
18MEPE5X	Professional Elective – V	PE	45	3	0	0	3	40	60	100
18MEPE6X	Professional Elective – VI	PE	45	3	0	0	3	40	60	100
18MEOE4X	Open Elective –IV	OE	45	3	0	0	3	40	60	100
PRACTICAL										
18ME801	Project –II	PRO	90	0	0	12	10	50	150	200
Total				**9**	**0**	**12**	**19**	**170**	**330**	**500**
Grand Total							**162**			

Definition of Credit

1 Hr. Lecture (L) per week	1 credit
1 Hr. Tutorial (T) per week	1 credit
1 Hr. Practical (P) per week	0.5 credit

Structure of Undergraduate Engineering Program:

S.NO	Category	Breakup of Credits
1	Humanities and Social Sciences including Management courses	6
2	Basic Science Courses	27
3	Engineering Science courses including Workshop, Drawing, Basic of Electrical/Mechanical/Computer etc	20
4	Professional Core Courses	64
5	Professional Elective Courses relevant to chosen specialization/Branch	18
6	Open subjects- Electives from other Technical and / or Emerging subjects	12
7	Project Work, Seminar and Internship in Industry or elsewhere	15
8	Mandatory Courses (Environmental Sciences, Induction Program, Essence of Indian Traditional Knowledge)	---
	Total	**162**

PROFESSIONAL ELECTIVE COURSES

Code No.	Course	Hours/Week				Maximum Marks		
		Lecture	Tutorial	Practical	Credits	CA	FE	Total
Electives- I (VI SEMESTER)								
		L	**T**	**P**	**C**	**CA**	**FE**	**Total**
18MEPE11	Composite Materials	3	0	0	3	40	60	100
18MEPE12	Design of Transmission System	3	0	0	3	40	60	100
18MEPE13	Gas Dynamics & Jet Propulsion	3	0	0	3	40	60	100
18MEPE14	Renewable Energy System	3	0	0	3	40	60	100
18MEPE15	Metal Cutting & Tool Design	3	0	0	3	40	60	100
18MEPE16	Aeronautical Engineering	3	0	0	3	40	60	100
18MEPE17	Operations Research	3	0	0	3	40	60	100
Electives- II (VI SEMESTER)								
18MEPE21	Advanced Strength of Materials	3	0	0	3	40	60	100
18MEPE22	Internal Combustion Engines	3	0	0	3	40	60	100
18MEPE23	Power plant Engineering	3	0	0	3	40	60	100
18MEPE24	Machine Drawing	3	0	0	3	40	60	100
18MEPE25	Engineering System Analysis and Design	3	0	0	3	40	60	100
Electives-III (VII SEMESTER)								
18MEPE31	Applied Hydraulics and Pneumatics	3	0	0	3	40	60	100
18MEPE32	Professional Ethics and Human Values	3	0	0	3	40	60	100
18MEPE33	Maintenance Engineering	3	0	0	3	40	60	100
18MEPE34	Fuels and Combustion	3	0	0	3	40	60	100
18MEPE35	Rapid Product Development Technologies	3	0	0	3	40	60	100
18MEPE36	Refrigeration & Air Conditioning	3	0	0	3	40	60	100
Electives-IV (VII SEMESTER)								
18MEPE41	Marine Engineering	3	0	0	3	40	60	100
18MEPE42	Fracture Mechanics and Failure Analysis	3	0	0	3	40	60	100
18MEPE43	Automation in Manufacturing	3	0	0	3	40	60	100
18MEPE44	Fundamentals of Tribology	3	0	0	3	40	60	100
18MEPE45	Advanced Decision Modelling Technique	3	0	0	3	40	60	100
18MEPE46	Total Quality Management	3	0	0	3	40	60	100
Electives-V (VIII SEMESTER)								

18MEPE51	Advanced Mechanics of Solids	3	0	0	3	40	60	100
18MEPE52	Heat Transfer Problems in Electronics and Instrumentation	3	0	0	3	40	60	100
18MEPE53	Nuclear Engineering	3	0	0	3	40	60	100
18MEPE54	Analysis and Synthesis of Mechanism	3	0	0	3	40	60	100
18MEPE55	Thermal Turbo Machines	3	0	0	3	40	60	100
Electives-VI (VIII SEMESTER)								
18MEPE61	Cryogenic Engineering	3	0	0	3	40	60	100
18MEPE62	Introduction to Computational Fluid Dynamics	3	0	0	3	40	60	100
18MEPE63	Robotics	3	0	0	3	40	60	100
18MEPE64	Engineering System Modeling and Simulation	3	0	0	3	40	60	100
18MEPE65	Design of Production Tooling	3	0	0	3	40	60	100

LIST OF OPEN ELECTIVE COURSES

Code No.	Course	Hours/Week				Maximum Marks		
		Lecture	Tutorial	Practical	Credits	CA	FE	Total
		L	T	P	C	CA	FE	Total
18MEOE01	Design of Machine Elements and Machining	3	0	0	3	40	60	100
18MEOE02	Industrial Engineering	3	0	0	3	40	60	100
18MEOE03	Total Quality Management	3	0	0	3	40	60	100
18MEOE04	Principles of Management	3	0	0	3	40	60	100
18MEOE05	Professional Ethics and Human Values	3	0	0	3	40	60	100
18MEOE06	Robotics	3	0	0	3	40	60	100
18MEOE07	Robotic Process Automation	3	0	0	3	40	60	100

SEMESTER I

18MA101	MATRICES AND CALCULUS	L	T	P	C
		3	1	0	4

Course Objectives:

1. To know the use of matrix algebra needed by engineers for practical applications.
2. To understand effectively the geometrical application of differential calculus and Beta, Gamma functions.
3. To familiarize with partial differentiation concepts and its applications
4. To obtain the knowledge of multiple integration and their related applications.
5. To acquire the knowledge of vector differentiation and integration and its applications.

UNIT I MATRICES 9 + 3

Symmetric, Skew Symmetric and Orthogonal Matrices – Characteristic equation of a Matrix – Eigen values and Eigen vectors – Properties – Cayley-Hamilton theorem (excluding proof) – Diagonalization of Matrices - Reduction of quadratic form to canonical form by orthogonal transformation.

UNIT II CALCULUS 9 + 3

Curvature , Radius of Curvature (Cartesian coordinates) – Centre and Circle of curvature - Evolutes and Involutes- Definite integrals and their properties – Beta and Gamma functions and their properties.

UNIT III MULTIVARIABLE CALCULUS (DIFFERENTIATION) 9 + 3

Partial derivatives – Euler's theorem for homogenous functions – Total Derivatives – Jacobians – Maxima, Minima and Saddle point- – Method of Lagrangian multipliers- Taylor's series.

UNIT IV MULTIVARIABLE CALCULUS (INTEGRATION) 9 + 3

Multiple integrals- Double integrals – Change of order of integration in double integrals – Change of variables (Cartesian to Polar) – Application to Areas – Evaluation of Triple integrals – Application to volumes.

UNIT V VECTOR CALCULUS 9 + 3

Vector differentiation-Gradient- Directional derivative - Divergence - Curl ,Vector integration- Line integration - work done – Surface and Volume integrals - Green's theorem , Gauss divergence and Stokes theorem (without proof) – Simple applications involving cubes and rectangular parallelopipeds.

Total (45+15) = 60 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1 : learn the fundamental knowledge of matrix theory.
CO2 : familiar with the concept of the differentiation and integration and its applications.
CO3 : acquire skills in applications of integral and vector calculus.

Text Books:

1. Grewal. B.S, "Higher Engineering Mathematics", 43rd Edition, Khanna Publications, Delhi, (2015).
2. Veerarajan T., "Engineering mathematics for first year", Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2009

Reference Books:

1. James Stewart, "Essential Calculus", Cengage Learning, New Delhi, 2nd edition, 2013.
2. P. Kandasamy, K. Thilagavathy and K. Gunavathy," Engineering Mathematics (For I year B.E., B.Tech)", Nineth Edition, S. Chand & Co. Ltd. New Delhi, 2010.
3. Srimanta pal and Subath.C.Bhumia, "Engineering Mathematics", Oxford university publications, New Delhi , 2015
4. Ewinkreyzig, "Advanced Engineering Mathematics", 9th edition, John Wiley & Sons, 2006.
5. Sivaramakrishnadas.P, Ruknmangadachari.E. "Engineering Mathematics", Pearson, Chennai & Delhi, 2nd edition, 2013.

CO-PO MAPPING

CO /PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CO2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1
CO3	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1

1- Faintly
2- Moderately
3- Strongly

18PH102 **PHYSICS – ELECTROMAGNETISM** **L T P C**

3 1 0 4

Course Objectives:

1. The concept of electrostatics, electric potential and their application.
2. The concept of dielectrics, laplace and poisons equation for electrostatic potential.
3. The concept of magnetostatics, magnetic fields in matter and their application.
4. The concept of Faraday's law, Ampere's Law, Maxwell's Equation and their application.
5. The concept of Electromagnetic waves, and Poynting vector.

UNIT I ELECTROSTATICS IN VACUUM 9 + 3

Electric field and electric flux density - Gauss's Law - applications of Gauss's law - electric field due to infinite line charge- infinite sheet of charge- uniformly charged sphere; Electric potential - potential due to a point charge- electric potential energy of a system of point charges - relationship between electric field and electric potential; Energy density in electrostatic fields.

UNIT II ELECTROSTATICS IN A LINEAR DIELECTRIC MEDIUM 9 + 3

Classification of materials based on conductivity ; Electric dipole - electrostatic field and potential of a dipole; Dielectrics - induced dipoles - polarization in dielectrics - dielectric constant and strength; Linear, isotropic, and homogeneous dielectrics; Capacitance - parallel plate capacitor - coaxial capacitor - spherical capacitor; Electric displacement; Laplace's and Poisson's equations for electrostatic potential.

UNIT III MAGNETOSTATICS AND MAGNETIC FIELDS IN MATTER 9 + 3

Biot-Savart's Law - magnetic induction at point *P* due to a straight filamentary conductor; Ampere's circuit law - applications of ampere's law: infinite line current - infinite sheet of current; Magnetization and associated bound currents - auxiliary Field H - Ampere's law in magnetized materials; Magnetic susceptibility and permeability; Classification of magnetic materials - diamagnetic, paramagnetic and ferromagnetic materials - hysteresis loop.

UNIT IV FARADAY'S LAW AND MAXWELL'S EQUATION 9 + 3

Faraday's law in terms of emf produced by changing magnetic flux; Lenz's law; Transformer emf; Motional emf ; Electromagnetic breaking and its applications; Self Inductance -self-inductance of a solenoid; Mutual Inductance - mutual Inductance of two tightly wound solenoids; Energy density in magnetic Fields; Displacement current - modified ampere's law; Maxwell's equation in vacuum and non-conducting medium.

UNIT V ELECTROMAGNETIC WAVES 9 + 3

The wave equation- plane electromagnetic waves in vacuum, their transverse nature and polarization; Polarization by reflection- Brewster's law; Relation between electric and magnetic fields of an electromagnetic wave; Energy carried by electromagnetic waves; Flow of energy and Poynting vector; Variation of intensity of electromagnetic wave with distance; Radiation pressure.

Total (45+15) = 60 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1 : understand the concepts of electrostatics, electrical potential, and their applications.
CO2 : interpret the concepts of dielectrics, laplace and poisons equation for electrostatic potential. .
CO3 : apply the concepts of magneto statics, magnetic fields in matter and their application.
CO4 : apply the concepts of faraday's law, ampere's law, maxwell's equation.
CO5 : interpret the concepts of electromagnetic waves and poynting vector.

Text Books:

1. Mathew N. O.Sadiku, 'Elements of Electromagnetics', Oxford University Press, Third Edition, 2001.
2. Halliday, Resnick, Walker, 'Fundamentals of Physics-Electricity and Magnetism', Wiley India Pvt.Ltd., 2011.
3. Gangadhar K.A, Ramanthan P.M, 'Field Theory', Khanna Publications, 2002.

Reference Books:

1. David J. Griffiths, 'Introduction to Electrodynamics', Prentice-Hall, Inc., 1999.
2. Kraus and Fleish, 'Electromagnetics with Applications', McGraw Hill International Editions,Fifth edition, 2010.

CO-PO MAPPING

CO /PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	0	3	2	1	2	0	1	0	0	3	2	1	3
CO2	3	3	0	2	1	1	0	0	1	0	0	3	2	0	2
CO3	2	3	0	3	3	1	1	0	1	0	0	3	1	2	3
CO4	3	2	0	3	2	1	1	0	1	0	0	2	2	1	3
CO5	3	3	0	3	2	1	1	0	1	0	0	3	3	1	3

1- Faintly
2- Moderately
3- Strongly

18EE103 **BASICS OF ELECTRICAL ENGINEERING** **L T P C**
3 1 0 4

Course Objectives:

1. To understand and analyze basic electric circuits
2. To Study the working principles of Electrical Machines and Transformers
3. To Study the working principles of power converters and Drives

UNIT I DC CIRCUITS **9 + 3**

Electrical Circuit Elements – Voltage and Current Sources– Source transformation techniques – Ohms law, Kirchhoff's laws –Analysis of simple circuits with DC excitation – Superposition, Thevenin and Norton's theorem. Star and Delta transformation. Time domain analysis of first order RL and RC Circuits.

UNIT II AC CIRCUITS **9 + 3**

Representation of Sinusoidal waveforms, peak, rms and average value. Real power, reactive power, apparent power and power factor. Analysis of single phase AC circuits consisting of R,L, C, RL, RC, RLC combinations (Series and Parallel) – Resonance in series Circuits (Study of phenomenon). Three phase circuits – relation between voltage and current in star and delta connections – Three phase balanced circuits.

UNIT III DC MACHINES AND TRANSFORMERS **9 + 3**

Construction and Principle of operation and speed control of separately excited DC motor – Characteristics of motors – Applications - Magnetic materials – BH characteristics – Single phase transformer – Equivalent circuit – Types of Losses in a transformer – No Load test and Load test – Regulation and Efficiency – Auto transformer – Three phase transformer connections – Uses of transformers – Applications.

UNIT IV AC MACHINES **9 + 3**

Construction and Principle of operation of Three phase induction motor – Torque slip characteristics – Starting and speed control methods – Loss components and efficiency. Construction and working of Single phase induction motor – Construction and Working of Synchronous generators and types –– Applications of all machines.

UNIT V POWER CONVERTERS AND DRIVES **9 + 3**

Operation of three phase Converter and Inverter circuits – Working of Chopper and duty ratio control – Chopper control of separately excited DC motor – Stator voltage control of three phase induction motor drives – Rotor resistance control of three phase induction motor – Closed loop control of slip power recovery scheme.

Total (45+15) = 60 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1 : verify ohm's law and kirchoff's laws for simple electrical circuits.
CO2 : verify simple network theorems for electrical circuits.
CO3 : solve problems on ac circuits and analyze three phase ac circuits.
CO4 : understand the performance of dc machines and transformers.
CO5 : basic understanding of power electronic circuits and their application in speed control of ac and dc machines.

Text Books:

1. D.P.Kothari, I.J.Nagrath,, "Basic Electrical Engineering", Tata McGraw Hill, 2010.
2. P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.
3. M. H. Rashid, "Power electronics: circuits, devices, and applications", Pearson Education India, 2009.
4. G. K. Dubey, "Power Semiconductor Controlled Drives", Prentice Hall, 1989

Reference Books:

1. Nagsarkar T K and Sukhija M S, "Basic Electrical Engineering", Oxford Press (2005).
2. I. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010.

3. E.Hughes, “Electrical and Electronics Technology”, Pearson, 2010.
4. Mahmood Nahvi and Joseph A. Edminister, “Electric Circuits”, Schaum Outline Series, McGraw Hill, Sixth edition (2014).

CO-PO MAPPING

CO /PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	0	1	1	0	0	0	0	0	0	0	0	0	0
CO2	3	2	0	1	1	0	0	0	0	0	0	0	0	0	0
CO3	3	3	0	2	1	1	1	0	0	0	0	0	0	0	0
CO4	3	2	0	1	1	0	0	0	0	0	0	0	0	0	0
CO5	3	2	0	1	1	0	0	0	0	0	0	0	0	0	0

1- Faintly
2- Moderately
3- Strongly

18ME101 **ENGINEERING GRAPHICS & DESIGN** **L T P C**
1 0 4 3

Course Objectives:

1. To impart knowledge on concepts, ideas and design of engineering products and to provide an exposure to CAD Modelling.
2. Standards of Engineering Drawing: Size, layout and folding of drawing sheets, lettering - Use of drafting instruments

UNIT I PROJECTION OF POINTS, LINES AND PLANE SURFACES 9 + 3

General principles of orthographic projection- Projection of points, located in all quadrants – Projection of straight lines located in first quadrant – Determination of true lengths and true inclinations – Projection of polygonal surface and circular lamina inclined to both reference planes.

UNIT II PROJECTION OF SOLIDS 9 + 3

Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is perpendicular to one reference plane and also inclined to one reference plane by change of position method.

UNIT III SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES 9 + 3

Sectioning of above solids in simple vertical position by cutting planes inclined to one reference plane and perpendicular to other – solids inclined position with cutting planes parallel to one reference plane- Obtaining true shape of section. Development of lateral surfaces of simple and truncated solids – Prisms, pyramids cylinders and cones- Development of lateral surfaces of solids with square and cylindrical cutouts, perpendicular to the axis.

UNIT IV ISOMETRIC PROJECTION 9 + 3

Principles of isometric projection –isometric scale - isometric projections of simple solids, truncated prisms, pyramids, cylinders and cones.

UNIT V PERSPECTIVE PROJECTION 9 + 3

Perspective projection of prisms, pyramids and cylinders by visual ray and vanishing point methods.

Note: Study of drafting software – Auto CAD – Coordinate System (Absolute, relative and polar)
Creation of simple figures like polygon, Drawing a plan of residential building, Creation of 3-D
Models of simple objects and obtaining 2-D multi view drawing from 3-D model. (**Internal Assessment only)**

Total (45+15) = 60 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1 : understand the conventions and the methods of engineering drawing.
CO2 : understand the fundamental concepts of theory of projection.
CO3 : understand the development of different surfaces.
CO4 : develop the relationships between 2d and 3d environments.
CO5 : demonstrate computer aided drafting.

Text Books:

1. Bhatt N.D, “Engineering Drawing”, Charotar publishing House, 2003
2. Natarajan, K.V, “A Text book of Engineering Graphics”, Dhanalakshmi Publishers, 2006.

Reference Books:

1. Gopalakrishnana K.R, “Engineering Drawing", Vol. I and II, Subhas Publications, 1999.
2. Dhananjay A. Jolhe, “Engineering Drawing with an Introduction to AutoCAD”, Tata McGraw Hill Publishing Company Limited, 2008.
3. Venugopal, K and Prabhu Raja, V., “Engineering Graphics”, New Age International (P) Ltd, 2008.
4. Gill, P.S, “Engineering Drawing-Geometrical Drawing”, S.K Kataria and Sons, 2008.
5. CAD Software Theory and User Manuals

CO-PO MAPPING

CO /PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	1	2	0	0	0	0	0	0	0	0	0	0	1	1	2
CO2	0	0	2	0	0	0	0	0	0	0	0	0	1	2	1
CO3	0	0	0	2	1	0	0	0	0	0	0	0	2	1	1
CO4	0	1	1	0	0	0	0	0	0	3	0	0	1	2	1
CO5	1	2	0	1	1	0	0	0	0	0	0	2	2	1	3

1- **Faintly**
2- **Moderately**
3- **Strongly**

18PH103 **PHYSICS LABORATORY** **L T P C**
0 0 3 1.5

Course Objectives:

1. To handle different measuring instruments.
2. To understand the basic concepts of interference, diffraction, heat conduction and to measure the important parameters.

EXPERIMENTS:

1. Newton's rings – Determination of radius of curvature of a Plano convex lens.
2. Carey Foster's bridge – Determination of specific resistance of the material of the wire.
3. Poiseuille's flow – Determination of Coefficient of viscosity of a liquid.
4. Spectrometer – Grating – Normal incidence – Determination of Wavelength of Mercury lines.
5. Lee's disc – Determination of thermal conductivity of a Bad conductor.
6. Ultrasonic interferometer – Determination of velocity of Ultrasonic Waves in Liquid.
7. Non-uniform bending – Determination of young's modulus of the material of the Bar.
8. Determination of Band gap of a given semi conductor.
9. Determination of Wavelength of laser using grating and determination of particle size using Laser.
10. Determination of Acceptance angle and Numerical Aperture of fiber.

Total = 45 Periods

Course Outcomes:

After completing the laboratory course the students will be able to

CO1 : handle different measuring instruments and to measure different parameters.

CO2 : calculate the important parameters and to arrive at the final result based on the experimental measurements.

CO-PO MAPPING

CO /PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	2	3	1	1	2	0	3	0	1	2	1	0	3
CO2	3	3	2	3	1	1	2	0	3	0	1	2	1	0	3

1- Faintly
2- Moderately
3- Strongly

18CY102 **CHEMISTRY LABORATORY** **L T P C**
0 0 3 1.5

Course Objectives:

1. To gain practical knowledge by applying theoretical principles and performing the following experiments**.**

EXPERIMENTS:

1. Estimation of hardness of Water by EDTA
2. Estimation of Copper in brass by EDTA
3. Estimation of Alkalinity in water
4. Estimation of Chloride in water sample (Iodimetry)
5. Conductometric titration of Strong Acid and Strong Base
6. Conductometric titration of Mixture of acids and Strong base
7. Determination of strength of Iron by Potentiometric method
8. Estimation of Iron by Spectrophotometry
9. Determination of molecular weight and degree of Polymerisation by Viscometry.

Total = 45 Periods

Course Outcomes:

After completing the laboratory course the students will be able to

CO1 : know the applicability of the practical skill gained in various fields.

CO2 : know the composition of brass quantitatively and the molecular weight of polymers.

CO3 : understand the principle and applications of conductometric titrations, spectrometer and potentiometric titrations.

CO-PO MAPPING

CO /PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	1	0	0	0	0	0	0	0	0	0	0	0	0
CO2	3	3	1	0	0	0	0	0	0	0	0	0	0	0	0
CO3	3	3	1	0	0	0	0	0	0	0	0	0	0	0	0

1- Faintly
2- Moderately
3- Strongly

18EE104 BASICS OF ELECTRICAL ENGINEERING LABORATORY L T P C
0 0 2 1

Course Objectives:

1. To gain practical knowledge by applying theoretical principles and performing the following experiments**.**

EXPERIMENTS:

1. Introductions to measuring instruments – voltmeter, ammeter, wattmeter, multimeter and Digital Storage Oscilloscope.
2. Resonance in RLC circuits, verification of laws in electrical circuits.
3. Measurement of phase difference between voltage and current
4. No load test on single phase transformer and equivalent test
5. Load Test on single phase transformer
6. Three phase transformer connections
7. Voltage - Current relations in three phase circuit and three phase power measurement
8. Demonstration of cut out section of machines
9. Swinburne's Test, Speed Control and Load test on DC motor
10. Direction change and load test on three phase induction motor
11. Alternator load test and regulation test
12. Demonstration of LT switchgear components
13. Demonstration of AC and DC drives

Total = 30 Periods

Course Outcomes:

After completing the laboratory course the students will be able to

CO1 : making electrical connections by wires of appropriate wires
CO2 : acquire exposure to common electrical components and measuring instruments.
CO3 : verify simple laws using electrical circuits.
CO4 : do experiment to understand the characteristics of transformers and electrical machines.
CO5 : understand the working of low tension switch gear components, ac and dc drives.

CO-PO MAPPING

CO /PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	0	1	1	0	1	1	0	0	0	0	0	0	0
CO2	3	2	0	1	1	0	0	0	0	0	0	0	0	0	0
CO3	2	1	0	1	1	0	0	0	0	0	0	0	0	0	0
CO4	3	1	0	2	1	0	0	0	0	0	0	0	0	0	0
CO5	3	2	0	2	1	0	1	1	0	0	0	0	0	0	0

1- Faintly
2- Moderately
3- Strongly

18EN103 **PROFESSIONAL COMMUNICATION LABORATORY** **L T P C**
0 0 2 1

Course Objectives:

1. To help students improve their reading skills.
2. To help students address an audience and present a topic.
3. To help students acquire speaking competency in English.
4. To help students strengthen their fluency in speaking.

METHODOLOGY – READING

1. Reading a story aloud with exact pronunciation, with intonation, and with expressing sense.
2. Reading poems for improving verbal skills, memory, and critical thinking.
3. Reading newspaper articles for strengthening the vocabulary and writing skills
4. Reading homophones with exact pronunciation for expressing different meanings.

METHODOLOGY – SPEAKING

1. Power point presentation – on general topics - for organising and structuring presentation.
2. Oral presentation -on basic technical ideas related to engineering.
3. Speaking on a given topic – current affairs, expressing opinion on social issues.
4. Describing a process – booking Ticket online, survey for starting a new office, sending an e-mail, etc.
5. Organising official events –compering, presenting welcome address, proposing vote of thanks.

Total = 30 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1 : read short passages fluently, avoiding mispronunciation, substitution, omission and transposition of word-pairs.
CO2 : vocalize words without the aid of pictures.
CO3 : develop a well-paced, expressive style of reading.
CO4 : make effective oral presentations on technical and general contexts.
CO5 : describe a process with coherence and cohesion.

Text Books:

1. Norman Whitby. Business Benchmark – Pre-Intermediate to Intermediate, Students book, Cambridge University Press, 2014.

Recommended Reading and Reference Sources:

1. Spoken English: A Self-Learning Guide. V.Sasikumar and P V Dhamija
2. English Conversation Practice: Grant Taylor Paperback 1976ly. Krishna Mohan, N P Singh
3. Discussions that Work. Penny Ur.CUP, 1981.
4. http://www.onestopenglish.com/skills/speaking/speaking-matters/
5. Speak Better Write Better English Paperback – November 2012 Norman Lewis, Goyal Publishers and Distributors.

CO-PO MAPPING

CO /PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	0	0	2	2	0	2	1	1	2	3	2	1	0	1	2
CO2	0	0	2	1	0	1	2	2	2	3	1	0	0	2	2
CO3	0	0	1	1	0	1	1	1	1	3	1	1	0	0	1
CO4	0	0	2	2	0	0	2	2	1	3	2	2	0	1	2
CO5	0	0	2	1	0	1	1	1	0	3	2	2	0	2	3

1- Faintly
2- Moderately
3- Strongly

SEMESTER II

18EN101 **PROFESSIONAL ENGLISH** **L T P C**

2 0 0 2

Course Objectives:

1. Master basic reading skills such as phonics, word recognition and meaningful division of sentences.
2. Read fast, decode accurately and remove oral reading errors that affect text meaning.
3. Acquire and develop writing skills for academic, social and professional purposes.
4. Gain skills in academic and functional writing tasks.

WRITING:

1. Word Formation with Prefix and Suffix, Synonyms and Antonyms, Tenses, Parts of Speech, Common Errors in English (Subject –Verb Agreement, Noun-Pronoun Agreement, Prepositions, Articles, Conditional statements, Redundancies, Clichés etc), Voices.
2. Email – Training Programme and related details, paper submission for seminars and conferences, Fixing an appointment, Arranging and Cancelling a meeting with team members, conference details, hotel accommodation, Reminder mails, Raising queries with team members, Congratulatory mails at work, arranging for a meeting with a foreign client, personal emails.
3. Letter Writing – Business and need based communication – Formats of official, personal and business letters, official leave and request applications (Bonafide certificate, course completion, conduct certificate, permission to arrange industrial visits) complaints, replies to queries from business customers, inviting dignitaries, accepting and declining invitations, Placing orders, cover letter for a job application with resume.
4. Technical Report Writing – status reports – Work Done in the Project, Feasibility Reports on Office Accommodation, Introduction of New Products, Sales Promotion, Customers Feedback, Starting a New Company, Event Reports- Seminars, Conferences, Meeting, Recommendations and Checklists.
5. Charts- interpreting pie charts, graphs etc.,

READING:

1. Understanding notices, messages, timetables, adverts, graphs, etc.- understanding meaning and purpose of short texts.
2. Gapped sentences – Meanings, collocations and meanings of individual words.
3. Reading passage with multiple choice questions – reading for gist and reading for specific Information – skimming for general idea of and meaning and contents of the whole text.
4. Short reading passage; gap-filling – Grammar, especially prepositions, articles, auxiliary verbs, modal verbs, pronouns, relative pronouns and adverbs.
5. Short reading passages; sentence matching – Scanning – ability to pick out specific information in a short text.

METHODOLOGY:

Objective Type:

1. Vocabulary of business communication.
2. Collocations related to technical and business.
3. Coherence in paragraphs – use of sequence clues.
4. Conversations and appropriate responses.
5. Tenses with time makers.
6. Verbal phrases
7. Description of objects in a sentence or two
8. Products and likely slogans
9. Tone, vocabulary, expressions in formal and informal letters.
10. Email writing- tone, vocabulary, expressions, mail ID., creation, CC, BCC.

DESCRIPTIVE WRITING:

1. Skimming and scanning to look for specific information.
2. Spotting Errors.
3. Email writing in different work place/ profession based contexts with hints.
4. Letter writing in different business based contexts with hints.
5. Report writing: feasibility report, progress in project reports, accident reports and event reports.

6. Checklists in business, office and profession based context.
7. Recommendations in business, office and profession based context.
8. Resume and Cover letter.
9. Mind mapping visuals on social and environmental issues – essay writing based on the given mind map visual.

Total = 30 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1 : read and summarize the main ideas, key details and inferred meanings from a passage.
CO2 : internalize the grammar items such as prepositions, articles, tenses, verbs, pronouns, and adverbs adjectives through contexts and apply them to spot errors.
CO3 : develop the ability to classify, check information and prepare reports.
CO4 : apply the academic and functional writing skills in new contexts.
CO5 : interpret pictorial representation of data and statistic.

Text Books:

1. Norman Whitby. Business Benchmark –Pre - Intermediate to Intermediate, Students Book, Cambridge University Press, 2014.

Recommended Reading and Reference Sources:

1. M. Ashraf Rizvi, Effective Technical Communication, McGraw Hill.
2. Farhathullah, T.M. Communication Skills for Technical Students.
3. Meenakshi Raman and Sangeetha Sharma, Technical Communication: Principles and Practice, Oxford University Press, New Delhi, 2004.
4. David F. Beer and David McMurray, Guide to Writing as an Engineer, John Willey. New York, 2004.
5. Collins Cobuild- Student's Grammar: Self-Study Edition with Answers (Collins Cobuild Grammar) paperback- 6 May 1991.
6. Essential English Grammar paperback Raymond Murphy CUP 2007.
7. Android App for Grammar: https://play.google.com/store/apps/details?id=com.zayaninfotech.english.grammar.
8. http://www.onestopenglish.com/grammar/
9. Speak Better Write Better English paperback – Nov 2012, Norman Lewis, Goyal Publishers and Distributors.
10. Essential English Grammar Paperback Raymond Murphy CUP 2007.
11. English Reading Comprehension 2014 RPH Editorial Board.
12. Proficiency in Reading Comprehension Simplifying the 'Passage' for you, 2008 Ajay Singh.

CO-PO MAPPING

CO /PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	0	0	2	1	0	1	2	2	2	3	1	1	0	1	2
CO2	0	0	1	2	0	0	1	1	1	3	2	1	0	1	2
CO3	0	0	2	1	0	0	2	2	2	3	1	2	0	0	2
CO4	0	0	2	1	0	1	2	1	1	3	1	2	0	2	3
CO5	0	0	1	2	0	1	0	1	1	3	2	1	0	1	3

1- Faintly
2- Moderately
3- Strongly

18MA201 DIFFERENTIAL EQUATIONS AND COMPLEX VARIABLES L T P C
3 1 0 4

Course Objectives:

1. To obtain the knowledge to solve second order differential equations with constant and Variable coefficients.
2. To familiarize with formation and solutions of first order partial differential equation.
3. To familiarize with the solutions of higher order partial differential equations.
4. To know about analytic functions with properties, construction of analytic functions and conformal transformations
5. To obtain the knowledge of Cauchy's integral theorems, calculus of residues and complex Integration around unit circle and semi-circle.

UNIT I ORDINARY DIFFERENTIAL EQUATIONS OF HIGHER ORDER 9 + 3

Second order linear differential equations with constant and variable coefficients –Cauchy-Euler equation and Cauchy- Legendre's linear equation - Method of variation of parameters –Simultaneous first order linear equations with constant coefficients.

UNIT II PARTIAL DIFFERENTIAL EQUATIONS – FIRST ORDER 9 + 3

Formation of partial differential equations by elimination of arbitrary constants and functions –Solutions to first order partial differential equations – Standard types of first order linear and non-linear PDE- Lagrange's linear PDE.

UNIT III PARTIAL DIFFERENTIAL EQUATIONS – HIGHER ORDER 9 + 3

Solution to homogeneous and non-homogeneous linear partial differential equations of second and higher order by complementary function and particular integral method - Separation of variables method: simple problems in Cartesian coordinates, Laplace equation in Cartesian and polar coordinates, one dimensional diffusion equation, one dimensional wave equation.

UNIT IV COMPLEX DIFFERENTIATION 9 + 3

Functions of a complex variable – Analytic functions – Cauchy – Riemann equation and sufficient conditions (excluding proof) – Harmonic and orthogonal properties of analytic function –Construction of analytic functions – Conformal mappings: w= z+c, cz, 1/z, z2 and Bilinear transformations.

UNIT V COMPLEX INTEGRATION 9 + 3

Cauchy's integral theorem - Cauchy's integral formula – Taylor's and Laurent's theorems (Statements only) and expansions – Poles and Residues – Cauchy's Residue theorem – Contour integration: Circular and semi-circle contours with no poles on the real axis.

Total (45+15) = 60 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1 : learn the techniques of solving ordinary and partial differential equations of second and higher order that arise in engineering problems
CO2 : familiar with the concept of conformal and bilinear transformations.
CO3 : acquire the knowledge of contour integration over unit circle and semi-circle.

Text Books:

1. Grewal. B.S, "Higher Engineering Mathematics", 43rd Edition, Khanna publications, Delhi, 2015. Ltd., New Delhi, 2009
2. Veerarajan T., "Engineering mathematics for first year", Tata McGraw Hill Education Pvt.

Reference Books:

1. James Stewart, "Essential Calculus", Cengage Learning, New Delhi, 2nd edition, 2013.
2. P. Kandasamy, K. Thilagavathy and K. Gunavathy," Engineering Mathematics (For I year

B.E., B.Tech)", Nineth Edition, S. Chand & Co. Ltd. New Delhi, 2010.
3. Srimanta pal and Subath.C.Bhumia, "Engineering Mathematics", Oxford university publications, New Delhi, 2015
4. Ewinkreyzig, "Advanced Engineering Mathematics", 9th edition, John Wiley & Sons, 2006.
5. Sivaramakrishnadas.P, Ruknmangadachari.E. "Engineering Mathematics", Pearson, Chennai & Delhi, 2nd edition, 2013.

CO-PO MAPPING

CO /PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CO2	3	2	1	1	1	1	1	1	1	1	1	1	1	1	1
CO3	3	2	1	1	1	1	1	1	1	1	1	1	1	1	1

1- Faintly
2- Moderately
3- Strongly

18CY101 **CHEMISTRY** **L T P C**
3 1 0 4

Course Objectives: Technology is being increasingly based on the electronic, atomic and molecular level modifications. The course will enable the students to:

1. Analyze microscopic chemistry in terms of atomic and molecular orbitals.
2. Rationalize periodic properties of elements and the knowledge of acids and bases.
3. Analyze the stereo chemical aspects of organic molecules and chemical reactions that are used in the synthesis of organic molecules
4. Rationalize bulk properties and processes in thermodynamic aspects and its extension in electrochemical processes.
5. Distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques

UNIT I MOLECULAR STRUCTURE 9 + 3

Formation of molecular orbitals of diatomic molecules - energy level diagrams of – H_2, He_2, N_2, O_2, CO and NO – bond order, bond length, bond energy, magnetic behaviour and relative stability;

Aromaticity- Huckel rule - concept of aromaticity - aromatic, non-aromatic and anti-aromatic molecules- Benzenoid, Non-benzenoid and Annulenes only;

Crystal field theory – Postulates- d-orbital splitting in octahedral and tetrahedral complexes- strong field and weak field ligands - spectrochemical series- high spin and low spin complexes- magnetic properties of complexes – crystal field stabilisation energy (CFSE) and its calculations for octahedral and tetrahedral complexes.

