P.S.R. ENGINEERING COLLEGE

(An Autonomous Institution, Affiliated to Anna University, Chennai)

Sevalpatti (P.O), Sivakasi – 626140.

B.E. Mechanical Engineering

CURRICULUM
AND
SYLLABI

UG
Regulations 2016

Department of Mechanical Engineering

CANDIDATES ADMITTED DURING 2016-2017 AND ONWARDS

P.S.R. ENGINEERING COLLEGE

(An Autonomous Institution, Affiliated to Anna University, Chennai)

Sevalpatti (P.O), Sivakasi – 626140.

Department of Mechanical Engineering

CURRICULUM
AND
SYLLABI

UG
Regulations 2016

Department of Mechanical Engineering

CANDIDATES ADMITTED DURING 2016-2017 AND ONWARDS

Vision

- To provide broad-based education and training in mechanical engineering and its applications to enable the graduates to meet the demands in a rapidly changing needs in industry, academia and society.

Mission

- To impart high quality technical education and training that encompasses both theory and practices with human and social values
- To equip the students to face tomorrows technology embedded global changes
- To create, explore, and develop innovations in mechanical engineering research

Programme Educational Objectives (PEOs)

- Lead a professional career by acquiring the basic knowledge in the field of specialization and allied Engineering.
- Assess the real life problems and deal with them confidently relevance to the society.
- Engage in lifelong learning by pursuing higher studies and participating in professional organizations.
- Exhibit interpersonal skills and able to work as a team for success.

Programme Specific Outcomes (PSOs)

- Apply the concepts of mathematics and science in mechanical systems.
- Design and analyze components and systems for mechanical engineering applications
- Synthesis data and technical concepts for application to mechanical engineering software.
- Apply manufacturing and management practices in industries.

PROGRAMME OUTCOMES (POs)

Engineering Graduates will be able to:

a. **Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. **Problem Analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. **Design/ Development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

d. **Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

e. **Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

f. **The Engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

g. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

h. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

i. **Individual and teamwork:** Function effectively as an individual, and as a member or leader in diverse teams, and in multi disciplinary settings.

j. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

k. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

l. **Lifelong learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

P.S.R. ENGINEERING COLLEGE, SIVAKASI-626 140
U.G REGUALTION-2016
B.E. MECHANICAL ENGINEERING
CURRICULUM
[I – VIII SEMESTER]

Total Credits: 180

SEMESTER – I

Sl. No.	Code	Course Title	Category	L-T-P	C
Theory					
1	161HS11	Essential English	HS	3-0-0	3
2	161MA11	Engineering Mathematics - I	BS	3-1-0	4
3	161PH11	Engineering Physics	BS	3-0-0	3
4	161CY11	Engineering Chemistry	BS	3-0-0	3
5	161CS11	Computer Programming	ES	3-0-0	3
6	161ME11	Engineering Graphics	ES	1-0-3	3
Practical					
7	161PC17	Physics and Chemistry Laboratory - I	BS	0-0-3	2
8	161CS17	Computer Practices Laboratory	ES	0-0-3	2
9	161EE17	Engineering Practices Laboratory	ES	0-0-3	2
				No. of Credits:	**25**

SEMESTER – II

Sl. No.	Code	Course Title	Category	L-T-P	C
Theory					
1	161HS21	Technical English	HS	3-0-0	3
2	161MA21	Engineering Mathematics - II	BS	3-1-0	4
3	161PH21	Physics of Materials	BS	3-0-0	3
4	161CY21	Environmental Science and Engineering	BS	3-0-0	3
5	161ME21	Engineering Mechanics	ES	2-2-0	3
6	161ME22	Manufacturing Processes	PC	3-0-0	3
Practical					
7	161PC27	Physics and Chemistry Laboratory – II	BS	0-0-3	2
8	161ME23	Computer Aided Drafting Laboratory	ES	0-0-3	2
9	161ME24	Manufacturing Processes Laboratory	PC	0-0-3	2
				No. of Credits:	**25**

SEMESTER – III

Sl. No.	Code	Course Title	Category	L-T-P	C
Theory					
1	161MA31	Transforms and Partial Differential Equation	BS	3-2-0	4
2	161ME31	Manufacturing Technology	PC	3-0-0	3
3	161ME32	Engineering Thermodynamics	PC	3-0-0	3
4	161ME33	Engineering Materials and Metallurgy	PC	3-0-0	3
5	161ME34	Kinematics of Machinery	PC	3-2-0	4
6	161ME35	Electrical Drives and Controls	ES	3-0-0	3
Practical					
7	161ME37	Manufacturing Technology Laboratory	PC	0-0-3	2
8	161ME38	Electrical Engineering Laboratory	ES	0-0-3	2
9	161HS39	Functional English – I	EEC	0-0-2	-
				No. of Credits:	**24**

SEMESTER – IV

Sl. No.	Code	Course Title	Category	L-T-P	C
Theory					
1	161MA42	Statistics and Numerical Methods	BS	2-2-0	3
2	161ME41	Fluid Mechanics and Machinery	PC	3-2-0	4
3	161ME42	Engineering Metrology and Measurements	PC	3-0-0	3
4	161ME43	Mechanics of Materials	PC	3-2-0	4
5	161ME44	Modern Machining Processes	PC	3-0-0	3
6	161ME45	Electronics Engineering	ES	3-0-0	3
Practical					
7	161ME47	Material Testing and Fluid Mechanics Laboratory	PC	0-0-3	2
8	161ME48	Metrology and Measurements Laboratory	PC	0-0-3	2
9	161HS49	Functional English – II	EEC	0-0-2	-
				No. of Credits:	**24**

SEMESTER – V

Sl. No.	Code	Course Title	Category	L-T-P	C
Theory					
1	161ME51	CAD/CAM/CAE	PC	3-0-0	3
2	161ME52	Dynamics of Machinery	PC	3-2-0	4
3	161ME53	Machine Design and Drawing	PC	3-0-2	4
4	161ME54	Thermal Engineering	PC	2-2-0	3
5	161ME55	Automobile Engineering	PC	3-0-0	3
6	161ME56	Applied Hydraulics and Pneumatics	PC	3-0-0	3
Practical					
7	161ME57	Thermal Engineering Laboratory	PC	0-0-3	2
8	161ME58	Dynamics Laboratory	PC	0-0-3	2
9	161HS59	Career English – I	EEC	0-0-2	-
				No. of Credits:	**24**

SEMESTER – VI

Sl. No.	Code	Course Title	Category	L-T-P	C
Theory					
1	161HS61	Engineering Economics and Management	HS	3-0-0	3
2	161ME61	Heat and Mass Transfer	PC	3-0-2	4
3	161ME62	Finite Element Analysis	PC	3-2-0	4
4	161ME63	Design of Transmission Systems	PC	2-2-0	3
5	E1	Elective –I	PE	3-0-0	3
6	E2	Elective –II	OE / PE	3-0-0	3
Practical					
7	161ME67	CAD/CAM Laboratory	PC	0-0-3	2
8	161ME68	Design and Fabrication Project	EEC	0-0-3	2
9	161HS69	Career English – II	EEC	0-0-2	-
				No. of Credits:	**24**

SEMESTER – VII

Sl. No.	Code	Course Title	Category	L-T-P	C
Theory					
1	161ME71	Total Quality Management	PC	3-0-0	3
2	161ME72	Mechatronics	PC	3-0-0	3
3	161ME73	Gas Dynamics and Jet Propulsion	PC	2-2-0	3
4	161ME74	Power Plant Engineering	PC	3-0-0	3
5	E3	Elective – III	PE	3-0-0	3
6	E4	Elective – IV	OE/PE	3-0-0	3
Practical					
7	161ME77	Computer Aided Simulation & Analysis Laboratory	PC	0-0-3	2
8	161ME78	Mechatronics Laboratory	PC	0-0-3	2
				No. of Credits:	**22**

SEMESTER – VIII

Sl. No.	Code	Course Title	Category	L-T-P	C
Theory					
1	E5	Elective – V	PE	3-0-0	3
2	E6	Elective – VI	OE/PE	3-0-0	3
Practical					
3	161ME87	Project Work	EEC	0-0-12	6
				No. of Credits:	**12**

HS – Humanity Science,
BS – Basic Science,
ES – Engineering Science,
PC – Programme Core,
PE – Programme Elective,
OE – Open Elective,
EEC – Employability Enhancement Course

Additional Eligibility requirement for the award of degree

1. The co-curricular activities one or more of the following is/are compulsory for a student in the first three years of his/her study with satisfactory grade to eligible for the award of degree with a satisfactory grade is compulsory to be eligible for the award of degree in the first two years of study
    - National Service Scheme (NSS)
    - Youth Red Cross (YRC)
    - Red Ribbon Club (RRC)
    - Institute of Electrical Electronics Engineering (IEEE)
    - Indian Society for Technical Education (ISTE)
    - Society of Automotive Engineers (SAE)
    - Innovation Cell (i-cell)
    - Entrepreneurship Cell (e-cell)
    - Sports & Games
2. Every student should undergo In Plant Training/Internship/Industrial visit with due approval of HOD & Principal

List of Electives

Programme Electives					
Sl. No.	**Code**	**Course Title**	**Category**	**L-T-P**	**Credit**
1	161MEE01	Advanced I.C. Engines	PE	3-0-0	3
2	161MEE02	Composite Materials and Engineering	PE	3-0-0	3
3	161MEE03	Computational Fluid Dynamics	PE	3-0-0	3
4	161MEE04	Computer Integrated Manufacturing	PE	3-0-0	3
5	161MEE05	Design of Jigs, Fixtures and Press Tools	PE	3-0-0	3
6	161MEE06	Fireworks Safety	PE	3-0-0	3
7	161MEE07	Foundry Technology	PE	3-0-0	3
8	161MEE08	Fundamentals of Nano Technology	PE	3-0-0	3
9	161MEE09	Industrial Engineering & Management	PE	3-0-0	3
10	161MEE10	Nuclear Engineering	PE	3-0-0	3
11	161MEE11	Polymer Technology	PE	3-0-0	3
12	161MEE12	Process Planning and Cost Estimation	PE	3-0-0	3
13	161MEE13	Production Planning and Control	PE	3-0-0	3
14	161MEE14	Rapid Prototyping	PE	3-0-0	3
15	161MEE15	Refrigeration and Air Conditioning	PE	3-0-0	3
16	161MEE16	Welding Technology	PE	3-0-0	3
17	161MEE17	Additive Manufacturing	PE	3-0-0	3

List of Open Electives

Offered by Department of Computer Science and Engineering

Sl. No.	Course Code	Name of the Course	Category	L-T-P	Credit
1	161OE101	Web development using PHP	OE	3-0-0	3
2	161OE102	Programming in PERL	OE	3-0-0	3
3	161OE103	Multimedia & Animation Tools	OE	3-0-0	3
4	161OE104	Multicore Architecture	OE	3-0-0	3
5	161OE105	Green Computing	OE	3-0-0	3
6	161OE106	Soft Computing	OE	3-0-0	3
7	161OE107	Java Scripts	OE	3-0-0	3

Offered by Department of Electronics and Communication Engineering

Sl. No.	Course Code	Name of the Course	Category	L-T-P	Credit
1	161OE201	Bio Medical Instrumentation	OE	3-0-0	3
2	161OE202	Digital Image Processing	OE	3-0-0	3
3	161OE203	Consumer Electronics	OE	3-0-0	3
4	161OE204	Multimedia Compression and Communication	OE	3-0-0	3
5	161OE205	High Speed Networks	OE	3-0-0	3

Offered by Department of Electrical and Electronics Engineering

Sl. No.	Course Code	Name of the Course	Category	L-T-P	Credit
1	161OE401	Energy audit and conservation	OE	3-0-0	3
2	161OE402	Principles of Virtual Instrumentation	OE	3-0-0	3
3	161OE403	Sensors and Transducers	OE	3-0-0	3
4	161OE404	Aircraft electronic system	OE	3-0-0	3
5	161OE405	Electrical safety	OE	3-0-0	3
6	161OE406	Vehicle electric power Systems	OE	3-0-0	3
7	161OE407	Domestic and Industrial Electrical Installation	OE	3-0-0	3

Offered by Department of Bio Technology

Sl. No.	Course Code	Name of the Course	Category	L-T-P	Credit
1	161OE501	Process Equipment and Plant Design	OE	3-0-0	3
2	161OE502	Biomaterials	OE	3-0-0	3
3	161OE503	Biosensors	OE	3-0-0	3
4	161OE504	Food Science and Technology	OE	3-0-0	3

Offered by Department of Mechanical Engineering

Sl. No.	Course Code	Name of the Course	Category	L-T-P	Credit
1	161OE601	Maintenance Engineering	OE	3-0-0	3
2	161OE602	Non Destructive Testing and Materials	OE	3-0-0	3
3	161OE603	Operations Research	OE	3-0-0	3
4	161OE604	Renewable Sources of Energy	OE	3-0-0	3
5	161OE605	Robotics	OE	3-0-0	3
6	161OE06	Professional Ethics in Engineering	OE	3-0-0	3

Offered by Department of Civil Engineering

Sl. No.	Course Code	Name of the Course	Category	L-T-P	Credit
1	161OE701	Disaster Management System	OE	3-0-0	3
2	161OE702	Fundamentals of Fire Safety Engineering	OE	3-0-0	3
3	161OE703	Optimization in Engineering	OE	3-0-0	3
4	161OE704	Renewable Energy Sources	OE	3-0-0	3
5	161OE705	Environmental Impact and Risk Assessment	OE	3-0-0	3
6	161OE706	Environment and Ecology	OE	3-0-0	3
7	161OE707	Technology Management	OE	3-0-0	3
8	161OE708	Sustainable Management of Urban Ecology	OE	3-0-0	3

Offered by Department of Management Studies

Sl. No.	Course Code	Name of the Course	Category	L-T-P	Credit
1	161OE801	Essentials of Management	OE	3-0-0	3
2	161OE802	Fundamentals of Marketing	OE	3-0-0	3
3	161OE803	Managing Human Resources	OE	3-0-0	3
4	161OE804	Professional Ethics in Engineering	OE	3-0-0	3

161HS11	ESSENTIAL ENGLISH	L-T-P	C
		3-0-0	3

Programme: B.E./B.Tech. Common to all branches **Sem:** 1 **Category:** HS

Aim: To impart Basic English Language skill to develop the students ability to use English effectively

Course Outcomes:

The students will be able to

CO1. Understand and use different forms of language
CO2. Write formal letters
CO3. Speak in English with clarity
CO4. Listen actively and grasp the contents of the speech
CO5. Read general texts and comprehend their content
CO6. Use grammar to make meaning in both speaking and writing

UNIT I **9**

Grammar – tense – past simple, present simple, verbal vs non-verbal communication, Vocabulary – Commonly used words – Spelling, Reading – Reading News papers, Writing – Formal Letters – Requisition for leave – Bonafide, Listening – Listening to famous speeches, Speaking – introducing oneself

UNIT II **9**

Grammar – tense – past and present simple continuous, Vocabulary – Prefixes, Suffixes – Parts of Speech, Reading – Basic reading comprehension, Writing Formal Letters – Permission letters – In-plant training – Industrial visit, Listening – Listening to Interviews, Speaking – Speaking about interests, one's friends, hobbies, favourite programmes

UNIT III **9**

Grammar – tense – past and present perfect, Vocabulary – Forms of Verb – Analogy – Sentences – Types, Reading-Cloze Test, Writing – Paragraph writing – descriptions – Comparing and contrasting – describing pictures, Listening – Listening to News, Speaking – Future plan – Native place, Appropriate body language.

UNIT IV **9**

Grammar – perfect tenses, Vocabulary – Single – line definitions – Pronoun – Adverbs – Preposition, Reading – Reading for comprehension, Writing – e- mail – basic conventions writing – Instructions – Recommendations, Listening – Listening to Debates, Speaking – Giving opinions

UNIT V **9**

Grammar – subject – verb agreement, Vocabulary – commonly confused words – Linkers – Abbreviation – Voice, Reading – Reading for Inferences, Writing – Agenda Note-taking – Editing the text, Listening – Listening to Telephonic Conversation, Speaking – short talks on general topics, short conversations

Total Periods: 45

Text Book:

1. Jack.C.Richards, interchange, Cambridge University Press, New Delhi. (2015) ISBN 9781107570894

References:

1. Dhanavel, S.P. English and Communication Skills for Students of Science and Engineering. Orient Blackswan, Chennai. (2011)
2. www.usingenglish.com
3. www.grammar.org
4. www.audioenglish.com
5. http://www.manythings.org
6. www.onestopenglish.com
7. www.learnenglish.com

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1										3		3				
CO2										3		2				2
CO3										3		3				2
CO4					2					3		3				
CO5										3		3				
CO6										3		2				

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161MA11 ENGINEERING MATHEMATICS – I L-T-P C

3-1-0 4

Programme: B.E./B.Tech. Common to all branches **Sem: 1 Category: BS**

Aim: To develop the basic mathematical skills of Engineering students

Course Outcomes:

The students will be able to

CO1. Find the inverse of given matrix and reduce matrix equation using Cayley-HamiltonTheorem

CO2. Elaborate given function as a power series using Taylor's series

CO3. Develop a series solution to an ODE, and recognize special functions defined by series

CO4. Make use of calculus in finding the envelope, Evolutes & Involutes

CO5. Able to check whether the series is convergent or divergent

CO6. Evaluate maxima and minima for function of two variables

MATRICES 12

Characteristic equation – Eigen Values and Eigen vectors of a real matrix – Properties of Eigen values – Cayley-HamiltonTheorem (without proof) and its application – Orthogonal Transformation of a Symmetric matrix to diagonal form – Quadratic form – Orthogonal reduction to canonical form

ORDINARY DIFFERENTIAL EQUATIONS 12

Higher order linear differential equations with constant coefficients – Method of variation of parameters – Cauchy's and Legendre's linear equations – Simultaneous first order linear equations with constant coefficients

DIFFERENTIAL CALCULUS 12

Curvature – Radius of curvature – Cartesian and Parametric Coordinates – Circle of Curvature – Involutes and Evolutes – Envelope

FUNCTIONS OF SEVERAL VARIABLES 12

Partial Derivatives – Total Derivative – differentiation of Implicit function – Jacobian – Taylor's Expansion – Maxima/Minima for function of two variables – Method of Lagrange's multipliers

SEQUENCES AND SERIES 12

Sequences: Definition and examples – Series: Types and Convergence – Series of positive terms – Tests of convergence: Comparison test and D'Alembert's ratio test – Alternating series – Leibnitz's test – Series of positive and negative terms – Absolute and conditional convergence

Lecture: 45 Tutorial: 15 Total Periods: 60

Text Books:

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, Delhi, (2005)
2. Veerarajan T., "Engineering Mathematics", Tata McGraw – hill publishing company Ltd., New Delhi, (2005)

References:

1. Greenberg M.D., "Advanced Engineering Mathematics", Pearson Education Inc., (2002)
2. Venkataraman M.K., "Engineering Mathematics", Volume I and II, The National Publishing Company,Chennai, (2004)
3. Ravish R Singh, Mukul Bhatt, "Engineering Mathematics-I", McGraw Hill Education (India) Private Ltd, New Delhi
4. Kreyszig, E., "Advanced Engineering Mathematics", John Wiley Sons, (2001)

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3		1								2		2	1	
CO2	2	3		2								1				1
CO3	3	3										3	2			
CO4	1	1													2	
CO5	3	2		1										2		
CO6	2	2		1								3	2			2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161PH11	ENGINEERING PHYSICS	L-T-P	C
		3-0-0	3

Programme: B.E./B.Tech. Common to all branches **Sem: 1 Category: BS**

Aim: To endow the students with the fundamentals of Physics and apply new ideas in the field of Engineering and Technology

Course Outcomes:

The students will be able to

CO1. Understand the theory and various crystal structures and crystal growth techniques

CO2. Acquire knowledge about the properties of sound and effect of sounds within the building

CO3. Attain the knowledge of ultrasonic waves and their application in the field of Non-destructive testing and Sonogram.

CO4. Gain knowledge about basic equations of Quantum mechanics and its applications

CO5. Know about the basic configuration of a Laser, types of lasers and the industrial applications of Laser

CO6. Understand principle behind fiber optic communication and the electronic devices involved in the transmission and reception of data

CRYSTAL PHYSICS **9**

Lattice – Unit cell – Bravais lattice – Lattice planes – Miller indices – d spacing in cubic lattice – Calculation of number of atoms per unit cell – Atomic radius – Coordination number – Packing factor for SC, BCC, FCC and HCP structures – Crystal growth techniques – Solution, melt (Bridgemann and Czochralski)

ACOUSTICS **9**

Classification of sound – Decibel – Weber – Fechner Law – Sabine's formula – Derivation using growth and decay method – absorption coefficient and its determination – Acoustic of building – Factors affecting acoustics of buildings and their remedies

ULTRASONICS **9**

Production of Ultrasonics – Magnetostriction – Piezoelectric methods – Velocity measurement – Acoustic grating – Industrial applications – Non Destructive Testing – Pulse echo system through transmission and reflection modes – SONAR, Medical applications – Sonograms

QUANTUM PHYSICS **9**

Black body radiation – Planck's theory (derivation) – Photoelectric effect – Matter waves – Schrodinger's wave equation – Time independent and time dependent equations – Physical significance of wave function – Particle in a one dimensional box

APPLIED OPTICS **9**

LASERS: Introduction – Principle of Spontaneous emission and stimulated emission – Population inversion, pumping – Einsteins A and B coeffcients – Derivation – Types of lasers – CO_2, Nd-YAG – Industrial Applications – Lasers in welding, cutting – Holography and its applications

FIBER OPTICS: Optical Fiber – Classification – Principle and propagation of light in optical fibres – Numerical aperture and Acceptance angle – Fibre optical communication system – Sensors (Active and passive) – Displacement and Temperature Sensors

Total Periods: 45

Text Books:

1. Gaur R. K., Gupta S. C., "Engineering Physics", DhanpatRai Publications, New Delhi, (2003)
2. Avadhanulu M. N., Kshirsagar, P. G., "A Text book of Engineering Physics", S.Chand and company, Ltd., New Delhi, (2005)

References:

1. Serway and Jewett., "Physics for Scientists and Engineers with Modern Physics", Thomson Brooks/Cole, Indian reprint (2007)
2. Arither Beiser, "Concepts of Modern Physics", Tata McGraw Hill, NewDelhi (2010)
3. Palanisamy P.K., "Engineering Physics", Scitech publications, Chennai, (2007)
4. Rajendran V and Marikani A, "Engineering Physics", Tata McGraw Hill Publications Ltd, New Delhi, (2004)

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2	1		2		3					2	1	1		
CO2	3	2	2	2			3					2	1	1		
CO3	2	2					3					1	1	1		
CO4	3	2	2	2			2					2	1	1		
CO5	3	2	2				2					2	1	1		
CO6	3	2	2	2			2					2	1	1		

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161CY11	ENGINEERING CHEMISTRY	L-T-P	C
		3-0-0	3

Programme: B.E./B.Tech. Common to all branches **Sem: I Category: BS**

Aim: To impart a sound knowledge on the principles of chemistry involving the different application oriented topics required for all engineering branches

Course Outcomes:

The students will be able to

CO1. Understand the theory and various crystal structures and crystal growth techniques
CO2. Demonstrate the essential concept of water chemistry with their properties and applications of water technology
CO3. Understand the operating principles and the reaction involved in electrochemistry
CO4. Explain the core concepts of surface chemistry
CO5. Illustrate the structure, properties and applications of nano materials
CO6. Learn the principles, importance and application of analytical techniques

WATER TECHNOLOGY **9**

Hardness – Types and Estimation by EDTA method, alkalinity – types of alkalinity and determination – Domestic water treatment – disinfection methods (Chlorination, ozonation, UV treatment) – Boiler feed water – requirements – disadvantages of using hard water in boilers – internal conditioning (phosphate, calgon and carbonate conditioning methods) – external conditioning – demineralization process – desalination and reverse osmosis