UNIT II PERIODIC PROPERTIES AND ACID-BASE CONCEPTS 9 + 3

Effective nuclear charge – shielding effect, penetration of orbitals - variations of s, p, d and f orbital energies of atoms –Aufbau principle - electronic configuration of elements – periodic properties - atomic and ionic size, ionization energy, electron affinity and electro negativity - anomalous properties of second period elements - diagonal relationship;

Acids and bases - Bronsted-Lowry concept - Lewis concept - pH and pKa – problems – HSAB - buffer solutions – types- mechanism of buffer action- Henderson–Hasselbalch equation- derivation and problems.

UNIT III STEREOCHEMISTRY AND ORGANIC REACTIONS 9 + 3

Stereoisomerism – geometrical isomerism – cis-trans and E-Z nomenclature – optical isomerism – symmetry, chirality, optical activity, enantiomer and diastereomers – absolute configuration - R-S notation - conformational analysis – Ethane, butane, cyclohexane;

Addition reaction – hydrogenation, halogenations - Markovnikov rule – Kharasch effect - hydration, hydro halogenation, hydroboration;

Aliphatic nucleophilic substitution reaction –SN_1, SN_2 and SN_i mechanism – electrophilic substitution reaction in benzene– mechanism - nitration, halogenations, suffocation, alkylation and acylation; Elimination reaction –E_1, E_2 and E_1CB- mechanism- Saytzeff rule **–** examples.

UNIT IV USE OF FREE ENERGY IN CHEMICAL EQUILIBRIA 9 + 3

Thermodynamic functions- internal energy, enthalpy, entropy and free energy- first and second law of thermodynamics - partial molar properties - Gibbs Duhem equation – variation of chemical potential with temperature and pressure – Third and Zeroth law of thermodynamics – definition only;

Free energy and EMF relation - single electrode potential - electrochemical series and its significance.- cell potential and its measurement (Poggendorff method only) - Nernst equation-derivation and problems-Standard cell potential and equilibrium constant relation- problems.

UNIT V SPECTROSCOPY TECHNIQUES AND APPLICATIONS 9 + 3

Beer-Lambert's law (problem) – UV visible spectroscopy: Principle, Chromophores, auxochrome, Electronic transitions and instrumentation (No applications);

IR spectroscopy: Principles – instrumentation and applications of IR in H_2O, CO_2 and NH_3;

Flame photometry – principle – instrumentation – estimation of sodium by flame photometer;

Atomic absorption spectroscopy – principles – instrumentation – estimation of nickel by atomic absorption spectroscopy.

Total (45+15) = 60 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1 : Understand in-depth knowledge of atomic and molecular orbitals based chemical aspects.
CO2 : Realize the nature of periodic properties of elements and the knowledge of acids and bases.
CO3 : Grasp the knowledge of 3d structural aspects of organic molecules and chemical reactions that are used in the synthesis of organic molecules.
CO4 : Substantiate the various processes involved in thermodynamic considerations and its involvement in electrochemical aspects.
CO5 : Aware of spectroscopic techniques in the field of molecular identification of materials.

Text Books:

1. P.R. Puri, L.R.Sharma and Madan S. Pathania,"Principle of physical chemistry" 47th Vishal Publishing Co, Jalandhar-8
2. C. N. Banwell and E. M. Mccash, "Fundamentals of Molecular Spectroscopy", Tata McGraw-Hill Publishing Company Limited, New Delhi, 2009.
3. Raj. K. Bansal – "A Text Book of Organic Chemistry" Revised 4th Ed.,(2005), New Age International Publishers Ltd., New Delhi.
4. P.S. Kalsi – "Stereochemistry conformation and Mechanism", 6th Ed., (2005), New Age International Publishers Ltd., New Delhi.
5. J.D. Lee – "A New Concise Inorganic Chemistry", 5th Edn., Oxford University Press, 2011.
6. Wahid Malik, G.D.Tuli and R.D.Madan, "Selected Topic in Inorganic Chemistry",S.Chand& Co., Ltd (2011).

Reference Books:

1. David.W.Ball, Physical Chemistry, Cengage Learning India Pvt. Ltd., New Delhi, 2009.
2. G.Aruldhas, Molecular structure and spectroscopy, second edition, PHI learning Pvt. Ltd., New Delhi, 2008.
3. Cotton and Wilkinson – "Advanced Inorganic Chemistry", 6th Ed., John Wiley & Sons, New York- 2004.
4. James E. Huheey, Ellen A. Keiter and Richard L. Keiter – "Inorganic Chemistry-Principles of Structure and Reactivity", 4 thEdn., Pearson Education, 11th Impression, 2011.
5. F.A. Carey and R.J. Sund berg – "Advanced organic chemistry" Vol. I and II– 3rd Ed.,(1984), Plenum Publications.
6. Ernest. Eliel and Samuel H. Wilen – "Stereochemistry of Organic Compounds" – Wiley Student Ed., (2006). John Wiley and Sons Pvt. Ltd., Singapore.

CO-PO MAPPING

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	0	0	2	0	0	0	3	0	0	0	0	0	0	0
CO2	3	0	0	0	0	3	0	0	0	0	0	0	0	0	0
CO3	3	0	0	2	0	0	0	0	0	0	0	0	0	0	0
CO4	3	0	0	0	0	0	0	3	0	3	0	0	0	0	0
CO5	3	0	0	2	0	3	0	0	0	3	0	0	0	0	0

1- Faintly
2- Moderately
3- Strongly

18CS101 **FUNDAMENTALS OF PROBLEM SOLVING AND C PROGRAMMING** **L T P C**
3 0 0 3

Course Objectives:

1. To express problem solving through programming.
2. To practice the basic concepts of C programming language.
3. To provide the basics knowledge about array and strings to solve simple applications.
4. To use pointers and functions in the simple applications.
5. To review the elementary knowledge of structures and unions.

UNIT I INTRODUCTION TO COMPUTER AND PROBLEM SOLVING 9 + 0

Problem formulation, Problem Solving methods, Need for logical analysis and thinking – Algorithm – Pseudo code – Flow Chart- Need for computer languages, Generation and Classification of Computers- Basic Organization of a Computer.

UNIT II C PROGRAMMING BASICS AND CONTROL STATEMENTS 9 + 0

C Character set- Identifies and Keywords- Data Type- Declarations-Expressions-Statements and Symbolic constants- Operators – Arithmetic Operators – Unary operators – Relational and Logical Operators – Assignment operators – Conditional operators- Managing Input and Output operations- Decision Making-Branching and Looping statements.

UNIT III ARRAYS AND STRINGS 9 + 0

Pre-processor directives-Storage classes-Arrays – Initialization – Declaration – one dimensional and two dimensional arrays. Strings - String operations – String handling functions-Simple programs-sorting-searching.

UNIT IV FUNCTIONS AND POINTERS 9 + 0

Function – Library functions and user-defined functions – Function prototypes and function definitions – Call by value –Call by reference – Recursion – Pointers - Definition – Initialization – Pointers arithmetic – Pointers and arrays.

UNIT V STRUCTURES, UNIONS AND FILE 9 + 0

Introduction – need for structure data type – structure definition – Structure declaration – Structure within a structure – Passing structures to functions – Array of structures – Pointers to structures-Union-basic file operation.

Total (45+0) = 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1 : formulate and apply logic to solve basic problems.
CO2 : write, compile and debug programs in c language.
CO3 : apply the concepts such as arrays, decision making and looping statements to solve real time applications.
CO4 : solve simple scientific and statistical problems using functions and pointers.
CO5 : write programs related to structures and unions for simple applications.

Text Books:

1. Anita Goel and Ajay Mittal, “Computer Fundamentals and Programming in C”, Dorling Kindersley (India) Pvt. Ltd., Pearson Education in South Asia, 2011. (Unit-I).
2. E.Balagurusamy, “Programming in ANSI C” fourth Edition, Tata McGraw-Hill, 2008. (Unit II-V).

Reference Books:

1. Byron S Gottfried, “Programming with C”, Schaum’s Outlines, Second Edition, Tata McGraw-Hill, 2006.
2. Kernighan,B.W and Ritchie,D.M, “The C Programming language”, Second Edition, Pearson Education, 2006.
3. Yashavant P. Kanetkar. “Let Us C”, BPB Publications, 2011.

CO-PO MAPPING

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	3	3	3	2	2	1	1	1	3	3	3	2	0
CO2	3	3	3	3	3	2	2	1	1	1	3	3	3	2	0
CO3	3	3	3	3	3	2	2	1	1	1	3	3	3	1	0
CO4	3	3	3	3	3	2	2	1	1	1	3	3	3	1	0
CO5	3	3	3	3	3	2	2	1	1	1	3	3	3	1	0

1- Faintly
2- Moderately
3- Strongly

18EN102	PROFESSIONAL ENGLISH LABORATORY	L	T	P	C
		0	0	2	1

Course Objectives:

1. To acquire and develop listening skills for academic, social and professional purposes.
2. To understand short conversations or monologues
3. To master basic reading skills such as phonics, word recognition, and fluency
4. Acquire and develop pre-intermediate level fluency in oral skills such as discourse management, grammar and vocabulary, pronunciation and interactive communication for academic, social and professional purposes.
5. Address an audience and present a topic.
6. Express an opinion and justify it.

METHODOLOGY - LISTENING

List of Audio files:

1. Job Responsibilities
2. Conversation between two employees on company culture
3. Emails
4. Description of gadgets
5. Interview with a leading industrialist
6. Office procedures – applying for permission, placing an order for office equipment,
7. Enquiries about orders and deliveries
8. Conversation between two people on general topics
9. Telephone Messages
10. Fixing and Cancelling appointments
11. Asking for directions
12. Rescheduling a travel plan
13. Tones : Rude and Polite
14. Conversation : Statements, Discussions, Debating, Accepting, Negotiating
15. Conferences ; Announcements about changes in schedules and sessions
16. Motivational Speech
17. TED Talk on Team Work
18. Describing charts and data
19. Presentation at an office
20. Short self-descriptions

METHODOLOGY: - Speaking

1. Self-Introduction – Personal information –Name, Home background, study details, area of interest, hobbies, strengths and weaknesses, projects and paper presentations if any, likes and dislikes in food, clothes, Special features of home town, Personal role models in life, goals and dreams, favorite inspirational quote.

2. Situational Role Play between Examiner and Candidate – Customer and Sales Manager, Hotel Manager and Organiser, Team Leader and Team member, Bank Manager and Candidate, Interviewer and Applicant, Car Driver and Client, Industrialist and Candidate, Receptionist and Appointment Seeker, New Employee and Manager, Employee and Employee, P.A. and Manager Schedule for training, Asking for directions, Seeking help with office equipment, Clarifying an error in the bill, Quality of Products, Buying a Product, Selling a Product, cancelling and fixing appointments, hotel accommodation, training facilities, dress code, conference facilities, faculty advisors and student, student and student, college Office personnel and student.

Total = 30 Periods

Course Outcomes:

At the end of the course, students will have acquired the following Listening and Speaking skills

CO1 : Infer, interpret and correlate routine, classroom-related conversation.

CO2 : Use a range of common vocabulary and context based idioms.

CO3 : Comprehend native speakers when they speak quickly to one another, although the student might still have trouble.

CO4 : Identify the most important words in a story/article.

CO5 : Summarize the main ideas, key details, and inferred meanings from listening passages of up to five minutes.

CO6 : Vocalize words without the aid of pictures

CO7 : Make effective self-introductions.

CO8 : Study options, compare and contrasts the options.

CO9 : Exercise a choice, justify it by giving examples and illustrations.

CO10 : Construct a situation and to participate in conversations.

Textbooks:

1. Norman Whit by. Business Benchmark –Pre - Intermediate to Intermediate, Students Book, Cambridge University Press, 2014.

Reference sources:

1. Spoken English: A Self-Learning Guide. V. Sasikumar and P V Dhamija.
2. English Conversation Practice: Grant Taylor Paperback 1976ely. Krishna Mohan, N P Singh.
3. Discussions that Work. Penny Ur. CUP, 1981.
4. http://www.onestopenglish.com/skills/speaking/speaking-matters/
5. Speak Better Write Better English Paperback - November 2012 Norman Lewis, Goyal Publishers and Distributors.

CO-PO MAPPING

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	0	0	1	1	0	1	1	2	1	3	1	2	0	1	3
CO2	0	0	1	2	0	1	1	2	2	3	1	1	0	1	2
CO3	0	0	1	1	0	0	1	2	1	3	2	1	0	0	1
CO4	0	0	2	2	0	1	2	3	1	3	1	2	0	1	3
CO5	0	0	1	1	0	0	1	1	1	3	2	1	0	1	3
CO6	0	0	1	1	0	1	1	2	0	3	1	2	0	0	2
CO7	0	0	2	1	0	0	2	3	0	3	2	1	0	1	2
CO8	0	0	2	2	0	0	2	2	1	3	2	0	0	1	3
CO9	0	0	2	1	0	2	1	2	1	3	0	1	0	0	2
CO10	0	0	1	1	0	1	1	1	2	3	1	2	0	0	2

1- Faintly
2- Moderately
3- Strongly

18CS102 **COMPUTER PRACTICE LABORATORY** **L T P C**
0 0 4 2

Course Objectives:

1. To provide basic knowledge of creating Word documents and also producing mail merge.
2. To make use of basic functions, formulas and charts in Spread sheet.
3. To implement problem solving techniques.
4. To promote the programming ability to develop applications for real world problems.

LIST OF EXERCISES

A. Word Processing

1. Document creation, Text manipulation with Scientific notations, Table creation, Table formatting and Conversion
2. Letter preparation using Mail merge and Draw flow Charts using tools

B. Spread Sheet

3. Chart - Line, XY, Bar and Pie.
4. Formula - formula editor, Sorting and Import and Export features.
5. Spread sheet - inclusion of object, Picture and graphics, protecting the document and sheet.

C. Simple C Programming

6. Program using Control statements.
7. Program using Looping.
8. Program using Array.
9. Program using String.
10. Program using Function.
11. Program using Structures.
12. Program using Pointers.
13. Program using Files.

*** For programming exercises Flow chart and pseudo code are essential**

Total = 60 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1 : demonstrate the basic mechanics of word documents and working knowledge of mail merge.
CO2 : demonstrate the use of basic functions and formulas in spread sheet.
CO3 : apply good programming methods for program development.
CO4 : implement c programs for simple applications.

CO/PO MAPPING

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	3	3	3	2	2	1	1	1	3	3	3	2	0
CO2	3	3	3	3	3	2	2	1	1	1	3	3	3	2	0
CO3	3	3	3	3	3	2	2	1	1	1	3	3	3	1	0
CO4	3	3	3	3	3	2	2	1	1	1	3	3	3	1	0

1- Faintly
2- Moderately
3- Strongly

18ME102 **WORKSHOP MANUFACTURING PRACTICES** **L T P C**
1 0 4 3

COURSE OBJECTIVES:

1. To provide an exposure of basic engineering practices to the student
2. To provide exposure to the students with hands on experience on various basic engineering practices in Civil and Mechanical Engineering

LIST OF EXERCISES

1. Introduction to Safety measures and First aid.
2. Study of Lathe -Welding methods and equipment's- Casting process and tools- Sheet metal and fitting tools- Carpentry tools and joints.
3. Fitting: V-fitting, Square fitting, Curve fitting.
4. Lathe: Facing, turning, taper turning and knurling.
5. Welding: BUTT, LAP and T- joints.
6. Foundry: Green sand preparation- mould making practice.
7. Sheet metal: Cone, tray, cylinder.
8. Carpentry: CROSS, T and DOVETAIL joints.
9. Drilling: simple exercises.

Total = 60 Periods

COURSE OUTCOMES:

Upon completion of this course, the students will be able to:

CO1 : prepare fitting of metal and wooden pieces using simple fitting and carpentry tools manually.
CO2 : prepare simple lap, butt and tee joints using arc welding equipment.
CO3 : prepare green sand moulding.
CO4 : prepare sheet metal components.
CO5 : prepare simple components using lathe and drilling machine.

REFERENCE BOOKS:

1. Bawa, H.S, "Work shop Practice", Tata McGraw Hill Publishing Company Limited, 2007.
2. Jeyachandran, K, Natarajan, K and Balasubramanian, S, "A Primer on Engineering Practices Laboratory", Anuradha Publications, 2007.
3. Jeyapoovan, T, SaravanaPandian, M and Pranitha, S, "Engineering Practices Lab Manual", VikasPuplishing House Pvt. Ltd, 2006.

CO-PO MAPPING

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	1	1	2	2	1	1	0	1	1	0	0	1	1	1	2
CO2	1	1	2	2	1	1	0	1	1	0	0	1	1	1	2
CO3	1	1	2	2	1	1	0	1	1	0	0	1	1	1	2
CO4	1	1	2	2	1	1	0	1	1	0	0	1	1	1	2
CO5	1	1	2	2	1	1	0	1	1	0	0	1	1	1	2

1- Faintly
2- Moderately
3- Strongly

SEMESTER III

18PH202	PHYSICS – WAVES & OPTICS AND QUANTUM MECHANICS	L	T	P	C
		3	1	0	4

Course Objectives:

1. To make the students to understand Simple harmonic motion and Waves
2. To understand the Propagation of light
3. To get clear idea of wave optics
4. To understand the Principle and working of laser with applications
5. To know the basic concepts of quantum Mechanics and Matter Waves

UNIT I SIMPLE HARMONIC OSCILLATION AND WAVES 9 + 3

Simple harmonic motion ; Damped Simple harmonic motion ; Forced vibrations – resonance; Wave motion- types and characteristics - velocity of a transverse wave along a stretched string -frequency of a vibrating string – harmonics and overtones - progressive waves & stationary waves – wave equation for progressive and Stationary waves.

UNIT II THE PROPAGATION OF LIGHT AND GEOMETRIC OPTICS 9 + 3

Fermats Principle - laws of reflection and refraction ; Mirage effect ; Total internal reflection ; Matrix method - imaging by a spherical refracting surface - imaging by a coaxial optical system; Optical Instruments - simple and compound microscope - astronomical telescope.

UNIT III WAVE OPTICS 9 + 3

Huygens Principle ; Principle of superposition ; Interference of Light – Youngs double slit experiment - Newtons rings - experimental arrangement to determine the wavelength of sodium light ; Michelson Interferometer ; Fraunhofer diffraction from a single slit ; Diffraction grating –determination of wavelength of light and dispersive power ; Polarisation - Polarisation by reflection - Brewsters Law.

UNIT IV LASERS 9 + 3

Properties of Laser beams - monochromacity , coherence , directionality and brightness ; Einstiens theory of matter radiation interaction and A&B coeffiecients - amplification of light by population inversion - pumping methods ; Different types of laser - Ruby , Nd-YAG , He-Ne,CO_2 $laser$ - Energy level diagrams ; Applications of lasers in science ,engineering and medicine.

UNIT V QUANTUM MECHANICS 9 + 3

Introduction - matter waves - Debroglie's equation - Davisson-Germer experiment-G.P.Thomson experiment; Time independent and dependent Schroedinger equation; Wave packet; Uncertainity Principle; Schroedinger equation for Particle in a one dimensional box; Physical Significance of wave function.

Total (45+15) = 60 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1 : understand simple harmonic oscillation and propagation of waves.
CO2 : apply matrix method to analyse system of reflecting and refracting surfaces.
CO3 : know various experimental techniques in wave optics.
CO4 : understand the concept of laser and its applications.
CO5 : gain knowledge in the basics of quantum mechanics.

Text Books:

1. Ajoy Ghatak,'Optics', Tata Mc Graw Hill Publishing Co.Ltd, Fourth Edition,2009
2. Gupta Kumar Sharma, 'Quantum Mechanics', Jai Prakash Nath & co, 25th Edition, 2005
3. Gaur R.K and Gupta S.L,'Engineering Physics', Dhanpat Rai Publishers,2009

Reference Books:

1. Palanisamy P.K,'Engineering Physics', Scitech Publications,2011
2. Rajendran V and Marikani A, 'Engineering Physics', PHI learning PVT, India, 2009

CO-PO MAPPING

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	0	3	3	1	2	0	1	0	0	3	2	0	2
CO2	3	3	0	2	2	1	0	0	1	0	0	3	2	0	2
CO3	2	3	0	2	3	1	1	0	1	0	0	3	1	0	2
CO4	3	2	0	2	3	1	1	0	1	0	0	2	2	0	1
CO5	3	3	0	2	3	1	1	0	1	0	0	3	2	0	2

1- **Faintly**
2- **Moderately**
3- **Strongly**

18MA204 **FOURIER SERIES AND TRANSFORMS** **L T P C**
3 1 0 4

Course Objectives:

1. To impact analytical skills in the areas of boundary value problems and transform techniques.
2. To obtain the knowledge of solving second order ODE using Laplace transform techniques and inverse Laplace transform using convolution theorem.
3. To familiarize with Fourier transform of a function and its sine and cosine transforms.
4. It serves as a prerequisite for post graduate and specialized studies and research.
5. To gain the skills to form difference equations and find its solution by using Z-transform method.

UNIT I FOURIER SERIES **9 + 3**

Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Parseval's Identity – Harmonic Analysis.

UNIT II BOUNDARY VALUE PROBLEMS **9 + 3**

Classification of second order quasi linear partial differential equations – Solutions of one dimensional wave equation – One dimensional heat equation – Steady state solution of two-dimensional heat equation (Insulated edges excluded) – Fourier series solutions in Cartesian coordinates.

UNIT III LAPLACE TRANSFORM **9 + 3**

Laplace Transform- Conditions for existence – Transform of elementary functions – Basic Properties – Transform of derivatives and integrals – Initial and Final value theorems- Transform of periodic Functions – Inverse Laplace Transform- solutions of linear ODE of second order with constant coefficient's using Laplace transformation techniques- statement and application of convolution theorem

UNIT IV FOURIER TRANSFORM **9 + 3**

Statement of Fourier integral theorem – Fourier transform pair – Sine and Cosine transforms – Properties – Transforms of simple functions – Convolution theorem - Parseval's Identity

UNIT V Z -TRANSFORM AND DIFFERENCE EQUATIONS **9 + 3**

Z-transform of simple functions and properties – Inverse Z – transform –initial and final value theorems- Convolution theorem -Formation of difference equations – Solution of difference equations using Z – transform technique.

Total (45+15) = 60 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1 : acquire the knowledge about fourier series
CO2 : learn the techniques of solving boundary value problems
CO3 : familiar with the transform techniques.

Text Books:

1. Veerarajan T, "Engineering Mathematics (For Semester III)", 3rd Edition, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2009.
2. P.Kandasamy, K.Thilagavathy and K.Gunavathy, "Engineering Mathematics, Volume III", S. Chand & Company ltd., New Delhi, 1996.

Reference Books:

1. Grewal, B.S., "Higher Engineering Mathematics", 43rd Edition, Khanna Publishers, Delhi, 2014.
2. Wylie C. Ray and Barrett Louis, C., "Advanced Engineering Mathematics", Sixth Edition, McGraw-Hill, Inc., New York, 1995.
3. Andrews, L.A., and Shivamoggi B.K., "Integral Transforms for Engineers and Applied Mathematicians", MacMillan, New York, 1988.

4. Narayanan, S., Manicavachagom Pillai, T.K. and Ramaniah, G., “Advanced Mathematics for Engineering Students”, Volumes II and III, S. Viswanathan (Printers and Publishers) Pvt. Ltd. Chennai, 2002.

CO-PO MAPPING

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	1	1	1	1	1	1	1	1	1	1	1	1	1
CO2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1
CO3	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1

1- Faintly
2- Moderately
3- Strongly

18ME301 **MANUFACTURING PROCESSES** **L T P C**
2 1 0 3

Course Objectives:

1. To make the students to familiarise with various manufacturing processes such as casting, welding, machining, metal forming, power metallurgy etc. involved in manufacturing of piston, connecting rod, crankshaft, engine block, front axle, frame, body, etc.

UNIT I CASTING **9 + 0**

Casting types, procedure to make sand mould, types of core making, moulding tools, machine moulding, special moulding processes – CO_2 moulding; shell moulding, investment moulding, permanent mould casting, pressure die casting, centrifugal casting, continuous casting, casting defects.

UNIT II WELDING **8 + 0**

Classification of welding processes. Principles of Oxy-acetylene gas welding. A.C metal arc welding, resistance welding, submerged arc welding, tungsten inert gas welding, metal inert gas welding, plasma arc welding, thermit welding, electron beam welding, laser beam welding, defects in welding, soldering and brazing.

UNIT III MACHINING **10 + 0**

General principles (with schematic diagrams only) of working and commonly performed operations in the following machines: Lathe, Shaper, Planer, Horizontal milling machine, Universal drilling machine, Cylindrical grinding machine, Capstan and Turret lathe. General principles and applications of the following processes: Abrasive jet machining, Ultrasonic machining, Electric discharge machining, Electro chemical machining.

UNIT IV FORMING AND SHAPING OF PLASTICS **9 + 0**

Types of plastics - Characteristics of the forming and shaping processes – Moulding of Thermoplastics – Working principles and typical applications of - Injection moulding – Plunger and screw machines – Blow moulding – Rotational moulding – Film blowing – Extrusion - Typical industrial applications – Thermoforming – Processing of Thermosets – Working principles and typical applications - Compression moulding – Transfer moulding.

UNIT V METAL FORMING AND POWDER METALLURGY **9 + 0**

Principles and applications of the following processes: Forging, Rolling, Extrusion, Wire drawing and Spinning, Powder metallurgy – Principal steps involved advantages, disadvantages and limitations of powder metallurgy.

Total (45+0) = 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1 : understand various casting and moulding processes.
CO2 : familiar with welding processes
CO3 : able to learn various types of machining processes.
CO4 : gained knowledge about forming and shaping of plastics.
CO5 : understand various forming processes and principles of powder metallurgy.

Text Books:

1. Hajra Choudhury, "Elements of Workshop Technology", Vol. I and II, Media Promoters and Publishers Pvt., Ltd., Mumbai, 2005.
2. NagendraParashar B.S. and Mittal R.K., "Elements of Manufacturing Processes", Prentice-Hall of India Private Limited, 2007.

Reference Books:

1. SeropeKalpajian, Steven R.Schmid, "Manufacturing Processes for Engineering Materials",4/e, Pearson Education, Inc. 2007.
2. Jain. R.K., and S.C. Gupta, "Production Technology", 16th Edition, Khanna Publishers, 2001.
3. "H.M.T. "Production Technology – Handbook", Tata McGraw-Hill, 2000.

4. Roy. A. Linberg, "Process and Materials of Manufacture", PHI, 2000.
5. Mikell P. Groover, Fundamentals of Modern Manufacturing: Materials, Processes, and Systems.

CO-PO MAPPING

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	0	2	0	1	0	0	0	0	0	0	0	0	2	0	1
CO2	0	1	0	0	0	0	0	0	1	0	0	0	0	0	3
CO3	0	1	0	0	0	0	1	0	0	0	1	0	0	1	1
CO4	0	1	0	0	0	0	0	0	2	0	0	0	0	0	1
CO5	0	1	0	0	0	0	0	0	1	0	0	0	0	0	1

1- Faintly
2- Moderately
3- Strongly

18ME302 **ENGINEERING MECHANICS** **L T P C**
3 0 0 3

Course Objectives:

1. To develop capacity to predict the effect of force and motion in the course of carrying out the design functions of engineering.
2. To analyze the force systems, friction and to study the dynamics of particles, impulse and momentum.

UNIT I STATICS OF PARTICLES **9 + 0**

Introduction – Units and Dimensions – Laws of Mechanics – Lami's theorem, Parallelogram and triangular Law of forces – Vectorial representation of forces – Vector operations of forces -additions, subtraction, dot product, cross product – Coplanar Forces – rectangular components – Equilibrium of a particle – Forces in space – Equilibrium of a particle in space – Equivalent systems of forces – Principle of transmissibility .

UNIT II EQUILIBRIUM OF RIGID BODIES **9 + 0**

Free body diagram – Types of supports and their reactions – requirements of stable equilibrium – Moments and Couples – Moment of a force about a point and about an axis – Vectorial representation of moments and couples – Scalar components of a moment – Varignon's theorem – Equilibrium of Rigid bodies in two dimensions – Equilibrium of Rigid bodies in three dimensions – Examples

UNIT III PROPERTIES OF SURFACES AND SOLIDS **9 + 0**

Centroid of simple figures from first principle, centroid of composite sections; Centre of Gravity and its applications; Area moment of inertia- Definition, Moment of inertia of plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections and composite sections.

UNIT IV FRICTION **9 + 0**

Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction; Motion of Bodies, wedge friction, screw jack & differential screw jack.

UNIT V KINETICS OF PARTICLES AND RIGID BODIES **9 + 0**

Equations of motion- Rectilinear motion-curvilinear motion- Relative motion- D'Alembert's Principle-work-Energy equation-Conservative forces and principle of conservation of energy-Impulse- momentum- Impact- Direct central impact and oblique central impact. Plane motion- Absolute motion- Relative motion- work and energy- impulse and momentum

Total (45+0) = 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1 : illustrate the vectorial and scalar representation of forces and moments
CO2 : draw free body diagrams and write appropriate equilibrium equations firm free body diagram.
CO3 : evaluate the properties of surfaces and solids
CO4 : analyze the systems that involve frictional forces.
CO5 : apply fundamental concepts of kinematics and kinetics of particles to the analysis of simple, practical problems

Text Books:

1. A Textbook of Engineering Mechanics, R.K. Bansal, Laxmi Publications, 2010.
2. Engineering Mechanics, R.S. Khurmi, S.Chand Publishing, 2010.

Reference Books:

1. Engineering Mechanics, D.S. Bedi, Khanna Book Publishing Co. (P) Ltd.
2. Rajasekaran S and Sankarasubramanian G., "Fundamentals of Engineering Mechanics", Vikas Publishing House Pvt. Ltd., 2000
3. Palanichamy M.S. and Nagam S., "Engineering Mechanics – Statics & Dynamics", Tata McGraw-Hill, 2001
4. Engineering Mechanics, DP Sharma, Pearson

5. F. P. Beer and E. R. Johnston, Vector Mechanics for Engineers, Vol I - Statics, Vol II, – Dynamics, 9th Ed, Tata McGraw Hill, 2011.

CO-PO MAPPING

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	2	0	0	0	0	0	0	0	0	0	0	1	1	0
CO2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
CO3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CO4	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0
CO5	1	2	0	0	0	0	0	0	0	0	0	0	1	0	0

1- Faintly
2- Moderately
3- Strongly

18ME303 **THERMODYNAMICS** **L T P C**
3 1 0 4

(Use of standard thermodynamic tables, Mollier diagram, Psychometric chart and Refrigerant property tables are permitted)

Course Objectives:

1. To understand the fundamentals of thermodynamics such as zeroth, first and second law concept.
2. To understand real and ideal gas behavior and thermodynamic relations.
3. To impart basic knowledge on psychrometry.

UNIT I BASIC CONCEPT AND FIRST LAW 9 + 3

Basic concepts - concept of continuum, macroscopic approach, thermodynamic systems - closed, open and isolated. Property, state, path and process, quasi-static process, work, modes of work, Zeroth law of thermodynamics – concept of temperature and heat. Concept of ideal and real gases. First law of thermodynamics – application to closed and open systems, internal energy, specific heat capacities, enthalpy, steady flow process with reference to various thermal equipments.

UNIT II SECOND LAW, ENTROPY AND AVAILABILITY 9 + 3

Second law of thermodynamics – Kelvin's and Clausius statements of second law. Reversibility and irreversibility. Carnot cycle reversed Carnot cycle, efficiency, COP. Thermodynamic temperature scale, Clausius inequality, concept of entropy, entropy of ideal gas, and principle of increase of entropy – Carnot theorem, absolute entropy, and availability.

UNIT III PROPERTIES OF PURE SUBSTANCE AND STEAM POWER CYCLE 9 + 3

Properties of pure substances – Thermodynamic properties of pure substances in solid, liquid and vapour phases, phase rule, P-V, P-T, T-V, T-S, H-S diagrams, PVT surfaces, thermodynamic properties of steam. Calculations of work done and heat transfer in non-flow and flow processes. Standard Rankine cycle, Reheat and regenerative cycle.

UNIT IV IDEAL AND REAL GASES AND THERMO DYNAMIC RELATIONS 9 + 3

Gas mixtures – Properties of ideal and real gases, equation of state, Avogadro's law, Vander Waal's equation of states, compressibility, and compressibility chart. Dalton's law of partial pressure, Exact differentials, Tds, relations, Maxwell relations, Clausius Clapeyron equations, Joule Thomson Coefficient.

UNIT V PSYCHROMETRY 9 + 3

Psychrometry and psychrometric charts, property calculations of air vapour mixtures. Psychrometric process – Sensible heat exchange processes. Latent heat exchange processes. Adiabatic mixing, evaporative cooling, problems.

Total (45+15) = 60 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1 : understand the concepts of zeroth, first and second law of thermodynamics.
CO2 : analyze the various work and heat interactions for different types of processes for closed and open systems.
CO3 : understand the properties of pure substance and concepts of rankine cycle.
CO4 : derive thermodynamic relations for ideal and real gases.
CO5 : understand the basic concepts of Psychrometry.

Text Books:

1. Nag. P.K, "Engineering Thermodynamics", Tata McGraw-Hill, New Delhi, 1998.
2. Holman. J.P, "Thermodynamics", 3rd Ed. McGraw-Hill, 1995.
3. Arora C.P, "Thermodynamics", Tata McGraw Hill, New Delhi, 2003.
4. Venwylen and Sontag, "Classical Thermodynamics", Wiley Eastern, 1987.

Reference Books:

1. Cengel, “Thermodynamics- An Engineering Approach”, 3rd Edition, Tata McGraw Hill,2003.
2. Merala C, Pother, Craig W and Somerton, “Thermodynamics for Engineers”, Schaum Outline Series, Tata McGrawHill, New Delhi, 2004.

CO-PO MAPPING

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	1	3	1	2	1	1	1	0	0	0	0	0	1	2	1
CO2	2	1	1	2	3	1	1	0	0	0	0	0	1	3	1
CO3	2	1	3	1	2	1	1	0	0	0	0	0	2	1	3
CO4	1	2	2	1	3	1	1	0	0	0	0	0	2	1	2
CO5	1	2	1	3	1	2	1	0	0	0	0	0	1	2	1

1- Faintly
2- Moderately
3- Strongly

18EC308	BASIC ELECTRONICS ENGINEERING	L	T	P	C
		3	0	0	3

Course Objectives:

1. To introduce the basics of electronic components and circuits.
2. To introduce the concepts of digital electronics and integrated circuits.

Unit I SEMICONDUCTOR DIODES AND APPLICATIONS 9 + 0

Introduction to Resistors, Inductors, Capacitors and their colour codes, Semi-conductors, Characteristics of PN Junction Diode – Zener Effect – Zener Diode and its Characteristics, Photodiodes, LEDs. Half-wave rectifier, Full-wave rectifier, Full-wave rectifier with capacitor filter.

Unit II BIPOLAR JUNCTION TRANSISTOR 9 + 0

Bipolar junction transistor – CB, CE, CC configurations and characteristics, CE amplifier, Concept of feedback, Negative feedback, voltage series feedback amplifier, Current series feedback amplifier.

Unit III DIGITAL ELECTRONICS 9 + 0

Binary Number System, Logic gates: Basic gates and universal gates, Combinational logic circuit: Half adder, Full adder. Flip-Flops: SR, JK, D and T flip-flops.

Unit IV INTEGRATED CIRCUITS 9 + 0

Introduction to Operational Amplifiers. Ideal OPAMP, Inverting and Non Inverting OPAMP circuits, OPAMP applications: voltage follower, addition, subtraction, integrator and differentiator. Digital to Analog converters – R-2R and weighted resistor types, Analog to Digital converters – Successive approximation and Flash types.

Unit V FUNDAMENTALS OF COMMUNICATION ENGINEERING 9 + 0

Types of Signals: Analog and Digital Signals – Principle of Amplitude and Frequency Modulations. Communication Systems: Radio, TV, Microwave, Satellite and Optical Fibre. (Block Diagram Approach only).

Total (45+0) = 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1 : to understand the concepts of electronic components and circuits.
CO2 : to understand the concepts of digital electronics.
CO3 : gain knowledge of integrated circuits.
CO4 : to understand the fundamentals concepts of communication engineering.

Text Books:

1. David A. Bell, “Electronic Devices and Circuits”, Oxford University Press, 5th Edition, 2008.
2. R.S. Sedha, “Applied Electronics” S. Chand & Co., 2006.

Reference Books:

1. D.P. Kothari, I. J. Nagrath, “Basic Electronics”, McGraw Hill Education (India) Private Limited, 2014.
2. Robert Boylestad and Louis Nashelsky, ―Electron Devices and Circuit Theory‖ Pearson Prentice Hall, 10th edition, July 2008.
3. Yang, ―Fundamentals of Semiconductor devices‖, McGraw Hill International Edition, 1978.
4. Mehta V K, “Principles of Electronics”, S.Chand & Company Ltd, (1994).

E-References:

1. https://www.elprocus.com/basic-electronic-books/
2. https://www.mheducation.co.in/engineering/electronics-engineering/basic-electronics

CO-PO MAPPING

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	1	0	2	0	0	0	0	1	0	0	0	2	0	0
CO2	3	1	0	2	0	0	0	0	1	0	0	0	2	0	0
CO3	3	2	1	2	0	0	0	0	1	0	0	0	2	0	0
CO4	3	2	1	2	0	0	0	0	1	0	0	0	2	0	2

1- Faintly
2- Moderately
3- Strongly

18ME304 MANUFACTURING TECHNOLOGY LABORATORY

L	T	P	C
0	0	3	2

Course Objectives:

1. Study of different types of machine tools like lathe, drilling machine, shaper, grinding machine etc.,

EXPERIMENTS:

1. Eccentric turning
2. Multi starts thread cutting
3. Drilling and grooving
4. Counter boring
5. Counter sinking
6. Shaping the sides of a cubical blank
7. Groove cutting and V-cutting
8. Dovetail cutting
9. T –slot cutting
10. Spur gear cutting in milling machine
11. Helical Gear Cutting in milling machine
12. Contour milling using vertical milling machine
13. Surface Grinding of cubical block
14. Cylindrical Grinding of circular shaft

Total = 45 Periods

Course Outcomes:

After the successful completion of the practical session, the students will be able to:

CO1 : Acquire necessary skills to operate different machineries.

CO2 : Perform machining time calculation in machining jobs.

CO-PO MAPPING

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	0	2	0	2	3	0	0	1	0	0	0	2	2	2	1
CO2	3	2	3	2	0	0	0	1	0	0	0	0	1	1	2

1- Faintly
2- Moderately
3- Strongly

18EC309 **ELECTRONICS LABORATORY** **L T P C**
0 0 2 1

Course Objectives:

1. To understand the working of Semiconductor diodes and rectifiers.
2. To understand the Basics of digital electronics.
3. To understand the applications of Operational Amplifier.

EXPERIMENTS

1. Characteristics of PN Junction Diode
2. Characteristics of Zener Diode
3. Characteristics of Photodiode/LED
4. Half-Wave Rectifier and Full-Wave Rectifier
5. Full-Wave Rectifier with C Filter
6. Characteristics of CE Configuration of BJT
7. Study of Logic Gates (Basic gates, Universal gates)
8. Implementation of Half Adder
9. Implementation of Full Adder
10. Realization of JK, D and T Flip flops using NAND Gates
11. Inverting and Non inverting Operational amplifier
12. Operational amplifier applications (Any two)

Total = 30 Periods

Course Outcomes:

Upon completion of this course, the students will be able to :

CO1 *:* study experimentally the characteristics of diodes, bjt.
CO2 *:* demonstrate functional verification of combinational logic circuits
CO3 *:* to demonstrate various applications of operational amplifier

Reference Books:

1. *Analog Electronic circuits Laboratory Manual. 2. David A. Bell, "Electronic Devices and Circuits",* 5thEdition, Oxford University Press,
2. B.Sasikala, S.Poornachandra Rao, "Handbook of experiments in Electronics and Communication Engineering", Vikas Publishing, 2007.
3. "David A Bell, "Laboratory Manual for Electronic Devices and Circuits", 4th edition, PHI, 2001.

E-References:

1. http://nptel.ac.in/courses/117105080/40
2. http://nptel.ac.in/courses/117108038/1

CO-PO MAPPING

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	1	0	3	1	0	0	0	2	0	0	2	1	0	0
CO2	3	2	0	3	1	0	0	0	2	0	0	2	1	0	0
CO3	3	1	0	3	1	0	0	0	2	0	0	2	1	0	0

1- Faintly
2- Moderately
3- Strongly

SEMESTER IV

18ME401	KINEMATICS OF MACHINERY	L	T	P	C
		3	1	0	4

Course Objectives:

1. To understand the principles in analyzing the assembly with respect to the displacement, velocity, and acceleration at any point in a link of a mechanism.
2. To understand the motion resulting from a specified set of linkages, design few linkage mechanisms and cam mechanisms for specified output motions.
3. To understand the basic concepts of toothed gearing and kinematics of gear trains and the effects of friction in motion transmission and in machine components.

UNIT I BASICS OF MECHANISMS 9 + 3

Classification of mechanisms- Basic kinematic concepts and definitions- Degree of freedom, mobility- Grashof's law, Kinematic inversions of four bar chain and slider crank chains-Limit positions- Mechanical advantage- Transmission angle- Description of some common mechanisms- Quick return mechanism, straight line generators- Universal Joint- Rocker Mechanisms.

UNIT II KINEMATIC ANALYSIS 9 + 3

Displacement, velocity and acceleration analysis of simple mechanisms, graphical velocity analysis using instantaneous centers, velocity and acceleration analysis using loop closure equations- kinematic analysis of simple mechanisms- slider crank mechanism dynamics- Coincident points- Coriolis component of acceleration- introduction to linkage synthesis three Position graphical synthesis for motion and path generation.

UNIT III KINEMATICS OF CAM 9 + 3

Classification of cams and followers- Terminology and definitions- Displacement diagrams-Uniform velocity, parabolic, simple harmonic and cycloidal motions- derivatives of follower motions- specified contour cams- circular and tangent cams- pressure angle and undercutting, sizing of cams, graphical and analytical disc cam profile synthesis for roller and flat face Followers.

UNIT IV GEARS AND GEARTRAINS 9 + 3

Involute and cycloidal gear profiles, gear parameters, fundamental law of gearing and conjugate action, spur gear contact ratio and interference/undercutting- helical, bevel, worm, rack & pinion gears, epicyclic and regular gear train kinematics.

UNIT V FRICTION IN MACHINE ELEMENTS 9 + 3

Surface contacts- sliding and rolling friction- friction drives- bearings and lubrication friction Clutches- belt and rope drives- friction in brakes.

Total (45+15) = 60 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1 : demonstrate and understanding of the concepts of various mechanisms and pairs.
CO2 : synthesize simple mechanisms for function, path generation and motion generation.
CO3 : develop CAM profiles
CO4 : analyze gears and gear trains
CO5 : examine friction in machine elements

Text Books:

1. Rattan S.S, "Theory of Machines", Tata McGraw Hill Publishing Company Ltd., New Delhi, 1998.
2. Ghosh, A and Mallick, A.K, "Theory of Mechanisms and Machines", East-West Pvt. Ltd., New Delhi, 1988.

Reference Books:

1. Thomas Bevan, "Theory of Machines", CBS Publishers and Distributors, 1984.
2. Rao J.S and Dukkipati R.V, "Mechanism and Machine Theory", Wiley-Eastern Ltd., New Delhi, 1992.
3. Erdman AG and Sandor G N, "Mechanism Design, Analysis and Synthesis", Vol.I, PHI Inc., 1997.

4. Ambekar A.G, “Mechanism and Machine Theory” Prentice Hall of India, New Delhi, 2007.
5. John Hannah and Stephens R C, “Mechanisms of Machines”, Viva Low Price Student Edition, New Delhi, 1999.

CO-PO MAPPING

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	2	2	1	0	0	0	0	0	0	0	3	2	0
CO2	2	2	1	1	1	0	0	0	0	0	0	0	3	2	0
CO3	3	2	2	1	1	0	0	0	0	0	0	0	2	2	0
CO4	3	2	2	2	1	0	0	0	0	0	0	0	3	2	0
CO5	2	1	2	1	1	0	0	0	0	0	0	0	2	3	0

1- Faintly
2- Moderately
3- Strongly

18ME402 **APPLIED THERMODYNAMICS** **L T P C**

3 0 0 3

(Use of standard thermodynamic tables, Mollier diagram, Psychometric chart and Refrigerant property tables are permitted in the examination)

Course Objectives:

1. To integrate the concepts, laws and methodologies from the first course in thermodynamics into analysis of cyclic processes
2. To apply the thermodynamic concepts into various thermal application like IC engines, Steam Turbines, Compressors and Refrigeration and Air conditioning systems

UNIT I GAS POWER CYCLES **9 + 0**

Otto, Diesel, Dual, Brayton cycles, Calculation of mean effective pressure and air standard efficiency, Actual and theoretical PV diagram of Four stroke engines, Actual and theoretical PV diagram of two stroke engines.

UNIT II INTERNAL COMBUSTION ENGINES **9 + 0**

Classification of IC engine, IC engine components and functions. Valve timing diagram and port timing diagram. Comparison of two stroke and four stroke engines. Fuel supply systems, Ignition Systems, Performance calculation. Comparison of petrol and diesel engine. Fuels, Air-fuel ratio calculation, Knocking and Detonation. Lubrication system and cooling system. Exhaust gas analysis, pollution control norms.

UNIT III STEAM NOZZLES AND TURBINES **9 + 0**

Flow of steam through nozzles, shapes of nozzles, effect of friction, critical pressure ratio, supersaturated flow. Impulse and reaction principles, compounding, velocity diagrams for simple and multistage turbines, speed regulations-governors and nozzle governors.

UNIT IV AIR COMPRESSOR **9 + 0**

Classification and working principle, work of compression with and without clearance. Volumetric efficiency, Isothermal efficiency and isentropic efficiency of reciprocating air compressors. Multistage air compressor and inter cooling – work of multistage air compressor, various types of compressors (Descriptive treatment only).

UNIT V REFRIGERATION AND AIR-CONDITIONING **9 + 0**

Vapour compression Refrigeration cycle – super heat, sub cooling, performance calculations. Working principle of vapour absorption system. Ammonia – water, Lithium bromide – water systems (Description only), Comparison between vapour compression and absorption systems. Psychrometry, Psychometric chart, Cooling load calculations. Concept of RSHF, GSHF, ESHF, Air conditioning systems.

Total (45+0) = 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1 : analyze the air standard cycles of internal combustion engines based on otto, diesel and dual cycles.

CO2 : get an insight of various components of internal combustion engines.

CO3 : apply thermodynamic concepts in steam nozzles and turbines

CO4 : get an insight of various types of air compressors.

CO5 : design refrigeration and air conditioning system for applications.

Text Books:

1. Rajput, R.K, “Thermal Engineering”, S. Chand Publishers, 2000.
2. Rudramoorthy, R, “Thermal Engineering”, Tata McGraw Hill, New Delhi, 2003.
3. Kothandaraman, C.P., Domkundwar,S. and Domkundwar , A.V, “A course in Thermal Engineering”, Dhanpat Rai and Sons, 5th Edition, 2002.
4. Sarkar B.K, “Thermal Engineering”, Tata McGraw Hill, 1998

Reference Books:

1. Holman. J.P., “Thermodynamics”, McGraw Hill, 1985.
2. Arora.C.P, “Refrigeration and Air Conditioning”, TMH, 1994.

CO-PO MAPPING

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	1	0	0	0	0	0	0	0	0	0	0	3	1	1
CO2	3	3	2	3	0	0	0	0	0	0	0	0	3	2	1
CO3	3	2	3	1	0	2	0	0	0	0	0	0	3	2	1
CO4	3	2	2	2	0	0	0	0	0	0	0	0	3	2	1
CO5	3	0	0	0	0	1	0	0	0	0	0	0	3	3	1

1- Faintly
2- Moderately
3- Strongly

18ME403 **FLUID MECHANICS AND MACHINERY** **L T P C**
3 1 0 4

Course Objectives:

1. To study the basics of fluid properties.
2. To study the kinematics and dynamics concept of the fluid flow.
3. To study the working and performance of turbine and pump.

UNIT I INTRODUCTION **9 + 3**

Definitions and units of measurement of physical quantities. Behavior of fluids - density, relative density, bulk modulus of elasticity, vapour pressure, surface tension, capillarity and viscosity. Fluid Statics: Concept of Hydrostatic Pressure, Manometers. Buoyancy and Archimedes' principle.

UNIT II FLUID KINEMATICS **9 + 3**

Classification of fluid flows, streamline, streak line, path line, stream function, velocity potential function, vorticity and circulation, flow net. Continuity equation and applications. Fluid Dynamics: Bernoulli's equation and its applications. Dimensional Analysis: Buckingham Π theorem, similarity laws and models.

UNIT III INCOMPRESSIBLE FLUID FLOW **9 + 3**

Viscous flow – Navier-Stokes equation. Shear stress, pressure gradient relationship. Laminar flow through circular pipes, Laminar flow between parallel plates. Turbulent flow through pipes. Friction factors in turbulent flow. Moody's friction factor chart. Flow through Pipes Series and Parallel pipes, Power transmission. Boundary Layer flows Boundary layer thickness, Boundary layer separation, Drag and Lift coefficients.

UNIT IV HYDRAULIC TURBINES **9 + 3**

Fluid Machines classification, Euler's equation for turbo machines. Working principles, velocity triangles, work done, specific speed, efficiency and performance curves of Pelton, Francis and Kaplan turbines.

UNIT V HYDRAULIC PUMPS **9 + 3**

Classification of pumps. Centrifugal pumps - working principle, velocity triangle, specific speed, efficiency and performance curves. Reciprocating pumps - classification, working principle, indicator diagram, air vessels and performance curves. Cavitation in pumps. Working principles of gear and vane pumps.

Total (45+15) = 60 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1 : understand the fundamental concepts of fluid mechanics
CO2 : apply the bernoulli equation to solve problems in fluid mechanics.
CO3 : understand the concepts of viscous flow and also have a knowledge in boundary layer concept.
CO4 : apply the principles of fluid mechanics to the design and operation of hydraulic pumps and turbines.

Text Books:

1. Bansal, R.K., "Fluid Mechanics and Hydraulic Machines", Laxmi Publication Pvt Ltd, 2007.
2. Kumar, D.S., "Fluid Mechanics and Fluid Power Engineering", S.K.Kataria Sons, 2009.
3. Subramanya, K., "Fluid Mechanics", Tata McGraw Hill publishing company Ltd, 2007.
4. Rajput, R.K., "Fluid Mechanics and Hydraulic Mechanics", S.Chand and Company Ltd, 2002.

Reference Books:

1. Streeter, V.L and Wyile, E.B., "Fluid Mechanics", Mc-Graw-Hill, 1999.
2. Som, S.K and Biswas, G, "Introduction to Fluid Mechanics and Fluid Machines", Tata McGraw Hill publishing company Ltd., New Delhi, 1998.

CO-PO MAPPING

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	0	0	0	0	0	1	0	0	0	0	2	2	1
CO2	2	3	0	1	0	0	0	1	0	0	0	0	3	2	1
CO3	3	1	0	1	0	0	0	0	0	0	0	1	2	2	1
CO4	2	2	3	3	0	0	0	1	0	0	0	0	2	3	1

1- Faintly
2- Moderately
3- Strongly

18ME404	STRENGTH OF MATERIALS	L	T	P	C
		3	0	0	3

Course Objectives:

1. To understand the nature of stresses developed in simple geometries such as bars, cantilevers, beams, shafts, cylinders and spheres for various types of simple loads
2. To calculate the elastic deformation occurring in various simple geometries for different types of loading

UNIT I STRESS, STRAIN AND DEFORMATION OF SOLIDS 9 + 0

Deformation in solids- Hooke's law, stress and strain- tension, compression and shear stresses-elastic constants and their relations- volumetric, linear and shear strains- principal stresses andprincipal planes- Mohr's circle. Deformation of simple compound bars-Relation between elastic constants-Thermal stresses.

UNIT II TRANSVERSE LOADING ON BEAMS AND STRESSES IN BEAMS 9 + 0

Beams and types transverse loading on beams- shear force and bend moment diagrams- Types of beam supports, simply supported and over-hanging beams, cantilevers. Theory of bending of beams, bending stress distribution and neutral axis, shear stress distribution, point and distributed loads. Shear stress distribution of simple beams- circular, rectangular, "I" section, "T" section and channel sections.

UNIT III DEFLECTION OF BEAMS AND COLUMNS 9 + 0

Moment of inertia about an axis and polar moment of inertia, deflection of a beam using double integration method, computation of slopes and deflection in beams, Macaulay's method – Area moment method - Conjugate beam and strain energy – Maxwell's reciprocal theorems. Columns: End conditions-Equivalent length of a column-Euler's equation-Slenderness ratio-Rankine's formula for columns.

UNIT IV THIN CYLINDERS, SPHERES AND THICK CYLINDERS 9 + 0

Axial and hoop stresses in cylinders subjected to internal pressure, deformation of thick and thin cylinders, deformation in spherical shells subjected to internal pressure – Lame's theorem.

UNIT V TORSION AND SPRINGS 9 + 0

Torsion, stresses and deformation in circular and hollow shafts, stepped shafts, deflection of shafts fixed at both ends. Torsion on springs-Wahl's factor of spring-Stresses in helical springs under torsion loads-Stiffness and deflection of springs under axial load.

Total (45+0) = 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1 : understand the concepts of stress and strain in simple and compound bars, the importance of principal stresses and principal planes

CO2 : understand the load transferring mechanism in beams and stress distribution due to shearing force and bending moment

CO3 : calculate the slope and deflection in beams using different methods.

CO4 : analyze and design thin and thick shells for the applied internal and external pressures.

CO5 : apply basic equation of simple torsion in designing of shafts and helical spring

Text Books:

1. Rajput, R.K, "Strength of Materials", S.Chand and Co, 3rd Edition, 2003.
2. Bansal, R.K., "Strength of Materials", Laxmi Publications (P) Ltd., 2016.

Reference Books:

1. Strength of Materials, D.S. Bedi, Khanna Publishing House
2. Subramanian R., "Strength of Materials", Oxford University Press, Oxford Higher Education Series, 2010.
3. Mechanics of Materials, Punmia, Jain and Jain, Laxmi Publications
4. Strength of Materials (Mechanics of Solid), R.S. Khurmi, S.Chand Publications
5. Strength of Materials, Jindal U.C., Asian Books Pvt. Ltd., New Delhi, 2009

CO/PO MAPPING

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0
CO2	2	2	1	1	0	0	0	0	0	0	0	0	1	2	0
CO3	3	2	1	1	0	0	0	0	0	0	0	0	2	2	0
CO4	3	2	2	2	0	0	0	0	0	0	0	0	2	0	1
CO5	2	2	2	2	0	0	0	0	0	0	0	0	2	0	1

1- Faintly
2- Moderately
3- Strongly

18ME405 **MATERIALS ENGINEERING** **L T P C**
3 0 0 3

Course Objectives:

1. To impart concept on reactions, treatment, microstructure and mechanical behavior of engineering materials at different temperature.
2. To learn basic principles in metallurgy and materials engineering.
3. To identity and select suitable engineering materials based on their applications

UNIT I FERROUS AND NON FERROUS METALS 9 + 0

Constitution of alloys – Solid solutions, substitution and interstitial – phase diagrams, Isomorphous, eutectic, peritectic, eutectoid and peritectoid reactions, Iron – Iron carbide equilibrium diagram. Classification of steel and cast Iron microstructure, properties and application. Effect of alloying additions on steel (Mn, Si, Cr, Mo, V Tiand W) - stainless and tool steels – HSLA - maraging steels – Gray, White, Malleable, spheroid - Graphite - alloy cast irons , Copper alloys – Brass, Bronze and Cupronickel , Aluminium alloys, Bearing alloys.

UNIT II HEAT TREATMENT 9 + 0

Definition – Full annealing, stress relief, recrystallisation and spheroidizing –normalizing, hardening and Tempering of steel. Isothermal transformation diagrams – cooling curves superimposed on I.T. diagram CCR - Hardenability, Jominy end quench test – Austempering, martempering – case hardening, carburising, nitriding, cyaniding, carbo-nitriding – Flame and Induction hardening. Heat treatment of non-ferrous alloys - precipitation and age hardening .Heat treatment of HSS tools, gears, springs and gauges.

UNIT III NON-METALLIC MATERIALS 9 + 0

Engineering Ceramics – Properties and applications of Al2O3, SiC, SiC, Si3, N4, PSZ Fracture and Defects of ceramics - Ceramic coating methods: Plasma spraying - APS and VPS, process principles, component preparation, deposition rates, coating materials. Chemical vapour deposition - deposition rates, carbon control of the substrate, industrial CVD, typical procedures, advantages and disadvantages, use of CVD coatings in metal cutting, wear mechanisms.– Fibre and particulate reinforced composites.

UNIT IV MECHANICAL PROPERTIES AND TESTING 9 + 0

Mechanical properties of engineering materials - Mechanisms of plastic deformation, slip and twinning – Creep, Fatigue and Fracture - Types of fracture – Testing of materials - tension, compression and shear loads - fatigue and creep tests – hardness and its effects – testing for hardness (Brinell, Vickers and Rockwell) - Impact test - Izod and Charpy.

UNIT V NON DESTRUCTIVE TESTING AND SURFACE ENGINEERING 9 + 0

Non Destructive Testing: Non Destructive Testing basic principles and testing method for radiographic Testing, Ultrasonic testing, Magnetic Particle Inspection and Liquid Penetrant Inspections Introduction to surface engineering Definition of surface engineering, diffusion techniques, deposition methods, high and low energy beam methods, surface engineering charts, elastic contact mechanics

Total (45+0) = 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1 : understand the formation of materials and their classification based on atomic structure.
CO2 : describe properties, applications and types of various ferrous and non-ferrous metals used in fabrication industry.
CO3 : understand the principles of various heat treatment processes in fabrication industry.
CO4 : describe various types of failure and select suitable techniques for failure analysis.

Text Books:

1. Kenneth G. Budinski and Michael K. Buinski, “Engineering Materials”, Prentice Hall of India Ltd, 2002.
2. Raghavan, V, “Materials Science and Engineering”, Prentice Hall of India (P) Ltd., 1999.
3. Aswani.K.G, “A Text Book of Material Science”, S.Chand and Co. Ltd., New Delhi, 2001.

4. Khanna O.P., “A Text Book of Materials Science and Metallurgy”, Dhanpat Rai Sons, 2004.

Reference Books:

1. William. D.Callsber, “Material Science and Engineering”, John Wiley and Sons, 1997.
2. Sydney.H.Avner, “Introduction to Physical Metallurgy” Mc Graw Hill Book Company, 1994.

CO-PO MAPPING

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	1	1	2	2	1	1	1	0	0	0	0	0	2	3	1
CO2	1	0	2	1	1	2	1	0	0	0	0	0	2	3	1
CO3	0	1	1	1	1	0	1	0	0	0	0	0	3	2	1
CO4	0	2	2	1	1	1	1	0	0	0	0	0	2	3	1

1- Faintly
2- Moderately
3- Strongly

18CYMC01 **ENVIRONMENTAL SCIENCE**

L	T	P	C
0	0	1	0

AIM

To impart awareness to the student that they are separate from the environment and should not control the environment.

Course Objectives:

1. They are part of the environment
2. To have an ancient wisdom drawn from Vedas
3. Activities based knowledge to preserve environment
4. Conservation of water and its optimization.

Curriculum

Environmental Awareness **6**

1. Group activity on water management
2. Group discussion on recycle of waste (4R's)
3. Slogan making contest.
4. Poster making event.
5. Expert lecture on environmental awareness.
6. Imparting knowledge on reduction of electricity usage

Environmental activities **8**

1. Identification and segregation of biodegradable and non-biodegradable waste
2. Campus cleaning activity
3. Plantation of trees in the college campus and local waste lands.
4. Identification of varieties of plants and their usage
5. Shutting down the fans and ACs of the campus for an hour
6. Field work on growing of kitchen garden for mess.

Total = 14 Periods

18ME406 **STRENGTH OF MATERIALS AND FLUID MECHANICS LABORATORY**

L	T	P	C
0	0	3	1.5

Course Objectives:

1. To analyze and design structural members subjected to tension, compression, torsion, bending and combined stresses using the fundamental concepts of stress, strain and elastic behavior of materials.
2. To utilize appropriate materials in design considering engineering properties and sustainability.

STRENGTH OF MATERIAL LABORATORY EXERCISES

1. Double shear test on mild steel rod
2. Uniaxial tension test on mild steel rod
3. Torsion test on mild steel rod
4. Impact test on a metallic specimen
5. Brinell and Rockwell hardness tests on metallic specimen
6. Bending deflection test on beams

FLUID MECHANICS LABORATORY EXERCISES

1. Determination of friction factor of pipes
2. Performance characteristics of Kaplan turbine
3. Determination of the Coefficient of discharge of given Orifice meter
4. Determination of the Coefficient of discharge of given Mouthpiece
5. Determination of the Coefficient of discharge of given Venturi meter
6. Conducting experiments and drawing the characteristic curves of centrifugal pump
7. Conducting experiments and drawing the characteristic curves of reciprocating pump.

Total = 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1 : learn the various techniques of testing methods for materials.
CO2 : perform test and identify the different characteristics of materials.
CO3 : perform experiments on hydraulic machines to draw the performance characteristics.

CO-PO MAPPING

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	3	2	0	1	0	0	0	0	0	0	0	2	2	1
CO2	2	3	2	1	1	0	0	0	0	0	0	0	2	2	1
CO3	3	2	2	1	1	0	0	0	0	0	0	0	2	2	1

1- Faintly
2- Moderately
3- Strongly

18ME407	THERMAL ENGINEERING LABORATORY	L	T	P	C
		0	0	3	1.5

Course Objectives:

1. To study the value timing-V diagram and performance of IC Engines
2. To Study the characteristics of fuels/Lubricates used in IC Engines

EXPERIMENTS:

1. Study of I.C. Engines, Components and Loading Devices
2. Study of Steam Generators and Turbines.
3. Valve Timing and Port Timing Diagrams.
4. Performance Test on 4-stroke Diesel Engine.
5. Heat Balance Test on 4-stroke Diesel Engine.
6. Morse Test on Multi cylinder Diesel Engine.
7. Retardation Test to find Frictional Power of a Diesel Engine.
8. Determination of Viscosity - Red Wood Viscometer.
9. Determination of Flash Point and Fire Point.

Total = 45 Periods

Course Outcomes:

After the successful completion of the practical session, the students will be able to:

CO1 : apply thermodynamic theory to real thermodynamic cycles
CO2 : understand the knowledge on testing the properties of fuels and lubricating oils
CO3 : demonstrate the performance of internal combustion engines

CO-PO MAPPING

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	1	1	3	1	1	0	0	0	0	0	1	1	2
CO2	1	2	1	1	1	2	1	0	0	0	0	0	2	1	1
CO3	2	1	3	1	1	2	1	0	0	0	0	0	3	1	3

1- Faintly
2- Moderately
3- Strongly

SEMESTER V

18ME501	HEAT AND MASS TRANSFER	L	T	P	C
		3	1	0	4

Course Objectives:

1. Understand the mechanisms of heat transfer under steady and transient conditions
2. Understand the concepts of heat transfer through extended surfaces.
3. Learn the thermal analysis and sizing of heat exchangers and to understand the basic concepts of mass transfer

UNIT I CONDUCTION 9 + 3

Basic concepts, Mechanism of heat transfer, Fourier's law of conduction, general differential equation of heat conduction- Cartesian and cylindrical coordinates, one dimensional steady state heat conduction, conduction through plane wall, cylinders and spheres, composite geometries, contact resistance, conduction with heat generation, extended surface heat transfer, unsteady state heat conduction, lumped analysis and use of Heisler charts.

UNIT II CONVECTIVE HEAT TRANSFER 9 + 3

Dimensional analysis, boundary layer concept, basic governing equations, external flow-flow over plates, cylinders and spheres, internal flow- laminar and turbulent flow, combined laminar and turbulent flow, flow over bank of tubes, free convection-flow over vertical plate, horizontal plate, inclined plate, cylinders and spheres.

UNIT III PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGERS 9 + 3

Modes of boiling, Nusselt theory of condensation, correlations in boiling and condensation, types of heat exchangers, methods of analysis, LMTD and NTU method, overall heat transfer coefficient, fouling factors.

UNIT IV RADIATION 9 + 3

Basic laws of radiation, view factor algebra, black body radiation, grey body radiation, radiation shields, electrical analogy using radiosity and irradiation, gaseous emission and absorption.

UNIT V MASS TRANSFER 9 + 3

Basic concepts, Diffusion mass transfer-Fick's Law of diffusion, steady state molecular diffusion, convective mass transfer.

Total (45+15)= 60 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1 : analyze the basic concept of conduction, convection and radiation.
CO2 : analyze the extended surfaces and evaluate performance parameters
CO3 : design and analyze the performance of heat exchangers by using the method of LMTD and NTU
CO4 : understand the fundamental relationship between heat transfer and mass transfer.

Text Books:

1. Holman J.P, “Heat and Mass Transfer”, Tata McGraw Hill, 2000.
2. Sachdeva, R.C, “Fundamentals of Engineering Heat and Mass Transfer”, New Age International Publishers, New Delhi, 1995.
3. Bejan, A, “Heat Transfer”, John Wiley and Sons, 1995.
4. Ozisik, M.N, “Heat Transfer”, McGraw Hill Book Co., 1994.

Reference Books:

1. Yadav, R, “Heat and Mass Transfer”, Central Publishing House, Allahabad, 1995.
2. C.P.Kothandaraman,“Fundamentals of Heat and Mass Transfer”, New Age International Publishers, New Delhi,1998.

CO-PO MAPPING

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	3	3	3	1	0	1	0	0	0	0	0	3	3	0
CO2	3	3	3	2	2	0	1	0	0	0	0	0	3	3	0
CO3	1	3	3	3	2	0	1	0	0	0	0	0	3	3	0
CO4	2	1	3	1	0	0	0	0	0	0	0	0	3	2	0

1- Faintly
2- Moderately
3- Strongly

18ME502 **INSTRUMENTATION AND CONTROL** **L T P C**
3 0 0 3

Course Objectives:

1. To make the students aware of the modern sensors and advanced measurement systems
2. To select the correct system of instrumentation and sensing as per the industrial requirements.
3. To understand statistical signal processing
4. To provide adequate knowledge in the time response of systems and steady state error analysis.
5. To introduce stability analysis and design of compensators

UNIT I GENERAL CONCEPTS OF MEASUREMENT 9 + 0

Measurement systems- Sensors and transducers– Classifications of Transducers -Static and Dynamic Characteristics –Sensors for displacement, position and proximity; velocity, motion, force, fluid pressure, liquid flow, liquid level, temperature, light sensors–Selection of sensors

UNIT II SIGNAL CONDITIONING 9 + 0

Amplifier characteristics, wheat's stone bridge- Instrumentation sensor – integration and differentiation - sampling, A/D and D/A conversion, choppers, voltage to time conversion, voltage to freq. Conversion concept and methods.

UNIT III DATA ACQUISITION 9 + 0

Real-time interfacing – Introduction - Elements of data acquisition and control - Overview of I/O process, Digital I/O, counters and timers, DMA, Software and hardware installation, Data acquisition interface requirements,- General configuration-single channel and multichannel data acquisition – Data Logging – Data conversion – Introduction To Digital Transmission system.

UNIT IV Time Response Analysis 9 + 0

Response of systems for different time based input, Classification of feedback control system according to type; static error coefficients- generalized steady state errors steady state errors due to impulse, step, ramp and parabolic inputs.

UNIT V Frequency Domain Analysis 9 + 0

Frequency response–Bode plot –Polar plot –Determination of closed loop response, open loop response- Correlation between frequency domain and time domain specifications-Effect of Lag, lead and lag-lead compensation on frequency response-Analysis

Total (45+0)= 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1 : ability to apply common measurement characteristics and terms to select sensors to meet control and monitoring requirements.

CO2 : ability to design, build and test sensor interface circuits including amplifiers to process the measured variable into a useful signal in the presence of noise and environmental variations.

CO3 : ability to select, design appropriate signal processing to its instrumentation and control and their measurement

CO4 : ability to understand and apply basic science, theory control theory and apply them to control engineering problems.

CO5 : ability to aanalyse the performance of systems and components through the use of analytical techniques

Text Books:

1. John G. Webster, "Measurement, Instrumentation, and Sensors Handbook", CRC Press. 1999.
2. Murthy, D.V.S., Transducers and Instrumentation, 2nd Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2010

Reference Books:

1. Patranabis, D, “Sensors and Transducers”, Wheeler Publishing Co, Ltd., New Delhi, 1997.
2. M. Gopal, ‘Control Systems, Principles and Design’, 4th Edition, Tata McGraw Hill, New Delhi, 2012
3. K.Ogata, Modern Control Engineering, 4th Edition, Prentice Hall, 2002

CO-PO MAPPING

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	1	0	0	0	0	0	0	0	0	0	0	1	0	0
CO2	0	0	2	2	0	0	0	0	0	0	0	0	2	0	0
CO3	0	0	0	0	2	0	1	0	0	0	0	1	0	0	1
CO4	1	0	0	0	0	0	2	0	0	0	0	0	0	0	0
CO5	0	0	0	0	0	0	0	1	2	0	0	0	0	0	2

1- Faintly
2- Moderately
3- Strongly

18ME503	METROLOGY AND QUALITY CONTROL	L	T	P	C
		3	0	0	3

Course Objectives:

1. To provide knowledge on various Metrological equipments available to measure the dimension of the components
2. To provide knowledge on the correct procedure to be adopted to measure the dimension of the components.

UNIT I BASICS OF MEASUREMENT SYSTEM AND DEVICES 9 + 0

Definition of metrology, accuracy, precision and sensitivity, Abbe's principle. Three stages of generalized measurement system - mechanical loading - static characteristics of instruments - factors considered in selection of instruments - commonly used terms, error analysis and classification - sources of error. Principle of interferometry, laser interferometer.

UNIT II CALIBRATION OF INSTRUMENTS AND QUALITY STANDARDS 9 + 0

Calibration of measuring instruments - principles of calibration, Calibration of Instruments - Vernier caliper, Micrometer, feeler gauges, dial indicator, surface plates, slip gauges, care of gauge blocks. General cares and rules in measurement, ISO 9000 quality standards. Comparators - mechanical, electrical, optical and pneumatic.

UNIT III GEOMETRICAL MEASUREMENT AND MACHINE ELEMENTS 9 + 0

Angular measurement - optical protractors, sine bar, roundness measurement, limit gauge, design of plug gauge, Taylor's principle, three basic types of limit gauges, Tomlinson surface meter, computer controlled CMM. ISO metric thread, measurement of major, minor and effective diameters. Gear terminology; spur gear measurement, checking of composite errors, base pitch measurement.

UNIT IV STATISTICAL QUALITY CONTROL 9 + 0

Surface finish- terminology and measurements - Optical measuring instruments- Acceptance test for machines Statistical Quality Control - Control charts - Sampling plans.

UNIT V SIX SIGMA 9 + 0

Six sigma: define measure, analyse, improve and control phases. Analyse phase tools: Common Tools: Histogram, Box Plot, Control chart, Scatter chart, Cause and effect diagram, Pareto analysis, interrelations diagram. Special Tools: Regression Analysis, Hypothesis Testing, ANOVA, Multivariate analysis.

Total (45+0)= 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1 : upon completion of this course, the students can demonstrate different measurement technologies and use of them in industrial components

CO2 : evaluate quality of job, machine and instruments.

CO3 : perform calibration of measuring instruments

CO4 : differentiate the accuracy of instruments.

Text Books:

1. Gupta.I.C, ―A text book of Engineering Metrology‖, Dhanpat Rai publications, New Delhi, 2007
2. Beckwith.T.G,Roy D. Marangoni, John H. Lienhard, ―Mechanical Measurements‖, Prentice Hall, 2006
3 Jain.R.K, ―Mechanical and Industrial Measurements‖, Khanna Publishers, Delhi, 1999.

Reference Books:

1. Holmen.J.P, —Experimental Methods for Engineers‖, Tata McGraw Hill Publications Co Limited, 2004.
2. Grant, E.L., Statistical Quality Control, Mc Graw-Hill, 2004. 3. Doeblin E.O., Measurement Systems, Mc Graw-Hill, 2004.
3. Alan S Morris, —Measurement and Instrumentation Principles‖, Butterworth, 2006.
4. De Feo J A and Barnard W W, —Six Sigma: Break trough and Beyond‖, Tata McGraw-Hill, New Delhi, 2005.