ELECTRO CHEMISTRY **9**

Electrochemical cells – reversible and irreversible cells – EMF – electrochemical series and its significance – Single electrode potential – Nernst equation (problem) – reference electrodes – Standard Hydrogen electrode – Calomel electrode – Ion selective electrode – glass electrode and measurement of pH – potentiometer titrations (redox-Fe^{2+}vs dichromate) and conductometric titrations (acid-base – HCI vsNaOH) titrations

SURFACE CHEMISTRY **9**

Adsorption – types – adsorption of gases on solids – adsorption isotherms – Frendlich and Langmuir isotherms – adsorption of solutes from solution – role of adsorbents in catalysis, ion-exchange adsorption and pollution abatement

NANO CHEMISTRY **9**

Nanomaterials – introduction to nanochemistry – synthesis – hydrothermal, solvothermal – Chemical vapour deposition – sol-gel – Electro deposition – ball milling – properties of nanoparticles and applications – Carbon nanotubes – fabrication – arc method – pulsed laser deposition – Chemical vapour deposition – structure, properties & applications

SPECTROSCOPY & QUANTITATIVE ANALYSIS **9**

Beer-Lambert's law (problem) – UV-visible spectroscopy and IR spectroscopy – principles – instrumentation (problem) (block diagram only) – estimation of iron by colorimetry – Determination of the amount of calcium in milk powder by EDTA Complexometry – Estimation of iodine in iodized common salt by Iodometry – Estimation of phosphoric acid in soft drinks (coca cola) by molybdenum blue method

Total Periods: 45

Text Books:

1. Kannan P., Ravikrishnan A., "Engineering Chemistry", Sri Krishna Hi-tech Publishing Company Pvt. Ltd. Chennai, (2009)
2. Jain P.C., Monica Jain, "Engineering Chemistry", Dhanpat Rai Pub, Co., New Delhi (2002)

References:

1. Dara S.S., Umare S.S., "Engineering Chemistry", S. Chand & Company Ltd., New Delhi (2010)
2. B.K.Sharma, "Engineering chemistry", Krishna Prakasan Media (P) Ltd., Meerut, (2001)
3. B.Sivasankar, "Engineering chemistry", Tata McGraw Hill Publishing Company (P) Ltd., New Delhi, (2006)
4. Pradeep, "Nano the essential", McGraw Hill Publishing Company (P) Ltd., New Delhi

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	2		2	3			2		3	1	3		2
CO2	3	2		2	2	3		1	2		2	2	2	2		3
CO3				2			2					2	3	3		3
CO4	2	1	2	2	1		2					1	2	2		
CO5	3	2	2	1	2	1			2			2	3	3		2
CO6	3	3	3	2		2	3			2		3	2	3		3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161CS11 COMPUTER PROGRAMMING L-T-P C
3-0-0 3

Programme: B.E./B.Tech. Common to all branches **Sem: 1 Category: ES**

Aim: To provide an awareness to Computing and Programming

Course Outcomes:

The students will be able to

CO1. Have fundamental knowledge on basics of computers hardware and number systems
CO2. Understand the basic terminology used in computer programming
CO3. Write, compile and debug programs in C language
CO4. Use different data types in a computer program
CO5. Design programs involving decision structures, loops and functions
CO6. Understand the dynamics of memory by the use of pointers
CO7. Use different data structures and create/update basic data files

INTRODUCTION 9

Generation and Classification of Computers – Basic Organization of a Computer – Number System – Binary – Decimal – Conversion – Problems – Software – Types, Development Steps – Algorithm – Pseudo code – Flow Chart – Problem formulation – Problem Solving

C PROGRAMMING BASICS 9

Introduction to Unix Operating System – Introduction to ' C' programming – fundamentals – structure of a 'C' program – compilation and linking processes – Constants, Variables – Data Types – Expressions using operators in 'C' – Managing Input and Output operations – Decision Making and Branching – Looping statements – solving simple scientific and statistical problems

ARRAYS AND STRINGS 9

Arrays – Initialization – Declaration – One dimensional and Two dimensional arrays – String – String operations – String Arrays – Simple programs – sorting – searching – matrix operations

FUNCTIONS AND POINTERS 9

Function – definition of function – Declaration of function – Pass by value – Pass by reference – Recursion – Pointers – Definition – Initialization – Pointers arithmetic – Pointers and arrays – Example Problems

STRUCTURES AND UNIONS 9

Introduction – need for structure data type – structure definition – Structure declaration – Structure within a structure – Union – Programs using structures and Unions – File Manipulation – Storage classes – Preprocessor directives

Total Periods: 45

Text Books:

1. Anita Goel and Ajay Mittal, "Computer Fundamentals and Programming in C", Pearson Education in South Asia, (2011)
2. Pradip Dey, Manas Ghosh, "Fundamentals of Computing and Programming in C", Oxford University Press, (2009)

References:

1. Byron S Gottfried, "Programming with C", Schaum's Outlines, Tata McGraw-Hill, (2006)
2. Dromey R.G., "How to Solve it by Computer", Pearson Education, (2007)
3. Kernighan B.W and Ritchie D.M., "The C Programming language", Pearson Education, (2006)
4. Yashavant P. Kanetkar, "Let Us C", BPB Publications, (2011)

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2											3			
CO2	3	2											3	3		
CO3	3	3	2	1						1				3		
CO4	3	2	1										2			
CO5	2	2	3	2										2		
CO6	2	2			1									2	2	
CO7	2	2	2	2	1									3		1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161ME11	ENGINEERING GRAPHICS	L-T-P	C
		1-0-3	3

Programme: B.E./B.Tech. Common to all branches **Sem:** 1 **Category:** ES

Aim: To develop graphic skills in students

Course Outcomes:

The students will be able to

CO1. Follow the conventions used in engineering graphics
CO2. Practice plane curves and free hand sketching
CO3. Draw the projections of points, lines and plane
CO4. Draw the projections of simple solids and their sectional views
CO5. Describe the applications of development of surfaces
CO6. Practice isometric and perspective projections

PLANE CURVES **12**

Curves used in engineering practices:

Conics – Construction of ellipse, Parabola and hyperbola by eccentricity method – Construction of cycloid – Construction of involutes of square and circle – Drawing of tangents and normal to the above curves

PROJECTION OF POINTS, LINES AND PLANE SURFACES **12**

Projection of straight lines located in the first quadrant – inclined to both planes – Determination of true lengths and true inclinations – Projection of regular polygonal and circular lamina inclined to both reference planes.

PROJECTION OF SOLIDS **12**

Projection of simple solids like Prisms, Pyramids, Cylinder and Cone when the axis is inclined to one reference plane

SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES **12**

Sectioning of above solids in simple vertical position by cutting planes inclined to HP and perpendicular to VP – Obtaining true shape of section

Development of lateral surfaces of truncated solids – Prisms, Pyramids, Cylinder and Cone

ISOMETRIC AND PERSPECTIVE PROJECTIONS **12**

Principles of isometric projection – isometric scale – isometric projections of truncated Prisms, Pyramids, Cylinder and Cone

Perspective projection of simple prism and pyramid by Visual ray method

Total Periods: 60

Text Books:

1. Natrajan K.V., “A text book of Engineering Graphics”, Dhanalakshmi Publishers, Chennai (2015)
2. Kumar M.S., “Engineering Graphics”, D.D. Publications, (2015)

References:

1. Venugopal K. and Prabhu Raja V., “Engineering Graphics”, New Age International (P) Limited (2016)
2. Shah M.B. and Rana B.C., “Engineering Drawing”, Pearson Education (2009)
3. John K.C., “Engineering Graphics for degree” PHI Learning Pvt. Ltd., New Delhi, (2009)
4. Basant Agarwal and Agarwal C.M., “Engineering Drawing”, Tata McGraw Hill Publishing Company Limited, New Delhi, (2008)

Publication of Bureau of Indian Standards:

1. IS 10711 – 2001: Technical products Documentation – Size and lay out of drawing sheets
2. IS 9609 (Parts 0 and 1) – 2001: Technical products Documentation – Lettering
3. IS 10714 (Part 20) – 2001 and SP 46 – 2003: Lines for technical drawings
4. IS 11669 – 1986 and SP 46 – 2003: Dimensioning of Technical Drawings
5. IS 15021 (Parts 1 to 4) – 2001: Technical drawings – Projection Methods

Special points applicable to end semester examination on Engineering Graphics:

1. There will be five questions, first question is compulsory from Unit-I on engineering curves. Other four questions are either or type from Unit-II to V
2. All questions will carry equal marks of 20 each making a total of 100

3. The answer paper shall consist of drawing sheets of A3 size only. The students will be permitted to use appropriate scale to fit solution within A3 size
4. The end semester examination will be conducted in two sessions (FN and AN on the same day) for 50 percent of student (approx) at a time

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3		3		2					3				2		2
CO2	3		2		2					3				2		2
CO3	3		2		2					3				2		2
CO4	3		3		2					3				2		2
CO5	3		3		2					3				3		2
CO6	2		2		2					3				3		2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161PC17 PHYSICS AND CHEMISTRY LABORATORY – I **L-T-P** **C**
0-0-3 **2**

Programme: B.E/B.Tech. Common to all Branches **Sem: 1** **Category: BS**

Aim: To introduce the basic Physics concepts through experiments and to impart the basic analysis in chemistry

Course Outcomes:

The students will be able to

CO1. Understand the laser light propagation in optical fibre
CO2. Learn the principle of interference
CO3. Gain the knowledge of ultrasonic velocity in a liquid medium
CO4. Understand the knowledge of their home town water
CO5. Estimate the amount of substance by potentiometric technique
CO6. Outline the application of analytical instrument

LIST OF EXPERIMENTS – PHYSICS
(A minimum of five experiments shall be offered)

1. (a) Determination of Particle Size using Diode LASER
   (b) Determination of wavelength of the LASER source
   (c) Determination of Acceptance angle and Numerical aperture of an optical fibre
2. Determination of thickness of thin wire – Air wedge method
3. Determination of Velocity of sound and compressibility of liquid – Ultrasonic Interferometer
4. Determination of Dispersive power of a prism using Spectrometer
5. Determination of Young's modulus of the material - Non uniform bending
6. Determination of thermal conductivity of a bad conductor - Lee's Disc method

LIST OF EXPERIMENTS – CHEMISTRY
NAME OF THE EXPERIMENT

1 Estimation of Total Hardness of their home town water by EDTA method
2. Estimation of Copper in brass solution by EDTA method
3. Estimation of Ferrous Ion by Potentiometric Titrations
4. Conductometric titration of strong acid vs strong base
5. Estimation of Alkalinity of water sample
6. Estimation of Iron by spectrophotometer (Demo only)

Total Periods: 45

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1		2		1					1	1	1		
CO2	1	2	2				1					1	1	1		
CO3	2	1	3		2		2					2	1	1		
CO4	2	1	3		2		2					2				
CO5	2	2	1		1		2					1				
CO6	3	2	1	2	2		1					2				

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161CS17 COMPUTER PRACTICES LABORATORY L-T-P C
0-0-3 2

Programme: B.E/B.Tech. Common to all Branches **Sem: 1 Category: ES**

Aim: To provide an awareness to Computing and C Programming

Course Outcomes:

The students will be able to

CO1. Have fundamental concept on basics commands in Linux
CO2. Write, compile and debug programs in C language
CO3. Formulate problems and implement algorithms in C
CO4. Effectively choose programming components that efficiently solve computing problems in real world
CO5. Design application oriented programs in C
CO6. Structures and unions through which derived data types can be formed

LIST OF EXPERIMENTS

1. eSearch, generate, manipulate data using MS office/ Open Office
2. Presentation and Visualization – graphs, charts, 2D, 3D
3. C Programming using Simple statements and expressions
4. Scientific problem solving using decision making and looping
5. Simple programming for one dimensional and two dimensional arrays
6. Solving problems using String functions
7. Programs with user defined functions – Includes Parameter Passing
8. Program using Recursive Function and conversion from given program to flow chart
9. Program using structures and unions
10. Program using files

Total Periods: 45

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	1	2						2				3	1	1	
CO2	3	2	2						2				3	2	2	
CO3	3	2	3						2				3	3	2	
CO4	2	3	2						2				3	2	2	2
CO5	3		2						2				3	2	1	
CO6	2		2										2	2	1	

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161EE17	ENGINEERING PRACTICES LABORATORY	L-T-P	C
		0-0-3	2

Programme: B.E./B.Tech. Common to all branches **Sem: 1 Category: ES**

Aim: To Provide exposure to the students with hands on experience on various basic Engineering Practices in Civil, Electrical, Mechanical and Electronics Engineering

Course Outcomes:

The students will be able to

CO1. Express the pipe connections and identify the various components used in plumbing
CO2. Produce simple wooden joints using wood working tools
CO3. Create simple lap, butt and tee joints using arc welding equipments
CO4. Generate the simple components using lathe and drilling machine
CO5. Identify the fitting usage of square joint, L joint and stepped joints.
CO6. Facilitate the operation of fluorescent lamp, staircase wiring and measuring the consumed electrical energy
CO7. Express and analyze the fundamentals of Boolean algebra and digital logic gates
CO8. Generate clock signal and measure the parameters of the signal

LIST OF EXERCISES

GROUP A (CIVIL and MECHANICAL)

I. CIVIL ENGINEERING PRACTICE 9

Plumbing Works:

(a) Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in household fittings.
(b) Preparation of plumbing line sketches for water supply and sewage works
(c) Hands-on-exercise
(d) Basic pipe connections – Mixed pipe material connection – Pipe
(e) Connections with different joining components

Carpentry using Power Tools only:

(a) Study of the joints in roofs, doors, windows and furniture
(b) Hands-on-exercise: Dismantling & Assembling of various wooden furniture like stool, Chairs & Bench

II. MECHANICAL ENGINEERING PRACTICE 12

Welding:

(a) Preparation of arc welding of butt joints and lap joints
(b) Study of Gas welding equipments & practice

Fitting:

(a) Hands-on-exercise: Preparation of square fitting, vee & step – fitting models

GROUP B (ELECTRICAL and ELECTRONICS)

III ELECTRICAL ENGINEERING PRACTICE 12

1. Residential house wiring using switches, fuse, indicator, lamp and energy meter
2. Fluorescent lamp wiring
3. Stair case wiring
4. Measurement of electrical quantities – voltage, current, power and power factor in RLC circuit
5. Measurement of energy using single phase energy meter
6. Measurement of resistance to earth of electrical equipment

IV ELECTRONICS ENGINEERING PRACTICE 12

1. Study of Electronic components and equipments – Resistor, colour coding measurement of AC signal parameter (peak-peak, rms period, frequency) using CRO
2. Study of logic gates AND, OR, EOR and NOT
3. Generation of Clock Signal
4. Soldering practice – Components Devices and Circuits – Using general purpose PCB
5. Measurement of ripple factor of HWR and FWR

Total Periods: 45

LIST OF EQUIPMENTS
(For a batch of 30 students)

CIVIL

1.	Assorted components for plumbing consisting of metallic pipes, Plastic pipes, flexible pipes, couplings, unions, elbows, plugs and other fittings	15 Sets
2.	Carpentry vice (fitted to work bench)	15 Nos.
3.	Standard woodworking tools	15 Sets
4.	Models of industrial trusses, door joints, furniture joints	5 Nos.
5.	**Power Tools:**	
	Demolition Hammer	2 Nos.
	Hand Drilling Machine	2 Nos.
	Wooden Cutter	2 Nos.

MECHANICAL

1.	Arc welding transformer with cables and holders	5 Nos.
2.	Welding booth with exhaust facility	5 Nos.
3.	Welding accessories like welding shield, chipping hammer, Wire brush, etc.,	5 Sets
4.	Power Tool: Angle Grinder	2 Nos.
5.	Fitting vice (fitted to work bench)	15 Nos.
6.	Standard working tools	15 sets

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2	3	3	3				3				2			3
CO2	2	2	3	3	3				3				2			3
CO3	2	2	3	3	3				3				2			3
CO4	2	2	3	3									2			3
CO5	2	2	3	3									2			3
CO6	2	2	3	3	3				3							1
CO7	1	2	2	3	3				2							1
CO8	1	2	2	2	2				2							1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161HS21 **TECHNICAL ENGLISH** **L-T-P** **C**

3-0-0 **3**

Programme: B.E/B.Tech (Common to all Branches) **Sem: 2** **Category: HS**

Aim: To improve confident of the learner to communicate effectively using technical related workplace modules

Course Outcomes:

The students will be able to

CO1. Remember words and its meaning for the specific purpose
CO2. Apply written communication methodologies at workplace
CO3. Develop listening skill to respond and to gather information
CO4. Interpret the text using comprehending skill
CO5. Describe the topic using appropriate vocabulary
CO6. Summarize the key points in the audio script

UNIT I **9**

Language and Grammar – Technical words – Foreign words – Adjective, **Reading** – Reading Technical passages, **Writing** – Formal Letters – Calling for Quotation, placing order, **Listening** – Listening to TED Talks to take notes, **Speaking** – Introducing others

UNIT II **9**

Language and Grammar – Interrogative Statements – Acronym – One-word substitution, **Reading** – Note-taking, **Writing** – Essay writing – Preparing Questionnaire, **Listening** – Listening to Group Discussion, **Speaking** – Public Speech practice

UNIT III **9**

Language and Grammar – Conditional Clauses – Punctuation – Concord, **Reading** – Reading Book/film/music reviews, **Writing** – Report writing, **Listening** – Listening to Technical Presentation, **Speaking** – Reporting events

UNIT IV **9**

Language and Grammar – Words followed by prepositions – Articles – Action verb, **Reading** – Reading Famous speech text, **Writing** – Minutes – Checklist – Memo, **Listening** – Listening for Gist, **Speaking** – discussing about uses of gadgets & machines

UNIT V **9**

Language and Grammar Vocabulary, cause and effect, reported speech Reading – Reading for vocabulary, **Writing** – dialogue writing, **Listening** – Listening for Gist, **Speaking** – discussing about uses of gadgets & machines

Total Periods: 45

Text Books:

1. Department of English, Anna University, "English for engineers and technologists" (Vol. 1& 2) combined edition, Orient Black swan, Chennai (2012)

References:

1. Department of English, Anna University, "Mindscapes: English for Technologists and Engineers", Orient Blackswan, Chennai, (2012)
2. www.usingenglish.com
3. www.grammar.org
4. www.audioenglish.com
5. http://www.manythings.org

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1		2		3		1		2	3	3	3	3				
CO2						2		3	3	3	3	3				3
CO3		3		2	3	2	3	2	3	3	2	3				
CO4										2		3				
CO5									3	3	2	3				
CO6			2	2								3				

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161MA21	ENGINEERING MATHEMATICS - II	L-T-P	C
		3-1-0	4

Programme: B.E/B.Tech. Common to all Branches **Sem: 2 Category: BS**

Aim: To analyze the engineering problems using the techniques and the mathematical skills acquired by studying vector calculus, Laplace transform, complex variables and multiple integral

Course Outcomes:

The students will be able to

CO1. Apply Laplace transform to solve first and second order differential equations with elementary forcing function
CO2. Classify Green's theorem to evaluate line integrals along simple closed contours on the plane
CO3. Construct an analytic function using the properties of analytic function
CO4. Make use of Cauchy's residue theorem for applications in Engineering
CO5. Evaluate complicated real integrals using the basics of analytic functions and the complex Integration
CO6. Apply double integration to find area between two curves

LAPLACE TRANSFORM **12**

Laplace transform – Conditions for existence – Transform of elementary functions – Basic properties – First Shifting Theorem – Transform of derivatives on tf(t), f(t)/t and periodic functions – Transform of unit step function and impulse functions – Inverse Laplace transform by partial fraction method and Convolution theorem (excluding proof) – Initial and Final value theorems – Solution of linear ODE of second order with constant coefficients using Laplace transformation techniques

ANALYTIC FUNCTIONS **12**

Functions of a complex variable – Analytic functions – Necessary conditions, Cauchy – Riemann equation and Sufficient conditions (excluding proofs) – Harmonic and orthogonal properties of analytic function(without proof) – Harmonic conjugate – Construction of analytic functions – Conformal mapping: $w = z+c$, cz, $1/z$ and bilinear transformation

COMPLEX INTEGRATION **12**

Statement and application of Cauchy's theorem and Cauchy's integral formula, Taylor and Laurent expansion, Singularities, Classification, Residues, Cauchy's residue theorem, Contour integration (Type I&II)

MULTIPLE INTEGRALS **12**

Double Integration – Cartesian and Polar co-ordinates – Change of order of Integration – Change of variable between Cartesian and polar co-ordinates – Triple integration – Area as a double integral by Cartesian co-ordianates – Volume as a triple integral

VECTOR CALCULUS **12**

Gradient, Divergence and Curl – Directional derivative – Irrotational and Solenoidal vector fields – Vector integration – Green's theorem in a plane, Gauss divergence theorem and stokes' theorem (excluding proofs) – Simple applications involving cubes and rectangular parallelepipeds

Lecture: 45 Tutorial: 15 Total Periods: 60

Text Books:

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, Delhi, (2005)
2. Veerarajan T., "Engineering Mathematics", Tata McGraw Hill publishing company Ltd, New Delhi, (2005)

References:

1. Greenberg M.D., "Advanced Engineering Mathematics", Pearson Education Inc., (2002)
2. Venkataraman M.K., "Engineering Mathematics", Volume I and II, The National Publishing Company, Chennai, (2004)
3. Kreyszig E., "Advanced Engineering Mathematics", John Wiley Sons, (2001)
4. Ravish R Singh, Mukul Bhatt, "Engineering Mathematics-I", McGraw Hill Education (India) Private Ltd, New Delhi

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1		1								3		2	1	
CO2	2	2		2												1
CO3	2	1		2								1	2			
CO4	1	2		3								1			2	
CO5	3	3												2		
CO6	3	3			3				1			3	2			2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161PH21	PHYSICS OF MATERIALS	L-T-P	C
		3-0-0	3

Programme: B.E/B.Tech. Common to all Branches **Sem:** 2 **Category:** BS

Aim: To endow the students with the fundamentals of physics, materials and apply new ideas in the field of Engineering and Technology

Course Outcomes:

The students will be able to

CO1. Understand the theory and processing of conducting, superconducting materials
CO2. Acquire knowledge of classification of semi conducting materials
CO3. Gain knowledge about the types of magnetic and dielectric materials and their applications
CO4. Acquire knowledge about optical materials
CO5. Acquire knowledge about nano material and their characterization techniques
CO6. Attain a clear view of material characterization techniques

CONDUCTING MATERIALS **9**

Conductors: Classical free electron theory of metals – Electrical and thermal conductivity – Wiedemann – Franz law – Lorentz number – Draw backs of classical theory –Fermi distribution function – Effect of temperature on Fermi Function – Density of energy states – carrier concentration in metals

Super Conductors: Properties – Types of super conductors – Applications of superconductors – SQUID, cryotron, magnetic levitation

SEMICONDUCTING MATERIALS **9**

Intrinsic semiconductor – carrier concentration derivation – Fermi level – Variation of Fermi level with temperature – Extrinsic semiconductors – carrier concentration derivation in n-type and p-type semiconductor – variation of Fermi level with temperature and impurity concentration – Hall effect – Determination of Hall coefficient – Applications

MAGNETIC AND DIELECTRIC MATERIALS **9**

Magnetic Materials: Origin of magnetic moment – Bohr magneton – Dia and para magnetism – Ferro magnetism – Domain theory – Hysteresis – soft and hard magnetic materials – anti – ferromagnetic materials – Ferrites – applications

Dielectric Materials: Polarization – electronic, ionic, orientational and space charge polarization – frequency and temperature dependence of polarisation –dielectric loss – dielectric breakdown – uses of dielectric materials (capacitor and transformer) – ferroelectricity and applications

ADVANCED MATERIALS **9**

Metallic glasses: Preparation, properties and applications

Shape memory alloys (SMA): Characteristics – Properties of NiTi alloy – Applications – Advantages and disadvantages of SMA. **Bio Materials:** Biomaterials and their Types – Uses of biomaterials – Biosensor