CO-PO MAPPING

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	2	1	0	0	0	0	0	0	0	0	1	0	0
CO2	2	1	2	2	1	0	0	0	0	0	0	0	2	0	0
CO3	2	2	1	2	0	0	2	0	0	0	0	0	0	0	0
CO4	2	2	1	1	0	0	0	0	0	0	0	1	0	0	0

1- Faintly
2- Moderately
3- Strongly

18ME504 **DYNAMICS OF MACHINERY** **L T P C**
3 0 0 3

Course Objectives:

1. To impart students with the knowledge about motion, masses and forces in machines and the Principle of Virtual Work
2. To facilitate students to understand the concept of balancing of rotating and reciprocating masses
3. To teach students concepts of linear vibration analyses of one and two degree-of-freedom rigid body systems
4. To teach students concepts of torsional vibrations analyses of rigid body systems and to give awareness to students on the phenomenon of vibration and its effects
5. To teach students about the concept of various types of governors

UNIT I FORCE ANALYSIS **9 + 0**

Rigid Body dynamics in general plane motion – Equations of motion - Dynamic force analysis - Inertia force and Inertia torque – D'Alemberts principle - The principle of superposition - Dynamic Analysis in Reciprocating Engines – Gas Forces - Equivalent masses - Bearing loads - Crank shaft Torque - Turning moment diagrams - Fly wheels –Engine shaking Forces - Cam dynamics - Unbalance, Spring, Surge and Windup.

UNIT II BALANCING **9 + 0**

Static and dynamic balancing - Balancing of rotating masses - Balancing a single cylinder Engine - Balancing Multi-cylinder Engines - Partial balancing in locomotive Engines - Balancing linkages - balancing machines

UNIT III LONGITUDINAL AND TRANSVERSE VIBRATION **9 + 0**

Basic features of vibratory systems - idealized models - Basic elements and lumping of parameters - Degrees of freedom - Single degree of freedom - Free vibration - Equations of motion - Natural frequency of longitudinal and transverse (Free, Forced) vibrations - Types of Damping - Damped vibration (Free, Forced) - critical speed of simple shaft. Response to periodic forcing - Harmonic Forcing - Forcing caused by unbalance - Support motion – Force transmissibility and amplitude transmissibility – Vibration isolation.

UNIT IV TORSIONAL VIBRATION & VIBRATING MEASUREMENTS **9 + 0**

Torsional systems - Natural frequency of free torsional vibration – Single, two and three rotor systems – Torsionally Equivalent shaft - Introduction to multi-degree-of-freedom systems. Vibration instruments: vibrometer, accelerometer. Vibration Measuring Devices- Vibration exciters - FFT analyzer.

UNIT V GOVERNORS **9 + 0**

Governors - Types - Centrifugal governors - Gravity controlled and spring controlled centrifugal governors – Characteristics - Effect of friction - Controlling Force - other Governor mechanisms.

Total (45+0) = 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1 : apply basic principles of mechanisms in mechanical system
CO2 : perform static and dynamic analysis of simple mechanisms
CO3 : perform balancing of rotating and reciprocating masses
CO4 : model and analyse mechanical systems subjected to vibration
CO5 : study the various types of governors and its speed control mechanism

Text Books:

1. Design of Machinery, Fourth Edition, by R.L. Norton, McGraw Hill, 2007
2. Mechanical Vibration, V.P.Singh, Dhanpatrai, Delhi

Reference Books:

1. Ballaney, P.L., "Theory of Machines and Mechanisms", Khanna Publishers, New Delhi, 2002.
2. Shigley, J.E. and Uiker, J.J., "Theory of Machines and Mechanisms", TMH ND, 1998.

3. Amithabha Ghosh, and Ashok Kumar Malik., “Theory of Mechanisms and Machines”, 2nd Ed., Affiliated East and West Press Limited, 1998.
4. Prof.Nakara, IIT-Delhi Reference Books

E-References:

1. www.university.youth4work.com/IIT_Kharagpur_Indian-Institute-of-Technology/study/1653-dynamics-of-machinery-ebook
2. http://nptel.ac.in/courses/112104114/

CO-PO MAPPING

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	2	3	3	1	0	0	0	0	0	1	0	3	2	1
CO2	2	2	3	2	1	0	0	0	0	0	1	0	3	2	1
CO3	2	2	3	2	0	0	0	0	0	0	1	0	3	2	1
CO4	2	2	3	2	1	0	0	0	0	0	1	0	3	2	1
CO5	1	2	3	2	0	0	0	0	0	0	1	0	3	2	1

1- Faintly
2- Moderately
3- Strongly

18MC301	INDIAN CONSTITUTION	L	T	P	C
		2	0	0	0

Course Objectives:

1. Learn the salient features of the Indian Constitution.
2. To study the List the Fundamental Rights and Fundamental Duties.
3. To study the Present a systematic analysis of all dimensions of Indian Political System.
4. To study the Understand the power and functions of the Parliament, the Legislature and the Judiciary.

UNIT I

Union and its Territory – Citizenship–Fundamental Rights–Directive Principles of State Policy–Fundamental Duties

UNIT II

The Union–The States–The Union Territories–The Panchayats–The Municipalities

UNIT III

The Co-operative Societies–The scheduled and Tribal Areas–Relations between the Union and the States–Finance, Property, Contracts and Suits–Trade and Commerce within the territory of India

UNIT IV

Services under the Union, the States – Tribunals – Elections– Special Provisions –Relating to certain Classes

UNIT V

Languages–Emergency Provisions – Miscellaneous–Amendment of the Constitution

Total (15+0) = 15 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1 : Understand the emergence and evolution of the Indian Constitution
CO2 : Explain the key concepts of Indian Political System
CO3 : Describe the role of constitution in a democratic society.
CO4 : Present the structure and functions of the Central and State Governments, the Legislature and the Judiciary

Reference Books:

1. SubhashC.Kashyap, Our Constitution, National Book Trust, 2017.
2. Durga Das Basu, Introduction to the Constitution of India, Lexis Nexis, 2015
3. Granville Austin, The Indian Constitution: Cornerstone of a Nation, Oxford University Press, 1999.
4. M.V.Pylee, Constitutional History of India, S.Chand publishing, 2010.

18ME505 HEAT TRANSFER AND REFRIGERATION LABORATORY

L	T	P	C
0	0	3	1.5

Course Objectives:

1. To impart knowledge on conduction, convection and radiation heat transfer through experiments.
2. To study the performance of refrigeration cycle / components.

EXPERIMENTS:

HEAT TRANSFER

1. Thermal conductivity measurement by guarded plate method
2. Thermal conductivity of metal bar
3. Thermal conductivity of insulating powder
4. Thermal conductivity of pipe insulation using lagged pipe apparatus
5. Natural convection heat transfer from a vertical cylinder
6. Forced convection inside tube
7. Heat transfer from pin-fin (natural and forced convection modes)
8. Determination of Stefan-Boltzmann constant
9. Determination of emissivity of a grey surface
10. Effectiveness of Parallel/counter flow heat exchanger

REFRIGERATION AND AIR CONDITIONING

11. Determination of COP of a refrigeration system
12. Experiments on air-conditioning system
13. Performance test on single/two stage reciprocating air compressor.

Total = 45 Periods

Course Outcomes:

After the successful completion of the practical session, the students will be able to:

CO1 : demonstrate the conduction and convection heat transfer through experiments.
CO2 : evaluate heat transfer efficients for natural convection and Forced convention
CO3 : analyze heat exchanger performance using effectiveness method.
CO4 : calculate radiation heat exchange between black body and gray body surfaces.
CO5 : demonstrate the working principle of refrigeration and air-conditioning system

CO-PO MAPPING

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	3	2	2	0	0	0	0	0	0	0	0	2	3	1
CO2	2	2	3	1	0	0	0	0	0	0	0	0	2	3	1
CO3	2	3	2	1	0	0	0	0	0	0	0	0	3	3	1
CO4	2	2	3	3	0	0	0	0	0	0	0	0	3	2	1
CO5	2	2	2	3	0	0	0	0	0	0	0	0	2	3	2

1- Faintly
2- Moderately
3- Strongly

18EN501 **COMMUNICATION SKILLS AND LANGUAGE LABORATORY** **L T P C**

0 0 2 2

Course Objectives:

1. Communicate effectively with interviewers
2. Express opinions, illustrate with examples, elucidate and conclude in group discussions
3. Write error free letters and prepare reports
4. Speak fluently and avoid pitfalls in pronunciation and grammatical errors

EXPERIMENTS:

1. **WRITING SKILLS**
   - Letter seeking permission to go on industrial visit
   - Letter of invitation
   - Letter of request for leave
   - Resume and Cover Letter
   - Report Writing – Progress in project work
2. **SPEAKING SKILLS**
   - Welcome Address and Vote of Thanks
   - Conversation Skills
   - Analysing and presenting business articles
   - Power Point Presentation
   - Group Discussion
3. **SOFT SKILLS**
   - Psychometric profile
   - Self-Introduction
   - Interview skills
   - Leadership traits

   Conducting a board meeting
4. **VERBAL ABILITIES**
   - Error Spotting
   - Listening Comprehension
   - Reading Comprehension
   - Rearranging Jumbled sentences
   - Vocabulary
5. **Lab Record**
   1. Group Discussion - Literature survey
   2. Group Discussion - Transcripts
   3. Group Discussion - Assessment forms
   4. InterviewSkills – Psychometric profile
   5. Interview Skills - Self-introduction
   6. Interview Skills – Resume and Cover Letter
   7. Interview Skills - Transcription of interview
   8. Interview Skills - Assessment sheet signed by interview panel
   9. Power Point Presentation
   10. Error spotting worksheet
   11. Jumbled sentences worksheet
   12. Reading comprehension worksheet
   13. Welcome Address
   14. Vote of Thanks
   15. Letter seeking permission to go on industrial visit
   16. Letter of request for leave
   17. Report Writing – Progress in project work
   18. Presentation of business articles - Transcription

Total = 30 Periods

Course Outcomes:

After the successful completion of the practical session, the students will be able to:

CO1 : write error free letters and prepare reports
CO2 : deliver welcome address and vote of thanks
CO3 : speak coherently with proper pronunciation and accent
CO4 : avoid common indianisms and grammatical errors
CO5 : improve repertoire of passive vocabulary
CO6 : answer questions posed by interviewers confidently
CO7 : participate in group discussion effectively
CO8 : undertake online psychometric and iq test to understand their strengths and weaknesses

References:

1. Anderson, P.V, Technical Communication, Thomason Wadsworth, Sixth Edition, New Delhi, 2007.
2. Prakash, P, Verbal and Non-Verbal Reasoning, Macmillan India Ltd., Second Edition, New Delhi, 2004.
3. John Seely, The Oxford Guide to Writing and Speaking, Oxford University Press, New Delhi, 2004.
4. Evans, D, Decision maker, Cambridge University Press, 1997.
5. Thorpe, E, and Thorpe, S, Objective English, Pearson Education, SecondEdition, New Delhi, 2007.
6. Turton, N.D and Heaton, J.B, Dictionary of Common Errors, Addision WesleyLongman Ltd., Indian reprint 1998.
7. Ready,Steaady, Go. Deepak Mehra, Jaico Publishing House, Delhi,2015
8. Business English Certificate Materials, Cambridge University Press.
9. http://www.learnmyself.com (Personality Test and IQ Test).
10. http://www.humanmetrics.com/cgi-win/jtypes2.asp

CO-PO MAPPING

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	0	0	2	1	0	2	2	1	1	3	2	2	0	2	3
CO2	0	0	1	1	0	1	1	2	1	3	2	1	0	1	2
CO3	0	0	2	1	0	0	0	1	2	3	1	2	0	0	2
CO4	0	0	2	2	0	2	2	3	1	3	1	2	0	2	1
CO5	0	0	1	2	0	1	1	2	2	3	2	1	0	1	3
CO6	0	0	1	1	0	0	0	1	0	3	2	2	0	0	2
CO7	0	0	1	2	0	0	2	3	0	3	1	1	0	2	3
CO8	0	0	2	2	0	0	2	1	1	3	2	0	0	1	3

1- Faintly
2- Moderately
3- Strongly

18ME506 **DYNAMICS AND METROLOGY LABORATORY** **L T P C**
0 0 3 1.5

Course Objectives:

1. To be familiar With Different Measuring Equipment.
2. And Use Of these instruments in Industry For Quality Inspection
3. To know the need of accuracy in industry

EXPERIMENTS

1. Governors - Determination of sensitivity, effort, etc. for Watt, Porter, Proell, Hartnell governors
2. Cam - Study of jump phenomenon and drawing profile of the cam.
3. Motorized Gyroscope-Verification of laws -Determination of gyroscopic couple.
4. Whirling of shaft-Determination of critical speed of shaft with concentrated loads.
5. Determination of moment of inertia by oscillation method for connecting rod and flywheel.
6. Vibrating system - Spring mass system-Determination of damping co-efficient of single degree of freedom system.
7. Determination of transmissibility ratio - vibrating table.
8. Determination of torsional frequencies for compound pendulum and flywheel system with Lumped Moment of inertia.
9. Transverse vibration –free- Beam. Determination of natural frequency and deflection of beam.
10. Calibration of Vernier / Micrometer / Dial Gauge
11. Checking Dimensions of part using slip gauges
12. Measurements of Gear Tooth Dimensions
13. Measurement of Taper Angle using sine bar / tool makers microscope
14. Measurement of thread parameters
15. Checking the limits of dimensional tolerances using comparators (Mechanical / Pneumatic / Electrical)

Total = 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1 : ability to handle different measurement tools
CO2 : perform measurements in quality impulsion
CO3 : avoid errors in measurement
CO4 : understand balancing of equipment

CO-PO MAPPING

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	1	3	2	2	3	0	0	0	0	0	0	0	3	1	2
CO2	0	2	0	3	1	1	0	0	0	0	0	0	1	2	3
CO3	3	1	0	0	0	2	0	0	0	0	0	0	2	3	1
CO4	2	3	0	1	3	1	0	0	0	0	0	0	3	2	1

1- Faintly
2- Moderately
3- Strongly

SEMESTER VI

18ME601	COMPUTER INTEGRATED MANUFACTURING	L	T	P	C
		3	0	0	3

Course Objectives:

1. To gain knowledge on how computers are integrated at various levels of planning and manufacturing.
2. To understand the flexible manufacturing system and to handle the product data and various software used for manufacturing

UNIT I INTRODUCTION 9 + 0

The meaning and origin of CIM- the changing manufacturing and management scene - External communication - islands of automation and software-dedicated and open systems-manufacturing automation protocol - product related activities of a company- marketing engineering - production planning - plant operations - physical distribution- business and financial management.

UNIT II GROUP TECHNOLOGY AND COMPUTER AIDED PROCESS PLANNING 9 + 0

History of group technology- role of G.T. in CAD/CAM integration - part families - classification and coding - DCLASS and MICLASS and OPITZ coding systems-facility design using G.T. -benefits of G.T. - cellular manufacturing. Process planning - role of process planning in CAD/CAM integration - approaches to computer aided process planning -variant approach and generative approaches - CAPP and CMPP process planning systems.

UNIT III SHOP FLOOR CONTROL AND INTRODUCTION OF FMS 9 + 0

Shop floor control-phases -factory data collection system -automatic identification methods- Bar code technology-automated data collection system. FMS-components of FMS - types -FMS workstation -material handling and storage systems- FMS layout -computer control systems-application and benefits.

UNIT IV CIM IMPLEMENTATION AND DATA COMMUNICATION 9 + 0

CIM and company strategy - system modeling tools -IDEF models - activity cycle diagram - CIM open system architecture (CIMOSA) - manufacturing enterprise wheel-CIM architecture - Product data management-CIM implementation software. Communication fundamentals- local area networks -topology - LAN implementations - network management and installations.

UNIT V OPEN SYSTEM AND DATABASE FOR CIM 9 + 0

Open systems-open system inter connection - manufacturing automations protocol and technical office protocol (MAP /TOP). Development of databases -database terminology- architecture of database systems-data modeling and data associations -relational data bases - database operators - advantages of data base and relational database.

Total (45+0) =45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1 : recognize the manufacturing activities interrelated with computers.
CO2 : understand the concept of group technology and the various approaches of computer aided process planning.
CO3 : explain the phases of shop floor control activities.
CO4 : apply the system modeling tools in cim
CO5 : explain the applications of database and system protocol

Text Books:

1. Mikell.P.Groover, “Automation, Production Systems and Computer Integrated Manufacturing”, Pearson Education, 2008.
2. Roger Hanman, “Computer Integrated Manufacturing”, Addison –Wesley, 1997.

Reference Books:

1. Ranky and Paul G., “Computer Integrated Manufacturing”, Prentice Hall International 1986.
2. David D.Bedworth, Mark R.Hendersan and Phillip M.Wolfe, “Computer Integrated Design and Manufacturing”, McGraw Hill Inc, 1998.
3. Kant Vajpayee S, “Principles of Computer Integrated Manufacturing”, Prentice Hall India,2003
4. Mikell. P.Groover and Emory ZimmersJr, “CAD/CAM”, Prentice Hall of India Pvt. Ltd, 1998
5. Yoremkoren, “Computer Integrated Manufacturing system”, McGraw-Hill, 1983.

CO-PO MAPPING

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	1	3	0	2	0	1	0	0	0	2	3	3	2	2
CO2	2	1	1	0	2	0	2	0	2	0	2	2	2	3	2
CO3	2	0	2	0	2	0	0	0	1	0	2	2	2	2	1
CO4	1	2	2	0	2	0	1	0	1	0	2	2	1	2	2
CO5	1	1	1	0	1	0	1	0	1	0	2	1	2	1	2

1- Faintly
2- Moderately
3- Strongly

18ME602 **FINITE ELEMENT ANALYSIS** **L T P C**

3 0 0 3

Course Objectives:

1 To equip the students with the basic concepts of Finite Element methods.
2 To make the students to formulate the physical design problems into FEA including domain discretization, polynomial interpolation, application of boundary conditions, assembly of global arrays, and solution of the resulting algebraic systems.
3 To learn and apply finite element solutions to structural, thermal, dynamic problem to develop the knowledge and skills.
4 To familiarize the students in deriving FEA equations for 1D and 2D problems with different types of elements.
5 To make the students understand the need for FEA package and the procedure for solving problems

UNIT I INTRODUCTION 9 + 0

Basics of FEM – history - Comparison with other methods - General steps of FEM - Applications and Advantages -Matrix approach- Application to the continuum – Discretization - Types of elements based on geometry- Node numbering, Half band width - Matrix algebra- Gaussian elimination - Classical techniques in FEM - Weighted residual methods –general weighted residual statement – weak formulation of the weighted residual statement – comparisons – piecewise continuous trial functions example of a bar finite element – functional and differential forms – principle of stationary total potential – Rayleigh Ritz method – piecewise continuous trial functions – application to bar element.

UNIT II ONE DIMENSIONAL FEA 9 + 0

General form of total potential for 1-D applications – generic form of finite element equations – linear bar element – quadratic element –nodal approximation – development of shape functions – derivation of element stiffness matrices and vectors – assembly- example problems – extension to plane truss– development of element equations – assembly – element connectivity – global equations – solution methods –beam element – nodal approximation – shape functions – element matrices and vectors – assembly – solution – example solid mechanics problems - Temperature effects.

UNIT III TWO DIMENSIONAL FEA 9 + 0

Introduction – approximation of geometry and field variable – 3 noded triangular elements – four noded rectangular elements – higher order elements – Interpolation polynomials- Linear, quadratic and cubic. Simplex complex and multiplex elements- 2D PASCAL's triangle - generalized coordinates approach to nodal approximations – difficulties – natural coordinates and coordinate transformations – CST elements - Shape functions and Nodal load vector - Strain displacement matrix and Jacobian for triangular and rectangular element – structural mechanics applications in 2-dimensions – elasticity equations – stress strain relations – plane problems of elasticity – element equations – assembly – example problems in plane stress, plane strain - axisymmetric element applications.

UNIT IV ISOPARAMETRIC FORMULATIONS 9 + 0

Isoparametric elements – sub parametric and Super parametric elements - natural co-ordinate systems - Shape functions for isoparametric elements – One and two dimensions – Serendipity elements – axisymmetric applications - need for quadrature formula – transformations to natural coordinates – Gaussian quadrature Numerical integration and application to plane stress problems – Matrix solution techniques - Lagrange's interpolation- Higher order one dimensional elements - Quadratic and cubic element - Applying numerical integration: 1, 2 and 3 gauge point for 1D and 2D cases - example problems.

UNIT V HEAT TRANSFER AND FLUID FLOW APPLICATION 9 + 0

One dimensional heat transfer element – Steady state heat transfer, 1D heat conduction governing Equations - Functional approach for heat conduction- Galerkin's approach for heat conduction - application to one-dimensional heat transfer problems- 1D heat transfer in thin fins problems - scalar variable problems in 2-

Dimensions – Applications to heat transfer in 2- Dimension – Incompressible fluid flow- Basic equations - solution procedure - Galerkin Approach - Problems in incompressible fluid flow.

Total (45+0) = 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1 : perform the mathematical formulation of the finite element method and apply the same to basic (linear) ordinary and partial differential equations.

CO2 : develop and solve stiffness equations for 1d fea using bar, truss and beam elements.

CO3 : develop and solve stiffness equations for 2d fea using cst and other plane elements.

CO4 : implement the finite element method efficiently in order to solve simple structural problems

CO5 : solve the basic 1d and 2d heat transfer and fluid flow problems.

Text Books:

1. Chandrupatla T. R &Belagundu A. D, “Introduction to Finite Elements in Engineering”, 3rd Edition, Prentice Hall College Div, 1990.
2. Seshu, P, “Text Book of Finite Element Analysis”, Prentice-Hall of India Pvt. Ltd., New Delhi, 2007.

Reference Books:

1. Reddy. J.N., “An Introduction to the Finite Element Method”, 3rd Edition, Tata McGraw-Hill, 2005.
2. Rao, S.S., “The Finite Element Method in Engineering”, 3rd Edition, Butterworth Heinemann, 2004.
3. Robert D. Cook, David S. Malkus, Michael E. Plesha, Robert J. Witt, “Concepts and Applications of Finite Element Analysis”, 4th Edition, Wiley Student Edition, 2002.
4. Bathe K.J, “Finite Element Procedures in Engineering Analysis”, Prentice hall, 1981.
5. C.S. Desai and J.P. Abel, “Introduction to Finite Element Method”, Affiliated East West Press, 1972.

CO-PO MAPPING

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	1	0	0	0	0	0	0	0	0	0	1	2	0
CO2	3	2	1	0	0	0	0	0	0	0	0	0	2	1	0
CO3	3	2	1	0	0	0	0	0	0	0	0	0	2	1	0
CO4	3	1	2	2	1	0	0	0	0	0	0	0	2	1	0
CO5	3	2	1	0	1	0	0	0	0	0	0	0	2	1	0

1- Faintly
2- Moderately
3- Strongly

18ME603 **DESIGN OF MACHINE ELEMENTS** **L T P C**
3 1 0 4

Course Objectives:

1. A strong background in mechanics of materials based failure criteria underpinning the safety-critical design of machine components
2. An understanding of the origins, nature and applicability of empirical design principles, based on safety considerations
3. An overview of codes, standards and design guidelines for different elements
4. An appreciation of parameter optimization and design iteration
5. An appreciation of the relationships between component level design and overall machine system design and performance

UNIT I STEADY STRESSES AND VARIABLE STRESSES IN MACHINE MEMBERS 9 + 3

Introduction to the design process – Product development cycle- factors influencing machine design, selection of materials based on mechanical properties - Preferred numbers– Direct, Bending and Torsional stress – Impact and shock loading – Calculation of principle stresses for various load combinations, eccentric loading – Design of curved beams – crane hook and 'C' frame - Factor of safety -theories of failure – stress concentration – design for variable loading – Soderberg, Goodman and Gerber relations .

UNIT II DESIGN OF SHAFTS, COUPLINGS AND PIN JOINTS 9 + 3

Design of solid and hollow shafts based on strength, rigidity and critical speed – Design of keys and key ways - Design of rigid and flexible couplings – Design of pin joints like cotter and knuckle joints.

UNIT III DESIGN OF THREADED FASTENERS, RIVETED AND WELDED JOINTS 9 + 3

Threaded fasteners - Design of bolted joints including eccentric loading – Design of riveted and welded joints for pressure vessels and structures.

UNIT IV DESIGN OF ENERGY STORING ELEMENTS AND ENGINE COMPONENTS 9 + 3

Various types of springs, optimization of helical springs - rubber springs - Flywheels considering stresses in rims and arms for engines and punching machines- Connecting Rods and crank shafts. Heat engines- Brief details about external combustion and internal combustion engines, Design of I.C engine cylinder, piston, connecting rod, crankshaft and flywheel.

UNIT V DESIGN OF BEARINGS, LEVERS, PRESSURE VESSELS AND PIPES 9 + 3

Sliding contact and rolling contact bearings - Hydrodynamic journal bearings, Sommerfeld Number - Selection of Rolling Contact bearings. Design of Levers - Design of pressure vessels and pipes

Total = (45+15) = 60 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1 : explain the influence of steady and variable stresses in machine component design.
CO2 : apply the concepts of design to shafts, keys and couplings.
CO3 : apply the concepts of design to temporary and permanent joints
CO4 : apply the concepts of design to various energy storing elements and engine components.
CO5 : design the various types of bearings and levers.

Textbooks:

1. Bhandari V.B, "Design of Machine Elements", Tata McGraw Hill Book Co, 2003
2. Md.Jalaludeen.S, "A text book of Machine Design", Anuradha Publications, 2006

Reference Books:

1. Shigley, J.E. and Mischke, C.R., Mechanical Engineering Design, Fifth Edition, McGraw-Hill International; 1989.

2. Deutschman, D., Michels, W.J. and Wilson, C.E., Machine Design Theory and Practice, Macmillan, 1992.
3. Juvinal, R.C., Fundamentals of Machine Component Design, John Wiley, 1994.
4. PSG Tech, “Design Data Handbook”, M/s.DPV Printers, Coimbatore, 2009
5. R. L. Norton, Mechanical Design – An Integrated Approach, Prentice Hall, 1998
6. Md.Jalaludeen.S, “Design Data Handbook”, Anuradha Publications, 2006

CO-PO MAPPING

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	3	2	0	0	0	0	0	0	0	0	3	2	0
CO2	3	2	2	1	0	0	0	0	0	0	0	0	2	2	0
CO3	3	2	2	2	0	0	0	0	0	0	0	0	2	2	0
CO4	3	3	2	2	0	0	0	0	0	0	0	0	2	2	0
CO5	3	3	2	1	0	0	0	0	0	0	0	0	3	2	0

1- Faintly
2- Moderately
3- Strongly

18ME604	CAD/CAM LABORATORY	L	T	P	C
		0	0	3	1.5

Course Objectives:

1. To train students in modeling the 3-D geometric information of machine components including assemblies, and automatically generate 2-D production drawings.
2. To improve visualization ability of machine components and assemblies before their actual fabrication through modeling.
3. To equip the students for implement CNC programs for milling and turning machining operations.
4. To create a computer aided manufacturing (CAM) model and generate the machining codes automatically using the CAM system.
5. To use full-scale CAD/CAM software systems designed for geometric modeling of machine components and automatic generation of manufacturing information

EXPERIMENTS:

A. CAD EXPERIMENTS

1. The students will be required to carry out the following exercises using software packages (e.g. 3D modeling package / Pro Engineer/ CATIA /I-Deas/ Solid Edge/Solid Works etc.)

CAD LAB

2. Introduction to advanced modeling software
3. Part Modeling of Screw Jack
4. Part Modeling of Flange Coupling
5. Part Modeling of Plummer Block
6. Part Modeling of Knuckle Joint
7. Creation of 3D assembly model of universal joint
8. Creation of 3D assembly model of connecting rod
9. Creation of 3D assembly model of crank shaft
10. Creation of 3D assembly model of Lathe Tailstock
11. Detailing of Lathe Tailstock
12. Surface Modeling /File import & Export/ STL file generation

B. CAM EXPERIMENTS

13. Tool path generation, Part programming, G & M codes development for machining operations, Physical interpretation of machining features and tool geometries

CAM LAB

14. Manual part programming- CNC Turning Centre
    Facing, Turning, Chamfering, Taper turning, Thread cutting
15. Manual part programming- CNC Turning Centre
    Facing, Turning, Chamfering, Taper turning, Grooving, Threading using canned cycles
16. Manual part programming- CNC Milling
    Linear and circular Profile, Pocket, Drill, Peck-Drill, Bore, Tap- Using canned cycles.
17. Part Program generation and tool path simulation for turning & Milling for Fanuc Control System using CAM software.
18. Demonstration on CNC Turning & Milling Machines

Total = 45 Periods

Course Outcomes:

After the successful completion of the practical session, the students will be able to:

CO1 : understand how cad technology can be leveraged in the design process and the basic and advanced features available with cad software

CO2 : design a part or assembly of parts using computer-aided design software.

CO3 : understand the cnc concepts and manual part programming using g and m codes.

CO4 : understand modern cnc control systems (fanuc, siemens etc.) and application of various cnc machines.

CO5 : prepare cnc part programming and perform manufacturing.

CO-PO MAPPING

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	1	2	0	1	3	0	0	0	0	1	0	1	1	1	1
CO2	2	0	0	0	3	0	0	0	0	0	0	0	1	3	2
CO3	2	1	0	0	3	0	0	0	0	0	0	0	1	2	3
CO4	2	1	0	0	3	0	0	0	0	0	0	0	1	2	3
CO5	2	2	0	1	2	0	0	0	0	0	0	0	1	2	3

1- Faintly
2- Moderately
3- Strongly

18ME605 **MINI PROJECT** **L T P C**
0 0 6 1

Course Objectives:

1. To get hands on training in the fabrication of one or more components of a complete working model, which is designed by them
2. To design and fabricate models

FABRICATION PROJECT GUIDELINES

a. Mechanical Assembly and Dismantling Models
b. Day-life Usage Project
c. New Scientific Invention
d. Implementation of Mechanical Principle

Total = 30 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1 : initiate the students to come out with innovative ideas for various applications.

CO2 : create an environment to convert the ideas into design of prototype for useful industrial, agricultural and social applications.

CO-PO MAPPING

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	0	2	1	0	2	1	2	1	3	1	1	3	3	2	2
CO2	2	2	3	1	3	2	2	1	2	1	0	3	1	2	3

1- Faintly
2- Moderately
3- Strongly

SEMESTER VII

18ME701	MECHATRONICS	L	T	P	C
		3	0	0	3

Course Objectives:

1. To impart knowledge about the elements and techniques involved in Mechatronics systems which are very much essential to understand the emerging field of automation.

UNIT I INTRODUCTION TO MECHATRONICS 9 + 0

Definition and Introduction to Mechatronic Systems- Mechatronic Products and their functioning- Advanced applications in Mechatronics -Measurement systems- Control Systems- sequential controllers.

UNIT II PHYSICAL SYSTEM MODELING 9 + 0

General System Models- zero order-first order- second order-mechanical systems, electrical systems, thermal systems, electromechanical systems, hydro-mechanical systems, pneumatic systems-Basis of analogies in physical system models.

UNIT III ACTUATION SYSTEMS 9 + 0

Electric motors - Solenoids - Solid state switches - Stepper motors- Servo motors- Mechanical actuators- Hydraulic motors - Piezo actuators– Control systems - PID Controllers.- Artificial intelligence in Mechatronics – Adaptive and nonlinear control design- Neural networks and fuzzy systems.

UNIT IV PROGRAMMING LOGIC CONTROLLERS 9 + 0

Introduction to Programmable Logic Controllers – Basic Structure – Input / Output processing – Ladder logic programming – Mnemonics –relays and counters – Shift registers – Master and Jump controls – Data handling – Analog Input / Output – Case studies on PLC.

UNIT V MECHATRONICS SYSTEMS DESIGN 9 + 0

Stages in designing of Mechatronics systems – Traditional and Mechatronic design - Possible design solutions. Case studies: Data acquisition and control - Pick and place robot – automatic car park barrier systems – Engine management systems- Mechatronic control in automated manufacturing.

Total (45+0)= 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1 : students will be able to understand the basic elements underlying mechatronics systems and integrate them in the design of mechatronics systems.

CO2 : students will be able to develop a simulation model for simple physical systems and illustrate mechatronics design process.

CO3 : students will be capable of designing, interfacing and understand issues of implementation of different actuation in a mechatronics system for a set of specifications.

CO4 : students understand how to interface electromechanical systems to plcs.

CO5 : students will gain practical experience in applying knowledge gained in the course through a hands-on project.

Text Books:

1. Bolton, W, Mechatronics, Pearson Education, 6th Edition, 2015.
2. Ganesh S.Hegde, Mechatronics, Jones & Bartlett publishers, 1st Edition, 2010.

Reference Books:

1. Michael B. Histand and David G. Alciatore, Introduction to Mechatronics and Measurement Systems, McGraw Hill International Editions, 3rd Edition, 2007.
2. Bradley D. A., Dawson D., Buru N.C. and. Loader A.J, Mechatronics, Chapman and Hall, 1st Edition, 1993.
3. Dan Necsulesu, Mechatronics, Pearson Education Asia, 1st Edition, 2002

4. Brian Morriss, Automated Manufacturing Systems - Actuators, Controls, Sensors and Robotics, McGraw Hill International Edition, 1995.

CO-PO MAPPING

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	1	2	0	0	0	0	0	0	0	0	0	0	1	0	0
CO2	0	0	2	0	1	0	0	0	0	0	0	0	0	2	0
CO3	0	0	0	1	0	0	2	0	0	0	0	0	0	0	0
CO4	0	0	0	0	2	0	0	0	0	0	3	0	0	2	1
CO5	0	0	0	2	0	0	0	0	0	0	0	3	0	0	3

1- Faintly
2- Moderately
3- Strongly

18ME702	MECHATRONICS AND SIMULATION LABORATORY	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES:

1. To acquire adequate knowledge to design and simulate the basic electric, hydraulic and pneumatic, PLC systems.
2. To gain practical experience in interfacing Microcontroller, Computer and data acquisition system in real world problems
3. To design, set up, and conduct engineering experiments and analyze complex engineering problems

1. **MECHATRONICS LABORATORY**

LIST OF EXPERIMENTS

1. Design and testing of fluid power circuits to control
   (i) velocity (ii) direction and (iii) force of single and double acting actuators
2. Simulation of basic Hydraulic, Pneumatic and Electric circuits using software.
3. Circuits with multiple cylinder sequences in Electro pneumatic using PLC.
4. Servo controller interfacing for open loop
5. Servo controller interfacing for closed loop
6. Stepper motor interfacing with 8051 Micro controller
   (i)full step resolution (ii) half step resolution
7. Computerized data logging system with control for process variables like pressure flow and temperature.

2 **SIMULATION LABORATORY**

LIST OF EXPERIMENTS

Analysis of Mechanical Components – Use of FEA packages, like ANSYS/ NASTRON etc., Excesses shell include FEA analysis of

(i) Machine elements under static loads
(ii) Heat transfer in mechanical systems
(iii) Determination of natural frequency
(iv) Axi-Symmetric
(v) Non-linear systems

Total =45 Periods

COURSE OUTCOMES:

Upon completion of this course, the students will be able to:

CO1 : select various control valves and use them in hydraulic and pneumatic circuit development.
CO2 : get adequate knowledge to simulate the basic electric, hydraulic and pneumatic system using simulation software.
CO3 : gain practical experience in data acquisition system and develop and evaluate alternate solutions to real world problems.
CO4 : use softwares as a tool for analyzing complex engineering problems.
CO5 : design, set up, and conduct engineering experiments and analyze the Results.

CO-PO MAPPING

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	1	3	0	0	0	0	0	0	0	0	0	0	1	1	1
CO2	0	0	1	2	0	0	0	0	0	0	0	0	1	2	2
CO3	0	0	1	0	0	0	1	2	0	0	0	0	2	1	3
CO4	0	0	0	3	0	0	0	0	0	0	2	3	2	1	3
CO5	0	0	0	0	0	0	0	0	2	1	2	0	2	2	3

1- Faintly
2- Moderately
3- Strongly

18ME703 **PROJECT – I** **L T P C**
0 0 10 4

COURSE OBJECTIVES:

1. The main objective is to give an opportunity to the student to get hands on training in the fabrication of one or more components of a complete working model, which is designed by them.
2. It is intended to start the project work early in the seventh semester and carry out both design and fabrication of a mechanical device whose working can be demonstrated. The design is expected to be completed in the seventh semester and the fabrication and demonstration will be carried out in the eighth semester

GUIDELINE FOR REVIEW AND EVALUATION

1. The students may be grouped into 2 to 4 and work under a project supervisor. The device/system/component(s) to be fabricated may be decided in consultation with the supervisor and if possible with an industry. A project report to be submitted by the group and the fabricated model, which will be reviewed and evaluated for internal assessment by a Committee constituted by the Head of the Department. At the end of the semester examination the project work is evaluated based on oral presentation and the project report jointly by external and internal examiners (Supervisors) constituted by the Head of the Department

Total = 75 Periods

COURSE OUTCOMES:

Upon completion of this course, Students will be able:

CO1 : to initiate and motivate the students to come out with innovative ideas for different applications.

CO2 : to create an environment to convert the ideas into design of prototype for useful industrial, agricultural and social applications.

CO3 : to create an environment to convert the design into manufacturing of prototype for useful industrial, agricultural and social applications.

CO-PO MAPPING

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	0	2	1	0	2	1	2	1	3	1	1	3	3	2	2
CO2	2	2	3	1	3	2	2	1	2	1	0	3	1	2	3
CO3	1	2	3	2	3	2	2	2	2	2	1	3	2	3	3

1- Faintly
2- Moderately
3- Strongly

SEMESTER VIII

18ME801	PROJECT – II	L	T	P	C
		0	0	12	10

COURSE OBJECTIVES:

1. The main objective is to give an opportunity to the student to get hands on training in the fabrication of one or more components of a complete working model, which is designed by them.

2. It is intended to start the project work early in the seventh semester and carry out both design and fabrication of a mechanical device whose working can be demonstrated. The design is expected to be completed in the seventh semester and the fabrication and demonstration will be carried out in the eighth semester.

GUIDELINE FOR REVIEW AND EVALUATION

1. The students may be grouped into 2 to 4 and work under a project supervisor. The device/system/component(s) to be fabricated may be decided in consultation with the supervisor and if possible with an industry. A project report to be submitted by the group and the fabricated model, which will be reviewed and evaluated for internal assessment by a Committee constituted by the Head of the Department. At the end of the semester examination the project work is evaluated based on oral presentation and the project report jointly by external and internal examiners (Supervisors) constituted by the Head of the Department

Total = 90 Periods

COURSE OUTCOMES:

Upon completion of this course, Students will be able:

CO1 : to initiate and motivate the students to come out with innovative ideas for different applications.

CO2 : to create an environment to convert the ideas into design of prototype for useful industrial, agricultural and social applications.

CO3 : to create an environment to convert the design into manufacturing of prototype for useful industrial, agricultural and social applications.

CO-PO MAPPING

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	0	2	1	0	2	1	2	1	3	1	1	3	3	2	2
CO2	2	2	3	1	3	2	2	1	2	1	0	3	1	2	3
CO3	1	2	3	2	3	2	2	2	2	2	1	3	2	3	3

1- Faintly
2- Moderately
3- Strongly

PROFESSIONAL ELECTIVES COURSES

Electives – I (SEMESTER VI)

18MEPE11	COMPOSITE MATERIALS	L	T	P	C
		3	0	0	3

Course Objectives:

1. To learn about the benefits gained when combining different materials into a composite.
2. To make the students to understand different processing methods, issues, properties.
3. To practice the testing methods of different composite materials.

UNIT I INTRODUCTION TO COMPOSITES 9 + 0

Fundamentals of composites - need for composites – enhancement of properties - classification of composites – Matrix-Polymer matrix composites (PMC), Metal matrix composites (MMC), Ceramic matrix composites (CMC) – Reinforcement – particle reinforced composites, Fibre reinforced composites. Applications of various types of composites. Fiber production techniques for glass, carbon and ceramic fibers

UNIT II POLYMER MATRIX COMPOSITES 9 + 0

Polymer resins – thermosetting resins, thermoplastic resins – reinforcement fibres – rovings – woven fabrics – non woven random mats – various types of fibres. PMC processes - hand layup processes – spray up processes – compression moulding – reinforced reaction injection moulding - resin transfer moulding – Pultrusion – Filament winding – Injection moulding. Fibre reinforced plastics (FRP), Glass Fibre Reinforced Plastics (GFRP). Laminates-Balanced Laminates, Symmetric Laminates, Angle Ply Laminates, Cross Ply Laminates.-applications of PMC in aerospace, automotive industries

UNIT III METAL MATRIX COMPOSITES 9 + 0

Characteristics of MMC, various types of metal matrix composites alloy vs. MMC, advantages of MMC, limitations of MMC, Reinforcements – particles – fibres. Effect of reinforcement - volume fraction – rule of mixtures. Processing of MMC – powder metallurgy process - diffusion bonding– stir casting – squeeze casting, a spray process, Liquid infiltration In-situ reactions-Interface- measurement of interface properties- applications of MMC in aerospace, automotive industries

UNIT IV CERAMIC MATRIX COMPOSITES AND SPECIAL COMPOSITES 9 + 0

Engineering ceramic materials – properties – advantages – limitations – monolithic ceramics - need for CMC – ceramic matrix - various types of ceramic matrix composites- oxide ceramics – non oxide ceramics – aluminium oxide – silicon nitride – reinforcements – particles- fibres- whiskers. Sintering - Hot pressing – Cold isostatic pressing (CIPing) – Hot isostatic pressing (HIPing). applications of CMC in aerospace, automotive industries-Carbon /carbon composites – advantages of carbon matrix – limitations of carbon matrix carbon fibre – chemical vapour deposition of carbon on carbon fibre perform. Sol-gel technique- Processing of Ceramic Matrix composites.

UNIT V MECHANICS OF COMPOSITES 9 + 0

Lamina Constitutive Equations: Lamina Assumptions – Macroscopic Viewpoint. Generalized Hooke's Law. Reduction to Homogeneous Orthotropic Lamina – Isotropic limit case, Orthotropic Stiffness matrix (Qij), Definition of stress and Moment Resultants. Strain Displacement relations. Basic Assumptions of Laminated anisotropic plates. Laminate Constitutive Equations – Coupling Interactions, Balanced Laminates, Symmetric Laminates, Angle Ply Laminates, Cross Ply Laminates. Laminate Structural Moduli. Evaluation of Lamina Properties from Laminate Tests. Quasi-Isotropic Laminates. Determination of Lamina stresses within Laminates.

Total (45+0) =45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1 : use different materials to design new composites

CO2 : apply different techniques to process different types of composites and know the limitations of each process

CO3 : derive mathematical techniques to predict the macroscopic properties of different laminates

Text Books:

1. Mathews F. L. and Rawlings R. D., “Composite Materials: Engineering and Science”, Chapman and Hall, London, England, 1st edition, 1994.
2. Chawla K. K., “Composite materials”, Springer – Verlag, Second Edition, 1998

Reference Books:

1. Clyne, T. W. and Withers, P. J., “Introduction to Metal Matrix Composites”, Cambridge University Press, 1993.
2. Strong, A.B., “Fundamentals of Composite Manufacturing”, SME, 1989.
3. Sharma, S.C., “Composite materials”, Narosa Publications, 2000.
4. Broutman, L.J. and Krock,R.M., “ Modern Composite Materials”, Addison-Wesley, 1967.
5. ASM Hand Book, “ Composites”, Vol.21, ASM International, 2001.

CO-PO MAPPING

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	2	3	2	0	2	0	0	0	0	0	0	2	0	1
CO2	1	2	3	2	1	0	0	0	0	0	0	0	0	2	0
CO3	3	1	1	2	3	1	0	0	0	0	0	0	0	0	0

1- Faintly
2- Moderately
3- Strongly

18MEPE12 **DESIGN OF TRANSMISSION SYSTEM** **L T P C**
3 0 0 3

Course Objectives:

1. To gain knowledge on the principles and procedures for the design of mechanical power transmission components.
2. To understand the standard procedures available for design of transmission elements.
3. To solve the problems for the real time applications of the systems

UNIT I DESIGN OF FLEXIBLE ELEMENTS **9 + 0**

Motor power capacity for various applications - Design of Flat belts and pulleys - Selection of V belts and sheaves – Selection of wire ropes and pulleys – Design of Transmission chains and Sprockets.

UNIT II SPUR AND HELICAL GEARS **9 + 0**

Gear materials - Design of straight tooth spur & helical gears based on speed ratios, number of teeth, Fatigue strength, Factor of safety, strength and wear considerations. Force analysis -Tooth stresses - Dynamic effects - Helical gears – Module - normal and transverse, Equivalent number of teeth - forces.

UNIT III BEVEL AND WORM GEARS **9 + 0**

Straight bevel gear: Gear materials - Tooth terminology, tooth forces and stresses, equivalent number of teeth, estimation of dimensions of straight bevel gears. Worm Gear: Gear materials - Tooth terminology, Thermal capacity, forces and stresses, efficiency, estimation of dimensions of worm gear pair.

UNIT IV GEAR BOXES **9 + 0**

Need - Design of sliding and constant mesh gear boxes: Speed selection - Geometric progression - Standard step ratio - Ray diagram, kinematic layout – Determination of number of teeth. Design of multi speed gear box for machine tool applications, Variable speed gear box, Fluid Couplings, Torque Converters for automotive applications.

UNIT V CLUTCHES, BRAKES AND CAMS **9 + 0**

Design of single and multi plate clutches, cone clutches, internal expanding rim clutches and Electromagnetic clutches. Design of brakes: External shoe brakes - Single and Double Shoe, Internal expanding shoe brakes and Band brakes. Design of Cams: Types- Pressure angle and under cutting, determination of base circle -forces and surface stresses.

Total (45+0) =45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1 : appreciate the functions of various transmission elements and their assemblies
CO2 : design different transmission components according to the requirement as per standards using data books.
CO3 : apply the appropriate calculation procedures for the various systems designing

Text Books:

1. Joseph Shigley,CharlesMischke, Richard Budynas and Keith Nisbett “Mechanical Engineering Design”, 10th Edition, Tata McGraw-Hill, 2014.
2. Sundararajamoorthy T. V and Shanmugam .N, “Machine Design”, 9th edition, Anuradha Publications, Chennai, 2003.

Reference Books:

1. Bhandari V, “Design of Machine Elements”, 15th Reprint, Tata McGraw-Hill Book Co, 2014.
2. Prabhu. T.J., “Design of Transmission Elements”, Mani Offset, Chennai, 2003.
   Md. Jalaludeen , Machine Design, Volume II, Design of Transmission Systems, 4th edition, Anuradha Publications, 2014.
3. GitinMaitra,L. Prasad “Handbook of Mechanical Design”, 2nd Edition, Tata McGraw-Hill,2001.

4. C.S.Sharma, KamleshPurohit, “Design of Machine Elements”, Prentice Hall of India,Pvt. Ltd., 2003.
5. Bernard Hamrock, Steven Schmid, Bo Jacobson, “Fundamentals of Machine Elements”,2nd Edition, Tata McGraw Hill, 2006.

CO-PO MAPPING

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	1	2	2	1	1	0	1	0	0	0	0	0	0	1	0
CO2	2	3	2	1	1	0	0	0	0	0	0	0	0	2	1
CO3	2	1	3	2	1	0	2	0	0	0	0	0	0	2	1

1- Faintly
2- Moderately
3- Strongly

18MEPE13 **GAS DYNAMICS & JET PROPULSION** **L T P C**
3 0 0 3

Course Objectives:

1. To learn the concepts of gas dynamics and various flows
2. To acquire the knowledge about the flow through ducts and their phenomena
3. To get the concepts of jet and space propulsion

UNIT I BASIC CONCEPTS AND ISENTROPIC FLOWS 9 + 0

Energy and momentum equations of compressible fluid flows - Stagnation states, Mach waves and Mach cone - Effect of Mach number on compressibility - Isentropic flow through variable area ducts - Nozzle and Diffusers - Use of Gas tables.

UNIT II FLOW THROUGH DUCTS 9 + 0

Flow through constant area ducts with heat transfer (Rayleigh flow) and Friction (Fanno flow) - Variation of flow properties - Use of tables and charts - Generalized gas dynamics.

UNIT III NORMAL AND OBLIQUE SHOCKS 9 + 0

Governing equations - Variation of flow parameters across the normal and oblique shocks - Prandtl – Meyer relations - Use of table and charts - Applications.

UNIT IV JET PROPULSION 9 + 0

Theory of jet propulsion - Thrust equation - Thrust power and propulsive efficiency - Operation principle, cycle analysis and use of stagnation state performance of ram jet, turbojet, turbofan and turbo prop engines – Aircraft combustors.

UNIT V SPACE PROPULSION 9 + 0

Types of rocket engines - Propellants - Ignition and combustion - Theory of rocket propulsion – Performance study - Staging - Terminal and characteristic velocity - Applications - Space flights.

Total (45+0) =45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1 : explain basic concepts of gas dynamics and describe the basic fundamental equations of one dimensional flow of compressible fluid and isentropic flow of an ideal gas

CO2 : analyze the concepts of flow through ducts and the shock flow.

CO3 : describe the basic concepts of jet and space propulsion

Text Books:

1. Yahya, S.M, “Fundamentals of Compressible Flow”, New Age International (P) Limited, New Delhi, 1996.
2. Ganesan, V, “Gas Turbines”, Tata McGraw Hill Publishing Co., New Delhi, 1999.

Reference Books:

1. Hill, P and Peterson, C, “Mechanics and Thermodynamics of Propulsion”, Addison -Wesley Publishing Company, 1992.
2. Zucrow, N.J, “Principles of Jet Propulsion and Gas Turbines”, John Wiley, New York, 1970.
3. Cohen,H, Rogers, G.E.C and Saravanamuttoo, “Gas Turbine Theory”, Longman Group Ltd., 1980.
4 Zucrow, N.J, “Aircraft and Missile Propulsion”, Vol. I and II, John Wiley, 1975.

CO-PO MAPPING

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	1	1	1	0	0	0	0	0	0	0	0	0	0	0
CO2	2	2	1	3	2	0	1	0	0	0	0	0	1	0	1
CO3	2	1	1	2	0	0	1	0	0	0	0	0	1	0	1

1- **Faintly**
2- **Moderately**
3- **Strongly**

18MEPE14 **RENEWABLE ENERGY SYSTEM** **L T P C**
3 0 0 3

Course Objectives:

1. To understand the principles and applications of solar and wind energy.
2. To learn the biomass energy and the conversion tecnologies.
3. To gain knowledge on wave and tidal energy and their appliations.

UNIT I SOLAR ENERGY **9 + 0**

Devices for thermal collectors and storage-Thermal applications-Solar thermal power plant-Solar Photo voltaic Conversion-Solar cell-PV application.

UNIT II WIND ENERGY **9 + 0**

Principles of wind Energy Conversion-Site Selection Considerations-Wind Energy Conversion system-Advantages and Disadvantages of WECS-Wind Energy Collectors Interconnected System Environmental Aspects.

UNIT III BIO ENERGY **9 + 0**

Biomass Conversion Technologies-Types of Bio gas plants-Bio gas from plant wastes-Site selection Problems related to Bio gas plants-Alternative liquid fuels-Advantages and Disadvantages of Biological Conversion of Solar Energy.

UNIT IV ENERGY FROM THE OCEANS **9 + 0**

Ocean thermal Electric Conversion-Energy fromTides-Layout of Tidal power house-Tidal power plants-Single and Double basin Arrangement wave-Energy Conversion devices-Hybrid System.

UNIT V GEOTHERMAL ENERGY AND FUEL CELLS **9 + 0**

Hot Dry Rock Resources systems-Advantages and Disadvantages-Applications of Geothermal Energy-Fuel Cells-Classifications-Advantages and disadvantages-Applications of Fuel cells

Total (45+0) =45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1 : acquire awareness about non-conventional sources of energy technologies.
CO2 : understand various renewable energy technologies and systems.
CO3 : impart the knowledge of storage technologies for the autonomous renewable energy sources.

Text Books:

1. Suhas P. Sukhatme, “Solar Energy”, Tata McGraw Hill Publishing Company Ltd., 2007.
2. G.D. Rai, “Non-Conventional Energy Sources”, Khanna publishers, 2008.

Reference Books:

1. Godfrey Boyle, “Renewable Energy”, Power for a Sustainable future, Oxford University Press,1996.
2. G.N. Tiwari, “Solar Energy – Fundamentals Design, Modelling and Applications”, Navosa Publishing House, 2002.
3. Johnson Gavy L, “Wind Energy Systems”, Prentice Hall, 1985.

CO-PO MAPPING

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	1	1	1	0	1	0	2	0	1	0	0	0	1	0	0
CO2	1	1	1	1	0	0	1	0	1	0	1	0	0	0	1
CO3	2	1	2	1	0	0	0	0	0	0	0	1	2	1	1

1- Faintly
2- Moderately
3- Strongly

18MEPE15 **METAL CUTTING & TOOL DESIGN** **L T P C**
3 0 0 3

Course Objectives:

1. To provide students with fundamental knowledge and principles in material removal processes.
2. To demonstrate the fundamentals of machining processes and machine tools.
3. To apply knowledge of basic mathematics to calculate the machining parameters for different machining processes.

UNIT I MECHANICS OF METAL CUTTING 9 + 0

Chip formation- Shear Zone- Shear Plane angle: Different Theories. Friction in Metal Cutting- Chip Flow Velocity- Shear Strain. Measurement of cutting forces- Dynamometer Requirements. Classification of Cutting Force Dynamometers. Heat in metal cutting - Heat Sources in Metal Cutting Temperature in Chip Formation- Temperature Distribution- Factors Effecting the Temperature-Work Material, Cutting Variables, Tool Geometry, Cutting Fluid.

UNIT II FAILURE OF CUTTING TOOLS 9 + 0

Tool Wear and Tool Life- Premature failure- Gradual Wear. Crater Wear. Flank Wear, Grooving Wear, Chip notching - Wear Mechanisms in Metal Cutting, Abrasive, Diffusion, Adhesion, and Oxidation Wear - Tool Life, Taylor's Tool Life Equation. Cutting Conditions for Limiting Tool Life Conditions. TV-he Tool Life Plots. Cutting Rate- Tool Life Characteristics Curve. Tool wear measurement – Optical Methods; Flank Wear, Crater Wear Measurement. Radioactive Methods - Augur Electron Spectroscopy (AES)

UNIT III TOOL GEOMETRY 9 + 0

Tool Nomenclature -Basic Tool Angles, Effect of Basic Angles. Tool Nomenclature Systems; British System, ISO System. Geometrical Relationship of True Rake Angle, Angle of Inclination. Design of single point tool - Tool Strength and Rigidity- Design of Form Tools- Types of Form Tools- Circular Form Tool- Profile Design- Geometrical and Analytical Method- Flat Form Tool Design- Grinding the Form Tool. Profile for a Tapered Surface- Tangential Type of Form Tool.

UNIT IV DESIGN OF DRILL BIT AND MILLING CUTTER 9 + 0

Twist Drill Construction- Drill Diameter- Flute Angle - Web Thickness and Chisel Edge- Land Width Margin- Shape of Flute Section - Flute Length- Shank. Geometry of the Cutting Edge, Rake Angle, Relief Angle, Angle of Inclination. Design of milling cutter- Types of Milling Cutters and its design -Profile Sharpened- Form Relieved Milling Cutters

UNIT V DESIGN OF BROACHING AND REAMING TOOL 9 + 0

Design of broach- Design Elements of Broach- Number of Teeth, Tooth, Pitch and Chip space- Rear Pilot Length of Broach- Strength of Broach - Reamer Design- Length- Flutes- Rake Angle and Relief Angle - Grinding of Reamer. Thread cutting tools -Thread Cutting Dies- Thread Rolling Tools- Design of Thread Cutting Taps.

Total (45+0) =45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1 : identify the various force acting and its measuring method on metal cutting
CO2 : find the various causes of failure of tool
CO3 : design the drill bit and milling cutter for the machining processes

Text Books:

1. B.J.Ranganth, “Metal Cutting and Tool Design” Vikas publishing
2. Bhattacharya. A., “Metal Cutting Theory and practice”, Central Book Publishers, India, 1984.

Reference Books:

1. Boothroid D.G. & Knight W.A., “Fundamentals of machining and machine tools”, Marcel Dekker, New York, 1989.
2. Shaw.M.C. “Metal cutting principles”, oxford Clare don press, 1984.
3. Graham T.Smith “Cutting Tool Technology” Industrial Handbook , Springer

CO-PO MAPPING

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	1	2	1	0	0	0	0	0	0	0	0	1	0	0
CO2	2	3	2	2	3	1	0	0	0	0	0	0	0	1	1
CO3	2	2	3	1	0	0	0	0	0	0	0	0	0	2	1

1- Faintly
2- Moderately
3- Strongly

18MEPE16 **AERONAUTICAL ENGINEERING** **L T P C**
3 0 0 3

Course Objectives:

1. To understand the fundamentals of aerospace engineering
2. To learn about the concepts of aero foil
3. To provide an understanding of flight instruments
4. To provide an understanding of aero propellers
5. To learn about the basics about aerodynamics

UNIT I INTRODUCTION **9 + 0**

The atmosphere-characteristics of troposphere, stratosphere, thermosphere, and ionosphere- pressure, temperature and density variations in the atmosphere. Application of dimensional analysis – aerodynamic force – model study and similitude. 2D aero foils -Nomenclature and classification- pressure distribution in inviscid and real flows- momentum and circulation theory of aerofoil- characteristics.

UNIT II CONCEPT OF AERO FOIL **9 + 0**

3D or Finite aero foils – effect of releasing the wingtips- wing tip vortices- replacement of finite wing by horse shoe vertex system, lifting line theory-wing load distribution – aspect ratio, induced drag calculation of induced drag from momentum considerations. Skin friction and from drag- changes in finite wing plan shape.

UNIT III AERO PROPELLERS **9 + 0**

Propellers – momentum and blade element theories –propeller coefficients and charts. Aircraft performance-straight and level flight –power required and power available graphs for propeller and jet aircraft.

UNIT IV GLIDING AND CLIMBING **9 + 0**

Rate of climb-service and absolute ceilings-gliding angle and speed of flattest glide takeoff and landing performance – length of runway required- aircraft ground run- circling flight – radius of tightest turn-jet and rocket assisted take –off high lift devices-range and endurance of airplanes-charts for piston and jet engine aircrafts.

UNIT V AERODYNAMICS **9 + 0**

Basics of aerodynamics- Fundamentals of potential flows from subsonic to supersonic speeds- Viscous flows including laminar and turbulent boundary layers- Aerodynamic models of airfoils and wings.

Total (45+0) =45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1 : identify, formulate and solve aerospace engineering problems
CO2 : perform analysis of flight dynamics of aircrafts
CO3 : provided an understanding of flight instruments
CO4 : provided an understanding of aero propellers
CO5 : learned about the basics about aerodynamics

Text Books:

1. Anderson , Fundamentals of Aerodynamics, McGraw-Hill, 2010
2. A.C. Kermode Mechanics of flight, Prentice Hall, 2007

Reference Books:

1. Kuethe, A.M., and Chow, C.Y., “Foundations of Aerodynamics”, John Wiley & Sons, 1982.
2. Hill, Mechanics and thermodynamics of propulsion
3. J.J.Bertin, “Aerodynamics for Engineers”, Prentice-Hall, 1988.
4. EHJ Pallett, Aircraft Instruments and Integrated systems, Longman,1992
5. Houghton and brock, Aerodynamics for Engineering Student, Hodder & Stoughton,1977

E-REFERENCES:

Nptel.ac.in / courses /downloads

CO-PO MAPPING

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	3	2	0	0	0	0	0	0	0	0	0	2	1	0
CO2	2	2	1	1	0	0	0	0	0	0	0	0	2	1	0
CO3	1	1	1	0	0	0	0	0	0	0	0	0	0	0	1
CO4	1	1	1	1	0	0	0	0	0	0	0	0	0	0	1
CO5	3	1	1	0	0	0	0	0	0	0	0	0	1	0	0

1- Faintly
2- Moderately
3- Strongly

18MEPE17	OPERATIONS RESEARCH	L	T	P	C
		3	0	0	3

Course Objectives:

1. Build the capabilities to analyze different industrial/business situations involving limited resources.
2. Develop the skills to build own formulations/expand existing formulations, to critically evaluate the impact of model assumptions.
3. Strengthen the ability to choose an appropriate solution technique for a given formulation.
4. Finding the optimal solution for any practical situation which is subjected with some constraints.
5. Enhance the skills on managerial science.

UNIT I LINEAR MODELS **9 + 0**

The phases of operations research study - Formation of linear programming model - Graphical method - Simplex algorithm - Big M method – Two phase method - Dual simplex method.

UNIT II TRANSPORTATION AND ASSIGNMENT MODELS **9 + 0**

Transportation models - Optimal solution by North West Corner method - Least Cost Method - Vogel's Approximation Method - optimality test - MODI method - Assignment problem formulation - Hungarian method - Unbalanced and maximization assignment problems.

UNIT III NETWORK MODELS **9 + 0**

Construction of project networks - Network optimization algorithms - Shortest route models, Minimal spanning tree models, Maximum flow models - CPM and PERT networks - Critical path scheduling.

UNIT IV REPLACEMENT AND SEQUENCING MODELS **9 + 0**

Replacement of items that deteriorate with time: value of money change with time, not change with time - Optimum replacement policy - Individual and group replacement - Sequencing problems – Problems with *n* jobs with *2* machines, *n* jobs with *3* machines, *n* jobs with *k* machines, *2* jobs with *k* machines.

UNIT V QUEUING THEORY AND SIMULATION **9 + 0**

Queuing systems and structures - Notations and parameters - Queuing models (Model I, Model II, Model III, Model IV) - Simulation- Random number generation - Application of simulation for queuing and maintenance.

Total (45+0)= 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1 : identify and develop mathematical models from the real situations.

CO2 : understand the mathematical tools that are needed to solve optimization problems.

CO3 : use mathematical software to solve the proposed models.

CO4 : propose recommendations to the decision-making processes in engineering/ management.

Text Books:

1. Taha, H.A, "Operations Research", 7th Edition, Prentice Hall of India, 2002.
2. Hira and Gupta, "Introduction to Operations Research", S. Chand and Co, 2002.

Reference Books:

1. Bhaskar, S, "Operations Research", Anuradha Publishers, Tamil Nadu, 1999.
2. Hillier and Lieberman, "Operations Research", Holden Day, 1986.

3. Sharma J.K, “Operations Research”, Macmillan, 2007.
4. Philip and Ravindran, “Operational Research”, John Wiley, 1992.

CO-PO MAPPING

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	2	2	2	0	0	0	0	0	0	0	1	1	0
CO2	2	2	1	1	3	0	0	0	0	0	0	0	0	1	0
CO3	1	2	2	2	3	0	0	0	0	0	0	0	2	1	0
CO4	1	2	1	2	1	0	0	0	0	0	0	0	1	1	1

1- Faintly
2- Moderately
3- Strongly

Elective – II (VI SEMESTER)

18MEPE21	ADVANCED STRENGTH OF MATERIALS	L	T	P	C
		3	0	0	3

Course Objectives:

1. To provide basic knowledge in mechanics of materials to solve real engineering problems and design engineering systems
2. To determine the Mechanical behavior of the body by determining the stresses, strains produced by the application of load.
3. To apply fundamental concepts related to deformation, moment of inertia, load carrying capacity, shear forces, bending moments, torsional moments, column and struts, principal stresses and strains.

UNIT I ELASTICITY 9 + 0

Stress – Strain relation and General equation of elasticity in cartesian- polar and spherical coordinates- differential equation of equilibrium – compact ability –boundary conditions- representations of three dimensional stress of a tension –generalized Hooke's law – St.Vennant's principle – Plane strain- plane stress – Airy's stress function. Shear Centre- Location of shear centre for various sections – shear flow.

UNIT II UNSYMMETRICAL BENDING 9 + 0

Stresses and deflection in beams subjected to unsymmetrical loading – Kern of a section. Curved flexural members - circumferential and radial stresses – deflection and radial curved beam with re-strained ends – closed ring subjected to concentrated load and uniform load – chain link and crane hooks.

UNIT III THICK CYLINDERS AND ROTATING DISKS 9 + 0

Thick walled cylinder subjected to internal and external pressures – Shrink fit joints – Stresses due to rotation – Radial and tangential stresses in solid disc and ring of uniform thickness and varying thickness – allowable speed. – Rotating shafts and cylinders.

UNIT IV TORSION OF NON CIRCULAR SECTIONS 9 + 0

Torsion of rectangular cross section – St.Vennant Theory – elastic membrane analogy – Prandtl's stress function – Torsional stresses in hollow thin walled tubes.

UNIT V STRESSES IN FLAT PLATES 9 + 0

Stresses in circular and rectangular plates due to various types of loading and end conditions – Buckling of plates. Theory of contact stresses – methods of computing contact stresses – deflection of bodies in point and line contact – applications.

Total (45+0) =45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1 : understand the concepts of stress and strain at a point as well as the stress-strain relationships for homogenous, isotropic materials.

CO2 : calculate the stresses and strains in axially-loaded members, circular torsion members, and members subject to flexural loadings.

CO3 : calculate the stresses and strains associated with thin-wall spherical and cylindrical pressure vessels.

Text Books:

1. Arthur P.Boresi and Richard J.Schmidt, "Advanced Mechanics of Materials", 6th Edition, John Wiley &Sons-Inc., 2003.
2. Arthur P.Boresi and Omar M.Siseborttom- "Advanced Mechanics of Materials", John Wiley International Education, 1985.

Reference Books:

1. Robert D.Cook and Wareen.C.Yound, "Advanced Mechanics of Materials", 2nd Edition, Macmilon Publishers Company, 1985
2. Srinath.L.S, "Advanced Mechanics of Solids", Tata McGraw Hill Publishing Company Limited, 2003
3. KrishnaRaju- N and Gururaja-D.R., "Advanced Mechanics of Solids and Structures", Narosa Publishing House, 1997.
4. U.C.Jindal, "Advanced Topics of Strength of materials", Galgotia Publications, 1st Edition, 1997

CO-PO MAPPING

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	1	1	0	0	0	1	0	2	0	0	3	2	1
CO2	2	3	3	1	0	0	0	0	0	0	0	0	3	2	1
CO3	2	3	3	2	0	0	0	1	0	0	0	0	2	3	1

1- Faintly
2- Moderately
3- Strongly

18MEPE22 **INTERNAL COMBUSTION ENGINES** **L T P C**
3 0 0 3

Course Objectives:

1. To Acquire the knowledge of engine components and fuel air cycles.
2. To understand the working of engine auxiliary systems.
3. To learn the combustion aspects of CI and SI Engines and the alternate fuels

UNIT I COMPONENTS OF IC ENGINES AND PERFORMANCE 9 + 0

Classification of Internal combustion Engine, Function and operation of Two stroke and Four stroke engines, Comparison of SI and CI and two stroke and four stroke engines, Effects of supercharging and supercharging Types - centrifugal, roots, vane, Types of scavenging process- Design and Performance data, Efficiency, Specific fuel consumption, IMEP determination -Simple calculations - Performance characteristics, Heat balance calculations, Fuel air cycles and their significance, Comparison of air-standard and fuel air cycles.

UNIT II ENGINE AUXILIARY SYSTEMS 9 + 0

Desirable air- fuel ratios for starting, warm up, acceleration, idling and normal operation, Necessity of Carburetors and their function and types, Function and classification of injection systems, Injection pump, governor and nozzle types, Description of construction and function of Electronic injection system and MPFI systems, Energy requirement of ignition system, need, Types - Battery and Magneto ignition types, Ignition timing and engine parameters, Engine oil properties, lubrication system types - mist, wet sump and dry sump lubrication systems, Types of cooling systems - Direct and Indirect - Coolant and antifreeze solutions.

UNIT III COMBUSTION IN SI ENGINES 9 + 0

Homogeneous and heterogeneous mixture, Combustion in spark ignition engines, Stages of combustion in spark ignition engines, Flame front propagation, Factors influencing flame speed, Rate of pressure rise, Phenomenon of knock in SI engines, Effect of engine variables on knock, Combustion chambers for SI engines - Smooth engine operation, High power output and thermal efficiency, Stratified charge engine.

UNIT IV COMBUSTION IN CI ENGINES 9 + 0

Combustion in CI engine, Stages of combustion in CI engines, Factors affecting the delay period - compression ratio, engine speed, output, atomization and duration of injection, quality of fuel, intake temperature, intake pressure, Phenomenon of knock in CI engines, Comparison of knock in SI and CI engines, Air motion - Swirl - Squish.

UNIT V ALTERNATE FUELS AND EMISSION 9 + 0

Alternate Fuels -Alcohol, Methanol, Ethanol, Gaseous fuel - Hydrogen, CNG, LPG, Biodiesel -production, advantages & disadvantages. Air pollution due to IC engines, Hydrocarbon emission and their reasons, Formation of oxides of nitrogen, CO, Particulates, aldehydes, sulphur, lead and phosphorus emissions, catalytic converter, exhaust gas recirculation, Flame ionization detector, NDIR, smoke types - measuring device. Emission standards.

Total (45+0) =45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1 : describe and explain different types of reciprocating internal combustion engines (ice), their typical design features and performance characteristics.

CO2 : describe and analyze the power cycle of internal combustion engines using ideal gas cycles, air cycles, and fuel-air cycles. compute indicated power and thermal efficiency.

CO3 : explain the characteristic of homogeneous combustion in si-engines and spray combustion in ci-engines.

Text Books:

1. Ganesan.V, "Internal Combustion Engines" , Tata McGraw-Hill, New Delhi,2009
2. Ramalingam.K.K, "Internal Combustion Engines- Theory and practice ",SciTech publications India Pvt. Ltd., Chennai, 2010

Reference Books:

1. Thipse.S.S, "internal Combustion Engines", Jaico Publication House., 2010.
2. Thipse.S.S, "Alternate Fuels", Jaico Publication House., 2010.
3. Mathur.M.L and Sharma.R.P, "A course in internal Combustion Engines", Dhanpat Rai & Sons, New Delhi, 2010.
4. Heywood.J.B, "Internal Combustion Engine Fundamentals", McGraw Hill International, New York, 2008
5. Domkundwar.V.M, "A course in internal Combustion Engines", Dhanpat Rai & Sons, 2010.

CO-PO MAPPING

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	3	2	1	0	0	0	0	0	0	0	0	3	2	1
CO2	3	3	2	2	0	0	0	0	0	0	0	0	2	3	1
CO3	3	2	1	2	0	0	0	0	0	0	0	0	3	2	1

1- Faintly
2- Moderately
3- Strongly

18MEPE23 **POWER PLANT ENGINEERING** **L T P C**
3 0 0 3

Course Objectives:

1. To learn about the various processes involved in the conventional power plants
2. To study about the instruments and testing methods used in thermal power plants
3. To learn the basic knowledge of different types of diesel, gas and nuclear power plants

UNIT I STEAM POWER PLANT 9 + 0

Layout of steam power plant – boilers - Modern high pressure and supercritical boilers -- Preparation and handling of coal - Pulverizer - Dust collector - Ash removal; Stokers - Different types - Pulverized fuel burning ; Draught - Different types - Chimney design - Selection of blowers, Cooling towers - Different types - Analysis of pollution from thermal power plants - Waste heat recovery, Fluidized bed boilers.

UNIT II INSTRUMENTATION, TESTING OF BOILERS, POWER PLANT ECONOMICS 9 + 0

CO_2 recorders - Automatic controls for feed water, steam, fuel, air supply and combustion, Boiler testing and trails - Inspection and safety regulations. Economics of power plant - Actual load curves, fixed costs – Operating costs - Variable load operation.

UNIT III HYDRO ELECTRIC POWER PLANT 9 + 0

Layout of hydel power plant- classification –working – components – layout of pumped storage power plant. Solar power plant- classification – components –working principle.

UNIT IV DIESEL AND GAS POWER PLANT 9 + 0

Layout of Diesel power plant- Important components – performance analysis – Layout of gas power plant – classification of gas turbine cycles – components – relative thermal efficiencies of different cycles. Wind mill: layout –components - working.