NANOMATERIALS & CHARACTERIZATION TECHNIQUES **9**

Synthesis of nanomaterials – Chemical vapour deposition – Ball milling – Properties of nanomaterials and applications Principle, Characterization and applications of X-Ray diffraction – Scanning Electron Microscope – Transmission Electron Microscope

Total Periods: 45

Text Books:

1. Ragavan V., “Material science and Engineering”, Prentice Hall of India (2004)
2. Arumugam M., “Materials Science”, Anuradha publications, Kumbakonam (2006)

References:

1. William D. Callister, “Material Science and Engineering”, John Wiley & Sons Inc., New Delhi (2010)
2. Charles P. Poole and Frank J. Ownen., “Introduction to Nanotechnology”, Wiley India (2007)
3. Charles Kittel, “Introduction to solid state Physics”, John Wiley & Sons, Singapore (2007)
4. Donald R. Askeland, Wendelin J. Wright, “Essentials of Materials Science and Engineering”, Cengage publication, (2014)

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	1	1	1	1		1					1	1	1	1	1
CO2	3	1	2	1	1		1					1	1	1	1	1
CO3	3	1	1	2	1		1					1	1	1	1	1
CO4	3	2	2	2	2		2					1	1	1	1	1
CO5	3	2	2	3	2		1					2	1	1	1	2
CO6	3	2	2	1	2		1					2	2	1	1	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161CY21 ENVIRONMENTAL SCIENCE AND ENGINEERING L-T-P C
3-0-0 3

Programme: B.E/B.Tech. Common to all Branches **Sem: 2 Category: BS**

Aim: To Impart the social groups and individuals to acquire knowledge of pollution and environmental degradation

Course Outcomes:

The students will be able to

CO1. Understand the basic concepts of environment studies and natural resources
CO2. Get knowledge about ecosystem and biodiversity
CO3. Identify and analyze causes, effects and control measures of various types of pollution
CO4. Get the knowledge about types of disaster and mitigation measures
CO5. Understand the impact of social issues
CO6. Understand the role of a human being in maintaining a clean environment

INTRODUCTION TO ENVIRONMENTAL STUDIES AND NATURAL RESOURCES 9

Definition, scope and importance – Need for public awareness – Forest resources: Use and over-exploitation, deforestation, case studies – dams and their effects on forests and tribal people – Energy resources: Growing energy needs, renewable (solar energy and wind energy) and non renewable energy sources- Nuclear energy – fission and fusion reactions and light water nuclear reactor for power generation (block diagram only), Petroleum processing and fractions, LPG and Natural gas

ECOSYSTEM AND BIODIVERSITY 9

ECOSYSTEM : Concept of an ecosystem – Structure and function of an ecosystem: Producers, consumers and decomposers, Energy flow in the ecosystem-Nitrogen cycle, Food chains, food webs and ecological pyramids - Introduction, types, characteristic features, structure and function of the Forest ecosystem and Aquatic ecosystems (lake and rivers)

BIODIVERSITY : Introduction to Biodiversity – Definition– Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values –India as a mega-diversity nation – Hot-spots of biodiversity

ENVIRONMENTAL POLLUTION 9

Definition – Causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Marine pollution (d) Noise pollution (e) Thermal pollution – Solid waste Management: Causes, effects and control measures of urban and industrial wastes – Role of an individual in prevention of pollution – Pollution case studies – Disaster management: floods, earthquake, cyclone and landslides

SOCIAL ISSUES AND THE ENVIRONMENT 9

From Unsustainable to Sustainable development – Urban problems related to energy – Water conservation, rain water harvesting, watershed management – Environmental ethics: Issues and possible solutions – Climate change, global warming, acid rain, Ozone layer depletion, nuclear accidents -case studies- Goal of Green chemistry

HUMAN POPULATION AND THE ENVIRONMENT 9

Population growth, variation among nations – Population explosion – Family Welfare Programme – Human Rights – Value Education – HIV/AIDS –Women and Child Welfare – Role of Information Technology in Environment and human health-Case studies

Total Periods: 45

Text Books:

1. Ravikrishnan A., "Environmental Science and Engineering", Sri Krishna Hitech Publishing Company Private Limited, (2010)
2. Benny Joseph, "Environmental Science and Engineering", Tata McGraw-Hill, New Delhi, (2006)

References:

1. Anubha Kaushik, Kaushik C.P., "Environmental Science and Engineering", New Age International Publishers, (2016)
2. Benny Joseph, "Environmental Science and Engineering", Tata McGraw-Hill Publishing Company Ltd, New Delhi, ISBN: 0070601690, (2006)
3. Raman Sivakumar, "Introduction to Environmental Science and Engineering", Tata McGraw Hill Education Private Limited, New Delhi, (2010)
4. P.Meenakshi, "Elements of Environmental Science and Engineering", PHI learning (P) Ltd., India.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	1	3	1	1			1		2		1	2	2		
CO2		2	1	1			1	1	1	2	1	1	2	2		
CO3	2	1		2				1		1		1	3	3		3
CO4	1	2	1		2							1	1			
CO5	2	3	2		2			2		2	1	2	2			2
CO6	3	2	3		2			2		2	1	3	3	2		3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161ME21	ENGINEERING MECHANICS	L-T-P	C
		2-2-0	3

Programme: B.E. Mechanical Engineering **Sem: 2 Category: ES**

Aim: To impart a sound knowledge on the applied physics laws in different engineering applications

Course Outcomes:

The students will be able to

CO1. Recite the laws of forces and principle of transmissibility
CO2. Describe the types of supports and equilibrium of rigid bodies in three dimensions
CO3. Explain the parallel axis theorem and perpendicular axis theorem
CO4. Determine moment of inertia and polar moment of inertia of various sections
CO5. Solve the displacement, velocity and acceleration problems and their relationship with work energy equation of particles
CO6. Explain the various Frictional forces and general plane motion of rigid bodies

BASICS & STATICS OF PARTICLES **9**

Introduction – Units and Dimensions – Laws of Mechanics – Lame's theorem, Parallelogram and triangular Law of forces – Vectors – Vectorial representation of forces and moments – Vector operations: additions, subtraction, dot product, cross product – Coplanar Forces – Resolution and Composition of forces – Equilibrium of a particle – Forces in space – Equilibrium of a particle in space – Equivalent systems of forces – Principle of transmissibility – Single equivalent force

EQUILIBRIUM OF RIGID BODIES **9**

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

PROPERTIES OF SURFACES AND SOLIDS **9**

Determination of Areas and Volumes – First moment of area and the Centroid of sections – Rectangle, circle, triangle from integration – T section, I section – Angle section, Hollow section by using standard formula – second and product moments of plane area – Parallel axis theorem and perpendicular axis theorem – Polar moment of inertia – Principal moments of inertia of plane areas – Principal axes of inertia

DYNAMICS OF PARTICLES **9**

Displacements, Velocity and acceleration, their relationship – Relative motion – Curvilinear motion – Newton's law – Work Energy Equation of particles

FRICTION AND ELEMENTS OF RIGID BODY DYNAMICS **9**

Frictional force – Laws of Coloumb friction – simple contact friction – Rolling resistance – Belt friction – Translation and Rotation of Rigid Bodies – Velocity and acceleration – General Plane motion

Total Periods: 45

Text books:

1. Beer F.P. and Johnson Jr. E.R., "Vector Mechanics for Engineers", Vol. 1 Statics and Vol. 2 Dynamics, McGraw-Hill International Edition, (2012)
2. Kottiswaran N., "Engineering Mechanics Statics & Dynamics", Sri Balaji Publications (2016)

References:

1. Rajasekaran S., Sankarasubramanian G., "Fundamentals of Engineering Mechanics", Vikas Publishing House Pvt. Ltd., (2009)
2. Hibbeller R.C., "Engineering Mechanics", Pearson Education Asia Pvt. Ltd., (2010)
3. Palanichamy M.S., Nagam S., "Engineering Mechanics–Statics & Dynamics", Tata McGraw-Hill, (2004)
4. Irving H. Shames, "Engineering Mechanics – Statics and Dynamics", Pearson Education Asia Pvt. Ltd., (2006)

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	2	3					2			2	3	1	
CO2	3	3	3	2	3					3			2	3	1	
CO3	3	3	1	2	2					2			2	3	1	
CO4	3	3	1	2	2					2			2	3	1	
CO5	2	3	2	2	1					3			2	3	1	
CO6	2	2	2	3	2					2			2	3	1	

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161ME22 MANUFACTURING PROCESSES L-T-P C
3-0-0 3

Programme: B.E. Mechanical Engineering **Sem: 2 Category: PC**

Aim: To introduce the basic concepts and methods of the production / fabrication of a component

Course Outcomes:

The students will be able to

CO1. Do sand moulding and casting
CO2. Perform the various types of joining processes used in engineering industries
CO3. Recall the latest welding techniques
CO4. Differentiate between the hot working and cold working process of metals
CO5. Fabricate the various products using sheet metal operations
CO6. Explain different moulding methods of plastics

METAL CASTING PROCESSES 9

Sand casting – Sand moulds – Type of patterns – Pattern materials – Pattern allowances – Types of Moulding sand – Properties – Core making – Methods of Sand testing – Moulding machines – Types of moulding machines – Melting furnaces – Working principle of Special casting processes – Shell, investment casting – Pressure die casting – Centrifugal casting – CO_2 process – Sand Casting defects – Inspection methods

JOINING PROCESSES 9

Fusion welding processes – Types of Gas welding – Equipments used – Flame characteristics – Arc welding equipments – Electrodes – Principles of Resistance, Spot/butt, seam, Percusion, Gas metal arc welding – Gas Tungsten Arc welding – Submerged arc welding – Electro slag welding – Plasma arc welding – Thermit welding – Electron beam welding – Friction welding – Diffusion welding – Weld defects – Brazing and soldering process – Filler materials and fluxes

BULK DEFORMATION PROCESSES 9

Hot working and cold working of metals – Forging processes – Open and closed die forging – Types of Forging Machines – Typical forging operations – Rolling of metals – Types of Rolling mills – Flat strip rolling – Shape rolling operations – Defects in rolled parts – Principle of rod and wire drawing – Tube drawing — Principles of Extrusion – Types of Extrusion – Hot and Cold extrusion

SHEET METAL PROCESSES 9

Sheet metal characteristics – Typical shearing operations, bending and drawing operations – Stretch forming operations – Formability of sheet metal – Test methods – Working principle and application of special forming processes – Hydro, Rubber pad, Explosive, Magnetic pulse, Peen, and Super plastic forming – Metal spinning

MANUFACTURING OF PLASTIC COMPONENTS 9

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 – Compression, Transfer, Blow, Rotational moulding – Film blowing – Extrusion – Thermoforming – Typical industrial applications

Total Periods: 45

Text books:

1. Sharma P.C., "A text book of Production Technology", S. Chand and company, (2014)
2. Hajra Choudhury, "Elements of Workshop Technology", Vol. I, Media Promotors, Mumbai, (2015)

References:

1. Magendran Parashar B.S. & Mittal R.K., "Elements of Manufacturing Processes", Prentice Hall of India, (2003)
2. Gowri S., Hariharan, Pand Suresh Babu A., "Manufacturing Technology-I", Pearson Education, (2008)
3. Rao P.N., "Manufacturing Technology", Tata McGraw-Hill Publishing Limited, (2009)
4. Begman "Manufacturing Process", John Wiley & Sons, (2005)

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1	1		3				2			3				3
CO2	2	2	2		2											3
CO3	2	2	1		1				3			2				3
CO4	2	2	2		2											3
CO5	2	2	2		2											3
CO6	2	2	2		2				3							2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161PC27 PHYSICS AND CHEMISTRY LABORATORY-II **L-T-P** **C**

0-0-3 **2**

Programme: B.E. Mechanical Engineering **Sem: 2** **Category: BS**

Aim: To introduce the basic Physics concepts through experiments and to impart knowledge on the application of chemistry in engineering branches

Course Outcomes:

The students will be able to

CO1. Understand the rigidity modulus of the materials
CO2. Learn the Young's modulus of the material
CO3. Study the flow of liquid in capillary tube
CO4. Determine the quantity of unknown solution by instrumental method
CO5. Analyze the corrosion rate of a iron
CO6. Estimate the molecular weight of polymer

LIST OF EXPERIMENTS – PHYSICS
(A minimum of five experiments shall be offered)

1. Torsional pendulum – Determination of rigidity modulus
2. Determination of Young's modulus of the material – Uniform bending
3. Determination of viscosity of liquid – Poiseuille's method.
4. Determination of wavelength of mercury spectrum- Spectrometer Grating
5. Determination of Band Gap of a semiconductor material.
6. Determination of specific resistance of a given coil of wire – Carey Foster Bridge

LIST OF EXPERIMENTS – CHEMISTRY

1. Esimation of HCl by pH metry
2. Conductometric titration of mixture of acids (HCl & CH_3COOH)
3. Estimation of Chloride ion in water sample by Argentometric method.
4. Determination of molecular weight of a polymer by viscometry method
5. Determination of corrosion rate by weight loss method

Total Periods: 45

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2	1	1	1		1					1	1	1		1
CO2	2	2	1	1	1		1					1	1	1		1
CO3	2	2	1	1	1		1					1	1	1		1
CO4	2	2	1	2	2		1					1	2	2		2
CO5	3	2	2	2	2		2					2	1	2		2
CO6	2	2	2	1	1		2						1	1		2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161ME23	COMPUTER AIDED DRAFTING LABORATORY	L-T-P	C
		0-0-3	2

Programme: B.E. Mechanical Engineering **Sem: 2 Category: ES**

Aim: To gain more knowledge in 2D & 3D drawings by using relevant software

Course Outcomes:

The students will be able to

CO1. Demonstrate the fundamentals of drafting techniques
CO2. Outline the basic shapes and modeling
CO3. Understand the drawing from different perspective
CO4. Convert Isometric to orthographic projections & from orthographic to isometric of simple objects
CO5. Draw simple 3D models using extrude and revolve
CO6. Assemble machine elements

Drawing Standards

Code of practice for Engineering Drawing, BIS specifications – Welding symbols, riveted joints, keys and fasteners – Selection of standard components like bolts, nuts, screws, keys etc. with the help of design data book

2-D Drawings

Limits, Fits – Tolerance of individual dimensions – Specification of Fits – Preparation of production drawings and reading of part and assembly drawings.

Basic commands used in Drafting Packages

Drawing, Editing, Plotting, Layering Concepts, Hatching, Detailing, Assembly, Solids, Rendering, Shading, basic principles of GD&T (geometric dimensioning & tolerance), Preparation of Bill of materials.

List of Exercises

- Drawing of curves like parabola, spiral, involute of square and circle
- Drawing of front view and top view of simple solids like bolt & Nut, welded joints
- Drawing sectional views of simple machine elements
- Drawing of Orthographic view from Isometric view
- Drawing of Isometric view from Orthographic view
- Drawing of simple 3D objects using Extrude and Revolve command
- Assembly drawing – Sleeve and Cotter joint
- Assembly drawing – Knuckle joint
- Assembly drawing – Flange Coupling
- Assembly drawing – Universal Coupling

NOTE: Practical examination duration is Three hours. Students will carry out one exercise in assembly drawing and one exercise in simple objects.

SYSTEM REQUIREMENTS
(For a batch of 30 Students)

Hardware:

1. Intel i3 core due processor with 4GB ram with 500GB hard disk – 30 Nos.
2. Laser Printer – 1 No.

Software:

1. Drafting package – AutoCAD – Adequate license (Open source)

Total Periods: 45

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1		1				2			3			3	3
CO2	3	2	1		1				2			2			3	3
CO3	3	2	1		1				3			2			3	3
CO4	3	2	2		2				3	2		2			3	3
CO5	3	3	2		2				3	2		3			3	3
CO6	3	3	2		2				3	2		3			3	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161ME24 MANUFACTURING PROCESSES LABORATORY L-T-P C
0-0-3 2

Programme: B.E. Mechanical Engineering **Sem: 2 Category: PC**

Aim: To study and acquire knowledge on preparation of sand mould process, welding and sheet metal

Course Outcomes:

The students will be able to

CO1. Prepare the green sand mould with various patterns
CO2. Prepare the core
CO3. Explain the major components of arc welding
CO4. Do welding to make various joints
CO5. Demonstrate welding and metal cutting using gas flame
CO6. Develop the funnel & rectangular trays using sheet metal

LIST OF EXPERIMENTS

PREPARATION OF SAND MOULD

Mould with solid, split patterns
Mould with loose-piece pattern
Mould with Core

WELDING EXERCISES

Demonstration on Horizontal, Vertical and Overhead welding
Hands on exercise: Vee joint, L-joint and Tee joint
Demonstration on Gas Cutting, Gas Welding and Brazing

SHEET METAL WORK

Fabrication of sheet metal tray and funnel

Total Periods: 45

LIST OF EQUIPMENTS
(For a batch of 30 students)

1. **Sand moulding Facility**
   - Moulding Table 05
   - Moulding boxes, tools and patterns 05
2. **Welding**
   - Arc welding machine 04
   - Gas welding machine 01
   - Brazing machine 01
3. **Sheet Metal Work facility**
   - Hand Shear 300mm 01
   - Bench vice 05
   - Standard tools and calipers for sheet 05

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	3	3	3					3			2				3
CO2	2	3	3						3							3
CO3	2	2	3						3							3
CO4	2	2	3		3				3			2				3
CO5	2	2	3		3				3			2				3
CO6	2	2	3		3				3			2				2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161MA31 TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATION

L-T-P C

3-2-0 4

Programme: B.E. Mechanical Engineering **Sem: 3 Category: BS**

Aim: To develop the basic mathematical skills of Engineering Student

Course Outcomes:

The students will be able to

CO1. Classify the Fourier series and half range Fourier sine and cosine series
CO2. Explain the Fourier transform and with their properties
CO3. Determine Z-inverse transform using convolution theorem and partial fraction method
CO4. Solve the partial differential equation by using Lagrange's linear equation
CO5. Analyze separation of variable to solve linear partial differential equation
CO6. Discuss the formation of partial differential equation

FOURIER SERIES **12**

Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Complex form of Fourier Series – Parseval's identify – Harmonic Analysis

FOURIER TRANSFORMS **12**

Fourier integral theorem (without proof) – Fourier transform pair – Sine and Cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity

PARTIAL DIFFERENTIAL EQUATIONS **12**

Formation of partial differential equations – Lagrange's linear equation – Solutions of standard types of first order partial differential equations(without reducing the standard type) – Linear partial differential equations of second and higher order with constant coefficients.

APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS **12**

Solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two-dimensional equation of heat conduction (Insulated edges excluded) – Fourier series solutions in Cartesian coordinates

Z -TRANSFORMS AND DIFFERENCE EQUATIONS **12**

Z-transforms – Elementary properties – Inverse Z-transform – Convolution theorem – Formation of difference equations – Solution of difference equations using Z-transform

Lecture: 45 Tutorial: 15 Total Periods: 60

Text Books:

1. Grewal B.S., "Higher Engineering Mathematics", Khanna publishers, Delhi, (2007)
2. Balaji G., "Transforms and Partial Differential Equation", Balaji Publishers, Chennai, (2016)

References:

1. Bali, N.P and Manish Goyal "A Textbook of Engineering Mathematics", Laxmi Publications (P) Ltd. (2007)
2. Ramana B.V., "Higher Engineering Mathematics", Tata Mc-GrawHill Publishing Company limited, New Delhi (2007)
3. Glyn James, "Advanced Modern Engineering Mathematics", Pearson Education, (2007)
4. Erwin Kreyszig "Advanced Engineering Mathematics", Wiley India, (2007)

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	3		3								3		2	1	
CO2	2	3		3								3				1
CO3	1	2		3								3	2			
CO4	1	1		1										2	2	
CO5	1	1										1				
CO6	2	2											2			2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161ME31 MANUFACTURING TECHNOLOGY L-T-P C
3-0-0 3

Programme: B.E. Mechanical Engineering **Sem: 3 Category: PC**

Aim: To understand the basic principles and working of various machine tools

Course Outcomes:

The students will be able to

CO1. Know the principle of metal cutting process
CO2. Learn the basic operation of centre lathe
CO3. Recognize the parts and working of special purpose lathe
CO4. Familiarize the working principle of reciprocating machine tools
CO5. Explain the hole making process
CO6. Introduce the various methods of Grinding and Gear cutting process

THEORY OF METAL CUTTING 9

Introduction: material removal processes, types of machine tools – theory of metal cutting: chip formation, orthogonal cutting, cutting tool materials, tool wear, tool life, surface finish, cutting fluids

CENTRE LATHE AND SPECIAL PURPOSE LATHES 9

Centre lathe, constructional features, cutting tool geometry, various operations, taper turning methods, thread cutting methods, special attachments, machining time and power estimation – Capstan and turret lathes – automats – single spindle, swiss type, automatic screw type, multi spindle – Turret Indexing mechanism, Bar feed mechanism

RECIPROCATING MACHINE TOOLS 9

Reciprocating machine tools: shaper, planer, slotter machine types, mechanism and operations – Sawing machine: hack saw, band saw, circular saw

MILLING, DRILLING, BROACHING MACHINES 9

Milling: types, milling cutters, operations – Hole making: drilling – Quill mechanism, Reaming, Boring, Tapping – Broaching machines: broach construction – push, pull, surface and continuous broaching machines

ABRASIVE PROCESSES AND GEAR CUTTING 9

Abrasive processes: grinding wheel – specifications and selection, types of grinding process – cylindrical grinding, surface grinding, centreless grinding – honing, lapping, super finishing, polishing and buffing, abrasive jet machining – Gear cutting, forming, generation, shaping, hobbing

Total Periods: 45

Text Books:

1. Hajra Choudry, "Elements of Work Shop Technology – Vol. II", Media Promoters, (2015)
2. Sharma P.C., "A Text Book of Production Engineering", S. Chand and Co. Ltd, (2013)

References:

1. Rao P.N., "CAD/CAM Principles and Applications', Tata Mc Graw Hill, (2014)
2. Rajput R.K., "A Textbook of Manufacturing Technology", Laxmi puplication, New Delhi, (2014)
3. Rao P.N., "Manufacturing Technology", Metal Cutting and Machine Tools, Tata McGraw Hill, New Delhi, (201)
4. Shrawat N.S. and Narang J.S., 'CNC Machines', Dhanpat Rai & Co., (2012)

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3		1			2	1		2			2				3
CO2	3		1			2	1		2			2				3
CO3	3		1			2	1		2			2				3
CO4	3		1			2	1		2			2				3
CO5	3		1			2	1		2			2				3
CO6	3		1			2	1		2			2				2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161ME32 ENGINEERING THERMODYNAMICS L-T-P C
3-0-0 3

Programme: B.E. Mechanical Engineering **Sem: 3 Category: PC**

Aim: To learn the basic concepts of Thermodynamics and its application

Course Outcomes:

The students will be able to

CO1. Describe the thermodynamics basic principles and different processes
CO2. Explain the laws of thermodynamics
CO3. Introduce the engines, refrigeration and air conditioning concepts
CO4. Ensure the working principle of Steam power cycles
CO5. Realize the ideal, real gases concepts and thermodynamic relations
CO6. Explain the principles of psychrometric processes and cooling load calculation in Air conditioner

BASIC CONCEPT AND FIRST LAW OF THERMODYNAMICS 9

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

SECOND LAW OF THERMODYNAMICS 9

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

PROPERTIES OF PURE SUBSTANCE AND STEAM POWER CYCLE 9

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. Estimation of workdone and heat transfer in non flow and flow processes – Standard Rankine cycle, Reheat and regenerative cycle

IDEAL AND REAL GASES AND THERMODYNAMIC RELATIONS 9

Gas mixtures – properties ideal and real gases, equation state, Avagadro's Law, Vander Waal's equation of state, compressability factor, compressability chart – Dalton's law of partial pressure, exact differentials, T-D relations, Maxwell's relations, Clausius Clapeyron equations, Joule – Thomson coefficient

PSYCHROMETRY 9

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

Total Periods: 45

Text Books:

1. Natarajan E., "Engineering Thermodynamics", Anugraham Publication, (2015)
2. Nag P.K., "Engineering Thermodynamics", Tata McGraw-Hill, New Delhi, (2014)

References:

1. Rajput R.K., "Thermal Engineering", S. Chand Publishers, (2010)
2. Holman J.P., "Thermodynamics", Tata McGraw Hill, (2006)
3. Cengel, "Thermodynamics–An Engineering Approach", Tata McGraw Hill, New Delhi (2012)
4. Khurmi R.S., "Steam Tables", S.Chand publication, (2014)

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3		1						2			3	2		
CO2	3	3		1						2			3			
CO3	3	3	2	3	2		2					2	3	3		2
CO4	2	2		3	2	1	1							2		1
CO5	3	3	1	2									2			
CO6	3	3	2	1	1							1		2		1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161ME33 ENGINEERING MATERIALS AND METALLURGY L-T-P C
3-0-0 3

Programme: B.E. Mechanical Engineering **Sem: 3 Category: PC**

Aim: To impart the knowledge on properties and the applications of materials

Course Outcomes:

The students will be able to

CO1. Construct a phase diagram and identify the material in various phases
CO2. Illustrate the various types of heat treatment processes
CO3. Construct a TTT diagram by changes that takes place during the cooling processes
CO4. Explain the plastic deformation and testing of materials
CO5. Learn the properties and applications various ferrous and non-ferrous metals
CO6. Recognize the properties and applications of non metallic materials

CONSTITUTION OF ALLOYS AND PHASE DIAGRAMS 9

Constitution of alloys – Solid solutions, substitutional and interstitial – phase diagrams, Isomorphous, eutectoid, eutectic, peritectic, and peritectroid reactions, Iron – Iron carbide equilibrium diagram – Classification of steel and cast Iron, microstructure, properties and applications

HEAT TREATMENT 9

Definition – Full annealing, stress relief, recrystallization and spheroidizing – normalizing, hardening and tempering of steel – isothermal transformation diagrams – cooling curves superimposed on T.T.Diagram, CCR – Hardenability, Jominy and quench test – Austempering, martempering – case hardening – Carburizing, Nitriding, cyaniding, carbonitriding, flame and induction hardening

MECHANICAL PROPERTIES AND TESTING 9

Mechanism of plastic deformation, slip and twinning – Types of fracture – Testing of materials under tension, compression and shear loads – Hardness tests (Brinell, Vickers and Rockwell), Impact test – Izod and Charpy, Fatigue and creep tests, fracture toughness tests

FERROUS AND NON FERROUS METALS 9

Effect of alloying elements on steel (Mn, Si, Cr, Mo, V, Ti & W) – stainless and tool steels – HSLA – maraging steels – Cast Irons – Grey, White malleable, spheroidal – Graphite, Alloy cast irons, Copper and Copper alloys – Brass, Bronze and Cupronickel – Aluminum and Al-Cu alloy – precipitation hardening – Bearing alloys

NON-METALLIC MATERIALS 9

Polymers – types of polymer, commodity and engineering polymers – Properties and applications of PE, PP, PS, PVC, PMMA, PET, PC, PA, ABS, PI, PAI, PPO, PPS, PEEK, PTFE Polymers – Urea and Phenol Formaldehydes – Engineering Ceramics – Introduction to Fibre reinforced plastics

Total Periods: 45

Text Books:

1. Khanna O.P., "A text book of Materials Science and Metallurgy", Khanna Publishers, (2013)
2. Kenneth G.Budinski and Michael K.Budinski "Engineering Materials", Prentice Hall of India Private Limited, (2012)

References:

1. William D Callister "Material Science and Engineering", John Wiley and Sons, (2010)
2. Raghavan V., "Materials Science and Engineering", Prentice Hall of India Pvt., Ltd., (2012)
3. Sydney H. Avner "Introduction to Physical Metallurgy" McGraw Hill Book Company, (2010)
4. Dieter, G. E., "Mechanical Metallurgy", McGraw Hill Book Company, (2013)

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2		2										2			
CO2	1			2			2						2			2
CO3	1			2			2						2			
CO4	2		1	1									2			1
CO5	2		3	1									2			2
CO6	2		3	1								2	2			2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161ME34	KINEMATICS OF MACHINERY	L-T-P	C
		3-2-0	4

Programme: B.E. Mechanical Engineering **Sem: 3 Category: PC**

Aim: To impart knowledge of motion characteristics of mechanisms and machines and to make the students to develop new mechanisms

Course Outcomes:

The students will be able to

CO1. Explain the concepts of machines, mechanisms and related terminologies
CO2. Recognize friction and its effects in mechanical components
CO3. Analyze planar mechanism for displacement, velocity and acceleration graphically
CO4. Examine various motion transmission elements like gears, gear trains, cams, belt drive and rope drive
CO5. Utilize analytical, mathematical and graphical aspects of kinematics of machines for effective design
CO6. Perform the kinematic analysis of a given cam mechanism

MECHANISMS AND MACHINES **12**

Definitions – Link, Kinematic pair, Kinematic chain, Mechanism, and Machine – Degree of Freedom – Mobility – Kutzbach criterion – Grashoff's law – Kinematic Inversions of four bar chain and slider crank chain – Mechanical Advantage – Transmission angle – quick return mechanisms, Toggle mechanism, Ratchets and pawl mechanisms – Indexing Mechanisms

KINEMATIC ANALYSIS **12**

Analysis of simple mechanisms – Graphical Methods for displacement, velocity and acceleration – Coriolis acceleration – Analytical method of analysis of slider crank mechanism and four bar mechanism – Approximate analytical expression for displacement, Pantograph, Straight line mechanism, approximate straight line motion mechanism, application of straight line motion in engine indicators, Steering gears, Hooke's joint

KINEMATICS OF CAMS **12**

Classifications – Displacement diagrams – Parabolic, Simple harmonic and Cycloidal motions – Graphical construction of displacement diagrams and layout of plate cam profiles – circular arc and tangent cams – Pressure angle and undercutting

GEARS AND GEAR TRAINS **12**

Classification of gears – Gear tooth terminology – Fundamental Law of toothed gearing and involute gearing – Length of path of contact and contact ratio – Interference and undercutting – Gear trains – Simple, compound and Epicyclic gear trains – Differentials

SYNTHESIS OF MECHANISM **12**

Number of synthesis – degrees of freedom of a planer kinematic chain – dimensional synthesis – mechanism for position guidance – computer aided analysis of mechanisms

Lecture: 45 Tutorial: 15 Total Periods: 60

Text Books:

1. Rattan S.S., "Theory of Machines", Tata McGraw-Hill, (2014)
2. Khurmi R.S., Gupta J.K., "Theory of Machines", Eurasia Publishing House, (2014)

References:

1. Norton R.L., "Kinematics and Dynamics of Machinery", Tata McGraw Hill, (2009)
2. Sadhu Singh, "Theory of Machines", Pearson Education, (2010)
3. Bansal R.K. Brar.J.S., "A Text Book of Theory of Machines", Lakshmi Publication, (2015)
4. Uicker (Jr) J.J., Pennock G.R. and Shigley J.E., "Theory of Machines and Mechanisms" Oxford International Student Edition, (2009)

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	2	3		1					1	3	2		2
CO2	3	3	2	1	2							2	2	3		1
CO3	2	2	3	2	1		1					1	2	2		1
CO4	3	2	2	1	1	1						2	3	2		2
CO5	3	1	2	2	2						1	2	2	3	1	1
CO6	2	3	2	2	2		2					1	3	2	1	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161ME35 ELECTRICAL DRIVES AND CONTROL L-T-P C
3-0-0 3

Programme: B.E. Mechanical Engineering **Sem: 3 Category: ES**

Aim: To provide sound knowledge in the basic concepts of electrical drives, their performance and control

Course Outcomes:

The students will be able to

CO1. Evaluate the basic concepts of electrical circuits and classify electrical machines
CO2. Identify suitable electrical drives for load requirements
CO3. Represent the mechanical characteristics of electrical drives
CO4. Select a starter for a particular electrical motor drive
CO5. Represent the braking characteristics of electrical drives
CO6. Analyze the conventional and solid state speed control methods of D.C. Drives
CO7. Investigate the conventional and solid state speed control methods of A.C. Drives

INTRODUCTION TO ELECTRICAL MACHINES 9

Ohm's Law – Kirchhoff's Laws – Introduction to D.C. and A.C. Circuits – Waveforms and RMS Value – Power and Power factor – Construction, Principle of Operation, Basic Equations and Applications of DC Generators, DC Motors, single phase and three phase induction Motor

ELECTRICAL DRIVES AND CHARACTERISTICS 9

Basic Elements – Types of Electric Drives – Factors are influencing the Choice of Electrical Drives – Heating and Cooling Curves – Loading Conditions and Classes of Duty – Load Equalization – Speed – Torque – Characteristics of various electrical drives

STARTING AND BRAKING METHODS FOR ELECTRICAL DRIVES 9

Types of Starters – Typical Control Circuits for Shunt and Series Motors, Three Phase Squirrel Cage and Slip Ring Induction Motors – Braking of Electrical Motors – D.C. Motors: Shunt, Series And Compound – Single Phase and Three Phase Induction Motors

SPEED CONTROL OF D.C. DRIVES 9

Speed Control of D.C. Series and Shunt Motors – Armature and Field Control, Ward – Leonard Control System – Using Controlled Rectifiers and D.C. Choppers – Applications

SPEED CONTROL OF A.C. DRIVES 9

Voltage Control, Voltage Frequency (V/f) Control and Slip Power Recovery Scheme – Using Inverters and A.C. Voltage Regulators – Applications

Total Periods: 45

Text Books:

1. Vedam Subrahmaniam, "Electric Drives (concepts and applications)", Tata McGraw- Hill, (2001)
2. Kothari D.P. and Nagrath I.J., "Basic Electrical Engineering", Tata McGraw Hill publishing company ltd, second edition, (2007)

References:

1. Pillai S.K., "A first course on Electric drives", Wiley Eastern Limited, (1998)
2. Singh M.D. and Khanchandani K.B., "Power Electronics", Tata McGraw-Hill, (1998)
3. Bhattacharya S.K., "Electrical Machines", Tata McGraw Hill Publishing company ltd., (2007)
4. Nagsarkar T.K. and Sukhija, "Basic Electrical Engineering", OUP India, (2011)

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	1	2	1							3	2		
CO2	2	2		2		2								1	2	3
CO3	2	2		2									2		2	
CO4	1	2				2										3
CO5	2	2	2			2							2		2	
CO6	2	2	3		1											2
CO7	2	2	3		1											2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161ME37 MANUFACTURING TECHNOLOGY LABORATORY L-T-P C
0-0-3 2

Programme: B.E. Mechanical Engineering **Sem: 3 Category: PC**

Aim: To understand the basic principles and working of various machine tools

Course Outcomes:

The students will be able to

CO1. Know the principle of Metal Cutting Process
CO2. Familiarize the working principle of Special Machine Tools
CO3. Introduce the various methods of Grinding
CO4. Learn the assembly of machined components for different fits
CO5. Discover the basic operation of Special purpose Lathe
CO6. Establish the various methods of Gear cutting process

LIST OF EXPERIMENTS

1. Measuring shear angle, cutting force and tool wear in metal cutting experiment
2. Exercises in Shaper machine – Round to square and dovetail
3. Exercise in Slotter machine – Internal keyway cutting
4. Exercise in Planner machine – Round to square
5. Exercises in Drilling machine – Drilling and Tapping
6. Exercise in Milling Machines – External keyway milling
7. Exercises in Grinding / Abrasive machining – Surface grinding and Cylindrical grinding
8. Exercises in Assembly of Machined Components for different fits in Lathe
9. Exercises in Capstan or Turret Lathes – Step turning and Drilling
10. Exercise in Gear Hobbing

Total Periods: 45

LIST OF EQUIPMENTS

(For a batch of 30 students)

1.	Centre Lathes	2 Nos.
2.	Turret and Capstan Lathes	1 No.
3.	Horizontal Milling Machine	1 No.
4.	Vertical Milling Machine	1 No.
5.	Surface Grinding Machine	1 No.
6.	Cylindrical Grinding Machine	1 No.
7.	Shaper	2 Nos.
8.	Slotter	1 No.
9.	Planner	1 No.
10.	Radial Drilling Machine	1 No.
11.	Tool Dynamometer	1 No.
12.	Gear hoping machine	1 No.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1			2	1		2			2				3
CO2	3	2	1			2	1		2			2				3
CO3	3	2	1			2	1		2			2				3
CO4	3	2	1			2	1		2			2				3
CO5	3	2	1			2	1		2			2				3
CO6	3	2	1			2	1		2			2				2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161ME38 ELECTRICAL ENGINEERING LABORATORY L-T-P C
0-0-3 2

Programme: B.E. Mechanical Engineering **Sem: 3 Category: ES**

Aim: To expose the students to the basic operations of electrical machines and help them to develop experimental skills

Course Outcomes:

The students will be able to

CO1. Model and analyze the performance of D.C. motor and their applications
CO2. Control the speed of D.C. shunt motor
CO3. Investigate the characteristics of D.C. shunt generator under no-load and loading condition
CO4. Design and analyze the performance of three phase induction motor
CO5. Model and analyze the performance of single phase induction motor and their applications
CO6. Control the speed of three phase induction motor
CO7. Investigate the braking characteristics of three phase induction motor
CO8. Select suitable A.C. and D.C. starter for domestic application

LIST OF EXPERIMENTS

1. Load Test on D.C. series motor
2. Load test on D.C. Shunt Motor
3. Load test on D.C. Compound Motor
4. Speed control of D.C. shunt motor
5. Open circuit and Load characteristics of separately excited generator
6. Open circuit and Load characteristics of self excited generator
7. Load test on three phase slip ring Induction motor
8. Load test on three phase squirrel cage Induction motor
9. Load test on single phase Induction motor
10. Speed control of three phase slip ring induction motor by variable frequency method
11. Braking of three phase induction motor
12. Study of Starters: for A.C. motors and D.C. motors

Total Periods: 45

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	2		2					2				2	3	3	3
CO2		2	3	2					2					2		3
CO3	2	2		2					2				2	3	3	
CO4	2	2		2					2				1	2	3	
CO5	1	2		2					2				1	2	3	
CO6		2	3	2					2					2		3
CO7	2	2		2					2				2	3	3	
CO8		2							2				2			

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161HS39	FUNCTIONAL ENGLISH – I	L-T-P	C
		0-0-2	-

Programme: Common to all branches **Sem** 3 **Category:** EEC

Aim: To create an Environment to improve learner's communication skill

Course Outcomes:

The students will be able to,

CO1. To impart basics of Language & Grammar relating to Business Communication
CO2. To develop learners ability to understand Technical communication
CO3. To widen learners ability to understand any kind of text
CO4. Learning the nuances of effective writing by using short and crisp sentences
CO5. Listen and comprehend talks and lectures on technical subjects
CO6. Describe a process both in speaking and writing

UNIT I **6**

GRAMMAR: Parts of Speech, Tense- simple present, perfect, continuous, present perfect continuous
READING: Reading different genres of text (literature, media and technical) for comprehension, Reading for making inferences, reading news bulletins and weather forecast, advertisements
WRITING: , Writing apology letters, Writing e-mail – difference between formal and informal mails, giving information, making an enquiry, answering, announcing a job opportunity, enquiry, confirming terms, informing about a new service
LISTENING: Telephone etiquette- types of calls, greetings, making and receiving a call, transferring information, making appointments and closing a call. Listening to telephonic conversation, listening to famous personalities' speech
SPEAKING: **Role play**- planning a training course, phoning a hotel, enquiring about a new job, launching a new product, negotiating a deal and interviewing someone about a change in job. **Just a minute**- describing a business trip, the importance of internal communication of the company, describing a product and how it is advertised

UNIT II **6**

GRAMMAR: Simple past, perfect, continuous, past perfect continuous
READING: Reading technical article and making notes, Reading a technical report for gist
WRITING: Making and taking notes, writing project introduction, Writing for giving assurance and Notice, Agenda and Minutes
LISTENING: Listening to documentaries, listening to interviews
SPEAKING: Small talks- introducing oneself, remembering one's childhood, describing one's positive and negative features, making comparisons, describing abilities and skills, making requests and seeking permissions

UNIT III **6**

GRAMMAR: Simple future, perfect, continuous, future perfect continuous. Voice. Conditional Clause
READING: Cloze test, Reading and answering questions, reading job advertisements, job interviews
WRITING: Memos, writing user manuals, product review
LISTENING: Listening to group discussion
SPEAKING: Expressing personal opinion about social issues

Total Periods: 18

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1		2			2				3	3	3	3				
CO2					2	2			3	3	3	3				2
CO3		2		2	2				3	3	3	3				
CO4					2				3	3	3	3				
CO5		2		3					3	3	3	3				
CO6					2	2			3	3	3	3				

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161MA42	STATISTICS AND NUMERICAL METHODS	L-T-P	C
		2-2-0	3

Programme: B.E. Mechanical Engineering **Sem:** 4 **Category:** BS

Aim: To achieve high accuracy, many separate operate operation must be carried out

Course Outcomes:

The students will be able to

CO1. Classify the tests for single variance and equality of variances
CO2. Explain Eigen values of a matrix by Power method
CO3. Discover Numerical integration using Trapezoidal and Simpson's 1/3 rules
CO4. Apply Newton's forward and backward difference interpolation
CO5. Solution of ODE by Numerical method
CO6. Boundary value problem by Numerical method

TESTING OF HYPOTHESIS **12**

Sampling distributions – Tests for single mean, Proportion, Difference of means (large and small samples) – Tests for single variance and equality of variances – chi-square test for goodness of fit – Independence of attributes

SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS **12**

Newton-Raphson method – Gauss Elimination method – Pivoting – Gauss-Jordan methods – Iterative methods of Gauss-Jacobi and Gauss-Seidel – Matrix Inversion by Gauss-Jordan method – Eigen values of a matrix by Power method

INTERPOLATION, NUMERICAL DIFFERENTIATION AND NUMERICAL INTERGRATION **12**

Lagrange's and Newton's divided difference interpolation – Newton's forward and backward difference interpolation – Approximation of derivatives using interpolation polynomials – Numerical integration using Trapezoidal and Simpson's 1/3 rules

NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS **12**

Taylor's series method – Euler's method – Modified Euler's method – Fourth order Runge-Kutta method for solving first and second order equations – Milne's predictor – corrector methods for solving first order equations – Finite difference methods for solving second order equation

BOUNDARY VALUE PROBLEMS OF ORDINARY DIFFERENTIAL EQUATIONS **12**

Finite difference methods for solving second order ordinary differential equation – Finite differences solution of one dimensional heat equation by explicit and implicit methods – One dimensional wave equation and two dimensional Laplace and Poisson equations

Lecture: 45 Tutorial: 15 Total Periods: 60

Text Books:

1. Johnson R.A. and Gupta C.B., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, (2007)
2. Grewal B.S. and Grewal J.S., "Numerical methods in Engineering and Science", Khanna Publishers, New Delhi, (2004)

References:

1. Walpole R.E., Myers R.H., Myers S.L., and KYe, "Probability and Statistics for Engineers and Scientists", Pearson Education, Asia, (2007)
2. Spiegel M.R., Schiller J., and Srinivasan R.A., "Schaum's Outlines Probability and Statistics", Tata McGraw Hill edition, (2004)
3. Chapra S.C. and Canale R.P., "Numerical Methods for Engineers", Tata McGraw-Hill, New Delhi, (2007)
4. Gerald C.F., and Wheatley P.O., "Applied Numerical Analysis", Pearson Education Asia, New Delhi, (2006)

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	1										1	2			2
CO2	2	2		2											1	
CO3	2	2		3								3		2		
CO4	1	1														2
CO5	3	2		3								1	2		2	
CO6	1	1		1										1		

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161ME41 FLUID MECHANICS AND MACHINERY L-T-P C
3-2-0 4

Programme: B.E. Mechanical Engineering **Sem: 4 Category: PC**

Aim: To understand the characteristics of fluids and working of hydraulic machines

Course Outcomes:

The students will be able to

CO1. List the various fluid properties and to apply control volume analysis to fluid mechanics problems

CO2. Apply the concepts of mass and momentum conservation and the Bernoulli equation to solve problems

CO3. Differentiate the various losses that occur in fluid flow through pipes and to estimate the head losses

CO4. Manipulate dimensional analysis for various fluid parameters and complex problems

CO5. Learn the principle and working and construct performance curves of various types of turbine

CO6. Describe the various types, principle and working of hydraulic pumps

BASIC CONCEPTS AND PROPERTIES 12

Units & Dimensions – Properties of fluids – Specific gravity, specific weight, viscosity, compressibility – capillarity and surface tension – Flow characteristics: concepts of system and control volume – Application of control volume to continuity equation – energy equation, momentum equation Pascal's law, measurement of pressure, manometers, Hydrostatic law

FLOW THROUGH PIPES 12

Laminar flow though circular conduits and circular annuli – Boundary layer concepts – Boundary layer thickness – Hydraulic and energy gradient – Darcy, Weisbach equation – Friction factor and Moody diagram –Minor losses – Flow through pipes in series and in parallel – loss of energy in pipes – Equivalent pipes

DIMENSIONAL ANALYSIS 12

Dimension and units – Buckingham's Π theorem – Discussion on dimensionless parameters – Models and similitude – Applications of dimensionless parameters

HYDRAULIC TURBINES 12

Force exerted on moving plate vanes – Definition and classifications – Pelton, Francis, Propeller and Kaplan turbine: Working principles – Velocity triangle – Work done – specific speed – efficiencies – Performance curve for turbines

HYDRAULIC PUMPS 12

Definition and classifications – Centrifugal and Reciprocating Pumps: Working principles – Indicator diagram – Specific speed – efficiency and performance curves – Cavitations in pumps

Lecture: 45 Tutorial: 15 Total Periods: 60

Text Books:

1. Bansal R.K., "A text book of Fluid Mechanics and Hydraulics Machines", Laxmi Publication, India, (2015)
2. Rajput R.K., "Fluid Mechanics and Hydraulic Machines", S.Chand & Company Ltd., New Delhi, (2013)

References:

1. Modi P.N., & Seth S.M., "Hydraulics and Fluid Mechanics including Hydraulic Machines", Standard book house, (2012)
2. Kumar K.L., "Engineering Fluid Mechanics", S.Chand Publishing (P) Ltd., New Delhi, (2014)
3. Streeter V. L., and Wylie E.B., "Fluid Mechanics", McGraw Hill, (2008)
4. White F.M., "Fluid Mechanics", Tata McGraw-Hill, New Delhi, (2010)

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3		2	1					1		2	3	2		2
CO2	2	2		2	2					1		2	2	2		2
CO3	2	2		2	1					1		2	3	1		2
CO4	2	2		2	2					1		2	2	1		2
CO5	2	2		2	1					1	2	2	3	2		2
CO6	3	3		2	2					1	1	1	3	2		2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161ME42 **ENGINEERING METROLOGY AND MEASUREMENTS** **L-T-P** **C**

3-0-0 **3**

Programme: B.E. Mechanical Engineering **Sem:** 4 **Category:** PC

Aim: To understand the principles, methods and applications of measurements

Course Outcomes:

The students will be able to

CO1. Understand the basic concepts of measurements
CO2. Classify various linear, angular measuring equipments
CO3. Compare the working principles of various form measuring equipments
CO4. Explain the applications of laser in measurements
CO5. Describe the uses of coordinate measuring instruments and computer aided inspection
CO6. Analyze the methods of measuring power, torque, flow and temperature

CONCEPT OF MEASUREMENT **9**

General concept – generalized measurement system – units and standards – measuring instruments – sensitivity, stability, range, accuracy and precision – static and dynamic response – repeatability – systematic and random errors – correction, calibration – Introduction to Dimensional and Geometric Tolerance – interchangeability

LINEAR AND ANGULAR MEASUREMENT **9**

Definition of metrology – Linear measuring instruments – Vernier caliper, micrometer, Slip gauges and classification – Tool Makers Microscope – interferometry – optical flats – Comparators – limit gauges – Mechanical, pneumatic and electrical comparators, applications – Angular measurements – Sine bar, Sine center, bevel protractor and Angle Dekkor

FORM MEASUREMENT **9**

Measurement of screw threads – Thread gauges, floating carriage micrometer – measurement of gear tooth thickness – constant chord and base tangent method – Gleason gear testing machine – radius measurements – surface finish – equipment and parameters, straightness, flatness and roundness measurements

LASER AND ADVANCES IN METROLOGY **9**

Precision instruments based on laser – Principles – laser interferometer – application in measurements and machine tool metrology – Coordinate measuring machine – need, construction, types, applications – Computer aided inspection

MEASUREMENT OF MECHANICAL PARAMETERS **9**

Force, torque, power – Mechanical, pneumatic, hydraulic and electrical type – Pressure measurement – Flow – Venturimeter, orifice, rotameter, pitot tube – Temperature – bimetallic strip, thermocouples, pyrometer, electrical resistance thermometers and thermistor

Total Periods: 45

Text Books:

1. Jain R.K., “Engineering Metrology”, Khanna Publishers, (2012)
2. Gupta S.C, “Engineering Metrology”, Dhanpat rai Publications, (2013)

References:

1. Beckwith, Marangoni, Lienhard, “Mechanical Measurements”, Pearson Education, (2010)
2. Bewoor A.K. and Kulkarni V.A., “Metrology and Measurements”, Tata McGraw-Hill, (2009)
3. Jayal A.K., “Instrumentation and Mechanical Measurements”, Galgotia Publications, (2011)
4. Alan S. Morris, “The Essence of Measurement”, Prentice Hall of India, (2007)

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3												3			
CO2	2	1	3		2				1			1	3		1	1
CO3	2								1				3			1
CO4	1								1			1	2			
CO5	1								1			1	2			
CO6	2	1		2	2				1				3		2	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161ME43 MECHANICS OF MATERIALS L-T-P C
3-2-0 4

Programme: B.E. Mechanical Engineering **Sem: 4 Category: PC**

Aim: To understand the stresses developed in bars, compounds bars, beams, shafts, cylinders and spheres

Course Outcomes:

The students will be able to

CO1. Understand the basic concept of various stress, strains and elastic constant
CO2. Draw the SFD & BMD different beams with various types of applied loads
CO3. Calculate the torsion stress and deflections on the springs
CO4. Recognize the deflection of beam when the stress is acted
CO5. Analyze the stress on columns, thin cylinders and spherical shells
CO6. Know the application of theories of failure

STRESS, STRAIN AND DEFORMATION OF SOLIDS 12

Rigid bodies and deformable solids – Tension, Compression and Shear Stresses – Deformation of simple and compound bars – Thermal stresses – Elastic constants – Volumetric strains – Stresses on inclined planes – principal stresses and principal planes – Mohr's circle of stress

TRANSVERSE LOADING ON BEAMS AND STRESSES IN BEAM 12

Beams – types transverse loading on beams – Shear force and bending moment in beams – Cantilevers – Simply supported beams and over – hanging beams. Theory of simple bending – bending stress distribution – Load carrying capacity – Proportioning of sections – Flitched beams – Shear stress distribution

TORSION 12

Torsion formulation stresses and deformation in circular and hollows shafts – Stepped shafts – Deflection in shafts fixed at the both ends – Stresses in helical springs – Deflection of helical springs, carriage springs

DEFLECTION OF BEAMS 12

Double Integration method – Macaulay's method – Area moment Theorems for computation of slopes and deflections in beams - Conjugate beam and strain energy – Maxwell's reciprocal theorems

COLUMNS, THIN CYLINDERS AND SPHERES 12

Columns – End conditions – Equivalent length of a column – Euler equation – Slenderness ratio – Rankine formula for columns. Stresses in thin cylindrical shell due to internal pressure circumferential and longitudinal stresses and deformation in thin cylinders – spherical shells subjected to internal pressure – Deformation in spherical shells – Lame's theory – Application of theories of failure

Lecture: 45 Tutorial: 15 Total Periods: 60

Text Books:

1. Ramamrutham S., "Strength of Materials", Dhanpatrai Publishing company, (2012)
2. Bansal R.K., "A Text book of strength of material", Laxmi publication, New Delhi, (2014)

References:

1. Popov E.P., "Engineering Mechanics of Solids", Prentice-Hall of India, New Delhi, (2010)
2. Beer F.P. and Johnston R., "Mechanics of Materials", McGraw-Hill Book Co, (2012)
3. Timoshenko Gere, "Mechanics of Materials", D.Van Nostrand company , New York, (2009)
4. Don H. Morris, William F. Riley and Leroy D. Sturges, "Mechanics of Materials", John Wiley and Sons Inc., (2008)

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	2								2	3	2		1
CO2	3	2	1	2								2	3	2		1
CO3	3	2	1	2			2					2	3	2		1
CO4	3	1	2	1								2	3	2		1
CO5	3	1	2	1								2	3	2		1
CO6	3	1	2	1			2					2	3	2		1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161ME44 MODERN MACHINING PROCESSES L-T-P C
3-0-0 3

Programme: B.E. Mechanical Engineering **Sem: 4 Category: PC**

Aim: To understand the various unconventional machining processes, advantages and applications

Course Outcomes:

The students will be able to

CO1. Classify unconventional machining process and identify various process selection parameters
CO2. Learn various mechanical energy based process
CO3. Understand the various unconventional machining process based on electrical energy
CO4. Study the various chemical energy machining process, parameters affecting it and applications
CO5. Know the machining process that fall under electro chemical energy, its parameters and applications
CO6. Explain the various thermal energy based machining processes in detail along with their applications

MECHANICAL ENERGY BASED PROCESSES 9

Unconventional machining Process – Need – classification – Brief overview – Abrasive Jet Machining – Water Jet Machining – Abrasive Water Jet Machining – Ultrasonic Machining (AJM, WJM, AWJM and USM) – Working Principles – equipment used – Process parameters – MRR – Variation in techniques used – Applications

ELECTRICAL ENERGY BASED PROCESSES 9

Electric Discharge Machining (EDM) – working Principle – equipment's – Process Parameters – Surface Finish and MRR – electrode / Tool – Power and control Circuits – Tool Wear – Dielectric – Flushing – Wire cut EDM – Applications

CHEMICAL ENERGY BASED PROCESSES 9

Chemical machining and Electro-Chemical machining (CHM and ECM) – Etchants – maskants – techniques of applying maskants – Process Parameters – Surface finish and MRR – Applications

ELECTRO-CHEMICAL ENERGY BASED PROCESSES 9

Principles of ECM – equipments – Surface Roughness and MRR – Electrical circuit – Process Parameters – ECG and ECH – Applications

THERMAL ENERGY BASED PROCESSES 9

Laser Beam machining and drilling (LBM), plasma Arc machining (PAM) and Electron Beam Machining (EBM) – Principles – Equipment –Types – Beam control techniques – Applications

Total Periods: 45

Text Books:

1. Vijay K. Jain, "Advanced Machining Processes", Allied Publishers Pvt. Ltd., New Delhi, (2014)
2. Mishra P.K., "Non-Conventional Machining", The Institution of Engineers, India, (2015)

References:

1. Benedict G.F., "Nontraditional Manufacturing Processes", Marcel Dekker Inc., New York, (2014)
2. Pandey P.C. and Shan H.S., "Modern Machining Processes", Tata McGraw-Hill, New Delhi (2015)
3. Mc Geough, "Advanced Methods of Machining", Chapman and Hall, London, (2010)
4. Paul De Garmo, Black J.T. and Ronald A. Kohser., "Material and Processes in Manufacturing", Prentice Hall of India Pvt. Ltd., New Delhi, (2012)

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3			1				1	1		3	1	1		3
CO2	3	2	2	2	1		2	1	1	1		2	2	2		3
CO3	3	2	1	1	1		1	2	1	1		2	2	1		3
CO4	3	2	1	1	1		1	2	1	1		2	2	2		3
CO5	3	2	1	1	1		1	2	1	1		2	2	2		3
CO6	3	2	1	1	1		1	3	1	1		2	2	2		3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161ME45	ELECTRONICS ENGINEERING	L-T-P	C
		3-0-0	3

Programme: B.E. Mechanical Engineering **Sem:** 4 **Category:** ES

Aim: To instruct the importance of electronics and its utilization for developing applications in Mechanical Engineering

Course Outcomes:

The students will be able to

CO1: Understand the characteristics and applications of different types of diodes.
CO2: Analyze the BJT, FET and MOSFET devices in different configuration and their uses as Amplifiers.
CO3: Estimate the characteristics of thyristor family and its application to the Industry.
CO4: Implement of Boolean functions using logic gates.
CO5: Use the Flip-flops for applications
CO6: Develop programming for the applications using Microcontrollers

DIODES **9**

PN Junction Diode – approximations, characteristics – Half wave, Full wave and Bridge Rectifiers, Zener Diode – Characteristics – Voltage Regulation, DC Power Supply, Diode rating, Varactor diode, Schottky Diode, LED

TRANSISTORS **9**

Bipolar junction transistor (BJT) – CE, CC configuration and characteristics – Fixed Biasing and Self Biasing of CE – Stability – Gain, Field effect transistor (FET) – configuration and characteristics of FET amplifier, MOSFET Types and characterizes, MOSFET Amplifier

THYRISTORS **9**

Four layer Diode operation, , SCR, Diac, Triac – Characteristics, phase control, simple applications – temperature and motor speed control, UJT and PUT- Characteristics - application

DIGITAL ELECTRONICS **9**

Binary number system – addition and subtraction, Hexadecimal, Logic Gates – Truth Table – Logic Equation, Boolean Algebra – DeMorgan's Law, Flip flops – RS, JK & D, Half and Full adders, Counters – Shift Registers, D/A and A/D conversion (R-2R, Flash, Successive approximation)

MICROCONTROLLER **9**

8051 Microcontroller hardware – input/output pins, ports, Counters and Timers – Serial data transmission modes – Interrupts – Addressing modes – Instruction set, simple programming – arithmetic and logical operations- Traffic light controller- Stepper motor controller

Total Periods: 45

Text Books:

1. Albert Malvino and David Bates, "Electronic Principles", McGraw Hill, (2015)
2. Kenneth J Ayala, "The 8051 Microcontroller Architecture, Programming and Applications", Thomson / Delmar Learning, (2013)

References:

1. Malvino and Leach, "Digital Principles and Applications", Tata McGraw-Hill, (1996)
2. Mehta V.K, "Principles of Electronics", S. Chand and Company Ltd., (2005)
3. Dougles V.Hall, "Microprocessor and Interfacing", Programming and Hardware, Tata McGraw-Hill, (1999)
4. Salivahanan S, Suresh Kumar N, Vallavaraj A, "Electronic Devices and Circuits", Tata McGraw-Hill, (2003)

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	3	2							1				
CO2	3	2	3	3	2							1				
CO3	3	2	2	2	1							1	1			1
CO4	3	3	3	3	2							1		1		
CO5	3	2	2	2	3	2						1		2	1	1
CO6	2	2	2	1	2	2						2		2	1	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161ME47	MATERIAL TESTING AND FLUID MECHANICS LABORATORY	L-T-P	C
		0-0-3	2

Programme: B.E. Mechanical Engineering **Sem:** 4 **Category:** PC

Aim: To impart knowledge of motion characteristics of mechanisms and machines and to make the students to develop new mechanisms

Course Outcomes:

The students will be able to

CO1. Justify the behavior of structural elements, such as bars, beams and columns subjected to tension, compression, shear, bending, and torsion by means of experiments.
CO2. Represent the concepts of hardening and determine the hardness of the material
CO3. Identify with the tension and compression test on springs
CO4. Predict the pressure loss due to friction and minor losses in pipe flow
CO5. Perform the operations and plot the characteristics curves of various pumps
CO6. Do experiments in various turbines

LIST OF EXPERIMENTS – Material Testing

1. Tension test on a mild steel rod
2. Torsion test on mild steel rod
3. Impact test on metal specimen
4. Hardness test on metals – Brinell and Rockwell Hardness Number
5. Deflection test on helical springs
6. Deflection test on beams

LIST OF EXPERIMENTS – Fluid Mechanics

1. Determination of the Coefficient of discharge of given Venturimeter
2. Determination of friction factor for a given set of pipes
3. Performance test on centrifugal pump
4. Performance test on reciprocating pump
5. Performance test on Pelton wheel
6. Performance test on Francis turbine
7. Performance test on Kaplan turbine

LIST OF EQUIPMENTS – Material Testing
(For a batch of 30 students)

1. Universal Tensile Testing machine with double shear attachment – 40 Ton Capacity
2. Torsion Testing Machine (60 N/M Capacity)
3. Impact Testing Machine (300 J Capacity)
4. Brinell Hardness Testing Machine
5. Rockwell Hardness Testing Machine
6. Spring Testing Machine for tensile and compressive loads (2500 N)
7. Metallurgical Microscopes
8. Muffle Furnace (800^0C)

LIST OF EQUIPMENTS – Fluid Mechanics
(For a batch of 30 students)

1. Orifice meter and Venturimeter setup
2. Pipe Flow analysis setup
3. Centrifugal pump/submergible pump setup
4. Reciprocating pump setup
5. Pelton wheel setup
6. Francis turbine setup
7. Kaplan turbine setup

Total Periods: 45

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2		3						2	1	2	3	2		2
CO2	3	2		3						2	1	2	3	2		2
CO3	3	2		3						2		2	3	2		3
CO4	3	2		3						2	1	2	3	2		2
CO5	3	2		3						2	1	2	3	2		2
CO6	3	2		3						2	1	2	3	2		2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161ME48	METROLOGY AND MEASUREMENTS LABORATORY	L-T-P	C
		0-0-3	2

Programme: B.E. Mechanical Engineering **Sem:** 4 **Category:** PC

Aim: To learn the methods of handling different measuring instruments

Course Outcomes:

The students will be able to

CO1. Calibrate linear and angular measurement instruments
CO2. Check straightness, flatness using dial gauge
CO3. Measure screw and gear parameters
CO4. Handle vibration and displacement measuring instrument
CO5. Use the force and torque measuring tools
CO6. Learn different temperature measuring techniques

LIST OF EXPERIMENTS

1. Calibration of Vernier / Micrometer / Dial Gauge
2. Measurements using linear measurement tools/Vernier/Inside Micrometer/Depth gauge/Height Gauge (Checking Dimensions of part using slip gauges)
3. Measurements of Gear Tooth dimensions
4. Measurement of Angle using sine bar / sine center / tool makers microscope
5. Measurement of straightness and flatness
6. Measurement of thread parameters
7. Setting up of comparators for inspection (Mechanical / Pneumatic / Electrical)
8. Measurement of Temperature using Thermocouple / Pyrometer
9. Measurement of Displacement
10. Measurement of Force Measurement of Torque Measurement of Vibration / Shock

Total Periods: 45

LIST OF EQUIPMENTS
(For a batch of 30 students)

1.	Micrometer	5 Nos.
2.	Vernier Caliper	5 Nos.
3.	Vernier Height Gauge	2 Nos.
4.	Vernier Depth Gauge	2 Nos.
5.	Slip Gauge Set	1 No.
6.	Gear Tooth Vernier	1 No.
7.	Sine Bar	2 Nos.
8.	Bevel Protractor	1 No.
9.	Floating Carriage Micrometer	1 No.
10.	Profile Projector	1 No.
11.	Mechanical Comparator	1 No.
12.	Temperature Measuring Setup	1 No.
13.	Displacement Measuring Setup	1 No.
14.	Force Measuring Setup	1 No.
15.	Torque Measuring Setup	1 No.
16.	Vibration / Shock Measuring Setup	1 No.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3				1				2				3			
CO2	3	3							2				3		1	
CO3	3	2			1				3							
CO4	3	2			2				3							1
CO5	3	3							3				1	2	1	
CO6	3	3							3				3		1	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161HS49 **FUNCTIONAL ENGLISH – II** **L-T-P** **C**
0-0-2 **-**

Programme: Common to all branches **Sem: 4** **Category: EEC**

Aim: To Create an Environment to experiment communication skills with Intermediate resources

Course Outcomes:

The students will be able to,

CO1. To gain the spirit of accurate and appropriate Basic communication
CO2. Application of the different forms of advanced grammar
CO3. Recollect words and their meaning for the specific purpose
CO4. To develop students' accuracy in Written Communication
CO5. To improve Communication Skills in formal and informal situations
CO6. Sum up the key points

UNIT I **6**

GRAMMAR: Concord and Sentence structure
READING: Reading a passage and finding an error, reading charts, tables, graphs and making inference
WRITING: Creative writing-paragraph and essay writing, writing memo
LISTENING: Listening to short conversation, instructions and directions
SPEAKING: Describing- what I enjoy about my studies, describing about the history of a company, describing various designations in the company, describing a product and how it is advertised, describing the selection process of a company

UNIT II **6**

GRAMMAR: If clause
READING: Reading leaflet and pamphlets, reading for gathering information
WRITING: Writing report, proposals
LISTENING: Listening to lectures and ted talks
SPEAKING: Mini presentation on technical topics- English for presentations- Difference between lecture speech and presentation- what makes a good presentation-planning, purpose, audience, gathering information, using av materials, gestures, and interaction ability

UNIT III **6**

GRAMMAR: Reported speech
READING: Reading and interpreting visual material, reading online content and reading technical reports
WRITING: Writing product review, writing instructions and recommendations
LISTENING: Listening to technical presentation, speeches and interviews
SPEAKING: Group discussion, general interaction

Total Periods: 18

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1		2	2		2				3	3	3	3				
CO2	3										3	3				
CO3	2	2		2								3				
CO4										3		3				2
CO5									3	3	3	3				2
CO6									3	3	3	3				

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161ME51	CAD/CAM/CAE	L-T-P	C
		3-0-0	3

Programme: B.E. Mechanical Engineering **Sem:** 5 **Category:** PC

Aim: To introduce new and exciting field of Intelligent CAD/CAM/CAE with particular focus on engineering product design and manufacturing

Course Outcomes:

The students will be able to

CO1. Identify proper computer graphics techniques for geometric modeling
CO2. Transform, manipulate objects, store and exchange data
CO3. Write C program for production of drawings
CO4. Explore AI techniques to implement in manufacturing systems
CO5. Prepare part programming applicable to CNC machines
CO6. Interpret results of CAE modeling and transfer it into industrial processes

COMPUTER GRAPHICS AND TECHNIQUES **9**

Origin of computer graphics – interactive graphics display – display devices – pixels – Output primitives – algorithms for line and circle – Bresenham's algorithm – Bezier curves, Cubic Spline curve, B-Spline curve – Volume modeling – Boundary models – Constructive solid geometry (CSG) – Boundary Representation (B-Rep) – Hidden line removal & hidden surface removal algorithm – Graphical User Interface

TRANSFORMATION & DATA EXCHANGE **9**

2D & 3D Transformations – Translation, Rotation and Scaling – Matrix representation, Problems & object oriented programming on Transformations – Object transformation, mirror transformation – Clipping transformation – Graphics and computing standards – Open GL Data Exchange standards – bitmaps – IGES,STEP,CALS,DXF,STL etc., – Communication standards – LAN,WAN – writing interactive programs to solve design problems and production of drawings – using any languages like AutoLISP/C etc.,

INTELLIGENT AND SUSTAINABLE MANUFACTURING SYSTEMS **9**

Basic concepts of Artificial intelligence and expert systems – System Components – System architecture and Data flow – System Operations – Intelligent systems for project management & factory monitoring – Intelligent system Scheduling in manufacturing – Intelligent process planning system. Intelligent system for equipment selection – Concepts of sustainability and sustainable development – Concept Models and Various Approaches, Product Sustainability and Risk/Benefit assessment – Corporate Social Responsibility – Design for Environment, R3 and R6 cycles – ISO 14001 EMS and PAS 2050 standards

NC & CNC TECHNOLOGY **9**

Numerical Control (NC) – design considerations of NC machine tools – functions of MCU – NC programming with interactive graphics – Constructional details of CNC machines – Feedback devices – interpolators – tooling for CNC – point-to-point and contouring systems – CNC programming – APT programming – programming for CNC turning center, machining center and CNC EDM – DNC – Adaptive Control – Automated Material Handling & storage Systems like Robots, AGVs and AS/RS etc.,

COMPUTER AIDED ENGINEERING **9**

Fundamentals of computer aided engineering – CAE fields and phases – CAE includes mass property calculations, kinematic analysis and animation (movement, visualization, simulation and FEA) – need of numerical simulation of manufacturing processes Basics of Finite Element Method (FEM) – CAE in the automotive industry – The future of CAE in the product development process – Analysis and transfer of modeling and simulation results into industrial processes – Case study based on modeling and analysis of structural, thermal/fluid and dynamic system

Total Periods: 45

Text Books:

1. Donald Hearn and M. Pauline Baker, "Computer Graphics", Eastern Economy Edition, (2012)
2. Michael P. Groover & Emory W. Zimmers, "CAD/CAM: Computer-Aided Design and Manufacturing", Prentice Hall Publication, (2008)

References:

1. Ibrahim Zeid, Sivasubramanian R, "CAD/CAM Theory & Practice", Tata McGraw Hill Publications, (2009)
2. Andrew Kussiak, "Intelligent Manufacturing Systems", Prentice Hall, (2009)

3. Peter P. Rogers, Kazi F. Jalal and John A. Boyd, “An Introduction to Sustainable Development”, Earthscan, (2012)
4. Krar S. and Gill A., “CNC Technology and Programming”, McGraw Hill, (2010)

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1				2	1	2			2	2	3		3	3	3
CO2	1				3	2	2			2		3		3	2	3
CO3					3	2	2			2		3		3	2	3
CO4					3	2	2			3		3		3	2	3
CO5	2			1	3	2	3			3		3		3	2	3
CO6		3	3	2	2	2	2			2		3		3	1	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161ME52	DYNAMICS OF MACHINERY	L-T-P	C
		3-2-0	4

Programme: B.E. Mechanical Engineering **Sem: 5 Category: PC**

Aim: To understand the method of static and dynamic force analysis of mechanisms and to study the undesirable effects of unbalances in rotors, engines and the principles of governors and gyroscopes.