UNIT V NUCLEAR, MHD POWER GENERATION AND WIND MILL 9 + 0

Elementary treatment - Nuclear fission, chain reaction - Pressurized water reactors, boiling water reactors, gas cooled reactors - Fast breeder reactors, MHD power cycle principles

Total (45+0) =45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1 : select the suitability of site for a power plant.
CO2 : calculate performance of thermal power plant.
CO3 : able to find the suitable types of power plant in any location

Text Books:

1. Arora, S.C and Domkundwar, S, “A Course in Power Plant Engineering”, Dhanpat Rai and Sons, TMH, 1998.
2. Nag P.K, “Power Plant Engineering”, Tata McGraw Hill Publishing Co. Ltd., 1998

Reference Books:

1. Bernhardt G. Askrotzki and William A. Vopat, “Power Station Engineering and Economy”, Tata McGraw Hill Publishing Co. Ltd., 1972.
2. Frederick T. Mores, “Power Plant Engineering”, Affiliated East-West Press Private Ltd., 1953.
3. Nagpal, G.R, “Power Plant Engineering”, Khanna Publishers, 1998.
4. Joel Weisman and Roy Eckart, “Modern Power Plant Engineering”, Prentice Hall International Inc., 1985.

CO-PO MAPPING

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	1	1	1	0	0	0	0	0	0	0	0	2	1	3
CO2	3	3	2	2	0	0	0	0	0	0	0	0	3	3	1
CO3	3	2	2	1	0	0	0	0	0	0	0	0	3	2	3

1- Faintly
2- Moderately
3- Strongly

18MEPE24	MACHINE DRAWING	L	T	P	C
		3	0	0	3

Course Objectives:

1. Provide the fundamental concepts of machine drawing elaborating on how to concretize the idea of new structure such as a machine element.
2. Study the conventions and rules to be followed by engineers for making accurate drawings
3. Understand the basic dimensioning practices that have to be followed in the preparation of drawings

UNIT I SECTIONAL VIEWS 9 + 0

Review of sectioning – Conventions showing the section – symbolic representation of cutting plane- types of section – full section, half section, offset section, revolved section, broken section, removed section – section lining.

UNIT II LIMITS, FITS AND TOLERANCES 9 + 0

Limits, Fits and Tolerances- Indication of tolerances on linear dimension of drawings - General aspects, Nominal size and basic dimensions, Definitions, Basis of fit or limit system- Classifications of fits – Selection of fits – examples Systems of specifying tolerances, Designation of holes, Shafts and fits, Commonly used holes and shafts.

UNIT III SURFACE TEXTURE 9 + 0

Conventional representation of surface finish - Roughness number symbol, Symbols of Machine elements and welded joints - Surface texture – importance – controlled and uncontrolled surfaces.

UNIT IV KEYS, SCREW THREADS AND THREADED FASTENERS 9 + 0

Types of fasteners – temporary fasteners – keys – classification of keys – Heavy duty keys – light duty keys. Screw thread – Nomenclature – different types of thread profiles – threads in sections – threaded fasteners – bolts – nuts – through bolt – tap bolt, stud bolt – set screw – cap screws – machine screws – foundation bolts.

UNIT V MANUAL DRAWING PRACTICE 9 + 0

Assembly and detailed drawings of Sleeve & Cotter joint - Knuckle joint - Foot step bearing - Plummer Block - Universal Coupling - Simple Eccentric - Protected type flanged coupling - Union joint, Gland & Stuffing Box, Expansion joint.

Total (45+0) =45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1 : understand the principles and requirements of production drawings.
CO2 : understand the various symbols used in drawing.
CO3 : assemble and disassemble the various mechanical components and joints.

Text Books:

1. Geometrical and Machine Drawing, N.D. Bhatt, Cheroter book stalls, Anand, West Railway
2. Machine drawing – P.S. Gill S.K. Kataria& Sons Delhi.
3. Machine drawing – T.Jones.

Reference Books:

1. Mechanical Draughtsmanship, G.L. Tamta, DhanpatRai& Sons, Delhi
2. Engineering Drawing, D.N. Ghose, DhanpatRai& Sons, Delhi

CO-PO MAPPING

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	1	1	0	0	0	0	1	0	0	1	1	1	1	1
CO2	2	1	1	0	0	0	0	1	0	0	1	1	1	1	1
CO3	1	1	1	0	0	0	0	1	0	0	1	1	2	1	1

1- **Faintly**
2- **Moderately**
3- **Strongly**

18MEPE25 ENGINEERING SYSTEM ANALYSIS AND DESIGN L T P C
3 0 0 3

Course Objectives:

1. Analyze the asymptotic performance of Manual and automated systems.
2. Ability to understand the principles of systems documentation.
3. Demonstrate a familiarity with Systems flowcharts and structured charts.
4. Apply important Planning considerations for advance development.
5. Understand the basic concepts and implement the Object Oriented Analysis and design.

UNIT I SYSTEM DEFINITION AND CONCEPTS 9 + 0

Characteristics and types of system, Manual and automated systems Real-life Business sub-systems: Production, Marketing, Personal, Material, and Finance. Systems models types of models: Systems environment and boundaries, Real-time and distributed systems, Basic principles of successful systems.

UNIT II SYSTEMS ANALYST 9 + 0

Role and need of systems analyst, Qualifications and responsibilities, Systems Analyst and agent of change, Introduction to systems development life cycle (SDLC), Various phases of development: Analysis, Design, Development, Implementation, Maintenance Systems documentation considerations: Principles of systems documentation, Types of documentation and their importance, Enforcing documentation discipline in an organization.

UNIT III SYSTEMS DESIGN AND PROCESS MODELING 9 + 0

Logical and physical design, Design representation, Systems flowcharts and structured charts, Data flow diagrams, Common diagramming conventions and guidelines using DFD and ERD diagrams. Data Modeling and systems analysis, Designing the internals: Program and Process design, Designing Distributed Systems.

UNIT IV SYSTEM IMPLEMENTATION AND MAINTENANCE 9 + 0

Planning considerations, Conversion methods, producers and controls, System acceptance Criteria, System evaluation and performance, Testing and validation, Systems quality Control and assurance, Maintenance activities and issues. Threat to computer system and control measures, Disaster recovery and contingency planning.

UNIT V OBJECT ORIENTED ANALYSIS AND DESIGN 9 + 0

Introduction to Object Oriented Analysis and design life cycle, object modeling: Class Diagrams, Dynamic modeling: state diagram, Dynamic modeling: sequence diagramming.

Total (45+0) =45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1 : gather data to analyse and specify the requirements of a system.
CO2 : design system components and environments.
CO3 : build general and detailed models that assist programmers in implementing a system.
CO4 : design a database for storing data and a user interface for data input and output, as well as controls to protect the system and its data.
CO5 : able to analyse object modeling and dynamics modeling.

Text Books:

1. Analysis and design of information systems – James A.Senn, McGraw-Hill Education, 2008
2. System analysis and design –Perry Edwards , McGraw-Hill Companies, 1993

Reference Books:

1. System Analysis and Design Methods, Whitten, Bentaly and Barlow, Galgotia Publication.
2. System Analysis and Design Elias M. Award, Galgotia Publication
3. Modern System Analysis and Design, Jeffrey A. Hofer Joey F. George Joseph S. Valacich Addison Weseley.

CO-PO MAPPING

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	1	2	2	1	2	0	0	0	0	0	0	0	2	1	0
CO2	0	1	3	2	1	0	0	0	0	0	0	0	2	3	0
CO3	1	2	2	1	1	0	0	0	0	0	0	0	2	3	0
CO4	1	2	3	2	1	0	0	0	0	0	0	0	1	3	0
CO5	0	2	2	2	0	0	0	0	0	0	0	0	0	2	0

1- Faintly
2- Moderately
3- Strongly

Electives – III (VII SEMESTER)

18MEPE31	APPLIED HYDRAULICS AND PNEUMATICS	L	T	P	C
		3	0	0	3

Course Objectives:

1. To provide student with knowledge on the application of fluid power in process, construction and manufacturing Industries.
2. To provide students with an understanding of the fluids and components utilized in modern industrial fluid power system.
3. To develop a measurable degree of competence in the design, construction and operation of fluid power circuits.

UNIT I FLUID POWER PRINICIPLES AND HYDRAULIC PUMPS 9 + 0

Introduction to Fluid power – Advantages and Applications – Fluid power systems – Types of fluids - Properties of fluids and selection – Basics of Hydraulics – Pascal's Law – Principles of flow - Friction loss – Work, Power and Torque Problems, Sources of Hydraulic power : Pumping Theory – Pump Classification – Construction, Working, Design, Advantages, Disadvantages, Performance, Selection criteria of Linear and Rotary – Fixed and Variable displacement pumps.

UNIT II HYDRAULIC ACTUATORS AND CONTROL COMPONENTS 9 + 0

Hydraulic Actuators: Cylinders – Types and construction, Application, Hydraulic cushioning – Hydraulic motors - Control Components : Direction Control, Flow control and pressure control valves – Types, Construction and Operation – Servo and Proportional valves – Applications – Accessories : Reservoirs, Pressure Switches – Applications – Fluid Power ANSI Symbols.

UNIT III HYDRAULIC CIRCUITS AND SYSTEMS 9 + 0

Accumulators, Intensifiers, Industrial hydraulic circuits – Regenerative, Pump Unloading, Double Pump, Pressure Intensifier, Air-over oil, Sequence, Reciprocation, Synchronization, Fail-Safe, Speed Control, Hydrostatic transmission, Electro hydraulic circuits, Mechanical hydraulic servo systems.

UNIT IV PNEUMATIC AND ELECTRO PNEUMATIC SYSTEMS 9 + 0

Properties of air – Perfect Gas Laws – Compressor – Filters, Regulator, Lubricator, Muffler, Air control Valves, Quick Exhaust Valves, Pneumatic actuators, Design of Pneumatic circuit – Cascade method – Electro Pneumatic System – Elements – Ladder diagram – Problems, Introduction to fluidics and pneumatic logic circuits.

UNIT V TROUBLE SHOOTING AND APPLICATIONS 9 + 0

Installation, Selection, Maintenance, Trouble Shooting and Remedies in Hydraulic and Pneumatic systems, Design of hydraulic circuits for Drilling, Planning, Shaping, Surface grinding, Press and Forklift applications. Design of Pneumatic circuits for Pick and Place applications and tool handling in CNC Machine tools – Low cost Automation – Hydraulic and Pneumatic power packs.

Total (45+0)= 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1 : explain the Fluid power and operation of different types of pumps.
CO2 : summarize the features and functions of Hydraulic motors, actuators and Flow control valves
CO3 : explain the different types of Hydraulic circuits and systems
CO4 : explain the working of different pneumatic circuits and systems
CO5 : summarize the various trouble shooting methods and applications of hydraulic and pneumatic systems.

Text Books:

1. Anthony Esposito, "Fluid Power with Applications", Pearson Education, 2005.

2. Majumdar S.R., “Oil Hydraulics Systems- Principles and Maintenance”, Tata McGrawHill, 2001.

Reference Books:

1. Anthony Lal, “Oil hydraulics in the service of industry”, Allied publishers, 1982.
2. Dudelyt, A. Pease and John T. Pippenger, “Basic Fluid Power”, Prentice Hall, 1987.
3. Majumdar S.R., “Pneumatic systems – Principles and maintenance”, Tata McGraw Hill, 1995
4. Michael J, Prinches and Ashby J. G, “Power Hydraulics”, Prentice Hall, 1989.
5. Shanmuga sundaram.K, “Hydraulic and Pneumatic controls”, Chand & Co, 2006

CO-PO MAPPING

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	1	1	0	0	0	0	0	0	0	0	0	1	1	1
CO2	0	2	2	1	0	0	0	0	0	0	0	0	1	1	1
CO3	1	2	3	0	0	1	0	0	0	0	0	0	1	2	1
CO4	1	1	3	2	2	0	0	0	0	0	0	0	2	1	1
CO5	1	1	2	0	0	0	0	0	0	0	0	0	1	1	1

1- Faintly
2- Moderately
3- Strongly

18MEPE32 PROFESSIONAL ETHICS AND HUMAN VALUES

L	T	P	C
3	0	0	3

Course Objectives:

1. To create awareness on Engineering Ethics and providing basic knowledge about engineering Ethics, Variety of moral issues and Professional Ideals.
2. To provide basic familiarity about Engineers as responsible Experimenters, Codes of Ethics, Industrial Standards.
3. To inculcate knowledge and exposure on Safety and Risk, Risk Benefit Analysis.

UNIT I HUMAN VALUES **9 + 0**

Morals, Values and Ethics – Integrity – Work Ethic – Service Learning – Civic Virtue – Respect for Others – Living Peacefully – caring – Sharing – Honesty – Courage – Valuing Time – Co-operation – Commitment – Empathy – Self-Confidence – Character – Spirituality.

UNIT II ENGINEERING ETHICS **9 + 0**

Senses of 'Engineering Ethics' - variety of moral issued - types of inquiry - moral dilemmas - moral autonomy - Kohlberg's theory - Gilligan's theory - consensus and controversy – Models of Professional Roles - theories about right action – Self-interest- customs and religion - uses of ethical theories.

UNIT III ENGINEERING AS SOCIAL EXPERIMENTATION **9 + 0**

Engineering as experimentation - engineers as responsible experimenters - codes of ethics - a balanced outlook on law – the challenger case study.

UNIT IV SAFETY, RESPONSIBILITIES AND RIGHTS **9 + 0**

Safety and risk - assessment of safety and risk - risk benefit analysis and reducing risk - the three mile island and Chernobyl case studies. Collegiality and loyalty - respect for authority - collective bargaining - confidentiality - conflicts of interest – occupational crime - professional rights - employee rights - Intellectual Property Rights (IPR) - discrimination.

UNIT V GLOBAL ISSUES **9 + 0**

Multinational corporations - Environmental ethics - computer ethics - weapons development - engineers as managers consulting engineers-engineers as expert witnesses and advisors -moral leadership-sample code of Ethics like ASME,ASCE, IEEE, Institution of Engineers (India), Indian Institute of Materials Management, Institution of electronics and telecommunication engineers (IETE),India.

Total (45+0) = 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1 : understand the importance of ethics and values in life and society.
CO2 : understood the core values that shape the ethical behavior of an engineer.
CO3 : exposed awareness on professional ethics and human values.

Text Books:

1. Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw-Hill, New York 2005.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi, 2004.

Reference Books:

1. Tripathi A N, "Human values" , New Age international Pvt. Ltd., New Delhi, 2002.
2. Charles D. Fleddermann, "Engineering Ethics", Pearson Education / Prentice Hall, New Jersey, 2004.
3. Charles E Harris, Michael S. Protchard and Michael J Rabins, "Engineering Ethics – Concepts and Cases", Wadsworth Thompson Learning, United States, 2000.
4. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 2003.

CO-PO MAPPING

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	0	0	0	0	0	3	2	3	0	0	0	0	0	0	3
CO2	0	0	0	0	0	3	2	3	0	0	0	0	0	0	3
CO3	0	0	0	0	0	3	2	3	0	0	0	0	0	0	3

1- **Faintly**
2- **Moderately**
3- **Strongly**

18MEPE33 **MAINTENANCE ENGINEERING** **L T P C**
3 0 0 3

Course Objectives:

1. To provide the students with the fundamental concepts.
2. The necessary Knowledge and the basic skills related to systems reliability and systems maintenance function are learned.
3. The course intends to expose the students to the concept of reliability and to help them learn the techniques of estimating reliability and related characteristics of components/ systems
4. It exposes them to the necessary engineering techniques used for analyzing, planning and controlling maintenance systems

UNIT I INTRODUCTION **9 + 0**

Need of Maintenance Management- Maintenance Policies- Strategies and options in Maintenance management-Maintenance forms/actions and their inter relationships-Maintenance Organizations- factors determining effectiveness-objectives of organization design- types of organization. Types of maintenance – corrective-planned preventive and predictive maintenance- Factors affecting maintenance- opportunistic maintenance. Maintainability- Factors affecting Maintainability- Maintainability design criteria-operating and down time categories- Availability- types of Availability- approaches to increase equipment Availability.

UNIT II MAINTENANCE PLANNING AND CONTROL **9 + 0**

Establishing a Maintenance Plan-Preliminary considerations-Systematic method of Maintenance Plan and schedule planning and schedule of Plant shut downs- Maintenance practices on production machines- Lathe, Drilling, Milling, Welding, Shaper- Machine Reconditioning- Spare Parts Management-Capacity utilization, cost reduction approach to spares- reliability and quality of spares- spare parts procurement- and inventory control of spare parts.

UNIT III RELIABILITY **9 + 0**

Definition and basic concepts- Failure data- failure modes and reliability in terms of hazard rate and failure density Function-Hazard models and bath tub curve-applicability of Weibull distribution- Reliability calculations for series, parallel and parallel-series Systems-Reliability calculations for maintained and stand-by systems. Reliability Centred Maintenance.

UNIT IV COMPUTER AIDED MAINTENANCE MANAGEMENT **9 + 0**

Introduction –Definition- Basic components of CMMS- Uses of Computers in Maintenance -CMMS effectiveness - Approach towards Computerization- selection of computer system- Master files-Maintenance files- Maintenance Module- classification records- Preventive and repair planning module- codification for Break down- job sequencing files/records.

UNIT V CONDITION MONITORING **9 + 0**

Condition monitoring Techniques- Visual monitoring- Leak detection-wear monitoring-Crack monitoring- Noise and sound Monitoring-Temperature monitoring-Vibration monitoring-Signature analysis-Shock monitoring-Lubricant-Analysis-Methodology-Equipments-Applications.

Total (45+0)= 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1 : understand the maintenance principles, functions and practices adapted in industries.
CO2 : know the different categories of maintenance.
CO3 : gain knowledge about the instruments used for condition monitoring.
CO4 : provide in depth knowledge in Maintenance management systems
CO5 : provide the details of various Replacement and Inspection decision models for maximizing profit and minimizing downtime

Text Books:

1. S.K.Shrivastava, “Industrial Maintenance Management”, S. Chand and Co, 2000.
2. Bhattacharya, “Installation, Servicing and Maintenance”, S. Chand and Co, 1995.

Reference Books:

1. ADS Carter and Macmilan, “Mechanical Reliability Engineering”, *Macmillan* Education Ltd., 1991.
2. Roy Billington, Allen, R.N and Pitman, “Reliability Evaluation of Engineering Systems”, Pitman, London, 1983.
3. Gopal Krishnan, P and Banerji, A.K, “Maintenance & Spare Parts Management”, Prentice-Hall of India Pvt Ltd, 1995.
4. Grant Ireson, W and Clyde, F, “Hand Book of Reliability Engineering & Management”, McGraw Hill, 1998.

CO-PO MAPPING

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	1	0	1	2	1	3	0	2	1	0	0	3	1	1	1
CO2	2	0	0	3	1	2	0	1	2	0	0	1	2	1	1
CO3	2	0	2	2	3	2	0	2	1	0	2	1	2	1	1
CO4	1	0	0	2	2	1	0	0	0	0	3	2	3	2	1
CO5	1	0	3	0	2	0	3	0	2	0	1	1	1	1	1

1- Faintly
2- Moderately
3- Strongly

18MEPE34 **FUELS AND COMBUSTION** **L T P C**
3 0 0 3

Course Objectives:

1. Ability to characterize the fuels.
2. Understanding of thermodynamics and kinetics of combustion.
3. Understand and analyse the combustion mechanisms of various fuels.

UNIT I CHARACTERIZATION **9 + 0**

Fuels - Types and Characteristics of Fuels - Determination of Properties of Fuels – Fuels Analysis - Proximate and Ultimate Analysis - Moisture Determination - Calorific Value - Gross & Net Calorific Values - Calorimetry - DuLong's Formula for CV Estimation.

UNIT II SOLID FUELS & LIQUID FUELS **9 + 0**

Solid Fuels-Types - Coal Family - Properties - Calorific Value - ROM, DMMF, DAF and Bone Dry. Renewable Solid Fuels - Biomass - Agro Fuels – Manufactured Solid Fuels. Liquid Fuels-Types - Sources - Petroleum Fractions - Classification - Refining - Properties of Liquid Fuels - Calorific Value, Specific Gravity, Flash & Fire Point, Octane Number, Cetane Number etc., - Alcohols - Tar Sand Oil - Liquefaction of Solid Fuels.

UNIT III GASEOUS FUELS **9 + 0**

Classification - Composition & Properties - Estimation of Calorific Value – Gas Calorimeter. Rich & Lean Gas - Wobbe Index - Natural Gas - Dry & Wet Natural Gas- Stripped Natural Gas – Foul & Sweet Natural Gas - Liquefied Petroleum Gas - Liquefied natural gas - Compressed natural gas - Methane - Producer Gas - Gasifiers - Water Gas - Town Gas.

UNIT IV COMBUSTION **9 + 0**

Stoichiometry - Mass Basis & Volume Basis - Excess Air Calculation - Fuel & Flue Gas Compositions-Calculations - Rapid Methods - Combustion Processes – Stationary Flame - Surface or Flameless Combustion - Submerged Combustion - Pulsating & Slow Combustion Explosive Combustion.

UNIT V COMBUSTION EQUIPMENT'S **9 + 0**

Coal Burning Equipment's - Types - Pulverized Coal Firing - Fluidized Bed Firing – Fixed Bed & Recycled Bed - Cyclone Firing - Spreader Stokers - Vibrating Grate Stokers - Sprinkler Stokers, Traveling Grate Stokers. Oil Burners - Vaporizing Burners, Atomizing Burners. Gas Burners - Atmospheric Gas Burners - Air Aspiration Gas Burners – Burners.

Total (45+0) = 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1 : analyse the characterization of the fuel.
CO2 : determination of Flash and Fire point of various fuel blends.
CO3 : understand the various alternative fuel options available for conventional fuels.

Text Books:

1. Samir Sarkar, Fuels & Combustion, 2nd Edition, Orient Longman, 1990.
2. Bhatt, Vora Stoichiometry, 2nd Edition, Tata McGraw Hill, 1984.

Reference Books:

1. Blokh AG,Heat Transfer in Steam Boiler Furnace, Hemisphere Publishing Corpn, 1988.
2. Civil Davies, Calculations in Furnace Technology, Pergamon Press, Oxford, 1966.
3. Sharma SP, Mohan Chander, Fuels & Combustion, Tata McGraw Hill, 1984.
4. Shaha AK (2003), Combustion Engineering & Fuel Technology, Oxford and IBH Publications, New York.
5. Kenneth K Kou (2002), Principles of Combustion, Wiley & Sons Publications, New York.

CO-PO MAPPING

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	2	3	3	0	1	0	0	0	0	0	0	1	1	0
CO2	2	2	3	1	0	1	0	0	0	0	0	0	1	2	0
CO3	2	1	3	2	0	1	0	0	0	0	0	0	1	1	0

1- Faintly
2- Moderately
3- Strongly

18MEPE35 RAPID PRODUCT DEVELOPMENT TECHNOLOGIES L T P C
3 0 0 3

Course Objectives:

1. To understand advanced techniques in RPT
2. To familiarize the students with recent developments in RPT
3. To learn Precision machining techniques

UNIT I INTRODUCTION 9 + 0

Need for time compression in product development- Product development – conceptual design – development – detail design – prototype – tooling -History of RP systems- Survey of applications- Growth of RP industry-classification of RP systems

UNIT II STEREO LITHOGRAPHY SYSTEMS 9 + 0

Stereo lithography systems – Principle – process parameters – process details – machine details- Applications. Selective laser sintering – Principle – process parameters – process details – machine details- Applications-Direct Metal Laser Sintering (DMLS) system – Principle – process parameters – process details – machine details-Applications.

UNIT III FUSED DEPOSITION MODELING 9 + 0

Fusion Deposition Modelling – Principle – process parameters – process details – machine details- Applications. Laminated Object Manufacturing – Principle – process parameters – process details – machine details-Applications.

UNIT IV SOLID GROUND CURING AND CONCEPT MODELERS 9 + 0

Solid Ground Curing – Principle – process parameters – process details – machine details- Applications. 3-Dimensional printers – Principle – process parameters – process details – machine details- Applications- and other concept modelers like thermo jet printers- Sander's model maker- JP system 5- Object Quadra system. Laser Engineering Net Shaping (LENS)- Ballistic Particle Manufacturing (BPM) -Principle.

UNIT V RAPID TOOLING AND SOFTWARES 9 + 0

Introduction to rapid tooling – direct and indirect method- Indirect Rapid Tooling - Silicone rubber tooling-Aluminium filled epoxy tooling- Spray metal tooling- etc. Direct Rapid Tooling - Direct AIM- Quick cast process-Copper polyamide- Rapid Tool- DMILS- ProMetal- Sand casting tooling- Laminate tooling- soft tooling vs hard tooling. Software for RP – STL files- Magics- Mimics. Application of Rapid prototyping in Medical field.

Total (45+0)= 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1 : generating a good understanding of RP history, its development and applications.
CO2 : expose the students to different types of Rapid prototyping processes, materials used in RP systems and reverse engineering
CO3 : develop creativity in design of RPT product.

Text Books:

1. Pham D.T. & Dimov.S. S, "Rapid manufacturing", Springer Verlag, London, 2001.
2. Paul F Jacobs, "Rapid Prototyping and manufacturing – Fundamentals of Stereo lithographic", Society of Manufacturing Engineering, Dearborn, USA 1992.

Reference Books:

1. Terry wohlers, "Wohlers Report 2007", Wohlers Associates, USA 2007.
2. "Rapid Prototyping and Tooling", Industrial Design Centre, IIT Mumbai, 1998.

CO-PO MAPPING

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	2	3	0	3	1	1	0	0	0	0	0	3	2	2
CO2	2	3	2	0	3	1	1	0	0	0	0	0	2	1	2
CO3	2	2	1	0	3	1	1	0	0	0	0	0	2	1	2

1- Faintly
2- Moderately
3- Strongly

18MEPE36	REFRIGERATION & AIR CONDITIONING	L	T	P	C
		3	0	0	3

Course Objectives:

1. To understand the underlying principles of operations in various Refrigeration & Air conditioning systems
2. To familiarize the components of the refrigerating systems
3. To know the applications of refrigeration and air conditioning systems
4. To provide knowledge on cooling load calculation and the system design aspects
5. To know the wide range of applications of refrigeration and air conditioning systems

UNIT I INTRODUCTION 8 + 0

Thermodynamics of refrigeration- reversed Carnot cycle- heat pump and refrigeration machines, Limitations of reversed Carnot cycle - Unit of Refrigeration and C.O.P.– Ideal cycles- Refrigerants Desirable properties – Classification – Nomenclature – ODP & GWP.

UNIT II VAPOUR COMPRESSION REFRIGERATION SYSTEM 10 + 0

Vapour compression cycle: p-h and T-s diagrams – deviations from theoretical cycle – sub cooling and super heating- effects of condenser and evaporator pressure on COP- multi pressure system – low temperature refrigeration – Cascade systems – problems. Equipments: Type of Compressors, Condensers, Expansion devices, Evaporators.

UNIT III OTHER REFRIGERATION SYSTEMS 8 + 0

Working principles of Vapour absorption systems and adsorption cooling systems – Steam jet refrigeration- Ejector refrigeration systems- Thermoelectric refrigeration- Air refrigeration – Magnetic – Vortex and Pulse tube refrigeration systems.

UNIT IV PSYCHROMETRIC PROPERTIES AND PROCESSES 10 + 0

Properties of moist Air-Gibbs Dalton law, Specific humidity, Dew point temperature, Degree of saturation, Relative humidity, Enthalpy, Humid specific heat, Wet bulb temperature Thermodynamic wet bulb temperature, Psychometric chart; Psychometric of air-conditioning processes, mixing of air streams.

UNIT V AIR CONDITIONING SYSTEMS AND LOAD ESTIMATION 9 + 0

Air conditioning loads: Outside and inside design conditions; Heat transfer through structure, Solar radiation, Electrical appliances, Infiltration and ventilation, internal heat load; Apparatus selection; fresh air load, human comfort & IAQ principles, effective temperature & chart, calculation of summer & winter air conditioning load; Classifications, Layout of plants; Air distribution system; Filters; Air Conditioning Systems with Controls: Temperature, Pressure and Humidity sensors, Actuators & Safety controls.

Total (45+0)= 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1 : students understood the basic concepts of refrigeration and properties of refrigerants

CO2 : knowledge about the simple and multiple vapour compression systems has been acquired by the students

CO3 : students have understood the other refrigeration systems and their applications

CO4 : the Knowledge about the psychometric processes and the use of charts in problem solving have been practiced by the students

CO5 : students can able to demonstrate the operations in different Refrigeration & Air Conditioning systems and also able to design Refrigeration & Air conditioning systems

Text Books:

1. Arora, C.P., “Refrigeration and Air Conditioning”, 3rd edition, McGraw Hill, New Delhi, 2010
2. Arora S. C. and Domkundwar, Refrigeration and Air-Conditioning, Dhanpat Rai, 2010

Reference Books:

1. Roy J. Dossat, “Principles of Refrigeration”, 4th edition, Pearson Education Asia, 2009.
2. Stoecker, W.F. and Jones J. W., “Refrigeration and Air Conditioning”, McGraw Hill, New Delhi, 1986.
3. Ballaney P. L, Refrigeration and Air-Conditioning, Khanna Publishers, New Delhi, 2014
4. Manohar Prasad, Refrigeration and Air-Conditioning, New Age International, 2011
5. ASHRAE Hand book, Fundamentals, 2010

CO-PO MAPPING

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	2	3	0	0	0	0	0	0	0	0	2	1	0
CO2	2	2	1	3	0	0	0	0	0	0	0	0	2	1	0
CO3	2	2	1	2	0	0	0	0	0	0	0	0	1	1	0
CO4	2	1	1	2	0	0	0	0	0	0	0	0	1	1	0
CO5	1	1	1	3	0	0	0	0	0	0	0	0	2	1	0

1- Faintly
2- Moderately
3- Strongly

Electives – IV (VII SEMESTER)

18MEPE41	MARINE ENGINEERING	L	T	P	C
		3	0	0	3

Course Objectives:

1. To create an institution which provides an platform.
2. Naval architects and all those who seek professional avenues in fields related to the maritime industry are trained.
3. Learning that professional edge to succeed is better.
4. We endeavor to fulfill our vision of providing the maritime professionals with all the possibilities to make shipping safer, cleaner and environmentally adaptive.

UNIT I SHIP SYSTEMS 9 + 0

Ship system formulations, main propulsion system requirements, and main propulsion system trade-off studies, arrangement of machinery, piping diagrams, and auxiliary systems.

UNIT II I.C ENGINE CHARACTERISTICS 9 + 0

Characteristics of internal combustion engines, marine uses for such engines. Marine steam generators, selection and design of boilers. Main propulsion steam engines. Main propulsion steam turbines. Main propulsion gas turbines. Electric propulsion drives.

UNIT III VIBRATIONS ANALYSIS 9 + 0

Propeller shafting and shafting system vibration analysis. Pumps, blowers, compressors, ejectors, condensers, heat exchangers, distilling plants. Hull machinery design considerations and machinery installations, machinery foundation designs, hydrostatic power transmission equipment and systems.

UNIT IV ENVIRONMENTAL SYSTEM 9 + 0

Machinery for environmental control and waste treatment. Electric generating plants, switchboards and panels, lighting and power distribution, power equipment, lighting fixtures. Electronics navigation and radio communication. Automation systems. Safety considerations.

UNIT V NUCLEAR APPLICATION 9 + 0

Fundamentals of pressurized-water nuclear steam supply systems for use in marine propulsion, reactor design considerations, nuclear fuels, reactor coolants, reactor control, shielding, safety, health physics, and economics.

Total (45+0)= 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1 : understand the Marine Engineering principles, functions and practices.

CO2 : develop knowledge of reducing vibration and environmental pollution.

Text Books:

1. Grover T K, “Marine Engineering”, Anmol Publications Pvt Ltd, 2008.
2. Harrington and Roy, L, “Marine Engineering”, The Society of Naval Architects and Marine Engineers, 1991.

Reference Books:

1. Cameron, I.R., “Nuclear Fission Reactors”, Plenum Press, 1998.
2. Henke and Russell, W., “Introduction to Fluid Power Circuits and Systems”, Addison-Wesley, 1970.

CO-PO MAPPING

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	2	2	3	0	0	0	0	0	0	1	1	2	1	1
CO2	1	2	2	2	0	2	3	0	2	0	1	2	2	1	1

1- Faintly
2- Moderately
3- Strongly

18MEPE42 FRACTURE MECHANICS AND FAILURE ANALYSIS L T P C
3 0 0 3

Course Objectives:

1. Identify and explain the types of fractures of engineered materials and their characteristic features.
2. Understand the differences in the classification of fracture mechanics and how their corresponding parameters can be utilized to determine conditions under which engineering materials will be liable to fail catastrophically in service.
3. Understand and explain the mechanisms of fracture; and learn how to carry out engineering failure analysis.

UNIT I BASIC CONCEPTS IN FRACTURE MECHANICS 9 + 0

The geometry of stress and strain, elastic deformation, plastic and elasto-plastic deformation, Brittle fracture: Griffith's theory, Ductile fracture, Probabilistic aspects of fracture mechanics – Microstructure.

UNIT II MECHANICS OF FRACTURE- STATIC LOADING 9 + 0

Elastic fields – Analytical solutions yielding near a crack front – Irwin's approximation – plastic zone size – Dugdaale model – J integral and its relation to crack opening displacement. Strain energy release and stress intensity factor. Evaluation of fracture Toughness of different materials: size effect & control.

UNIT III FAILURE ANALYSIS OF FATIGUE FRACTURE 9 + 0

Fundamental sources of failures- Deficiency in design, Empirical Relation describing crack growth by fatigue – Life calculations for a given load amplitude – effects of changing the load spectrum – Effects of Environment. Micro structural analysis of fatigue failures, some case studies in analysis of fatigue failures.

UNIT IV FAILURE ANALYSIS OF CREEP RUPTURE 9 + 0

Fracture at elevated temperature: Time dependent mechanical behaviour, stress rupture, Micro Structural changes during creep, Mechanism of creep deformation and Creep deformation maps, Prediction of time to rupture, Creep-fatigue interaction. Some case studies in analysis of creep failures.

UNIT V FAILURE ANALYSIS OF CORROSION AND WEAR 9 + 0

A different environment. Types of wear, Role of friction, Interaction of corrosion and wear. Analysis of wear failure.

Total (45+0) = 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1 : Ability to design structure to prevent failure from the internal defect that unit within the structure.
CO2 : Ability to design structure to prevent fatigue and creep.
CO3 : Ability to define different deformation and related theories.
CO4 : Ability to analyse the corrosion and wear failure and system methods to prevent corrosion and wear
CO5 : Ability to analyse fatigue failures

Text Books:

1. Hertz berg R W, "Deformation and fracture mechanics of Engineering Materials" Second Edition John Wiley sons inc, New York 1983.
2. Knott. J.F, "Fundamentals of Fracture Mechanics" Butterworth London, 1973.

Reference Books:

1. Evalds H L and RJH Warnhil, "Fracture Mechanics", Edward Arnold Ltd, Baltimore,1984.
2. Campbell J E, Underwood J H, and Gerberich W., "Applications of Fracture Mechanics for the selection of Materials ", American Society for Metals, Metals Park Ohio, 1982.
3. Fracture Mechanics Metals Handbook, ninth edition, vol. 8 437-491, American Society of Metals Metal Park Ohio, 1985.

4. Kare Hellan, “Introduction of Fracture Mechanics”, McGraw-Hill Book Company, 1985.
5. Prashant Kumar, “Elements of Fracture Mechanics”, Wheeler Publishing, 1999.

CO-PO MAPPING

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
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CO2	1	3	2	2	1	0	0	0	0	0	0	0	1	2	2
CO3	1	3	2	3	1	0	0	0	0	0	0	0	2	1	1
CO4	2	2	1	2	3	0	0	0	0	0	0	0	1	2	1
CO5	1	3	0	2	3	0	0	0	0	0	0	0	1	1	1

1- Faintly
2- Moderately
3- Strongly

18MEPE43 **AUTOMATION IN MANUFACTURING** **L T P C**
3 0 0 3

Course Objectives:

1. To get the knowledge of various elements of manufacturing automation
2. To study various techniques of automatic material handling in a manufacturing organization.
3. To identify suitable automation hardware for the given application
4. To incorporate application of electronics and computer engineering in mechanical engineering for enhancing manufacturing automation
5. To develop CNC programs to manufacture industrial components

UNIT I Introduction to automation **9 + 0**

Automation overview, Requirement of automation systems, Architecture of Industrial Automation system - Basic Elements of an Automated System, Advanced Automation Functions, Levels of Automations. Manufacturing Support System - Automation in Manufacturing Systems - Reasons for Automating- Automation Principles and Strategies-Automation Migration Strategy

UNIT II Detroit-Type Automation **9 + 0**

Automated Flow lines, Methods of Work part Transport, Transfer Mechanism, Buffer Storage, Control Functions, and Automation for Machining Operations, Design and Fabrication Considerations. Analysis of Automated Flow Lines: General Terminology and Analysis, Analysis of Transfer Lines Without Storage, Partial Automation, Automated Flow Lines with Storage Buffers, Computer Simulation of Automated Flow Lines.