Course Outcomes:

The students will be able to

CO1. Understand the method of static force analysis and dynamic force analysis of mechanisms
CO2. Know the undesirable effects of unbalances in rotors and engines
CO3. Interpret the concept and basics of free vibratory systems and their analysis
CO4. Recognize the whirling and critical speed of shafts
CO5. Examine the forced vibratory systems and their analysis
CO6. Analyze the principles of governors, gyroscopes and vibration sensor

FORCE ANALYSIS AND FLYWHEELS **12**

Static force analysis – D'Alemberts principle – Inertia force and Inertia torque – Dynamic force analysis – Dynamic Analysis in Reciprocating Engines – Gas Forces – Equivalent masses – Bearing loads – Crank shaft Torque – Engine shaking Forces – Turning moment diagrams – Flywheels of engines and punch press

BALANCING **12**

Static and dynamic balancing – Balancing of rotating masses – Balancing a single cylinder Engine – Primary and secondary unbalanced forces – Balancing Multi – cylinder Engines – Firing order

SINGLE DEGREE OF FREEDOM SYSTEMS – FREE VIBRATION **12**

Basic features of vibratory systems – Basic elements and lumping of parameters – Degrees of freedom – Single degree of freedom – Free vibration – Formulation of equations of motion – natural frequency – Types of Damping – Damped free vibration – Whirling of shafts and critical speed – Torsional systems – Natural frequency of two and three rotor systems

SINGLE DEGREE OF FREEDOM SYSTEMS - FORCED VIBRATION **12**

Response to periodic forcing – Harmonic Forcing – Forced vibration – damping ratio – logarithmic decrement – Support motion – Force transmissibility and amplitude transmissibility – Vibration isolation, Vibration sensors

MECHANISMS FOR CONTROL **12**

Governors – Types – Centrifugal governors – Gravity controlled and spring controlled centrifugal governors – Characteristics – Effect of friction – Controlling Force – Quality of governors – hunting – Gyroscopes – Gyroscopic couple – Gyroscopic stabilization – Gyroscopic effects in Automobiles, aircrafts and ships

Lecture: 45 Tutorial: 15 Total Periods: 60

Text Books:

1. Khurmi R.K., Gupta J.K., "Theory of Machines", Eurasia Publishing House, New Delhi, (2014)
2. Rattan S.S., "Theory of Machines", McGraw Hill, (2014)

References:

1. Thomas Bevan, "Theory of Machines", CBS Publishers and Distributors, (2005)
2. Shigley J.E., and Uicker J.J., "Theory of Machines and Mechanisms", McGraw-Hill, (2009)
3. Rao J.S. and Dukkipati R.V., "Mechanism and Machine Theory", Wiley-Eastern Limited, New Delhi, (2015)
4. Singh V.P., "Theory of Machines", Dhanpat Rai Publishing Company (P) Limited, (2010)

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3											2			
CO2	3	3						3						3		
CO3	3		2												2	
CO4	3			2										2		
CO5	3							3								2
CO6	3	3	2			3								2		

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161ME53 MACHINE DESIGN & DRAWING L-T-P C
3-0-2 4

Programme: B.E. Mechanical Engineering **Sem: 5 Category: PC**

Aim: To study the design principles and procedures of Machine Elements

Course Outcomes:

The students will be able to

CO1. Select suitable materials and evaluate the failure of machine elements
CO2. Investigate the strength of shafts & coupling
CO3. Design screw jack with suitable thread
CO4. Choose the temporary and permanent joints depends on application
CO5. Design suitable spring for automobile applications
CO6. Implement the bearing design in their project work

STEADY AND VARIABLE STRESSES IN MACHINE PARTS 12

Introduction to design process – Selection of materials – Fits and tolerances – Direct, Bending and torsional stress equations – Application of Principal stresses in designing machine members – Factor of safety – Theories of failure – Stress concentration due to holes and notches – Gerber, Goodman & Soderberg relations

****Manual Drawing:** Tolerance zone, Types of fits & Stress concentration

SHAFTS AND COUPLINGS 12

Design of solid shafts based on strength, rigidity and critical speed – Design of keys – Design of rigid & flexible couplings – Applications

****Manual Drawing:** Flange Coupling & Bushed pin type coupling

POWER SCREWS AND LEVERS 12

Introduction of screw threads in power screws – Types of threads – Overhauling, Self-locking screws – Design of screw jack – Introduction of levers – Design of a lever – Hand levers, foot levers, safety valve levers & rocker arm – Applications

****Manual Drawing:** Screw Jack & Rocker arm for exhaust valve

TEMPORARY AND PERMANENT JOINTS 12

Design of Knuckle joint – Design of socket and spigot joint, sleeve and cotter joint – Design of pipe – Applications – Design of welded joints, Welding symbols – Applications – Design of riveted joints, Types of rivet heads – Applications

****Manual Drawing:** Knuckle joint & Pipe joints

SPRINGS AND BEARINGS 12

Design of helical springs – compression & tension springs – Leaf spring – Belleville spring – Applications – Sliding contact bearings – Design of hydrodynamic bearings – McKee's Equation, Sommerfield Number – Selection of lubrication – Rolling contact bearings – Life of bearings – Selection of Rolling Contact bearings – Applications

****Manual Drawing:** Leaf spring & Bearings

Lecture: 45 Practice: 15 Total Periods: 60

Text Books:

1. Khurmi R.K. and Gupta J.K., "A Textbook of Machine Design", Eurasia Publishing House, (2014)
2. Jain R.K., "Machine Design", Khanna Publishers, (2014)

References:

1. Bhandari V.B., "Design of Machine Elements", Tata McGraw-Hill Book Co, (2016)
2. Sadhu Singh, "Machine Design", JBA Publishers, (2015)
3. Kulkarni S.G., "Machine Design", McGraw-Hill Book Co., (2008)
4. Joseph E. Shigley and Charles R. Mischke, "Mechanical Engineering Design", Tata McGraw Hill Book Co., (2010)

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3	3		2	2			2		3	2	3		2
CO2	3	3	3			2				2		3	2	3	2	3
CO3	3	3	3			2				2		3	3	3	2	3
CO4	3	3	3			2				2		3	3	1	2	3
CO5	3	3	3			2				2		3	3	3	2	3
CO6	3	2	3			2	2	1	3	3	2	3	3	3	2	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161ME54	THERMAL ENGINEERING	L-T-P	C
		2-2-0	3

Programme: B.E. Mechanical Engineering **Sem:** 5 **Category:** PC

Aim: To acquire the basic knowledge, and thermodynamic concept into various thermal applications

Course Outcomes:

The students will be able to

CO1. Describe the classification of air standard efficiency
CO2. Know the concepts of PV diagram of four stroke and two stroke engines
CO3. Examine about the performance calculation of petrol and diesel engine
CO4. Analyze the flow of steam through nozzles and to draw the velocity diagram
CO5. Calculate the isentropic efficiency of multistage compressor
CO6. Demonstrate the principle and practice of thermal comfort and alternate refrigerants

GAS POWER CYCLES **9**

Air standard cycles – Otto, Diesel, Dual and Brayton cycles – air-standard efficiency – mean effective pressure – P-V and T-s diagrams – Actual cycles

INTERNAL COMBUSTION ENGINES **9**

Classification – Components and their function – working principle of 2 stroke and 4 stroke cycle – I.C Engine – valve and port timing diagrams – Comparison of two stroke and four stroke engines – Carburetor system, Diesel pump and injector system – Comparison of petrol and diesel engine – Lubrication system and Cooling system – Battery and Magneto Ignition System – Performance calculation

STEAM NOZZLES AND TURBINES **9**

Flow of steam through nozzles, shapes of nozzles, effect of friction, critical pressure ratio, supersaturated flow, Impulse and Reaction principles, compounding, velocity diagram for simple and multi-stage turbines, speed regulations – Governors

AIR COMPRESSOR **9**

Classification and working principle of various types of compressors, work of compression with and without clearance, Volumetric efficiency, Isothermal efficiency and Isentropic efficiency of reciprocating compressors, Multistage air compressor and inter cooling – work of multistage air compressor – Operating principle of rotary compressor

REFRIGERATION AND AIR CONDITIONING **9**

Vapour compression refrigeration cycle – super heat, sub cooling – Performance calculations – working principle of vapour absorption system – Comparison between vapour compression and absorption systems – Air conditioning system: Types, Working Principles – Psychometry, Psychometric chart – Cooling Load calculations

Total Periods: 45

Text Books:

1. Rajput R.K., "Thermal Engineering", S.Chand Publication, (2014)
2. Khurmi R.S. & Gupta J.K., "Refrigeration and Air Conditioning", S.Chand Publication, (2006)

References:

1. Ballaney P.L, "Thermal Engineering", Khanna Publishers, (2010)
2. Arora C.P, "Refrigeration and Air Conditioning", Tata McGraw-Hill Publishers, (2012)
3. Sarkar B.K., "Thermal Engineering", McGraw Hill Publication, (2001)
4. Rudramoorthy R., "Thermal Engineering", Tata McGraw-Hill, New Delhi, (2009)

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2										3	2			
CO2		2	3	3								3		3		
CO3			3		2							1				2
CO4		3		1	2							3		3		
CO5		3	2									1			2	
CO6				1	2							3				3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161ME55	AUTOMOBILE ENGINEERING	L-T-P	C
		3-0-0	3

Programme: B.E. Mechanical Engineering **Sem: 5 Category: PC**

Aim: To understand the construction and working principle of various parts of an automobile and practice assembling and dismantling of engine parts and transmission system

Course Outcomes:

The students will be able to

CO1. Describe vehicle construction, chassis, frame, body and engine components
CO2. Classify the various types of fuels used in automobiles
CO3. Identify the method of controlling pollution
CO4. Describe the transmission systems, wheels and tyre
CO5. Demonstrate the concepts of steering, braking and suspension systems
CO6. Explain electronically controlled gasoline, diesel injection systems and other electrical circuits used in automobiles

VEHICLE STRUCTURE AND ENGINE COMPONENTS 9

Types of automobiles, Vehicle construction and different layouts, Chassis, Frame and Body, Resistances to vehicle motion, Components of Engine – their forms, functions and materials, Flywheel –needs, Carburetor – Simple carburetor & Solex carburetor, Super chargers & Turbo chargers

ENERGY SOURCES 9

Important qualities of fuel, Rating of fuels, Properties – conventional fuels, Alternative fuels – Compressed Natural Gas, Liquefied Petroleum Gas, Alcohols, Bio-diesel and Hydrogen, Engine emission control by three way catalytic converter system, Electric and Hybrid Vehicles, Fuel Cell

TRANSMISSION SYSTEM, WHEELS AND TYRES 9

Clutch – types and construction, Need for a gearbox, Types of gear boxes – manual and automatic (epicyclic gear box), Over drive, Transfer box, Fluid flywheel – Torque converter, Propeller shaft, Universal joints, Final drive and Differential, Rear axle drive – Hotchkiss Drive and Torque Tube Drive – Wheels – Disc wheel, Wire wheel & Cast wheel, Tyres – Designations – Types – Tubed tyres & Tubeless tyres

FRONT AXLE, STEERING, BRAKES AND SUSPENSION SYSTEMS 9

Front Axle – Types of Front Axle, Steering geometry, Steering mechanism – Ackermann, Types of steering gear box & Steering ratio, Power Steering, Braking Systems – Drum brakes & Disc brakes, Antilock Braking System, Regenerative brake system, Suspension Systems – Types of Suspension Spring – Coil springs, Leaf springs & Torsion bars – Shock absorbers

AUTOMOTIVE ELECTRICAL & ELECTRONIC SYSTEMS 9

Lead acid battery – Construction, working & maintenance, Electronically controlled gasoline injection system for SI engines (Multi point fuel injection system), Electronically controlled diesel injection system for CI engines (Unit injector system, Rotary distributor type and common rail direct injection system), Electronic ignition system, Starter motor, Lighting system, Windscreen wiper, Automobile air conditioning, Vehicle tracking system

Total Periods: 45

Text Books

1. Kirpal Singh, "Automobile Engineering Vol 1 & 2", Standard Publishers, New Delhi, (2013)
2. Rajput R.K., " Internal Combustion Engines", Lakshmi Publication, (2005)

References

1. Newton, Steeds and Garet, "Motor Vehicles", Butterworth Publishers, (2009)
2. Joseph Heitner, "Automotive Mechanics", East-West Press, (1999)
3. Heinz Heisler, "Advanced Engine Technology", SAE International Publications, USA, (1998)
4. Jain K.K., and Asthana R.B., "Automobile Engineering", Tata McGraw Hill Publishers, New Delhi, (2010)

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2		2	2		3							3			
CO2			3			2										2
CO3						2							2			
CO4									2		1					1
CO5	2		3										3			
CO6			2						2			2	3			

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161ME56 APPLIED HYDRAULICS AND PNEUMATICS L-T-P C
3-0-0 3

Programme: B.E. Mechanical Engineering **Sem: 5 Category: PC**

Aim: To know the advantages and applications of fluid power system in automation of machine tools and other equipments.

Course Outcomes:

The students will be able to

CO1. Understand the fundamentals of hydraulic and pneumatic systems
CO2. Determine proper hydraulic cylinders for specific applications
CO3. Identify various components of pneumatic system used in simple applications
CO4. Illustrate the electronic circuits used in pneumatic systems
CO5. Design the hydraulic circuits with various components
CO6. Know the schematic diagrams to construct pneumatic circuits

FLUID POWER SYSTEMS AND FUNDAMENTALS 9

Introduction to fluid power, Advantages and application – Types of fluid power systems – General types of fluids, Maintaining and disposing of fluids – Fluid power Symbols – Basics of hydraulics – Applications of pascal's law

HYDRAULIC SYSTEMS & COMPONENTS 9

Fluid power actuators: Linear hydraulic actuators – Types of hydraulic cylinders – Single acting, double acting hydraulic cylinders special cylinders like tanden, rodless, telescopic and cushioning devices, Rotary actuators – Fluid gear, Vane and piston motors

PNEUMATIC SYSTEMS AND COMPONENTS 9

Properties of air – Compressors – Filter, Regulator, Lubricator Unit – Air control valves, Quick exhaust valves, pneumatic actuators – Fluid power circuit design, Speed control circuits, synchronizing circuit, Penumo hydraulic circuit, Sequential circuit design for simple applications using cascade method- Robotic circuits

DESIGN OF HYDRAULIC CIRCUITS 9

Directional control valve – 3/2 way valve – 4/2 way valve – Shuttle valve – check valve – pressure control valve – pressure reducing valve, sequence valve, Flow control valve – Fixed and adjustable, electrical control solenoid valves, relays, ladder diagram – Types of accumulators – Accumulators circuits, sizing of accumulators, intensifier – Applications of intensifier – Intensifier circuit – simple problems

DESIGN OF PNEUMATIC CIRCUITS 9

Servo systems – Hydro Mechanical, Electro hydraulic servo systems and proportional valves – Introduction to fluidic devices, simple circuits – Introduction to electro hydraulic pneumatic logic circuits, ladder diagrams– Fluid power circuits – Installation and maintenance of hydraulic and pneumatic power packs – failure and troubleshooting

Total Periods: 45

Text Books:

1. Anthony Esposito, "Fluid Power with Applications", Pearson Education, (2014)
2. Srinivasan.R, "Hydraulic and Pneumatic Controls", Vijay Nicole, (2015)

References:

1. Majumdar S.R., "Oil Hydraulics Systems–Principles and Maintenance", Tata McGraw-Hill, (2010)
2. Shanmugasundaram.K, "Hydraulic and Pneumatic Controls", Chand & Co, (2011)
3. Majumdar S.R., "Pneumatic Systems – Principles and Maintenance", Tata McGraw Hill, (2013)
4. Anthony Lal, "Oil Hydraulics in the Service of Industry", Allied publishers, (2012)

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2	3	2								2	2			
CO2	2		3									2		3		
CO3		2	3	3	2							1		3		
CO4	2	1		2								1			2	
CO5	2	1	1	1								2			2	
CO6		2	2	1	2							1				3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161ME57 THERMAL ENGINEERING LABORATORY L-T-P C
0-0-3 2

Programme: B.E. Mechanical Engineering **Sem: 5 Category: PC**

Aim: To obtain the basic knowledge about internal combustion engine and its performance

Course Outcomes:

The students will be able to

CO1. Draw the valve timing and port timing diagram for petrol & diesel engine
CO2. Find the flash point / fire point and viscosity for the given sample
CO3. Determine the performance and efficiency of petrol / diesel engine
CO4. Identify the performance difference of various engines
CO5. Draw the heat balance sheet for SI/CI engine
CO6. Understand the working principle of boilers and turbines

LIST OF EXPERIMENTS

- Valve Timing and Port Timing Diagrams
- Performance Test on 4-stroke Diesel Engine
- Heat Balance Test on 4-stroke Diesel Engine
- Morse Test on Multi cylinder Petrol Engine
- Retardation Test to find Frictional Power of a Diesel Engine
- Determination of Viscosity – Red Wood Viscometer
- Determination of Flash Point and Fire Point
- Study of Steam Generators and Turbines

Total Periods: 45

LIST OF EQUIPMENTS
(For a batch of 30 students)

1.	I.C Engine – 2 Stroke and 4 Stroke model	1 set
2.	Red Wood Viscometer	1 No.
3.	Apparatus for Flash and Fire Point	1 No.
4.	4-Stroke Diesel Engine with mechanical loading	1 No.
5.	4-Stroke Diesel Engine with hydraulic loading.	1 No.
6.	4-Stroke Diesel Engine with electrical loading	1 No.
7.	Multi-cylinder Petrol Engine	1 No.
8.	Single cylinder Petrol Engine	1 No.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	2		2	3			2		3	1	3		2
CO2	1			2		2	3		2	1		1		3		2
CO3	2	3	2	2		2	3	1	2	1		1	3	2		3
CO4	2	3	2	2		2	3	1	2	1		1	3	2		3
CO5	2	3	2	2		2	3	1	2	1		1	3	2		3
CO6	2	3	2	1			2		2			2	2	3		1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161ME58	DYNAMICS LABORATORY	L-T-P	C
		3-0-0	3

Programme: B.E. Mechanical Engineering **Sem:** 5 **Category:** PC

Aim: To educate the students to apply the kinetic solutions to various experiments

Course Outcomes:

The students will be able to

CO1. Know the functions of kinematic links and its mechanisms
CO2. Interpret the fundamentals of the natural frequency of free vibration of fixed beam
CO3. Find the gyroscopic effect
CO4. Determine the basic concepts of governor apparatus
CO5. Identify the different cam profile mechanisms
CO6. Enumerate the critical speed of shaft

LIST OF EXPERIMENTS

1. Study of velocity ratios of simple, compound, Epicyclic and differential gear trains.
2. Study of kinematics of Four Bar, Slider Crank, Crank Rocker, Double crank, Double rocker, Oscillating cylinder Mechanisms.
3. Determination of Mass moment of inertia of Fly wheel and Axle system.
4. Determination of Mass Moment of Inertia of axisymmetric bodies using Turn Table apparatus.
5. Determination of Mass Moment of Inertia using bifilar suspension and compound pendulum.
6. Determination of gyroscopic effect and couple.
7. Determination of range sensitivity, effort etc., for Watts, Porter and Proell Governors.
8. Cam profile and Motion curve drawings
9. Determination of natural Frequency and verification of Laws of springs in Single degree of freedom Spring Mass System.
10. Determination of torsional natural frequency of single and Double Rotor systems.
11. Vibration of Equivalent Spring mass system.
12. Determination of critical speeds of shafts.
13. Balancing of rotating masses
14. Transverse vibration of Free-Free beam – with and without concentrated masses.

Total Periods: 45

LIST OF EQUIPMENTS
(For a batch of 30 students)

1.	Cam analyzer	1 No.
2.	Motorized gyroscope	1 No.
3.	Governor apparatus - Watt, Porter, Proell and Hartnell governors	1 No.
4.	Whirling of shaft apparatus	1 No.
5.	Static and dynamic balancing machine	1 No.
6.	Vibrating table	1 No.
7.	Vibration test facilities apparatus	1 No.
8.	Gear Model	1 No.
9.	Kinematic Models to study various mechanisms	1 No.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2		2					3			2		3	1	3
CO2	3	2		3					3			2		3	2	3
CO3	2	3		2					3			2		2		3
CO4	3	3		2					3			2		2		2
CO5	3	3		2					3			2		3		3
CO6	3	2		3					3			2		2		3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161HS59	CAREER ENGLISH – I	L-T-P	C
		0-0-2	-

Programme: Common to all branches **Sem** **5** **Category:** **EEC**

Aim: To Improve learner's Communication Skills in English

Course Outcomes:

The students will be able to

CO1. Train the students in Language Skills, Soft Skills, Inter Personal Skills, Decision Making and Business Communication

CO2. Competent in Presentation skill

CO3. Imbibe the knowledge of effective classroom speaking and presentation

CO4. Provide opportunities to learners to practice their communicative skills to become proficient users of English

CO5. Write job applications

UNIT I **6**

Elements of effective presentation – Structure of presentation – Presentation tools – Voice Modulation – Audience analysis – Body language – Video samples

UNIT II **6**

Time management – Articulateness – Assertiveness – Psychometrics – Innovation and Creativity – Stress Management & Poise – Video Samples

UNIT III **6**

Covering letter – strategies to write, resume and it's various kinds

Total Periods: **18**

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1		2	2						3	3	3	3				3
CO2										3		2				2
CO3					2				2	3		2				
CO4									2	3		2				
CO5								3		3						

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161HS61	ENGINEERING ECONOMICS AND MANAGEMENT	L-T-P	C
		3-0-0	3

Programme: B.E. Mechanical Engineering **Sem:** 6 **Category:** HS

Aim: To impart knowledge about basics of economics and cost analysis related to engineering so as to take economically sound decisions

Course Outcomes:

The students will be able to

CO1. Explain about the fundamentals of economic concepts
CO2. Describe the concept of theory of production and Human resource management
CO3. Demonstrate the Management Principles, functions of management & organizational structures
CO4. Adjust inflation and solve different types of replacement problems
CO5. Prepare internal rate of return, payback period, net present value and cost benefit analysis
CO6. Prepare feasibility reports and break even analysis

FUNDAMENTALS OF ECONOMICS **9**

Concept and scope of engineering economics - basic concepts of goods, utility, value and wealth - relation between economic decision and technical decision - Law of demand & supply – factors influencing demand - elasticity of demand – demand forecasting - Basic economic problems - causes, types and measures to control Poverty, Un employment and Inflation

THEORY OF PRODUCTION **9**

Theory of production; production function, meaning, factors of production (meaning & characteristics of Land, Labour, capital & entrepreneur) - Law of variable proportions & law of returns to scale - Introduction to Human Resource Management; definitions, objectives of manpower planning, process, sources of recruitment, process of selection - Corporate Social Responsibility; meaning, importance - Business Ethics; meaning, importance

FUNCTIONS OF MANAGEMENT **9**

Introduction to Management & administration, skill, types and roles of managers – Management Principles; Scientific principles, Administrative principles, Maslow's Hierarchy of needs theory – Functions of Management – Planning, Organizing, Staffing, Directing, Controlling – Organizational Structures; meaning, principles of organization, types (explanation with merits and demerits), span of control, departmentalization

DEPRECIATION AND REPLACEMENT ANALYSIS **9**

Depreciation – various methods of depreciations – inflation adjusted decisions – procedure to adjust inflation – Types of maintenance – types of replacement problem - determination of economic life of an asset – replacement of an asset with a new asset – capital recovery with return and concept of challenger and defender

COST ANALYSIS **9**

Types of costing – traditional costing approach – activity base costing – cost output relationship in the short run and in long run – types of pricing and its practice – appraising project profitability – internal rate of return – payback period – net present value – cost benefit analysis –feasibility reports- break even analysis - managerial uses of break even analysis

Total Periods: 45

Text Books:

1. Dewett K.K. &Varma J.D., "Elementary Economic Theory", S Chand & Co., (2006)
2. Suma Damodaran, "Managerial economics", Oxford University press, (2006)

References:

1. Sharma K.K., "Principle of Economics", Abishek publications, (2002)
2. Panneer Selvam, R, "Engineering Economics", Prentice Hall of India Ltd, New Delhi, (2001)
3. Ranbir Singh, "Principles of Engineering Economics and Management", S.K. Kataria & Sons, (2010)
4. Mithal G. K. and Mittal R., "Engineering Economics and Management", G.K. Publishers, (1996)

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1				1				1	2	1	2	2				2
CO2				2				2	3	1	2	2				2
CO3				2				2	3	1	2	2				2
CO4	2	2		2				2	2	2	2	2				2
CO5	2	2		2				2	2	2	2	2				2
CO6	2	2		2				2	2	2	2	2				2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161ME61 **HEAT AND MASS TRANSFER** **L-T-P** **C**

3-0-2 **4**

Programme: B.E. Mechanical Engineering **Sem:** 6 **Category:** HS

Aim: To understand the basic concepts of Heat and Mass Transfer and its application

Course Outcomes:

The students will be able to

CO1. Identify the modes of heat transfer and solve the conduction and extended surface problems

CO2. Know about the basic concept of convection, flow over plate, cylinders and spheres

CO3. Familiarize the concept of pool boiling

CO4. Identify the types of heat exchanger and solve the heat exchanger problems

CO5. Well known about radiation and solve the radiation problems

CO6. Solve the mass transfer problem and know about the diffusion mass transfer

CONDUCTION **12**

Basic Concepts – Mechanism of Heat Transfer – Conduction, Convection and Radiation – Fourier 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 Spherical systems – Composite Systems – Conduction with Internal Heat Generation – Extended Surfaces – Unsteady Heat Conduction – Lumped Analysis – Use of Heislers Chart

**Practical: Thermal conductivity measurement by guarded plate method, Thermal conductivity of pipe insulation using lagged pipe apparatus

CONVECTION **12**

Basic Concepts – Heat Transfer Coefficients – Boundary Layer Concept – Types of Convection – Forced Convection – Dimensional Analysis – External Flow – Flow over Plates, Cylinders and Spheres – Internal Flow – Laminar and Turbulent Flow – Combined Laminar and Turbulent – Flow over Bank of tubes – Free Convection – Dimensional Analysis – Flow over vertical Plate, Horizontal Plate, Inclined Plate, Cylinders and Spheres

**Practical: Natural convection heat transfer from a vertical cylinder, Forced convection inside tube

PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGERS **12**

Nusselts theory of condensation – pool boiling, flow boiling, correlations in boiling and condensation – Types of Heat Exchangers – Heat Exchanger Analysis – LMTD Method and NTU – Effectiveness – Overall Heat Transfer Coefficient – Fouling Factors

**Practical: Effectiveness of Parallel/counter flow heat exchanger, Heat transfer from pin-fin (natural & forced convection modes

RADIATION **12**

Basic Concepts, Laws of Radiation – Stefan Boltzman Law, Kirchoffs Law – Black Body Radiation – Grey body radiation – Shape Factor Algebra – Electrical Analogy – Radiation Shields – Introduction to Gas Radiation

**Practical: Determination of emissivity of a grey surface

MASS TRANSFER **12**

Basic Concepts – Diffusion Mass Transfer – Fick's Law of Diffusion – Steady state Molecular Diffusion – Convective Mass Transfer – Momentum, Heat and Mass Transfer Analogy – Convective Mass Transfer Correlations

**Practical: Determination of Stefan-Boltzmann constant

Lecture: 45 **Practice: 15** **Total Periods: 60**

Text Books:

1. Sachdeva R.C., "Fundamentals of Engineering Heat and Mass Transfer", New Age International publication, (2017)
2. Kothandaraman C.P., "Fundamentals of Heat and Mass Transfer", New Age International, New Delhi, (2012)

References:

1. Yadav R., "Heat and Mass Transfer", Central Publishing House, (2004)
2. Ozisik M.N., "Heat Transfer", McGraw-Hill Book Co., (2001)
3. Nag P.K., "Heat Transfer", Tata McGraw-Hill, New Delhi, (2014)
4. Holman J.P., "Heat and Mass Transfer", Tata McGraw-Hill, (2013)

LIST OF EQUIPMENTS

1.	Guarded plate apparatus	1 No.
2.	Lagged pipe apparatus	1 No.
3.	Natural convection-vertical cylinder apparatus	1 No.
4.	Forced convection inside tube apparatus	1 No.
5.	Pin fin apparatus	1 No.
6.	Stefan-Boltzmann apparatus	1 No.
7.	Emissivity measurement apparatus	1 No.
8.	Parallel/counter flow heat exchanger apparatus	1 No.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	3		2	2					2	2	2		2
CO2	3	2	3	3		2	2					2	2	2		1
CO3	3	2	2	2		1	2						2	1	2	2
CO4	3	3	2	2		2	2					2	2	2		2
CO5	3	2	1	3		1	2					2	2	2		2
CO6	3	2	1	3		1	1					2	2	1		1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161ME62	FINITE ELEMENT ANALYSIS	L-T-P	C
		3-2-0	4

Programme: B.E. Mechanical Engineering **Sem:** 6 **Category:** PC

Aim: To introduce the concepts of Mathematical Modeling of Engineering Problems and to appreciate the use of FEM to a range of Engineering Problems

Course Outcomes:

The students will be able to

CO1. Express the various approximation and elimination methods to find the solution
CO2. Solve various numerical engineering problems in 1D bar & Truss element
CO3. Compile the elements in CST & Axisymmetric
CO4. Expose the difference between iso, super and sub parametric elements
CO5. Elucidate the numerical engineering problems in dynamic analysis & fluid mechanics problems
CO6. Realize the various applications involved in 1D, 2D heat transfer

INTEGRAL FORMULATION & VARIATION METHODS **12**

Methods of engineering analysis – weighted residual methods – general weighted residual statement – weak formulation of the weighted residual statement – principle of stationary total potential (PSTP) – Rayleigh Ritz method – piecewise continuous trial functions – simultaneous linear algebraic equations – Numerical integration – Gaussian quadrature

1D BAR & TRUSS ELEMENT **12**

Introduction to matrix algebra – general steps in FEA – co-ordinates – linear bar element – shape functions – stiffness matrix – application to bar element – quadratic bar element – spring element – truss element – development of element equations – assembly – element connectivity – global equations

PLANE STRESS & PLANE STRAIN ANALYSIS **12**

Introduction – constant strain triangular element (CST) – strain displacement matrix – stress strain relations – four noded rectangular element – iso-parametric elements – jacobian matrix – natural co-ordinate system and co-ordinate transformation – axisymmetric element

DYNAMIC & FLUID FLOW ANALYSIS **12**

Fundamentals of vibration – equations of motion based on weak form – longitudinal vibration of bars – transverse vibration of beams – consistent & lumped mass matrices – Eigen values & Eigen vectors – Fluid mechanics in 2-D – shape function, stiffness matrix, load vector, assembly – Application

HEAT TRANSFER ANALYSIS **12**

Temperature distribution using weighted residual approach – application to one-dimensional heat transfer problems in bar element – heat transfer analysis in CST element – axisymmetric element – scalar variable problems in 2-D

Lecture: 45 Tutorial: 15 Total Periods: 60

Text Books:

1. Seshu P., “Text Book of Finite Element Analysis”, Prentice-Hall of India Pvt. Ltd. New Delhi, (2013)
2. Senthil S. and Panneerdhass R., “Finite Element Analysis”, Lakshmi Publications, Chennai, (2014)

References:

1. Bhavikatti S.S., “Finite Element Analysis”, New Age International Publishers, (2015)
2. Reddy J.N., “An Introduction to the Finite Element Method”, McGraw-Hill Edition, (2010)
3. Chennakesava R. Alavala, “Finite Elements Methods-Basic Concepts and Applications”, Prentice-Hall of India, Eastern Economy Editions, (2009)
4. David V. Hutton, “Fundamentals of Finite Element Analysis”, Tata McGraw-Hill Edition, (2005)

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	2	1				2	2		3	3	2		
CO2	3	3	3	3	3				2	2	2	3	3	2	3	
CO3	3	2	3	2	3				2	2	2	3	3	2	1	
CO4	3	2	1	1	2					1		2	2	2	1	
CO5	3	3	3	3	3	2	2	2	3	3	3	3	3	3	2	3
CO6	3	3	3	3	3	2	2	2	3	3	3	3	3	3	2	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161ME63 DESIGN OF TRANSMISSION SYSTEMS L-T-P C
2-2-0 3

Programme: B.E. Mechanical Engineering **Sem: 6 Category: PC**

Aim: To study the design principles and procedures of Transmission systems

Course Outcomes:

The students will be able to

CO1. Gain basic concepts of various power transmission systems
CO2. Select and design flat, V belt drives and chain drives
CO3. Understand power transmission between parallel shafts and design spur & helical gears
CO4. Visualize transmission between intersecting shafts and design the bevel & worm gears
CO5. Prepare kinematic layout and structural arrangement of the gear boxes
CO6. Differentiate between clutches, brakes & cam and design the same

DESIGN FOR FLEXIBLE ELEMENTS 9

Selection of V belts and pulleys – selection of flat belts and pulleys – wire ropes and pulleys – selection of transmission chains and sprockets – Design of pulleys and sprockets

SPUR & HELICAL GEARS 9

Gear Terminology – spur gears – speed ratio and number of teeth – force analysis – factor of safety – gear materials – power rating calculations based on strength and wear considerations – helical gears – pressure angle in the normal and transverse plane – equivalent number of teeth – force analysis

BEVEL & WORM GEARS 9

Straight bevel gear – tooth terminology, tooth forces and stresses, equivalent number of teeth – estimating the dimensions of pair of straight bevel gears – worm gear – merits and demerits – terminology

DESIGN OF GEAR BOXES 9

Geometric progression – standard step ratio – ray diagram, kinematics layout – design of sliding mesh gear box – constant mesh gear box – design of multi speed gear box

DESIGN OF CAM CLUTCHES AND BRAKES 9

Cam Design – types – pressure angle and under cutting base circle determination – forces and surface stresses – design of plate clutches – axial clutches – cone clutches – internal expanding rim clutches – internal and external shoe brakes

Total Periods: 45

Text Books:

1. Khurmi R.S., Gupta J.K., "A Textbook of Machine Design", Eurasia Publications, (2014)
2. Sundararajamoorthy T.V. and Shanmugam N., "Machine Design", Anuradha Publications, (2013)

References:

1. Prabhu T.J., "Design of Transmission Elements", Mani Offset, Chennai, (2000)
2. Maitra G.M., Prasad, L.V., "Hand book of Mechanical Design", Tata McGraw Hill,(1985)
3. Bhandari V.B., "Design of Machine Elements", Tata McGraw-Hill Publishing Company Ltd., (1994)
4. Hamrock B.J., Jacobson B., Schmid S.R., "Fundamentals of Machine Elements", McGraw Hill Book Co., (1999)

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2	3		2					2		3	2	3		3
CO2	2	2	3	2	2					2		3	2	2	3	2
CO3	2	2	3	2	2		2			2		3	2	2	3	2
CO4	2	2	3	2	2		2			2		3	2	2	3	2
CO5	2	2	3	2	2		2			2		3	2	2	3	2
CO6	2	2	3	2	2		2			2		3	2	2	3	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161ME67	CAD/CAM LABORATORY	L-T-P	C
		0-0-3	2

Programme: B.E. Mechanical Engineering **Sem:** 6 **Category:** PC

Aim: To communicate knowledge in Solid Modeling & CNC by using relevant CAD/CAM software

Course Outcomes:

The students will be able to

CO1. Interpret the fundamentals of the Computer Aided Design which will equip them to pursue higher studies

CO2. Identify the different modeling, transformation and assembling tools in computer aided modeling of structural problems

CO3. Illustrate any solid part modeling and assembling the parts by using modeling software package

CO4. Recognize the need of G & M codes in CNC part programming

CO5. Write part programme for Milling and Lathe

CO6. Realize the need of simulation and hands on training in CNC machine

Computer Aided Design (CAD)

3D PART MODELING – Protrusion, revolve protrusion, swept protrusion, lofted protrusion, helical protrusion, rib, dimensioning, Move, Pattern, Mirror, Round, Chamfer, Hole, Thread etc.,

ASSEMBLY – 3D Modeling of

- Knuckle joint
- Universal coupling
- Plummer Block
- Screw Jack
- Stuffing Box
- Tail Stock
- Bushed Pin type Flange coupling
- Crane Hook
- C-Clamp

Computer Aided Manufacturing (CAM)

a) MANUAL PART PROGRAMMING (Using G and M Codes) in CNC lathe

Part programming for

- Chamfering,
- Grooving,
- Turning,
- Facing,
- Boring,
- Drilling
- Internal Thread cutting
- External Thread cutting

b) MANUAL PART PROGRAMMING (using G and M codes) in CNC milling

Part programming for

- Linear & Circular interpolation
- Rectangular pocketing
- Circular pocketing
- Mirroring
- Drilling

NOTE: Practical examination duration is Three hours. Students will carry out one exercise in modeling and one exercise in CNC part programming & simulation.

SYSTEM REQUIREMENTS
(For a batch of 30 Students)

Hardware:

1. Intel i3 core due processor with 4GB ram with 500GB hard disk – 30 Nos.
2. Laser Printer – 1 No.
3. Trainer CNC Lathe – 1 No.
4. Trainer CNC Milling – 1 No.

Software:

1. CAD/CAM software – Solid Edge V20/CREO V2.0 – 50 licenses
2. CAM Software – CNC Programming & Simulation software – 30 licenses

Total Periods: 45

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2	2	3	3		2			3	2	2	2	3	3	2
CO2	2	2	2	3	3		2			3	2	2	2	3	3	2
CO3	2	2	2	3	3		2			3	2	2	2	3	3	2
CO4	2	2	2	3	3		2			3	2	2	2	3	3	2
CO5	2	2	2	3	3		2			3	2	2	2	3	3	2
CO6	2	2	2	3	3		2			3	2	2	2	3	3	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161ME68 DESIGN AND FABRICATION PROJECT L-T-P C
0-0-3 2

Programme: B.E. Mechanical Engineering **Sem: 6 Category: EEC**

Aim: To design and fabricate the product to meet environmental safety and ethical constraints for a given problem statement

Course Outcomes:

The students will be able to

CO1. Develop design concepts using a decision matrix
CO2. Function effectively as a member of design team
CO3. Prepare a Gantt chart for planning a design project
CO4. Transform design concepts into product components drawings
CO5. Test the fabricated model for evaluating the performance
CO6. Prepare project report of fabricated model
CO7. Communicate technical information to peers both orally an in writing

The objective of this project is to provide opportunity for the students to implement their skills acquired in the previous semesters to practical problems.

The students in convenient groups of not more than 4 members have to take one small item for design and fabrication. Every project work shall have a guide who is the member of the faculty of the institution and if possible with an industry guide also.

The item chosen shall be small machine elements (Example-screw jack, coupling, machine vice, cam and follower, governor etc), attachment to machine tools, tooling (jigs, fixtures etc), small gear box, automotive appliances, agricultural implements, simple heat exchangers, small pumps, hydraulic /pneumatic devices etc.

The students have to design and fabricate the chosen item in the college and demonstrate its working apart from submitting the project report. The report should contain assembly drawing, parts drawings, process charts relating to fabrication.

Total Periods: 45

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	2	1	1	1	1	2	1	1	3	3	1	1
CO2	3	3	3	3	2	2	2	3	3	3	3	3	3	2	2	1
CO3	2	3	2	3	2	2	2	2	2	1	1	1	3	1	1	1
CO4	3	2	3	1	3	1	1	1	1	2	1	1	3	2	2	1
CO5	3	3	3	2	2	1	2	2	2	1	1	2	3	3	3	3
CO6	3	1	2	1	1	1	1	1	3	2	1	1	3	1	1	2
CO7	3	2	2	2	2	2	1	2	2	3	1	2	3	3	3	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161HS69	CAREER ENGLISH – II	L-T-P	C
		0-0-2	-

Programme: Common to all branches **Sem** 6 **Category:** EEC

Aim: To practice English for Enhancing Employability skills

Course Outcomes:

The students will be able to,

CO1. Enlarge the student's aptitude and reasoning skills

CO2. Acquire knowledge about the various principles of communication, understand its various stages and the role of audience and purpose, deal with the barriers that affect communication in a professional set up

CO3. Practice English for Enhancing Employability skills

CO4. Develop students job prospects through oral communication

CO5. Enhance the performance of learners at placement interviews and group discussions and other recruitment procedures

UNIT I **6**

Verbal analogy, verbal reasoning, error spotting, sentence completion

UNIT II **6**

Why is GD part of selection process? – Structure of GD – Moderator – Strategies in GD – Team work – Body Language – Mock GD – Video samples

UNIT III **6**

Kinds of interviews – Required Key Skills – Corporate culture – Mock interviews – Video samples

1. Resume / Report Preparation
2. Presentation Skills: Students make presentations on given topics. (8)
3. Group Discussion: Students participate in group discussions. (6)
4. Interview Skills: Students participate in Mock Interviews (8)

Total Periods: 18

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2								3	3	3	2				2
CO2						2			3	3	3	2				
CO3									2	3	2	2				
CO4										3						
CO5									3	2						

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161ME71	TOTAL QUALITY MANAGEMENT	L-T-P	C
		3-0-0	3

Programme: B.E. Mechanical Engineering **Sem:** 7 **Category:** PC

Aim: To understand the various principles, practices of TQM to achieve quality and to learn the various statistical approaches for Quality control

Course Outcomes:

The students will be able to

CO1. Know the basics of TQM
CO2. Understand the principles of TQM
CO3. Improve their workplace with the help of 5S
CO4. Learn the six sigma and bench marking techniques
CO5. Familiarize Quality circles and QFD
CO6. Study the various quality systems

EVALUATION OF TQM **9**

Introduction – Need for quality – Evolution of quality – Definition of quality – Dimensions of manufacturing and service quality – Basic concepts of TQM – Definition of TQM – TQM Framework – Contributions of Deming, Juran and Crosby – Barriers to TQM

TQM PRINCIPLES **9**

Leadership – Strategic quality planning, Quality statements – Customer focus – Customer orientation, Customer satisfaction, Customer complaints, Customer retention – Employee involvement – Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal – Continuous process improvement – PDSA cycle, 5S, Kaizen – Supplier partnership – Partnering, Supplier selection, Supplier Rating

TQM TOOLS & TECHNIQUES I **9**

The seven traditional tools of quality – New management tools – Six-sigma: Concepts, methodology, applications to manufacturing, service sector including IT – Bench marking– Reason to bench mark, Bench marking process – FMEA – Stages, Types

TQM TOOLS & TECHNIQUES II **9**

Quality circles – Quality Function Deployment – Taguchi quality loss function – TPM – Concepts, improvement needs – Cost of Quality – Performance measures

QUALITY SYSTEMS **9**

Need for ISO 9000 – ISO 9000:2000 Quality System – Elements, Documentation, Quality auditing – QS 9000 – ISO 14000 – TS1600 – Concepts, Requirements and Benefits – Case studies of TQM implementation in manufacturing and service sectors including IT

Total Periods: 45

Text Books:

1. Dale H. Besterfiled et al., “Total Quality Management”, Pearson Education Asia, (2014)
2. Shridhara Bhat K., “Total Quality Management”, Himalaya Publishing House, (2013)

References:

1. James R. Evans and William M. Lindsay, “The Management and Control of Quality”, Thomson South-Western, (2010)
2. Oakland J.S., “TQM – Text with Cases”, Butterworth – Heinemann Ltd., Oxford, (2003)
3. Suganthi L., Anand Samuel, “Total Quality Management”, PHI Pvt. Ltd., (2011)
4. Janakiraman B. and Gopal R.K., “Total Quality Management – Text and Cases”, PHI Pvt. Ltd., (2012)

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1		2							3	2	3	1		2		3
CO2								2	3			2				2
CO3								2	3			2		2		3
CO4	2			3					2		2	2		2	2	3
CO5	1			3						2	2	1		1		2
CO6								1		2	3	1				3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161ME72	MECHATRONICS	L-T-P	C
		3-0-0	3

Programme: B.E. Mechanical Engineering **Sem:** 7 **Category:** PC

Aim: To understand multidisciplinary applications of Electronics in Mechanical systems

Course Outcomes:

The students will be able to

CO1. Explain the basics of Mechatronics systems
CO2. Classify various sensors and transducers with their properties
CO3. Operate Hydraulic, Pneumatic, Electrical and Mechanical Systems
CO4. Develop solution for various types of system models and controllers
CO5. Illustrate the basic concept and structure of PLC
CO6. Realize various Mechatronics Systems design

MECHATRONICS, SENSORS AND TRANSDUCERS **9**

Introduction to Mechatronics Systems – Systems – Measurement Systems – Control Systems –Sensors and Transducers – Performance Terminology–Sensors for Displacement, Position, Proximity, Velocity, Motion, Force, Fluid Pressure, Liquid Flow, Liquid Level, Temperature, Light Sensors – compare Traditional and Mechatronics – Selection of Sensors

ACTUATION SYSTEMS **9**

Electrical Actuation Systems – Mechanical Switches – Solid State Switches – Solenoids – Construction and working principle of DC and AC Motors – speed control of AC and DC drives, Stepper Motors – AC & DC Servo motors

SYSTEM MODELS AND CONTROLLERS **9**

Building blocks of Mechanical, Electrical, Fluid and Thermal Systems, Rotational – Transnational Systems, Electromechanical Systems – Hydraulic – Mechanical Systems – Control Mode – Two Step mode – Proportional Mode – Derivative Mode – Integral Mode – PID Controllers – Digital Controllers – Velocity Control – Adaptive Control – Digital Logic Control – Micro Processors Control

PROGRAMMING LOGIC CONTROLLERS **9**

Programmable Logic Controllers – Basic PLC Structure – Input/Output Processing – Ladder Programming – Mnemonics – Timers, Latching, Internal relays and counters – Shift Registers – Master and Jump Controls – Data Handling – Analogs Input / Output – Selection of a PLC

DESIGN OF MECHATRONICS SYSTEM **9**

Stages in designing Mechatronics Systems – Possible Design Solutions – designing of various Mechatronics systems – automatic washing machine – digital camera – Pick and place Robot – Autonomous mobile robot – Wireless surveillance balloon– Engine Management system – Automatic car park barrier

Total Periods: 45

Text Books:

1. William Bolton., "Mechatronics – A multidisciplinary approach", Pearson education, (2016)
2. Rajput R.K., "A textbook of Mechatronics", S. Chand & Co., (2012)

References:

1. Smaili, A. and Mrad, F., "Mechatronics integrated technologies for intelligent machines", Oxford university press, (2010)
2. Michael B. Histand and David G. Alciatore, "Introduction to Mechatronics and Measurement Systems", McGraw-Hill International Editions, (2014)
3. Dan Necsulesu, "Mechatronics", Pearson Education Asia, (2002)
4. Nitaigour Premchand Mahadik, "Mechatronics", Tata McGraw-Hill publishing Company Ltd, (2010)

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3												1			
CO2	3		3										2	1		
CO3	2		3				2						2	2		2
CO4	2	2		2									3			
CO5	2		3										2		2	2
CO6	1		2		2							2		3		3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161ME73 GAS DYNAMICS AND JET PROPULSION L-T-P C

2-2-0 3

Programme: B.E. Mechanical Engineering **Sem: 7 Category: PC**

Aim: To understand the compressible flow, shock waves, jet propulsion and Rocket Propulsion

Course Outcomes:

The students will be able to

CO1. Explain the classification of compressible fluid flow

CO2. Describe the isentropic flow through ducts, nozzle, and diffusers

CO3. Analyze the flow through heat transfer for Rayleigh flow and fanno flow

CO4. Describe the governing equation using normal and oblique shocks to analyze the Mayer relation and its applications

CO5. List the jet engines and to determine the propulsive efficiency

CO6. Elaborate the performance of turbo jet, turbo fan and turbo prop engines

BASIC CONCEPTS AND ISENTROPIC FLOWS 9

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 ducts – Nozzle and Diffusers – Use of Gas tables

FLOW THROUGH DUCTS 9

Flows through constant area ducts with heat transfer (Rayleigh flow) and Friction (Fanno flow) – variation of flow properties – Use of tables and charts – Generalised gas dynamics

NORMAL AND OBLIQUE SHOCK 9

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

JET PROPULSION 9

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

SPACE PROPULSION 9

Types of rocket engines – Propellants – feeding systems – Ignition and combustion – Theory of rocket propulsion – Performance study – Staging – Terminal and characteristic velocity – Applications – space flights

Total Periods: 45

Text Books:

1. Anderson J.D., “Modern Compressible Flow”, McGraw Hill, (2011)
2. Yahya S.M., “Fundamentals of Compressible Flow”, New Age International (P) Limited, New Delhi, (2010)

References:

1. Hill P., Peterson C., “Mechanics and Thermodynamics of Propulsion”, Addison – Wesley Publishing company, (2012)
2. Zucrow N.J., “Principles of Jet Propulsion and Gas Turbines”, John Wiley, New York, (2010)
3. Sutton G.P., “Rocket Propulsion Elements”, John Wiley, (2012)
4. Ganesan V., “Gas Turbines”, Tata McGraw Hill Publishing Co., New Delhi, (2011)

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	3	1			2	2					3		2		
CO2	2	2	1	3	2		1					3	1			
CO3	1	3	3	3										2		
CO4	3		1	2								3		2		
CO5	3	2	1	3	1							3			3	
CO6	1	2	2	3	1							3		2		

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161ME74 **POWER PLANT ENGINEERING** **L-T-P** **C**

3-0-0 **3**

Programme: B.E. Mechanical Engineering **Sem:** 7 **Category:** PC

Aim: To understand the various components, operations and applications of different types of power plants

Course Outcomes:

The students will be able to

CO1. Express the various power plants and boilers
CO2. Identify the handling equipments and different types of condenser
CO3. Discuss the various types of reactor
CO4. Select the different types of turbines for reactor
CO5. List the application of gas turbine power plants and inter cooling of combined cycle
CO6. Compute the operating cost and tariffs using the various power plants