UNIT III Control Technologies in Automation **9 + 0**

Industrial Control Systems, Process Industries Verses Discrete-Manufacturing Industries, Continuous Verses Discrete Control, Computer Process Control and its Forms. Computer Based Industrial Control: Introduction & Automatic Process Control, Building Blocks of Automation System: LAN, Analog & Digital I/O Modules, SCADA System and RTU. man-machine interface

UNIT IV Numerical Control Machines **9 + 0**

NC components, NC coordinate systems, Point to point, line and contouring systems, open and close loop control system, Steps in NC manufacturing, Role of NC/CNC technology in modern manufacturing, Features of CNC system, components and tooling of machining centre and CNC turning centre, Automatic tool changer, Feedback devices: Encoders and linear scale, Features of DNC and adaptive control systems.

UNIT V CNC Programming **9 + 0**

Part programming fundamentals, Manual Part Programming, APT Programming, Geometric & motion commands, Post processor commands, Safety measures in CNC programming.

Total (45+0) =45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1 : the student shall be able to understand the effect of manufacturing automation strategies
CO2 : knowledge of industrial automation by transfer lines and automated assembly lines.
CO3 : ability to understand the electronic control systems in metal machining and other manufacturing processes.
CO4 : identify different CNC components, systems and controls CNC machines
CO5 : ability to write CNC programming to solve complex machining process

Text Books:

1. M.P.Grover, Automation, Production Systems and Computer Integrated Manufacturing, Pearson Education. 5th edition, 2009.

Reference Books:

1. Computer Numerical Control (CNC) Machines Paperback – 1, P. Radhakrishnan , New Central Book Agency; 1st edition, 2013
2. Steve F Krar, “Computer Numerical Control Simplified“, Industrial Press, 2001.

CO-PO MAPPING

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	1	1	2	1	1	2	2	0	0	0	1	1	1	2	2
CO2	1	2	2	1	1	2	1	0	0	0	1	1	1	2	2
CO3	1	2	2	2	2	2	1	0	0	0	1	1	1	2	2
CO4	0	1	1	1	3	2	2	0	0	0	1	1	1	2	2
CO5	0	1	1	1	3	2	2	0	0	0	1	1	1	2	2

1- Faintly
2- Moderately
3- Strongly

18MEPE44 **FUNDAMENTALS OF TRIBOLOGY** **L T P C**

3 0 0 3

Course Objectives:

1. To provide broad based understanding of the interdisciplinary subject 'tribology' and its technological significance.
2. To understand the nature of engineering surfaces, their topography and learn about surface characterisation techniques.
3. To learn about consequences of wear, wear mechanisms, wear theories and analysis of wear problems.

UNIT I SURFACES AND FRICTION **9 + 0**

Topography of Engineering surfaces- Contact between surfaces – Sources of sliding Friction– Adhesion- Ploughing- Energy dissipation mechanisms Friction Characteristics of metals – Friction of non-metals. Friction of lamellar solids – friction of Ceramic materials and polymers – Rolling Friction – Source of Rolling Friction – Stick slip motion – Measurement of Friction.

UNIT II WEAR **9 + 0**

Types of wear – Simple theory of Sliding Wear Mechanism of sliding wear of metals – Abrasive wear – Materials for Adhesive and Abrasive wear situations – Corrosive wear – Surface Fatigue wear situations – Brittle Fracture – wear – Wear of Ceramics and Polymers – Wear Measurements.

UNIT III LUBRICANTS AND LUBRICATION TYPES **9 + 0**

Types and properties of Lubricants – Testing methods – Hydrodynamic Lubrication – Elasto- hydrodynamic lubrication- Boundary Lubrication – Solid Lubrication- Hydrostatic Lubrication.

UNIT IV FILM LUBRICATION THEORY **9 + 0**

Fluid film in simple shear – Viscous flow between very close parallel plates – Shear stress variation Reynolds Equation for film Lubrication – High speed unloaded journal bearings – Loaded journal bearings – Reaction torque on the bearings – Virtual Co-efficient of friction – The Sommer field diagram.

UNIT V SURFACE ENGINEERING AND MATERIALS FOR BEARINGS **9 + 0**

Surface modifications – Transformation Hardening, surface fusion – Thermo chemical processes – Surface coatings – Plating and anodizing – Fusion Processes – Vapour Phase processes – Materials for rolling Element bearings – Materials for fluid film bearings – Materials for marginally lubricated and dry bearings.

Total (45+0) = 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1 : understand the surface phenomena related to relative motion, the nature of friction, and mechanisms of wear.
CO2 : introduce and expose students to the field and fundamentals in tribology and its applications.
CO3 : ability to identify different types of sliding & rolling friction, Wear and related theories.
CO4 : ability to distinguish among the different lubricant regime
CO5 : ability to select materials for bearing

Text Books:

1. A. Harnoy. "Bearing Design in Machinery "Marcel Dekker Inc, New York, 2003.
2. B.C. Majumdar ; A.H.Wheeler "Introduction to Tribology of Bearings"

Reference Books:

1. M. M. Khonsari & E. R. Booser, "Applied Tribology", John Willey &Sons, New York, 2001
2. E. P. Bowden and Tabor.D., "Friction and Lubrication ", Heinemann Educational Books Ltd., 1974.
3. A. Cameron, "Basic Lubrication theory", Longman, U.K.., 1981.
4. M. J. Neale (Editor), "Tribology Handbook", Newnes. Butterworth-Heinemann, U.K., 1995.

CO-PO MAPPING

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CO1	1	2	3	3	1	1	2	0	0	0	0	0	1	2	1
CO2	0	1	2	2	1	1	1	0	0	0	0	0	1	1	1
CO3	1	2	2	2	1	1	0	0	0	0	0	0	2	1	1
CO4	0	1	2	2	1	0	0	0	0	0	0	0	2	1	1
CO5	0	2	2	2	0	0	0	0	0	0	0	0	1	2	1

1- **Faintly**
2- **Moderately**
3- **Strongly**

18MEPE45 ADVANCED DECISION MODELLING TECHNIQUE L T P C
3 0 0 3

Course Objectives:

1. Consider the role of decision modelling in economic evaluation to guide decision making.
2. Use the basic building blocks of decision analysis such as joint and conditional probabilities and expected values.
3. Implement the principles of conceptual modelling as a way of planning a model.

UNIT I DECISION MAKING AND QUANTITATIVE TECHNIQUES 9 + 0

Forecasting methods & Time Series Analysis, Stochastic process introduction, Decision Analysis: Decision Trees& Utility Theory, Decision Making under uncertainty, Decision Making under risk, Decision Making under certainty, Decision Making under conflict (Game Theory).

UNIT II LINEAR PROGRAMMING FORMULATION AND SOLUTION 9 + 0

Linear Programming, Graphical & Simplex method, Dual simplex, Sensitivity Analysis & Duality, Integer Linear Programming, Transportation, Transhipment & Assignment Models.

UNIT III MULTI-CRITERIA DECISION MAKING TOOLS 9 + 0

Multi-criteria Decision making, Linear Goal Programming, Scoring Models, Fuzzy outranking, AHP (Analytic Hierarchy Process} concepts & applications, ANP (Analytic Network Process) an Introduction.

UNIT IV INVENTORY AND QUEUING MANAGEMENT 9 + 0

Inventory models (static, dynamic, probabilistic & stochastic), Waiting Line / Queuing models steady state operation(M/M/1), Simulation concepts & applications for inventory & Queuing situations, Network models; shortest route, maximal flow problem.

UNIT V ADVANCE QUANTITATIVE METHODS 9 + 0

PERT& CPM Techniques & Applications, Glimpses of Meta-heuristics, Tabu, Simulated Annealing & Genetic algorithm, Markov chains & Decision Processes, Sequencing, Dynamic Programming, Nonlinear Programming (Quadratic & Geometric Programming).

Total (45+0) = 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1 : apply the discussed techniques to solve basic problems.
CO2 : understand Structure real life problems, build and analyze a model.
CO3 : implement key generic analytic steps in decision analysis such as evidence identification and basic synthesis, sensitivity analysis and reporting results.
CO4 : think critically about the structure of decision models in particular situations and apply these appropriately
CO5 : Understand when and how the techniques can be applied in business

Text Books:

1. Charles A. Gallagher Hugh. J.Watson , 1985, Quantitative Methods for Business Decisions, McGraw Hill.
2. Nobbert Lloyd Enrick, 1979, Management Operations Research, Holt Rinchart and Winston.

Reference Books:

1. Ronald L. Rardin, 1998, Optimization in Operations Research, Prentice Hall, Upper saddle-River New Jersey.
2. Hadley.G, 1972, Linear Programming, Addison Wesley Publication Company.
3. Wisniewski MIK, 2004, Quantitative Methods for Decision Makers, Macmillan India Ltd.
4. Thomas L. Saaty, 2005, Theory and applications of the analytic network process: Decision making within benefits, opportunities, costs and risks, RWS Publications, Pittsburgh.

CO-PO MAPPING

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CO1	0	0	0	0	0	2	2	1	2	0	1	2	1	0	2
CO2	2	1	1	0	0	1	1	0	0	0	0	0	1	0	2
CO3	2	1	1	1	1	0	0	0	0	0	0	0	2	0	1
CO4	2	1	1	1	0	1	1	1	0	0	1	1	2	0	1
CO5	2	1	1	1	0	1	1	1	0	0	0	0	2	0	1

1- Faintly
2- Moderately
3- Strongly

18MEPE46 **TOTAL QUALITY MANAGEMENT** **L T P C**
3 0 0 3

Course Objectives:

1. Understand the philosophy and core values of Total Quality Management (TQM)
2. Explain the salient contributions of Quality Gurus like Deming, Juran and Crosby.
3. Determine the voice of the customer and convert into quality terms to enhance the economic performance and long-term business success of an organization.

UNIT I INTRODUCTION **9 + 0**

Definition of Quality - Dimensions of Quality - Quality planning - Quality costs, Analysis techniques for quality costs - Basic concepts of total quality management (TQM) - Historical review - Principles of TQM - Leadership - Role of senior management - Quality council, Quality statements - Strategic planning - Deming philosophy - Barriers to TQM implementation.

UNIT II TQM PRINCIPLES **9 + 0**

Customer satisfaction - Customer perception of quality, Customer complaints, Service quality, Customer Retention, Employee involvement - Motivation, Empowerment, Teams, Recognition and reward, Performance appraisal - Continuous process improvement – Juran Trilogy, PDSA Cycle, 5S, Kaizen - Supplier Partnership, Sourcing, Supplier selection, Supplier rating, Relationship development - Performance measures, Basic concepts, Strategy.

UNIT III STATISTICAL PROCESS CONTROL (SPC) **9 + 0**

The seven tools of quality, Statistical fundamentals – Measures of central tendency and dispersion, Population and sample, Normal curve - Control charts for variables and attributes, Process capability - Concept of six sigma, new seven Management tools.

UNIT IV TQM TOOLS **9 + 0**

Benchmarking – Reasons to benchmark, Benchmarking process, Quality function deployment (QFD) process – House of quality, Benefits - Taguchi quality loss function - Total productive maintenance (TPM) concept, Improvement needs - FMEA – Stages of FMEA.

UNIT V QUALITY MANAGEMENT SYSTEMS **9 + 0**

Need for ISO 9000 and other quality systems, ISO 9001:2008 quality system – Elements, Implementation of quality system, Documentation, Quality auditing, TS 16949:2002.

Total (45 + 0) = 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1 : Identify customer needs and convert those as quality index that will be used as inputs in TQM methodologies.

CO2 : Measure the performance quality i.e. cost of poor quality, process effectiveness and efficiency to identify areas for improvement.

CO3 : Determine the set of performance indicators that will align people with the objectives of an organization.

CO4 : Apply various TQM tools as a means to improve quality

CO5 : Explain ISO standards & quality systems, procedure for implementation, documentation and auditing

Text Books:

1. Dale H. Besterfiled et al., “Total Quality Management”, Pearson Education Asia, 1999.
2. Feigenbaum.A.V. “Total Quality Management”, McGraw Hill, 1991.

Reference Books:

1. Oakland.J.S, “Total Quality Management”, Butterworth – Hcinemann Ltd., Oxford. 1989.
2. Narayana V and Sreenivasan, N.S, “Quality Management – Concepts and Tasks”, New Age International, 1996.
3. James R.Evans and William M.Lidsay, “The Management and Control of Quality”, 5th Edition, South-Western, 2002.
4. Zeiri, “Total Quality Management for Engineers”, Wood Head Publishers, 1991.

CO-PO MAPPING

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	0	0	0	0	0	2	1	0	0	1	3	1	1	1	2
CO2	0	0	1	2	0	1	1	0	0	0	1	2	0	1	1
CO3	0	0	0	0	3	0	1	1	0	0	2	0	1	2	2
CO4	0	2	0	0	3	0	0	0	2	2	3	0	0	1	1
CO5	0	0	2	1	2	0	0	0	2	0	3	0	0	1	1

1- Faintly
2- Moderately
3- Strongly

Electives – V (VIII SEMESTER)

18MEPE51	ADVANCED MECHANICS OF SOLIDS	L	T	P	C
		3	0	0	3

Course Objectives:

1. Know the concepts of stress and strain.
2. Analyze the beam of different cross sections for shear force, bending moment, slope and deflection.
3. Understand the concepts necessary to design the structural elements and pressure vessels.
4. To gain knowledge of different types of stresses, Strains and deformation induced in Mechanical Components due to external loads.

UNIT I ELASTICITY 9 + 0

Stress-Strain relations and general equations of elasticity in Cartesian, Polar and curvilinear coordinates, differential equations of equilibrium-compatibility-boundary conditions-representation of three-dimensional stress of a tension generalized hook's law - St. Venant's principle - plane stress - Airy's stress function. Energy methods.

UNIT II SHEAR CENTER AND UNSYMMETRICAL BENDING 9 + 0

Location of shear center for various thin sections - shear flows. Stresses and Deflections in beams subjected to unsymmetrical loading-kern of a section.

UNIT III STRESSES IN FLAT PLATES AND CURVED MEMBERS 9 + 0

Circumference and radial stresses – deflections - curved beam with restrained ends - closed ring subjected to concentrated load and uniform load - chain links and crane hooks. Solution of rectangular plates – pure bending of plates – deflection – uniformly distributed load – various end conditions.

UNIT IV TORSION OF NON-CIRCULAR SECTIONS 9 + 0

Torsion of rectangular cross section - St.Venants theory - elastic membrane analogy - Prandtl's stress function - torsional stress in hollow thin walled tubes.

UNIT V STRESSES IN ROTATING MEMBERS AND CONTACT STRESSES 9 + 0

Radial and tangential stresses in solid disc and ring of uniform thickness and varying thickness allowable speeds. Methods of computing contact stress- deflection of bodies in point and line contact applications.

Total (45+0) =45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1 : apply concepts of stress and strain analyses in advanced mechanics of solids problems.
CO2 : use the procedures in theory of elasticity at a basic and advanced level.
CO3 : solve general bending problems.
CO4 : apply energy methods in structural mechanics problems
CO5 : gain understanding into the effects of various types of loading on structures.

Text Books:

1. Arthur P Boresi, Richard J. Schmidt, “Advanced mechanics of materials”, John Wiley, 2002.
2. Timoshenko and Goodier, "Theory of Elasticity", McGraw Hill.

Reference Books:

1. Allan F. Bower, “Applied Mechanics of Solids”, CRC press – Special Indian Edition -2012, 2010
2. G H Ryder Strength of Materials Macmillan, India Ltd, 2007.
3. Srinath. L.S., “Advanced Mechanics of solids”, Tata McGraw Hill, 1992.
4. Robert D. Cook, Warren C. Young, "Advanced Mechanics of Materials", Mc-Millan pub. Co., 1985.
5. K. Baskar and T.K. Varadan, “Theory of Isotropic/Orthotropic Elasticity”, Ane Books Pvt. Ltd., New Delhi, 2009

E-References:

1. NPTEL Videos/Tutorials

CO-PO MAPPING

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	1	2	1	1	2	1	2	0	0	0	0	0	1	1	1
CO2	2	1	3	1	1	3	1	0	0	0	0	0	2	3	1
CO3	3	1	2	1	2	1	1	0	0	0	0	0	3	1	2
CO4	1	2	1	2	1	1	1	0	0	0	0	0	1	1	2
CO5	3	1	3	1	1	1	1	0	0	0	0	0	1	1	1

1- Faintly
2- Moderately
3- Strongly

18MEPE52	HEAT TRANSFER PROBLEMS IN ELECTRONICS AND INSTRUMENTATION	L	T	P	C
		3	0	0	3

Course Objectives:

1. To understand the underlying principles of heat transfer
2. To learn the conduction heat transfer in electronic equipments
3. To familiarize with the convection heat transfer in electronic applications
4. To acquire the knowledge in the radiation heat transfer in electronic instruments
5. To understand the principles of thermal Design of Electronic Equipments

UNIT I INTRODUCTION 9 + 0

Basics of Electronic and instrumentations, basics of thermodynamics and heat transfer, Components of Electronic Systems, Thermal management in electronic devices - Packaging Trends. Electronic packaging and interconnection technology.

UNIT II CONDUCTION HEAT TRANSFER IN ELECTRONIC EQUIPMENT 9 + 0

Thermal Conductivity, Thermal Resistances, Conductivity in Solids, Conductivity in Fluids, Conduction—Steady State, Conduction in Simple Geometries, Conduction through a Plane Wall, Conduction through Cylinders and Spheres. Conduction—Transient, Lumped Capacitance Method, Conduction in Extended Surfaces. Fin Efficiency, Fin Optimization, Fin Surface Efficiency, Thermal Contact Resistance in Electronic Equipment, Discrete Heat Sources and Thermal Spreading.

UNIT III CONVECTION HEAT TRANSFER IN ELECTRONIC EQUIPMENT 9 + 0

Convection Heat Transfer in Electronic Equipment. Natural Convection in Electronic Devices, Overall Heat Transfer Coefficient. Liquid Cooling Systems, Coolant Selection, Pressure Drop and Pump Requirements. Air Cooling System, Induced or Draft Cooling, Selection of Fans and Blowers.

UNIT IV RADIATION HEAT TRANSFER IN ELECTRONIC EQUIPMENT 9 + 0

The Electromagnetic Spectrum, Radiation Equations , Stefan-Boltzmann Law, Surface Characteristics, Emittance, Emittance Factor, Emittance from Extended Surface, Absorptance, Reflectance, Specular Reflectance, Heat Transfer with Phase Change. Combined Modes of Heat Transfer for Electronic Equipment, Radiation and Convection in Parallel.

UNIT V INTRODUCTION TO THERMAL DESIGN OF ELECTRONIC EQUIPMENT 9 + 0

Analysis of Thermal Failure of Electronic Components. Analysis of Thermal Stresses and Strain, Effect of PCB Bending Stiffness on Wire Stresses, Vibration Fatigue in Lead Wires and Solder Joints. Electronics Cooling Methods in Industry. Heat Sinks, Heat Pipes, Heat Pipes in Electronics Cooling, Thermoelectric Cooling, Immersion Cooling, Cooling Techniques for High Density Electronics.

Total (45+0) =45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1 : students understood the basic concepts of heat and mass transfer principles
CO2 : knowledge about the concept of conduction heat transfer in electronic and instrumentation
CO3 : students have understood the convective heat transfer in the electronic appliances
CO4 : the Knowledge about the radiation heat transfer in electronic instruments
CO5 : students can able to design the thermal systems in electronic equipments

Text Books:

1. Heat transfer Dr. A.S. Padalkar, NiraliPrakashan, Pune 2012
2. Heat & mass transfer, D.S. Kumar, S.K. Kataria& Sons, 2010

Reference Books:

1. Heat transfer B.L. Singhal, Techmax, publication, Pune 2010
2. Heat & mass transfer,Mills and Ganesan, Pearson Publication, New Delhi 2010

E-References:

1. nptel.ac.in/ courses/downloads

CO-PO MAPPING

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	1	1	2	1	1	1	0	0	0	0	0	1	1	1
CO2	2	1	1	2	3	1	1	0	0	0	0	0	1	2	2
CO3	3	1	1	2	1	2	1	0	0	0	0	0	1	1	2
CO4	1	1	1	1	2	2	1	0	0	0	0	0	1	3	1
CO5	1	0	3	2	1	1	1	0	0	0	0	0	2	3	1

1- Faintly
2- Moderately
3- Strongly

18MEPE53	NUCLEAR ENGINEERING	L	T	P	C
		3	0	0	3

Course Objectives:

1. To teach students fundamental physics about nuclear processes and a heat transfer techniques from nuclear energy
2. To introduce students about the nuclear fuels with its properties and also extraction process of nuclear fuels.
3. To teach about the characteristics of spent fuel and reprocessing of solvent extraction
4. To teach about the nuclear reactor product
5. To teach about the safety aspects to be used in nuclear process and disposal of nuclear waste

UNIT I NUCLEAR REACTIONS 9 + 0

Mechanism of Nuclear Fission - Nuclides - Radioactivity – Decay Chains - Neutron Reactions - the Fission Process - Reactors - Types of Fast Breeding Reactor - Design and Construction of Nuclear reactors - Heat Transfer Techniques in Nuclear Reactors - Reactor Shielding.

UNIT II REACTOR MATERIALS 9 + 0

Nuclear Fuel Cycles - Characteristics of Nuclear Fuels - Uranium - Production and Purification of Uranium - Conversion to UF4 and UF6 - Other Fuels like Zirconium, Thorium - Beryllium.

UNIT III REPROCESSIG 9 + 0

Nuclear Fuel Cycles - Spent Fuel Characteristics - Role of Solvent Extraction in Reprocessing - Solvent Extraction Equipment.

UNIT IV NUCLEAR REACTOR 9 + 0

Nuclear reactors: types of fast breeding reactors-design and construction of fast breeding reactors-heat transfer techniques in nuclear reactors-reactor shielding. Fusion reactors.

UNIT V SAFETY AND DISPOSAL 9 + 0

Safety and disposal: Nuclear plant safety-safety systems-changes and consequences of accident-criteria for safety-nuclear waste-types of waste and its disposal-radiation hazards and their prevention-weapons proliferation.

Total (45 +0) = 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1 : learn about the fundamental knowledge about nuclear reactions
CO2 : learn about the various nuclear fuels and its properties.
CO3 : study about the processing of nuclear fuel cycles
CO4 : learn about the function of nuclear reactor
CO5 : study about safe disposal of nuclear wastes.

Text Books:

1. Thomas J.Cannoly, “Fundamentals of nuclear Engineering” John Wiley 1978.
2. Glasstone, S and Sesonske, A, “Nuclear Reactor Engineering”, 3rd Edition, Von Nostrand, 1981.
3. Lamarsh, J.R., “Introduction to Nuclear Reactor Theory”, Wesley, 1966.

Reference Books:

1. Winterton, R.H.S., “Thermal Design of Nuclear Reactors”, Pergamon Press, 1981.
2. Jelly N A, “Nuclear Engineering”, Cambridge University Press, 2005.
3. Duderstadt, J.J and Hamiition, L.J, “Nuclear Reactor Analysis”, John Wiley, 1976.
4. Walter, A.E and Reynolds, A.B, “Fast Breeder Reactor”, Pergamon Press, 1981.

E- Reference

1. http://nptel.ac.in/courses/112101007/

CO-PO MAPPING

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	1	2	2	1	1	1	1	0	0	0	0	0	1	1	1
CO2	1	1	2	1	2	1	2	0	0	0	0	0	2	3	3
CO3	1	1	1	1	1	1	1	0	0	0	0	0	1	2	1
CO4	3	1	1	1	1	2	1	0	0	0	0	0	3	1	1
CO5	1	1	2	1	1	1	1	0	0	0	0	0	1	3	1

1- Faintly
2- Moderately
3- Strongly

18MEPE54	ANALYSIS AND SYNTHESIS OF MECHANISM	L	T	P	C
		3	0	0	3

Course Objectives:

1. To Study of kinematics of various mechanisms and kinematic synthesis of linkages.
2. To Study of various graphical constructions of acceleration analysis.
3. To Study Static and dynamic force analysis of linkages.
4. To Study Kinematic analysis and kinematic synthesis of spatial mechanisms
5. To Study about the spatial mechanisms and robotics

UNIT I KINEMATIC ANALYSIS OF MECHANISMS 9 + 0

Review of Fundamentals of Kinematics - Mobility Analysis - Classifications of Mechanisms - Kinematic Inversion - Grashoff's law - Mechanical Advantage - Transmission Angle - Position Analysis - Vector Loop Equations for four bar, Slider Crank, Six bar linkages - Analytical and Graphical methods for velocity and acceleration analysis - Four bar linkage jerk analysis. Plane complex mechanism.

UNIT II KINEMATIC SYNTHESIS OF LINKAGES 9 + 0

Type, Number and Dimensional Synthesis - Function Generation - Path Generation and Motion Generation. - Graphical Methods: Two Position, Three Position and Four Position synthesis of four bar Mechanism, Slider crank Mechanism, Precision positions Over lay Method. Analytical Methods: Blotch's Synthesis - Freudestien's Method - Coupler curve Synthesis - Cognate linkages - The Roberts - Chebyshev theorem.

UNIT III PATH CURVATURE THEORY 9 + 0

Fixed and moving centrodes. - Hartmann's Construction - Inflection Points, The Inflection Circle - The Euler - Savary Equation - The collination axis and Bobiller's theorem - Conjugate points and inverse motion - The Cubic Stationary curvature - Ball's Point.

UNIT IV DYNAMICS OF MECHANISMS 9 + 0

Static force analysis - Inertia force analysis - Combined static and inertia force Analysis - Shaking force - Introduction to force and moment balancing of linkages.

UNIT V SPATIAL MECHANISMS AND ROBOTICS 9 + 0

Introduction: Mobility of mechanisms - Description of spatial motions - Kinematic analysis of spatial mechanism - Kinematic synthesis of spatial mechanisms: position, velocity and acceleration analysis. Eulerian Angles - Introduction to Robotic Manipulators - Topological arrangements of robotic arms - Kinematic analysis of spatial mechanism - Denavit - Hartenberg Parameters, Forward and inverse kinematics of robotic manipulators.

Total (45+0) =45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1 : analysis the kinematics of mechanisms
CO2 : synthesis the kinematics of linkages
CO3 : acquire knowledge about the theory of path curvature
CO4 : learned the dynamics of mechanisms
CO5 : design the robotics arms and manipulators

Text Books:

1. Rao.J.S and Dukkipatti.R.V, “Mechanisms and Machine Theory”, 2nd Edition, New Age international (P) Ltd., 2007
2. Shigley.J.E and Uicker J.J, “Theory of Machines and Mechanisms”, McGraw Hill, 1995.

Reference Books:

1. Norton.R. L, “Design of Machinery”, McGraw Hill, 2010.

2. Sandor.G.N and Erdman A. G, “Mechanism Design, Analysis and Synthesis”, Vol: I and Vol: II, Prentice Hall, Digitized 2007.
3. Hamilton.HMabie and Charles F. Reinhofz, “Mechanisms and Dynamics of Machinery”, John Wiley & Sons, Digitized 2007.
4. AmitabhaGhose and Ashok Kumar Malik, “Theory of Mechanisms and Machines”, EWLP, Delhi, 1999.

E-References:

1. Nptel.ac.in / courses / downloads

CO-PO MAPPING

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	1	2	1	1	2	1	1	0	0	0	0	0	1	2	1
CO2	2	1	3	1	1	1	1	0	0	0	0	0	1	2	1
CO3	1	3	1	1	1	2	1	0	0	0	0	0	1	1	3
CO4	1	2	1	1	1	2	3	0	0	0	0	0	2	1	1
CO5	1	1	1	1	2	1	1	0	0	0	0	0	3	1	2

1- Faintly
2- Moderately
3- Strongly

18MEPE55 **THERMAL TURBO MACHINES** **L T P C**
3 0 0 3

Course Objectives:

1. To understand the various systems, principles, operations and applications of different types of turbo machinery components.

UNIT I INTRODUCTION TO TURBO MACHINES 9 + 0

Turbines, Pumps, Compressors, Fans and Blowers – Stages of Turbo machines – Energy transfer between fluid and rotor – Stage velocity triangles Thermal Turbo machines – Classification – General energy equation – Modified to turbo machines – compression and expansion process – Velocity triangles – Work – T-S and H-S diagram, Total – to – Total and Total – to – Static efficiencies. Dimensional analysis – Non dimensional parameters of compressible flow Turbo machines – Similarity laws, applications and limitations.

UNIT II CENTRIFUGAL FANS AND COMPRESSOR 9 + 0

Definition, selection and classifications –Types of blading design-velocity triangles - Stage Parameters – Flow analysis in impeller blades –Design parameter- Volute and Diffusers – Efficiencies and Losses – Fan noises – Causes and remedial measures. Centrifugal Compressors: - Constructional details – Stage velocity triangles –– Stage work – Stage pressure rise – Stage efficiency – Degree of reaction – Slip factor – H-S diagram – Efficiencies – Performance characteristics.

UNIT III AXIAL FANS AND COMPRESSOR 9 + 0

Definition and classifications – Stage parameters – Types of fan stages-performance characteristics. Cascade of blades – Cascade tunnel - Blade geometry-Cascade variables-Energy transfer and loss in terms of lift and drag - Axial Flow Compressors: definition and classifications – Constructional details – Stage velocity triangles – Stage work – Stage pressure rise – H-S diagram – Stage efficiencies and losses- Degree of reaction – Radial equilibrium- Surging and Stalling – Performance characteristics.

UNIT IV AXIAL FLOW TURBINES 9 + 0

Construction details –90^0 IFR turbine- Stage work – Stage Velocity triangles – Stage pressure rise – Impulse and reaction stage – Effect of degree of reaction – H-S diagram – Efficiencies and Losses –Performance characteristics.

UNIT V RADIAL FLOW TURBINES AND WIND TURBINES 9 + 0

Constructional details –– Stage velocity triangles – H-S diagram – Stage efficiencies and losses –Performance characteristics. Wind turbines: definition and classifications – Constructional details –Horizontal axis wind turbine- Power developed – Axial thrust – Efficiency.

Total (45+0) =45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1 : understand the Basic Concept of Compressors, Turbines, Fans and Blowers
CO2 : analyze the velocity triangles of Centrifugal fans and Compressors.
CO3 : analyze the construction details and performance of axial fans and compressor.
CO4 : analyze the design variations of axial flow turbines.
CO5 : study the construction features and performance analysis of radial flow turbine and wind turbine

Text Books:

1. Yahya, S.M., “Turbines, Compressors and Fans”, Tata McGraw Hill Publishing Company, 1996.
2. Dixon S.L, “Fluid Mechanics, Thermodynamics of Turbo Machines”, 2nd Edition, Pergamon press, 1990.
3. Kadambi V and Manohar Prasad, “An Introduction to Energy Conversion - Vol. III Turbo Machines”, Wiley Eastern India Ltd, 1977.

Reference Books:

1. Bruneck, Fans, Pergamom Press, 1973.
2. Earl Logan, Jr., Hand book of Turbomachinery, Marcel Dekker Inc., 1992.
3. Shepherd, D.H., Principles of Turbomachinery, Macmillan, 1969.
4. Stepanpff, A.J., Blowers and Pumps, John Wiley and Sons Inc. 1965.
5. Ganesan, V., Gas Turbines, Tata McGraw Hill Pub. Co., 1999.
7. Rangwala A S, “Structural Dynamics of Turbo-Machines”, New Age International,2005.
8. Astashev VK, Babitsky VI and Kolovsky MZ, “Dynamics and Control of Machines”, Springer Pub, 2000

CO-PO MAPPING

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	1	2	1	1	3	1	1	0	0	0	0	0	1	2	2
CO2	1	3	1	1	2	1	1	0	0	0	0	0	1	1	3
CO3	2	1	3	1	1	2	1	0	0	0	0	0	1	1	2
CO4	2	1	1	1	3	1	1	0	0	0	0	0	1	1	2
CO5	2	1	1	3	1	2	1	0	0	0	0	0	2	3	1

1- Faintly
2- Moderately
3- Strongly

Electives – VI (VIII SEMESTER)

18MEPE61	CRYOGENIC ENGINEERING	L	T	P	C
		3	0	0	3

Course Objectives:

1. To provide the knowledge of evolution of low temperature science
2. To provide knowledge on the properties of materials at low temperature
3. To familiarize with various gas liquefaction systems and to provide design aspects of cryogenic storage and transfer lines
4. To learn information concerning low temperature processes and techniques
5. To be familiar with the applications of low temperature technology

UNIT I INTRODUCTION **9 + 0**

Liquefaction systems ideal system, Joule Thomson expansion, Adiabatic expansion, LindeHampson Cycle, Claude & Cascaded System, Magnetic Cooling, Stirling Cycle Cryo Coolers.

UNIT II GAS LIQUEFACTION SYSTEMS **9 + 0**

Introduction-Production of low Temperatures-General Liquefaction systems- Liquefaction systems for Neon. Hydrogen and Helium –Critical components of Liquefaction systems.

UNIT III CRYOGENIC REFRIGERATION SYSTEMS **9 + 0**

Ideal Refrigeration systems- Refrigeration using liquids and gases as refrigerant- Refrigerators using solids as working media.

UNIT IV CRYOGENIC FLUID STORAGE AND TRANSFER SYSTEMS **9 + 0**

Cryogenic Storage vessels and Transportation, Thermal insulation and their performance at cryogenic temperatures, Super Insulations, Vacuum insulation, Powder insulation, Cryogenic fluid transfer systems.

UNIT V CRYOGENIC FLUID STORAGE AND TRANSFER SYSTEMS **9 + 0**

Pressure flow-level and temperature measurements. Types of heat exchangers used in cryogenic systems (only description with figure) Cryo pumping Applications.

Total (45+0) =45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1 : Know about properties of material at cryogenic temperatures.
CO2 : know about various liquefaction systems.
CO3 : get ideas on cryogenic refrigeration systems, cryogenic instrumentation and cryogenic heat exchangers.
CO4 : learned about the cryogenic fluid storage and transfer systems.
CO5 : acquire knowledge about the cryogenic fluid storage and transfer systems.

Text Books:

1. J. H. Boll Jr, Cryogenic Engineering
2. R. B. Scott, Cryogenic Engineering, Van Nostrand Co., 1959

Reference Books:

1. Klaus D. Timmerhaus and Thomas M.Flynn, Cryogenic Process Engineering, Plenum Press, New York, 1989.
2. Randal F.Barron, Cryogenic systems, McGraw Hill, 1986.

E-References:

1. nptel.ac.in / courses / downloads

CO-PO MAPPING

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	0	0	0	2	0	0	0	0	0	0	0	0	0	1	0
CO2	0	0	3	0	0	0	0	0	0	0	0	0	0	0	2
CO3	0	0	0	0	2	0	0	0	0	0	0	0	3	0	0
CO4	0	3	0	0	0	0	0	0	0	0	0	0	0	0	1
CO5	1	0	0	0	0	0	0	0	0	0	0	0	0	2	0

1- Faintly
2- Moderately
3- Strongly

18MEPE62 INTRODUCTION TO COMPUTATIONAL FLUID DYNAMICS L T P C
3 0 0 3

Course Objectives:

1. To introduce numerical modeling and its role in the field of heat transfer and fluid flow.
2. To enable the students to understand the various discretization methods and solving methodologies.
3. To create confidence to solve complex problems in the field of heat transfer and fluid dynamics by using high speed computers.

UNIT I GOVERNING DIFFERENTIAL EQUATION AND FINITE DIFFERENCE METHOD 9 + 0

Classification, Initial and Boundary conditions, Initial and Boundary value problems. Finite difference method, Central, Forward, Backward difference, Uniform and non-uniform Grids, Numerical Errors, Grid Independence Test.

UNIT II CONDUCTION HEAT TRANSFER 9 + 0

Steady one-dimensional conduction, two and three dimensional steady state problems, Transient one-dimensional problem, Two-dimensional Transient Problems.

UNIT III INCOMPRESSIBLE FLUID FLOW 9 + 0

Governing Equations, Stream Function – Verticity method, Determination of pressure for viscous flow, simple Procedure of Patankar and Spalding, Computation of Boundary layer flow, Finite difference approach.

UNIT IV CONVECTION HEAT TRANSFER AND FEM 9 + 0

Steady One-Dimensional and Two-Dimensional Convection – Diffusion, Unsteady one-dimensional convection – Diffusion, Unsteady two-dimensional convection – Diffusion – Introduction to finite element method – Solution of steady heat conduction by FEM – Incompressible flow – Simulation by FEM.

UNIT V TURBULENCE MODELS 9 + 0

Algebraic Models – One equation model, K - £ Models, Standard and High and Low Reynolds number models, Prediction of fluid flow and heat transfer using standard codes.

Total(45+0) = 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1 : understand and be able to numerically solve the governing equations for fluid flow.
CO2 : solve computational problems related to fluid flows and heat transfer.
CO3 Solve the problems related to incompressible fluid flow.
CO4 : interpret the knowledge, capability of analyzing and solving heat convection problem.
CO5 : understand and apply turbulence models to engineering fluid flow problems.

Text Books:

1. Ghoshdasdidar, P.S, “Computer Simulation of flow and heat transfer”, Tata McGraw-Hill Publishing Company Ltd., 1998.
2. Muralidhar, K.andSundararajan, T., “Computational Fluid Flow and Heat Transfer”, Narosa Publishing House, New Delhi, 1995.

Reference Books:

1. Bose, T.X., “Numerical Fluid Dynamics”, Narosa Publishing House, 1997
2. Fletcher, C.A.J. “Computational Techniques for Fluid Dynamics 2-Specific Techniques for Different Flow Categories”, Springer and Verlag, 1987
3. Taylor, C and Hughes, J.B, “Finite Element Programming of the Navier Stock Equation”, Pineridge Press Limited, U.K., 1981.
4. Subas, V, Patankar, “Numerical heat transfer fluid flow”, Hemisphere Publishing Corporation, 1980.

CO-PO MAPPING

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	0	0	0	0	0	0	0	0	0	0	0	2	0	0
CO2	0	2	0	0	0	0	0	0	0	0	0	0	0	1	0
CO3	0	0	1	0	0	0	0	0	0	0	0	0	0	0	3
CO4	0	0	0	0	2	0	0	0	0	0	0	0	0	2	0
CO5	0	0	0	3	0	0	0	0	0	0	0	0	2	0	0

1- **Faintly**
2- **Moderately**
3- **Strongly**

18MEPE63 **ROBOTICS** **L T P C**
3 0 0 3

Course Objectives:

1. To explore concepts of Robot technologies that is playing vital role in manufacture.
2. Describe various Robot technology applications.
3. Develop an understanding of Robot Kinematics and dynamics.
4. Explain and summarize Robot End effectors and Sensors.
5. Explore conceptual understanding of Robot programming.

UNIT I INTRODUCTION 9 + 0

Robot - definition - robot anatomy - co-ordinate systems - work envelope - types and classification - specifications – joint notations – types of joints - speed of motion - pay load - robot parts and their functions - need for robots in Indian scenario.

UNIT II ROBOT DRIVE SYSTEMS AND END EFFECTORS 9 + 0

Drives - hydraulic, pneumatic, mechanical and electrical - servo motors - stepper motors - salient features, application – end effectors – types: tools - grippers - mechanical grippers - pneumatic and hydraulic grippers, magnetic grippers, vacuum grippers, multiple grippers.

UNIT III SENSORS AND MACHINE VISION 9 + 0

Requirements of sensors – principles, types and applications of following types of sensors proximity (inductive, Hall effect, capacitive, ultrasonic and optical) – range (Triangulation, structured light approach, laser range) – speed, position (resolvers, optical encoders, pneumatic) – force – torque – touch sensors (binary, analog sensor) - introduction to machine vision -functions - image processing and analysis.

UNIT IV ROBOT KINEMATICS AND ROBOT PROGRAMMING 9 + 0

Forward kinematics and reverse kinematics of manipulators - two, three degrees of freedom (in 2 dimensional) – homogeneous transformation matrix - simple problems - lead through programming, robot programming languages - VAL programming –motion commands - sensor commands - end effecter commands - simple programs for loading, unloading and palletizing operations.

UNIT V APPLICATIONS, IMPLEMENTATION AND ROBOT ECONOMICS 9 + 0

Robot cell design – types - Application of robots in processing - assembly - inspection - material handling - loading -unloading - automobile - implementation of robots in industries - safety considerations for robot operations – economic analysis of robots - pay back method and rate of return method.

Total (45+0) =45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1 : understand the basic concepts, parts of robots and types of robots.
CO2 : understand the potential applications of robots in industries as part of automation tool
CO3 : familiar with the various drive systems for robot, sensors and their applications in robots, programming of robots.
CO4 : discuss about the various applications of robots, justification, implementation and safety of robot
CO5 : select an appropriate robot for a particular application.

Text Books:

1. Mikell. P. Groover, 'Industrial Robotics Technology', Programming and Applications, McGraw Hill Co,1995.
2. Fu.K.S. Gonzalz.R.C., and Lee C.S.G., "Robotics Control, Sensing, Vision and Intelligence", McGraw Hill Book Co.,1987.

Reference Books:

1. Richard D.Klafter, Thomas A.Chmielewski and MichealNegin, "Robotic engineering –An Integrated Approach",Prentice Hall Inc, Englewoods Cliffs, NJ, USA, 2005.

2. Janakiraman.P.A. “Robotics and Image Processing”, Tata McGraw-Hill, 1995.
3. YoramKoren, “Robotics for Engineers”, McGraw-Hill Book Co., 1992.
4. A.K.Gupta and S.K.Arora, “Industrial Automation and Robotics”, Laxmi Publications Pvt ltd, 2007.
5. Fu. K. S., Gonzalez. R. C. & Lee C.S.G., ‘Robotics control, sensing, vision and intelligence’, McGraw Hill Book co, 1987.
6. Craig. J. J. ‘Introduction to Robotics mechanics and control’,Addison- Wesley, 1999.
7. Ray Asfahl. C., ‘Robots and Manufacturing Automation’, John Wiley & Sons Inc., 1985.

E-References:

1. NPTEL Videos/Tutorials

CO-PO MAPPING

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	0	0	0	3	0	0	0	0	0	0	0	0	2	0	0
CO2	0	0	0	0	2	0	0	0	0	0	0	0	0	2	0
CO3	0	0	3	0	0	0	0	0	0	0	0	0	1	0	0
CO4	0	0	0	0	0	0	2	0	0	0	0	0	0	0	3
CO5	0	0	0	0	0	0	0	3	0	0	0	0	0	2	0

1- Faintly
2- Moderately
3- Strongly

18MEPE64 ENGINEERING SYSTEM MODELING AND SIMULATION

L	T	P	C
3	0	0	3

Course Objectives:

1. Outline the fundamentals of system simulation
2. Identify the different types of techniques to generate Random numbers
3. Outline random number and variate generation.
4. The ability to analyze a system and to make use of the information to improve the performance

UNIT I INTRODUCTION **9 + 0**

Static physical models, dynamic physical models, static mathematical models, dynamic mathematical models, principles used in modeling. System studies, a corporate model: Environment segment, production segment, management segment. Types of system study.

UNIT II MATHEMATICAL AND STATISTICAL MODELS **9 + 0**

Probability concepts, Queuing Models, Methods for generating random variables and Validation of random numbers.

UNIT III DESIGN OF SIMULATION EXPERIMENTS **9 + 0**

Problem formulation, data collection and reduction, time flow mechanism, key variables, logic flow chart, starting condition, run size, experimental design consideration, output analysis and interpretation validation.

UNIT IV SIMULATION LANGUAGES **9 + 0**

Input modeling: data collection, identifying the distribution with data, parameter estimation, goodness of fit test, fitting a non-stationary Poisson process, selecting input models without data, multivariate and time series input models. Verification and validation of simulation models, model building, verification and validation, verification of simulation models, calibration and validation of models.

UNIT V CASE STUDIES **9 + 0**

Development of simulation models using simulation language studied for systems like queuing systems, Production systems, Inventory systems, maintenance and replacement systems and Investment analysis.

Total (45+0) =45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1 : modeling any given system with rationality.
CO2 : predicting the behavior through fine grained analysis.
CO3 : simulate the life cycle analysis, and drives over issues like model verification and validation.
CO4 : design simulation models for various case studies like inventory, traffic flow networks,etc.
CO5 : practice on simulation tools and impart knowledge on building simulation systems.

Text Books:

1. Geoffrey Gordon, “System Simulation”, 2nd Edition, Prentice Hall, India, 2002.
2. Narsingh Deo, “System Simulation with Digital Computer, “Prentice Hall, India, 2001.

Reference Books:

1. Jerry Banks and John S.Carson, Barry L. Nelson, David M.Nicol, “Discrete Event System Simulation”, 3rd Edition, Prentice Hall, India, 2002.
2. Thomas J. Schriber, Simulation using GPSS, John Wiley, 1991.
3. Shannon, R.E. Systems simulation, The art and science, Prentice Hall, 1975.

E-References:

1. NPTEL Videos/Tutorials

CO-PO MAPPING

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	0	2	0	0	0	0	0	0	0	0	0	0	0	3	0
CO2	0	0	0	3	0	0	0	0	0	0	0	0	1	0	0
CO3	0	0	2	0	0	0	0	0	0	0	0	0	0	0	3
CO4	0	0	0	0	0	3	0	0	0	0	0	0	0	2	0
CO5	0	0	0	0	1	0	0	0	0	0	0	0	2	0	0

1- Faintly
2- Moderately
3- Strongly

18MEPE65 **DESIGN OF PRODUCTION TOOLING** **L T P C**
3 0 0 3

Course Objectives:

1. Describe tool design methods and punch and die manufacturing techniques
2. Select material for cutting tools and gages; classify various cutting tools and gages and identify their nomenclature
3. Describe the principles of clamping, drill jigs and computer aided jig design
4. Design fixtures for milling, boring, lathe, grinding, welding; identify fixtures and cutting tools for NC machine tools
5. Explain the principles of dies and moulds design

UNIT I DESIGN OF CUTTING TOOLS **9 + 0**

Tool materials, design of single point cutting tool, form tool, drill, reamer, broach & plain milling cutter.

UNIT II METAL CUTTING **9 + 0**

Theory of metal cutting – design of tool holders for single point tools – Boring bars – selection of tools for machining applications – economics of machining.

UNIT III DESIGN OF FIXTURES **9 + 0**

Standard work holding devices – principles of location and clamping – clamping methods and elements – quick-acting clamps – design & sketching of milling fixtures for simple components – Turning, Grinding, Welding fixtures. Inspection fixtures and design of gauges.

UNIT IV DESIGN OF DRILL JIGS **9 + 0**

Drill bushings – types of jigs: Plate, Leaf, Turn over & Box Jigs – design & sketching of drill jigs for machining simple components.

UNIT V PRESS TOOLS **9 + 0**

Power presses – die cutting operations – centre of pressure – scrap strip lay out for blanking – press tonnage calculations – Progressive & Compound dies – die design for simple components. Drawing dies – blank development – estimation of drawing force – blank holders & blank holding pressure – design & sketching of drawing dies for simple components – Bending dies & Combination tools.

Total (45+0) =45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1 : identify the various cutting tools for different machining processes.
CO2 : select suitable tools for metal machining
CO3 : identify suitable fixures for various components.
CO4 : ability to design jigs for machining components.
CO5 : the students can able to design jigs, fixtures and press tools

Text Books:

1. Cyril Donaldson, Lecain and Goold: Tool Design – Tata McGraw Hill publications
2. A Bhattacharyya: Metal Cutting – Theory and Practice – Central Book Agency Kolkata

Reference Books:

1. ASTME: Fundamentals of Tool Design – Prentice Hall
2. F W Wilson: Hand Book of Fixture Design - McGraw Hill publications.
3. Edward G Hoffman, “Jigs and Fixture Design”, Thomson – Delmar Learning, Singapore 2004.
4. Joshi P H, “Jigs and Fixtures”, Tata McGraw Hill Publishing Company Limited, New Delhi 2004.

CO-PO MAPPING

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	0	0	2	0	0	0	0	0	0	0	0	0	2	0	0
CO2	0	0	0	0	3	0	0	0	0	0	0	0	0	1	0
CO3	0	0	0	2	0	0	0	0	0	0	0	0	0	0	3
CO4	0	0	1	0	0	0	0	0	0	0	0	0	0	0	2
CO5	0	2	0	0	0	0	0	0	0	0	0	0	0	3	0

1- Faintly
2- Moderately
3- Strongly

18MEOE01 DESIGN OF MACHINE ELEMENTS AND MACHINING L T P C
3 0 0 3

COURSE OBJECTIVES:

1. To familiarize the various steps involved in the design process
2. To understand the basic concepts of machining techniques
3. To know the factors influencing the processes and their applications

UNIT I STRESSES IN MACHINE ELEMENTS 9 + 0

Stress in simple machine members- axial, bending, torsional, bearing stress, Hertz contact stress; combined stresses, principle stresses, Theories of failure, factor of safety, stress concentration, preferred numbers.

UNIT II DESIGN OF SHAFTS AND WELDED JOINTS 9 + 0

Design of shaft members subjected to simple and combined stresses - Welded joints- Types of welding symbols, design of welded joints subjected to various load -Design of Riveted joints

UNIT III DESIGN OF MACHINE ELEMENTS 9 + 0

Springs: Design of helical springs- stresses and deflection - design procedure. Bearings: Need for bearing, Types, sliding and rolling contact bearings, hydro- dynamic and hydro static bearings- Life of bearings – Selection of bearings-Problems.

UNIT IV METAL CUTTING 9 + 0

Theory of metal cutting: Introduction, mechanics of metal cutting, orthogonal and oblique cutting, merchants equation, chip formation, heat generation, cutting fluids, cutting tool life, recent developments and applications (Dry machining and high speed machining)

UNIT V MACHINE TOOLS AND SURFACE FINISHING PROCESSES 9 + 0

Tools and machine tools: Cutting tool materials, cutting tool nomenclature, introduction to machine tools, lathe, shaper, planning, milling, drilling and boring machines, working principle, operations, work holding devices. Surface finishing processes**:** Introduction to Grinding honing, lapping processes and machines. Introduction to CAD/CAM/CIM.

Total (45+0)= 45 Periods

COURSE OUTCOMES:

Upon completion of this course, the students will be able to:

CO1 : analyze the stresses induced in a machine element.
CO2 : understand the design concept of joints under various loading.
CO3 : identify the process parameters associated with various machining processes.

TEXT BOOKS:

1. Rao P N, “Manufacturing Technology” Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2006
2. HMT, “Production Technology” Tata McGraw-Hill Co., New Delhi, 1998
3. Robert L Mott, “Machine Elements in Mechanical Design”, Macmillan Publishing Co., London. UK, 1992.
4. Shighley and Mische, “Mechanical Engineering Design” McGraw Hill, 1992.

REFERENCE BOOKS:

1. Milton C Shaw, “Metal Cutting Principles”, Clarendon Press, Oxford, 1999.
2. James Brown, “Advanced Machining Technology Handbook”, McGraw- Hill Book Company, New York, 1988.

CO-PO MAPPING

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	3	3	3	0	0	0	1	0	0	0	0	3	3	0
CO2	1	3	3	0	0	0	0	0	0	0	0	0	3	3	0
CO3	0	2	0	2	0	0	0	0	0	0	0	0	1	3	0

1- Faintly
2- Moderately
3- Strongly

18MEOE02 **INDUSTRIAL ENGINEERING** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

1. Assume professional, technical, managerial and leadership roles in the industrial organizations.
2. Apply knowledge through discovery, synthesis, and integration for the betterment of the organization.
3. Apply engineering principles to the work environment.
4. Use quality tools to foresee and solve issues in the industrial situations.
5. Work collaboratively.

UNIT I FORECASTING AND INVENTORY 9 + 0

Characteristics and Principles, Qualitative methods - Delphi technique, Market Research, Intrinsic method - Time-series analysis, Moving averages, Exponential smoothing - The Bon Jenkins method, Extrinsic methods - Regression models, Measurement of forecast errors. Inventory models - Classification of inventory systems – EOQ models and purchase discounts - ABC and other classification methods - Applications

UNIT II FACILITIES PLANNING 9 + 0

Facilities planning - An overview, Facilities planning and engineering economic analysis - Facilities location problems – Types of layouts - Computerized layout planning - Warehouse management, Value added management, Management system audit - Role of KAIZEN, TQM, QC and POKA YOKE in facilities planning.

UNIT III JIT AND MODERN MANUFACTURING PRINCIPLES 9 + 0

Introduction - Elements of Just In Time (JIT), Pull versus Push method, Kanban system - Single Minute Exchange of Die (SMED) - Continuous improvement - Optimized production technology - Business process reengineering (BPR), Lean manufacturing concepts – Implementation of Six Sigma concepts - Cellular manufacturing - Concurrent engineering - Agile manufacturing - Rapid manufacturing.

UNIT IV AGGREGATE PLANNING AND SUPPLY CHAIN MANAGEMENT 9 + 0

Approaches to aggregate planning - Development of master production schedule - Capacity planning - Materials requirements planning (MRP-I), Manufacturing resources planning (MRP-II), Enterprises resources planning (ERP) - Supply chain management (SCM) – Supply chain and “Keiretsu”.

UNIT V SCHEDULING AND CONTROLLING 9 + 0

Objectives in scheduling - Major steps involved - Production control in repetitive, batch and job shop manufacturing environment - Allocation of units for a single resource, allocation of multiple resources - Resource balancing - Flexible manufacturing system - Concepts, advantages and limitation.

Total (45+0)= 45 Periods

COURSE OUTCOMES:

Upon completion of this course, the students will be able to:

CO1 : apply knowledge of mathematics, science, and engineering in the direction to improve the productivity of industries.
CO2 : design a system to meet desired needs within realistic constraints.
CO3 : function in multidisciplinary teams.
CO4 : use the techniques, skills, and modern engineering tools in manufacturing practice.

TEXT BOOKS:

1. Dilworth B. James, “Operations Management Design, Planning and control for Manufacturing and Services”, McGraw Hill Inc., New York, 1992.
2. Samson Eilon, “Elements of Production Planning and Control”, Universal Book Corpn.1984.

REFERENCE BOOKS:

1. Tomkins, J.A and White, J.A, “Facilities Planning”, John Wiley and Sons, 1984.
2. Vollman T.E, “Manufacturing Planning and Control systems”, Galgotia Publications, 2002.
3. Elwood S. Buffa, and Rakesh K.Sarin, “Modern Production and Operations Management”, 8th Edition. John Wiley and Sons, 2000.

CO-PO MAPPING

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	1	1	0	0	0	0	0	0	0	0	2	2	0
CO2	1	2	3	1	0	0	0	0	0	0	0	0	1	2	1
CO3	0	0	0	0	0	0	0	0	3	0	0	1	0	0	2
CO4	0	2	2	0	3	1	0	0	0	0	0	0	1	2	3

1- Faintly
2- Moderately
3- Strongly

18MEOE03 **TOTAL QUALITY MANAGEMENT** **L T P C**
3 0 0 3

Course Objectives:

1. Understand the philosophy and core values of Total Quality Management (TQM)
2. Explain the salient contributions of Quality Gurus like Deming, Juran and Crosby.
3. Determine the voice of the customer and convert into quality terms to enhance the economic performance and long-term business success of an organization.

UNIT I INTRODUCTION **9 + 0**

Definition of Quality - Dimensions of Quality - Quality planning - Quality costs, Analysis techniques for quality costs - Basic concepts of total quality management (TQM) - Historical review - Principles of TQM - Leadership - Role of senior management - Quality council, Quality statements - Strategic planning - Deming philosophy - Barriers to TQM implementation.

UNIT II TQM PRINCIPLES **9 + 0**

Customer satisfaction - Customer perception of quality, Customer complaints, Service quality, Customer Retention, Employee involvement - Motivation, Empowerment, Teams, Recognition and reward, Performance appraisal - Continuous process improvement – Juran Trilogy, PDSA Cycle, 5S, Kaizen - Supplier Partnership, Sourcing, Supplier selection, Supplier rating, Relationship development - Performance measures, Basic concepts, Strategy.

UNIT III STATISTICAL PROCESS CONTROL (SPC) **9 + 0**

The seven tools of quality, Statistical fundamentals – Measures of central tendency and dispersion, Population and sample, Normal curve - Control charts for variables and attributes, Process capability - Concept of six sigma, new seven Management tools.

UNIT IV TQM TOOLS **9 + 0**

Benchmarking – Reasons to benchmark, Benchmarking process, Quality function deployment (QFD) process – House of quality, Benefits - Taguchi quality loss function - Total productive maintenance (TPM) concept, Improvement needs - FMEA – Stages of FMEA.

UNIT V QUALITY MANAGEMENT SYSTEMS **9 + 0**

Need for ISO 9000 and other quality systems, ISO 9001:2008 quality system – Elements, Implementation of quality system, Documentation, Quality auditing, TS 16949:2002.

Total (45 + 0) = 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1 : Identify customer needs and convert those as quality index that will be used as inputs in TQM methodologies.
CO2 : Measure the performance quality i.e. cost of poor quality, process effectiveness and efficiency to identify areas for improvement.
CO3 : Determine the set of performance indicators that will align people with the objectives of an organization.
CO4 : Apply various TQM tools as a means to improve quality
CO5 : Explain ISO standards & quality systems, procedure for implementation, documentation and auditing

Text Books:

1. Dale H. Besterfiled et al., “Total Quality Management”, Pearson Education Asia, 1999.
2. Feigenbaum.A.V. “Total Quality Management”, McGraw Hill, 1991.

Reference Books:

1. Oakland.J.S, “Total Quality Management”, Butterworth – Hcinemann Ltd., Oxford. 1989.

2. Narayana V and Sreenivasan, N.S, “Quality Management – Concepts and Tasks”, New Age International, 1996.
3. James R.Evans and William M.Lidsay, “The Management and Control of Quality”, 5th Edition, South-Western, 2002.
4. Zeiri, “Total Quality Management for Engineers”, Wood Head Publishers, 1991.

CO-PO MAPPING

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	0	0	0	0	0	2	1	0	0	1	3	1	1	1	2
CO2	0	0	1	2	0	1	1	0	0	0	1	2	0	1	1
CO3	0	0	0	0	3	0	1	1	0	0	2	0	1	2	2
CO4	0	2	0	0	3	0	0	0	2	2	3	0	0	1	1
CO5	0	0	2	1	2	0	0	0	2	0	3	0	0	1	1

1- Faintly
2- Moderately
3- Strongly

18MEOE04 **PRINCIPLES OF MANAGEMENT** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

1. To understand the term management basic features of management, principles usages in all walks of life and industrial growth.
2. Knowledge on the principles of management is essential for all kinds of people in all kinds of organizations. After studying this course, students will be able to have a clear understanding of the managerial functions like planning, organizing, staffing, leading and controlling.
3. Students will also gain some basic knowledge in international aspect of management.

UNIT I MANAGEMENT AN INTRODUCTION AND OVERVIEW 9 + 0

Definitions of management – features of management – Management thoughts – different schools of management – Scientific management – Arts or Science, Management Vs administration – Principles of Management.

UNIT II FUNCTIONS OF MANAGEMENT 9 + 0

Role of managers. Functions approach to management, Management functions, Management levels –, reconciling functions and role, responsibility of managers – towards subordinates, peers, supervisors, customers, government, company, creditors, shareholders, competitors etc..

UNIT III MANAGERIAL PLANNING AND DECISION MAKING 9 + 0

Planning fundamentals, objectives. Management by objectives – Changes in objectives – goal distortions – major types of planing, policies and objectives, procedures – methods, rules, programmes and schedule, projects, budgets – importance of decision making, types of decisions, decision making process – decision theory – quantitative techniques – decision making conditions – Operation Research (OR), Definition, successful areas of operation research - Decision tree.

UNIT IV ORGANIZATION 9 + 0

Organization: Basic concepts – organization as a structure – as a process – as a group properties of modern organization – typology, importance of organization – business /industrial organization – sole trading, partnership company, co – operative , public enterprise line (military), line and staff, functional , matrix committee based organization - departmentalization – need, bases of departmentation – career planning and management.

UNIT V STAFFING, CONTROLLING AND COMMUNICATION 9 + 0

Nature and purpose of staffing – man power planning, aims and objectives of HR recruitment, selection and training sources of recruitment, process of recruitment, training methods – performance appraisal methods – communication – importance process – barriers to communications. How to remove obstacles of effective communication – controlling – definition – Characteristics of control – types of control – requirements of effective control – direct and preventive control repairing, control techniques.

Total (45+0)= 45 Periods

COURSE OUTCOMES:

Upon completion of this course, the students will be able to:

CO1 : understand the basic concepts of management
CO2 : explain the contributions and functions, types of business organization
CO3 : list the various types of leadership and evaluate the motivation theories and techniques.
CO4 : select forecasting models for future demands and to make decision in the management processes.

TEXT BOOKS:

1. Herald knootz and Heinz weihrich, —Essentials of Managementǁ, McGraw-Hill Publishing Company, Singapore International Edition, 2007
2. Joseph L, Massie, —Essentials of Managementǁ, Prentice Hall of India Pvt., Ltd (Pearson) Fourth Edition, 2003.

REFERENCE BOOKS:

1. Stephen A. Robbins & David A. Decenzo & Mary Coulter, “Fundamentals of Management” 7th Edition, Pearson Education, 2011.
2. Robert Kreitner & Mamata Mohapatra, “Management”, Biztantra, 2008.
3. Harold Koontz & Heinz Weihrich “Essentials of management” Tata Mc Graw Hill, 1998.
4. Tripathy PC & Reddy PN, “Principles of Management”, Tata McGraw Hill, 1999.

E-REFERENCES:

1. Nptel.ac.in / courses / downloads

CO-PO MAPPING

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	0	0	0	0	0	0	0	0	0	1	0	3	0	1	3
CO2	0	0	0	0	0	1	0	2	1	0	0	2	0	1	2
CO3	0	0	0	1	0	0	0	0	3	2	0	2	0	1	3
CO4	0	0	0	0	0	1	1	0	2	0	0	1	0	1	2

1- Faintly
2- Moderately
3- Strongly

18MEOE05 PROFESSIONAL ETHICS AND HUMAN VALUES

L	T	P	C
3	0	0	3

Course Objectives:

1. To create awareness on Engineering Ethics and providing basic knowledge about engineering Ethics, Variety of moral issues and Professional Ideals.
2. To provide basic familiarity about Engineers as responsible Experimenters, Codes of Ethics, Industrial Standards.
3. To inculcate knowledge and exposure on Safety and Risk, Risk Benefit Analysis.

UNIT I HUMAN VALUES **9 + 0**

Morals, Values and Ethics – Integrity – Work Ethic – Service Learning – Civic Virtue – Respect for Others – Living Peacefully – caring – Sharing – Honesty – Courage – Valuing Time – Co-operation – Commitment – Empathy – Self-Confidence – Character – Spirituality.

UNIT II ENGINEERING ETHICS **9 + 0**

Senses of 'Engineering Ethics' - variety of moral issued - types of inquiry - moral dilemmas - moral autonomy - Kohlberg's theory - Gilligan's theory - consensus and controversy – Models of Professional Roles - theories about right action – Self-interest- customs and religion - uses of ethical theories.

UNIT III ENGINEERING AS SOCIAL EXPERIMENTATION **9 + 0**

Engineering as experimentation - engineers as responsible experimenters - codes of ethics - a balanced outlook on law – the challenger case study.

UNIT IV SAFETY, RESPONSIBILITIES AND RIGHTS **9 + 0**

Safety and risk - assessment of safety and risk - risk benefit analysis and reducing risk - the three mile island and Chernobyl case studies. Collegiality and loyalty - respect for authority - collective bargaining - confidentiality - conflicts of interest – occupational crime - professional rights - employee rights - Intellectual Property Rights (IPR) - discrimination.

UNIT V GLOBAL ISSUES **9 + 0**

Multinational corporations - Environmental ethics - computer ethics - weapons development - engineers as managers consulting engineers-engineers as expert witnesses and advisors -moral leadership-sample code of Ethics like ASME,ASCE, IEEE, Institution of Engineers (India), Indian Institute of Materials Management, Institution of electronics and telecommunication engineers (IETE),India.

Total (45+0) = 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1 : understand the importance of ethics and values in life and society.
CO2 : understood the core values that shape the ethical behavior of an engineer.
CO3 : exposed awareness on professional ethics and human values.

Text Books:

1. Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw-Hill, New York 2005.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi, 2004.

Reference Books:

1. Tripathi A N, "Human values" , New Age international Pvt. Ltd., New Delhi, 2002.
2. Charles D. Fleddermann, "Engineering Ethics", Pearson Education / Prentice Hall, New Jersey, 2004.
3. Charles E Harris, Michael S. Protchard and Michael J Rabins, "Engineering Ethics – Concepts and Cases", Wadsworth Thompson Learning, United States, 2000.
4. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 2003.

CO-PO MAPPING

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	0	0	0	0	0	2	1	3	0	0	1	0	1	1	0
CO2	0	0	0	0	0	0	2	3	0	0	0	0	1	0	0
CO3	0	0	0	0	0	1	1	3	0	0	0	0	1	0	3

1- Faintly
2- Moderately
3- Strongly

18MEOE06 **ROBOTICS** **L T P C**
3 0 0 3

Course Objectives:

1. To explore concepts of Robot technologies that is playing vital role in manufacture.
2. Describe various Robot technology applications.
3. Develop an understanding of Robot Kinematics and dynamics.
4. Explain and summarize Robot End effectors and Sensors.
5. Explore conceptual understanding of Robot programming.

UNIT I INTRODUCTION 9 + 0

Robot - definition - robot anatomy - co-ordinate systems - work envelope - types and classification - specifications – joint notations – types of joints - speed of motion - pay load - robot parts and their functions - need for robots in Indian scenario.

UNIT II ROBOT DRIVE SYSTEMS AND END EFFECTORS 9 + 0

Drives - hydraulic, pneumatic, mechanical and electrical - servo motors - stepper motors - salient features, application – end effectors – types: tools - grippers - mechanical grippers - pneumatic and hydraulic grippers, magnetic grippers, vacuum grippers, multiple grippers.

UNIT III SENSORS AND MACHINE VISION 9 + 0

Requirements of sensors – principles, types and applications of following types of sensors proximity (inductive, Hall effect, capacitive, ultrasonic and optical) – range (Triangulation, structured light approach, laser range) – speed, position (resolvers, optical encoders, pneumatic) – force – torque – touch sensors (binary, analog sensor) - introduction to machine vision -functions - image processing and analysis.

UNIT IV ROBOT KINEMATICS AND ROBOT PROGRAMMING 9 + 0

Forward kinematics and reverse kinematics of manipulators - two, three degrees of freedom (in 2 dimensional) – homogeneous transformation matrix - simple problems - lead through programming, robot programming languages - VAL programming –motion commands - sensor commands - end effecter commands - simple programs for loading, unloading and palletizing operations.

UNIT V APPLICATIONS, IMPLEMENTATION AND ROBOT ECONOMICS 9 + 0

Robot cell design – types - Application of robots in processing - assembly - inspection - material handling - loading -unloading - automobile - implementation of robots in industries - safety considerations for robot operations – economic analysis of robots - pay back method and rate of return method.

Total (45+0) =45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1 : understand the basic concepts, parts of robots and types of robots.
CO2 : understand the potential applications of robots in industries as part of automation tool
CO3 : familiar with the various drive systems for robot, sensors and their applications in robots, programming of robots.
CO4 : discuss about the various applications of robots, justification, implementation and safety of robot
CO5 : select an appropriate robot for a particular application.

Text Books:

1. Mikell. P. Groover, 'Industrial Robotics Technology', Programming and Applications, McGraw Hill Co,1995.
2. Fu.K.S. Gonzalz.R.C., and Lee C.S.G., "Robotics Control, Sensing, Vision and Intelligence", McGraw Hill Book Co.,1987.

Reference Books:

1. Richard D.Klafter, Thomas A.Chmielewski and MichealNegin, "Robotic engineering –An Integrated Approach",Prentice Hall Inc, Englewoods Cliffs, NJ, USA, 2005.

2. Janakiraman.P.A. “Robotics and Image Processing”, Tata McGraw-Hill, 1995.
3. YoramKoren, “Robotics for Engineers”, McGraw-Hill Book Co., 1992.
4. A.K.Gupta and S.K.Arora, “Industrial Automation and Robotics”, Laxmi Publications Pvt ltd, 2007.
5. Fu. K. S., Gonzalez. R. C. & Lee C.S.G., ‘Robotics control, sensing, vision and intelligence’, McGraw Hill Book co, 1987.
6. Craig. J. J. ‘Introduction to Robotics mechanics and control’,Addison- Wesley, 1999.
7. Ray Asfahl. C., ‘Robots and Manufacturing Automation’, John Wiley & Sons Inc., 1985.

E-References:

1. NPTEL Videos/Tutorials

CO-PO MAPPING

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	1	0	1	0	0	0	0	0	0	0	2	3	1
CO2	0	0	2	0	3	0	1	0	0	0	0	0	1	3	1
CO3	1	2	0	0	2	0	0	0	0	0	1	2	1	2	1
CO4	0	0	0	0	0	3	0	0	0	0	0	0	1	1	1
CO5	0	0	0	0	2	0	0	0	0	0	0	2	1	1	1

1- Faintly
2- Moderately
3- Strongly

18MEOE07 **ROBOTIC PROCESS AUTOMATION** **L T P C**
3 0 0 3

Course Objectives:

1. To study the various parts of robots and fields of robotics.
2. To study the various kinematics and inverse kinematics of robots.
3. To study the Euler, Lagrangian formulation of Robot dynamics.
4. To study the trajectory planning for robot.
5. To study the control of robots for some specific applications.

UNIT I BASIC CONCEPTS **9 + 0**

Definition and origin of robotics – different types of robotics – various generations of robots – degrees of freedom – Asimov"s laws of robotics – dynamic stabilization of robots.

UNIT II POWER SOURCES AND SENSORS **9 + 0**

Hydraulic, pneumatic and electric drives – determination of HP of motor and gearing ratio – variable speed arrangements – path determination – micro machines in robotics – machine vision – ranging – laser – acoustic – magnetic, fiber optic and tactile sensors.

UNIT III MANIPULATORS, ACTUATORS AND GRIPPERS **9 + 0**

Construction of manipulators – manipulator dynamics and force control – electronic and pneumatic manipulator control circuits – end effectors – U various types of grippers – design considerations.

UNIT IV KINEMATICS AND PATH PLANNING **9 + 0**

Solution of inverse kinematics problem – multiple solution jacobian work envelop – hill Climbing Techniques – robot programming languages

UNIT V CASE STUDIES **9 + 0**

Mutiple robots – machine interface – robots in manufacturing and non- manufacturing applications – robot cell design – selection of robot.

Total (45+0) =45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1 : explain the basic concepts of working of robot.
CO2 : analyze the function of sensors in the robot.
CO3 : analyze the working of manipulates, actuators and grippers.
CO4 : write program to use a robot for a typical application.
CO5 : use Robots in different applications.

Text Books:

1. Mikell P. Weiss G.M., Nagel R.N., Odraj N.G., "Industrial Robotics", Mc Graw-Hill Singapore, 1996.
2. Ghosh, Control in Robotics and Automation: Sensor Based Integration, Allied Publishers, Chennai, 1998.

Reference Books:

1. Deb. S.R.,"Robotics Technology and flexible Automation", John Wiley, USA 1992.
2. Klafter R.D., Chimielewski T.A., Negin M., "Robotic Engineering – An integrated approach", Prentice Hall of India, New Delhi, 1994.
3. Mc Kerrow P.J. "Introduction to Robotics", Addison Wesley, USA, 1991.
4. Issac Asimov "Robot", Ballantine Books, New York, 1986.
5. Barry Leatham – Jones, "Elements of industrial Robotics" PITMAN Publishing, 1987.
6. Mikell P.Groover, Mitchell Weiss, Roger N.Nagel Nicholas G.Odrey, "Industrial Robotics Technology, Programming and Applications ", McGraw Hill Book Company 1986.
7. Fu K.S. Gonzaleaz R.C. and Lee C.S.G., "Robotics Control Sensing, Vision and Intelligence" McGraw Hill International Editions, 1987.

CO-PO MAPPING

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	0	0	0	0	2	0	0	0	0	0	0	0	2	2	0
CO2	0	3	1	1	1	0	0	0	0	0	0	0	1	3	0
CO3	0	3	2	1	1	0	0	0	0	0	0	0	1	3	0
CO4	0	0	0	2	3	0	0	0	0	0	0	0	0	0	0
CO5	0	0	0	0	0	1	2	2	0	0	0	0	0	0	0

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2- Moderately
3- Strongly