INTRODUCTION TO POWER PLANTS AND BOILERS **9**

Layout of Steam, Hydel, Diesel, MHD, Nuclear and Gas turbine Power Plants Combined Power cycles – comparison and selection, Load duration Curves Steam boilers and cycles – High pressure and Super Critical Boilers – Fluidized Bed Boilers

STEAM POWERPLANT AND GAS TURBINE POWER PLANTS **9**

Fuel and ash handling, Combustion Equipment for burning coal, Mechanical Stokers – Pulveriser, Electrostatic Precipitator, Draught – Different Types, Surface condenser types, cooling towers – Gas turbine power plant – Fuels – Gas turbine material – open and closed cycles – reheating – Regeneration and intercooling – combined cycle

NUCLEAR AND HYDEL POWER PLANTS **9**

Nuclear Energy – Fission, Fusion Reaction, Types of Reactors, Pressurized water reactor, Boiling water reactor, Waste disposal and safety hydel Power plant – Essential elements, Selection of turbines, governing of Turbines – Micro hydel developments

DIESEL AND OTHER POWER PLANTS **9**

Types of diesel plants, components, Selection of Engine type, applications – Geo thermal – OTEC – Tidel – Pumped storage – Solar central receiver system, Principle of working, Wind energy – types – HAWT, VAWT – Tidal Energy, Solar energy

POWER PLANT ECONOMICS AND ENVIRONMENTAL CONSIDERATIONS **9**

Fixed and operating costs – Energy rates – Types tariffs – Economics of load sharing, Effluents from power plants and impact on Environment – pollutants and pollution standards – Method of pollution control

Total Periods: 45

Text Books:

1. Rajput R.K., “A Text Book of Power Plant Engineering”, Laxmi Publication, (2016)
2. Nag P.K., “Power Plant Engineering”, Tata McGraw- Hill, (2014)

References:

1. EI-Wakil M.M., “Power Plant Technology”, Tata McGraw-Hill, (2003)
2. Ramalingam K.K., “Power Plant Engineering”, Scitech Publications,(2002)
3. Nagpal G.R., “Power Plant Engineering”, Khanna Publishers, (2010)
4. Rai G.D., “Introduction to Power Plant Technology”, Khanna Publishers, (2009)

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2	2	2	1	1	2	1				2	2	3		3
CO2	3	3	2	2		1	1	2				2	2	3		2
CO3	2	2	2	3	2	2	2	2	2	1		2		3		2
CO4	3	2	2	2	2	3	2	2			2	2		3		2
CO5	2	3	2	2	2	2	2	2	2	1	2	2	2	3		2
CO6	3	2			2	2	2	3	2	2		2	1	1	2	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161ME77	ANALYSIS LABORATORY	L-T-P	C
		0-0-3	2

Programme: B.E. Mechanical Engineering **Sem:** 7 **Category:** PC

Aim: To gain knowledge in analyzing various structures by using relevant software

Course Outcomes:

The students will be able to

CO1. Demonstrate the features of ANSYS software
CO2. Validate the stress analysis in beam problems with empirical formulas
CO3. Explicit the stress analysis of a plate with a circular hole and axi-symmetric component
CO4. Identify the need of mode frequency analysis in 2D component
CO5. Realize the Thermal analysis of a 2D component
CO6. Import any solid model to ANSYS for contact analysis

List of Exercises

1. Static Analysis of 2-D beam problems
2. Static Analysis of Plane stress problems
3. Static Analysis of Axisymmetric problems
4. Structural Analysis of Trusses
5. Stress analysis of rectangular L bracket
6. Stress analysis of a plate with a circular hole
7. Stress analysis of a bicycle frame
8. Mode frequency analysis of a 2D plate
9. Mode frequency analysis of beams
10. Harmonic analysis of a 2D component
11. Transient Heat Transfer Analysis of 2D problems
12. Heat Transfer Analysis of Axisymmetric Problems
13. Contact Analysis of a simple solid model
14. Buckling Analysis of a column

NOTE: Practical examination duration is Three hours. Students will carry out two exercises by using ANSYS software.

SYSTEM REQUIREMENTS
(For a batch of 30 Students)

Hardware:

1. Intel i3 core due processor with 4GB ram with 500GB hard disk – 30 Nos.
2. Laser Printer – 1 No.

Software:

1. ANSYS V14.5/equivalent – 50 licenses

Total Periods: 45

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	3	3						2	3		2	2			2
CO2	2	1	1		2				2	2		3	3	3	1	2
CO3	2	3	3		2					2		2	3	3	2	2
CO4	2	3	3		2					2		2	3	3	2	2
CO5	2	3	3		2				2	2		2	3	3	2	2
CO6	2	3	3		2				2	1		3	2	3	3	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161ME78 MECHATRONICS LABORATORY L-T-P C
0-0-3 2

Programme: B.E. Mechanical Engineering **Sem: 7 Category: PC**

Aim: To communicate knowledge in fluid power circuits to control by using relevant Simulation Software

Course Outcomes:

The students will be able to

CO1. Get trained to concept of logic sequential circuit
CO2. Illustrate the Simulation of various basic circuits using software
CO3. Learn the operation of multiple cylinder sequences in Electro pneumatic using PLC
CO4. Ability to Servo controller DC motor and PID controller interfacing
CO5. Experience in hands on training of stepper motor interfacing with 8051 Micro controller
CO6. Gain knowledge in Modeling and analysis of various systems using LABVIEW software

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. Design of circuits with logic sequence using Electro pneumatic trainer kits
3. Simulation of basic Hydraulic, Pneumatic and Electric circuits using software
4. Circuits with multiple cylinder sequences in Electro pneumatic using PLC
5. Speed Control of DC drives
6. Servo controller interfacing for DC motor
7. PID controller interfacing
8. Stepper motor interfacing with 8051 Micro controller
   (i) full step resolution (ii) half step resolution
9. Modeling and analysis of basic electrical, hydraulic and pneumatic systems using LABVIEW

Total Periods: 45

LIST OF EQUIPMENTS

(For a batch of 30 students)

1.	Basic Pneumatic Trainer Kit	2 Nos.
2.	Electrical controls/PLC control kit	1 No.
3.	Hydraulics and Pneumatics Systems Simulation Software – Fluidsim	10 Nos.
4.	8051 - Microcontroller kit with stepper motor and drive circuit sets	2 Nos.
5.	LAB VIEW software with Sensors to measure Pressure, Flow rate, direction, speed, velocity and force	2 Nos.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3	2	2	3	3	1	1	3	3	3	3	3	2	2
CO2	2	3	3	1	3	2	1			2	2	2	3	3	2	2
CO3	2	2	2	1	3	1	1	1		1	1	2	3	2	2	1
CO4	2		2	2	3	1	2	2		2	2	1	2			1
CO5	2		2	2	3			1		1	1	2	2			
CO6	2	2	2	1	3	2		2		2	1	1	2	2	2	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161ME87 **PROJECT WORK** **L-T-P C**
0-0-12 6

Programme: B.E. Mechanical Engineering **Sem: 8** **Category: EEC**

Aim: To understand the real time applications in engineering fields through project work

Course Outcomes:

The students will be able to

CO1. Apply the basic principles of mechanical engineering courses
CO2. Ensure the working principle of mechanisms involved in the fabrication
CO3. Analyze the real time problems
CO4. Realize the industrial project work concepts
CO5. Simulate and design the mechanical systems
CO6. Use the software's in mechanical applications

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	2	2	1		2	2	1	1	3	3	2		
CO2	3	3	3	3	2		2	2	2	1	2	3	3		3	
CO3	3	3	3	3	2				2	1	2	3	2	3		
CO4	3	3	3	3		3	2		2	1	2	3	2		2	
CO5	3	3	3						2	2	2	3	2	3		2
CO6	3	3	3		3				2	2	2	3	3	2		2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

PROGRAMME ELECTIVES

161MEE01	ADVANCED I.C. ENGINES	L-T-P	C
		3-0-0	3

Programme: B.E. Mechanical Engineering **Sem:** -- **Category:** PE

Aim: To understand the basic concepts of advanced I.C. Engines and its application

Course Outcomes:

The students will be able to

CO1. Explain the stages of combustion, knocking phenomenon and thermo dynamic analysis of S.I. & C.I. engines

CO2. Develop an optimize future engine designs for specific sets of constraints

CO3. Explain the formation of different pollutants and their effects

CO4. Know the pollution norms and controlling techniques

CO5. Identify the method of production & characteristics of alternative fuels

CO6. Recognize the recent trends in the I.C engine technology

SPARK IGNITION AND COMPRESSION IGNITION ENGINES **9**

Air-fuel ratio requirements, Stages of combustion in S.I. Engine, Stages of combustion in C.I. Engine, Difference between knocking/detonation in S.I. & C.I. Engines, Normal and abnormal combustion, Factors affecting knock – S.I. engines & C.I. engines, Combustion chambers – S.I. & C.I. engines, Thermodynamic analysis – S.I. engines & C.I. engines

MODERN ENGINES **9**

Valve actuating mechanism – Types – Side camshaft & Overhead camshaft, VVT Technology, VTEC Technology, iVTEC Technology, Electronic Engine Management, Construction, working, advantages and disadvantages – Homogeneous Charge Compression Ignition Engine, Lean Burn Engine, Stratified Charge Engine and Surface Ignition Engine

EMISSIONS AND ITS CONTROL **9**

Emission – Exhaust & Non exhaust emission. Formation of NO_X, HC/CO mechanism, Smoke and Particulate emissions, Green House Effect & Human health hazards, Emission (HC,CO, NO and NO_X) measuring equipment, Advanced Exhaust Gas Analysis, Emission Norms – Indian standard (BS) & Euro standards, Methods of controlling emissions – Three way catalytic converter and Particulate Trap, Ammonia Injection system and Exhaust Gas Recirculation

ALTERNATE FUELS **9**

Method of Production, Performance, Combustion and Emission Characteristics – Alcohols, Vegetable oils, Bio-diesel, Bio-gas, Natural Gas, Liquefied Petroleum Gas and Hydrogen, Engine Modifications

RECENT TRENDS **9**

Flow visualization technique, Global NCAP (New Car Assessment Program) crash test, Variable Engine Displacement Technique (Cylinder deactivation), On board Diagnostics, Concept cars – Case study

Total Periods: 45

Text Books:

1. Kirpal Singh, “Automobile Engineering Vol.2”, Standard Publishers, New Delhi, (2014)
2. Ganesan V., “Internal Combustion Engines”, Tata McGraw Hill, (2012)

References:

1. Heinz Heisler, “Advanced Engine Technology”, SAE International Publications, USA, (2005)
2. John B. Heywood, “Internal Combustion Engine Fundamentals”, Tata McGraw-Hill, (1988)
3. Gupta H.N., “Fundamentals of Internal Combustion Engines”, Prentice Hall of India, (2006)
4. Ultrich Adler, “Automotive Electric/Electronic Systems”, Published by Robert Bosh GmbH, (1995)

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2		3	2	2	1	2		2		3	3	2		3
CO2	2	2	3	3	2	2	1	2		2		3	3	2		3
CO3	2	2	3	3	2	2	1	2		2		3	3	2		3
CO4	2	2	3	3	2	2	1	2		2		3	3	2		3
CO5	3	3	3	3	2	2	1	2	1	2		3	2	2	3	3
CO6	3	3	3	3	2	2	1	2	1	2		3	2	2	3	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161MEE02 COMPOSITE MATERIALS AND ENGINEERING L-T-P C
3-0-0 3

Programme: B.E. Mechanical Engineering **Sem:** -- **Category:** PE

Aim: To understand the fundamentals of composite material and its mechanical behavior

Course Outcomes:

The students will be able to

CO1. Understand the concept of fiber preparation and its applications
CO2. Identify the different composite manufacturing methods
CO3. Learn the flat plate laminate constitute equations
CO4. Understand the lamina strength analysis
CO5. Know the anisotropic analysis of composites
CO6. Analyze the thermal properties of composites

BASICS TO FIBERS AND REINFORCEMENT MATERIALS 9

Definition – Matrix materials – Polymers – Metals – Ceramics – Reinforcements – Particles, Whiskers, Inorganic Fibers, Metal Filaments – Ceramic Fibers – Fiber Fabrication – Natural Composite Wood, Jute – Advantages and Drawbacks of Composites Materials – Mechanical Properties and Applications of Composites – Particulate – Reinforced Composite Materials – Dispersion Strengthened Composite – Fiber – Reinforced Composites Rule of Mixtures – Characteristics of Fiber Reinforced Composites – Manufacturing

MANUFACTURING OF COMPOSITES 9

Manufacturing of Polymer Matrix Composites (PMCs) – Handlay-up, Spray Technique, Filament Winding, Pultrusion, Resin Transfer Moulding (RTM) – Bag Moulding, Injection Moulding, Sandwich Mould Composites (SMC) – Manufacturing of Metal Matrix Composites (MMCs) – Solid state, Liquid State, Vapour State Processing, Manufacturing of Ceramic Matrix Composites (CMCs) – Hot Pressing – Reaction Bonding Process – Infiltration Technique, Direct Oxidation – Interfaces

LAMINA CONSTITUTIVE EQUATIONS 9

Lamina Constitutive Equations: Lamina Assumptions – Macroscopic Viewpoint – 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

STRENGTH ANALYSIS OF COMPOSITES 9

Introduction – Maximum Stress and Strain Criteria – Von-Misses – Yield criterion for Isotropic Materials – Generalized Hill's Criterion for Anisotropic materials – Tsai-Hill's Failure Criterion for Composites – Prediction of laminate Failure Equilibrium Equations of Motion – Energy Formulations – Static Bending Analysis – Buckling Analysis – Free Vibrations – Natural Frequencies

THERMAL ANALYSIS 9

Assumption of Constant C.T.E's – Modification of Hooke's Law – Modification of Laminate Constitutive Equations – Orthotropic Lamina C.T.E's – C.T.E's for special Laminate Configurations – Unidirectional, off-axis, Symmetric Balanced Laminates, Zero C.T.E laminates, Thermally Quasi-Isotropic Laminates

Total Periods: 45

Text Books:

1. Gibson, R.F., "Principles of Composite Material Mechanics", McGraw-Hill, CRC press in progress (1994)
2. Mallick P.K., "Fiber Reinforced Composites: Materials, Manufacturing and Design", Maneel Dekker Inc, (1993)

References:

1. Issac M. Daniel and Ori Ishai, "Engineering Mechanics of Composite Materials", Oxford University Press Edition (2007)
2. Robert M. Jones, "Mechanics of Composite Materials", McGraw Hill, (1998)
3. Halpin J.C., "Primer on Composite Materials, Analysis", Techomic Publishing Co., (1984)
4. Agarwal B.D. and Broutman L.J., "Analysis and Performance of Fiber Composites", John Wiley and Sons, New York, (1990)

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2						1				1	2	1		3	
CO2	2		1				1				1	2	1			1
CO3	2	1		2			1					1	1	1		2
CO4	2	1	1	2			1					1	1	1		2
CO5	2	1	1	2								1	1	1		2
CO6	2	1	1	2								1	1	1		2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161MEE03	COMPUTATIONAL FLUID DYNAMICS	L-T-P	C
		3-0-0	3

Programme: B.E. Mechanical Engineering **Sem:** -- **Category:** PE

Aim: To impart the knowledge of numerical techniques to the solution of fluid dynamics and heat transfer problems

Course Outcomes:

The students will be able to

CO1. Understand the governing equations of fluid flow
CO2. Apply explicit, implicit and semi-implicit methods of finite differencing
CO3. Possess the knowledge of CFD techniques
CO4. Know the basic aspects of grid generation
CO5. Model fluid flow problems and heat transfer
CO6. Solve fluid flow field using some popular CFD techniques

INTRODUCTION AND GOVERNING EQUATIONS **9**

Introduction – Impact and applications of CFD in diverse fields – Governing equations of fluid dynamics – Continuity – Momentum and energy – Generic integral form for governing equations – Initial and Boundary conditions – Governing equations for boundary layers – Classification of partial differential equations – Hyperbolic – Parabolic – Elliptic and Mixed types – Applications and relevance

FINITE DIFFERENCE METHOD **9**

Introduction to Finite differences – Derivation of finite difference equations – Simple Methods – General Methods for first and second order accuracy – solution methods for finite difference equations – Elliptic equations – Iterative solution Methods – Parabolic equations – Explicit and Implicit – Crank-Nicolson – ADI scheme – Stability criterion – Example problems on elliptic and parabolic equations – Grid independence test – Optimum step size

GRID GENERATION **9**

Grid generation – General transformation of the equations – Form of the governing equations suitable for CFD – Boundary fitted Co-ordinate systems – Elliptic grid generation – Adaptive grids – Modern developments in grid generation

FINITE VOLUME METHOD FOR CONVECTION DIFFUSION **9**

Steady one-dimensional convection and diffusion – Central, upwind differencing schemes – properties of discretization schemes – Conservativeness, Boundedness, Trasnportiveness, Hybrid, Power-law, quick Schemes

CALCULATION OF FLOW FIELD **9**

Representation of the pressure gradient term and continuity equation – Staggered grid – Momentum equations – Pressure and Velocity corrections – Pressure Correction equation, simple algorithm and its variants – Turbulence models, mixing length model, Two equation (k-Є) models – High and low Reynolds number models

Total Periods: 45

Text Books:

1. Versteeg H.K. and Malalasekera W., "An Introduction to Computational Fluid Dynamics: The finite volume Method", Pearson Publication, (2008)
2. Hoffman K.A., "Computational Fluid Dynamics for Engineering", Engineering Education System, Austin, Texas, (2000)

References:

1. Muralidhar K., and Sundarajan T., "Computational Fluid Flow and Heat Transfer", Narosa Publishing House, New Delhi, (2011)
2. Anderson J.D., "Computational Fluid Dynamics – The basics with applications", McGraw-Hill, (2000)
3. Patankar S.V., " Numerical Heat Transfer and Fluid Flow", Hemisphere Publishing Corporation, (2004)
4. Prodip Niyogi, Chakrabarty S.K., Laha M.K., "Introduction to Computational Fluid Dynamics", Pearson Education, (2005)

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2		3	2										3		
CO2		2		2	3								3			
CO3	3		2	2									2		3	
CO4		3		3	2										3	
CO5	2		3		3									3		
CO6	2	2	3		3								2		3	

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161MEE04 COMPUTER INTEGRATED MANUFACTURING L-T-P C
3-0-0 3

Programme: B.E. Mechanical Engineering **Sem: -- Category: PE**

Aim: To gain the knowledge about the Advanced and computerized Manufacturing Techniques followed in the Shop floor of the Industries

Course Outcomes:

The students will be able to

CO1. Understand the concept of CIM
CO2. Explain the components of CIM
CO3. Recognize the Group Technology and CAPP
CO4. List out the various techniques in shop floor control
CO5. Know the concept of FMS
CO6. Familiarize the computer aided planning and control

BASICS OF CIM 9

Brief introduction to CAD and CAM – Manufacturing Planning, Manufacturing control – Introduction to CAD/CAM – Concurrent Engineering – CIM concepts – Computerized elements of CIM system – Types of production – Typical CAD command structure, wire frame modeling, surface modeling and solid modeling (concepts only) in relation to popular CAD packages

COMPONENTS OF CIM 9

CIM as a concept and a technology, CASA/SME model of CIM, CIM II, benefits of CIM, communication matrix in CIM, fundamentals of computer communication in CIM – CIM data transmission methods – serial, parallel, asynchronous, synchronous, modulation, demodulation, simplex and duplex – Types of communication in CIM – point to point (PTP), star and multiplexing. Computer networking in CIM – the seven layer OSI model, LAN model, MAP model, network topologies – star, ring and bus, advantages of networks in CIM

GROUP TECHNOLOGY AND COMPUTER AIDED PROCESS PLANNING 9

History Of Group Technology – role of G.T. in CAD/CAM Integration – part families – classification and coding – DCLASS and MICLASS and OPTIZ 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

SHOP FLOOR CONTROL AND FMS 9

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 system – FMS layout – computer control systems – applications and benefits

COMPUTER AIDED PLANNING, CONTROL AND MONITORING 9

Production planning and control – cost planning and control – inventory management – material requirements planning (MRP) – Lean and Agile Manufacturing – Types of production monitoring systems – structure model of manufacturing – process control and strategies – Direct Digital Control

Total Periods: 45

Text Books:

1. Mikell P. Groover, "Automation, Production Systems and Computer Integrated Manufacturing", Pearson Education (2013)
2. Mikell P. Groover, Emory Zimmers Jr., "CAD/CAM", Prentice Hall of India Pvt. Ltd., (2006)

References:

1. James A. Regh and Henry W.Kreabber, "Computer Integrated Manufacturing", Pearson Education, (2005)
2. Chris McMahon and Jimmie Browne, "CAD CAM Principles, Practice and Manufacturing Management", Pearson Education, (2005)
3. Ranky Paul G., "Computer Integrated Manufacturing", Prentice Hall of India Pvt. Ltd., (2005)
4. Yorem Koren, " Computer Integrated Manufacturing", McGraw Hill, (2005)

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1		1	2							1	1	1		2
CO2	2			2	2							2	1			2
CO3	1		2	1	1					1		1	1		1	1
CO4	2		1	1						1		1	1		1	1
CO5																
CO6	2			1	1					1		1	1			1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161MEE05 DESIGN OF JIGS, FIXTURES AND PRESS TOOLS **L-T-P** **C**

3-0-0 **3**

Programme: B.E. Mechanical Engineering **Sem: --** **Category: PE**

Aim: To study the design principles of Jigs, fixtures and press tools

Course Outcomes:

The students will be able to

CO1. Learn the locating and clamping principles
CO2. Understand the functions and design principles of Jigs and fixtures
CO3. Study the press working terminologies and elements of cutting dies
CO4. Design the die blocks and dies
CO5. Understand the function and design principles of bending and drawing dies
CO6. Familiarize in metal forming and analysis

LOCATING AND CLAMPING PRINCIPLES **9**

Objectives of tool design – Function and advantages of Jigs and fixtures – Basic elements – principles of location – Locating methods and devices – Redundant Location – Principles of clamping – Mechanical actuation – pneumatic and hydraulic actuation Standard parts – Drill bushes and Jig buttons – Tolerances and materials used

JIGS AND FIXTURES **9**

Design and development of jigs and fixtures for given component – Types of Jigs – Post, Turnover, Channel, latch, box, pot, angular post jigs – Indexing jigs – General principles of milling, Lathe, boring, broaching and grinding fixtures – Assembly, Inspection and Welding fixtures – Modular fixturing systems – Quick change fixtures

PRESS WORKING TERMINOLOGIES AND ELEMENTS OF CUTTING DIES **9**

Press Working Terminologies – operations – Types of presses – press accessories – Computation of press capacity – Strip layout – Material Utilization – Shearing action – Clearances – Press Work Materials – Center of pressure – Design of various elements of dies – Die Block – Punch holder, Die set, guide plates – Stops – Strippers – Pilots – Selection of Standard parts – Design and preparation of four standard views of simple blanking, piercing, compound and progressive dies

BENDING AND DRAWING DIES **9**

Difference between bending and drawing – Blank development – Types of Bending dies – Press capacity – Spring back – knockouts – direct and indirect – pressure pads – Ejectors – Variables affecting Metal flow in drawing operations – draw die inserts – draw beads – ironing – Design and development of bending, drawing reverse re-drawing and combination dies – Blank development for axi-symmetric, rectangular and elliptic parts – Single and double action dies

FORMING DIES **9**

Design and development of forming – Single and double action dies Bulging, Swaging, Embossing, coining, curling, hole flanging, shaving and sizing, assembly, fine Blanking dies – recent trends in tool design – computer Aids for sheet metal forming Analysis – Single minute exchange of dies – Poka Yoke

Total Periods: 45

Text Books:

1. Joshi, P.H. “Jigs and Fixtures”, Tata McGraw Hill Publishing Co., Ltd., New Delhi, (2004)
2. Donaldson, Lecain and Gold “Tool Design”, Tata McGraw Hill, (2000)

References:

1. Venkataraman K., “Design of Jigs Fixtures & Press Tools”, Tata McGraw Hill, New Delhi, (2005)
2. Kempster., “Jigs and Fixture Design”, Hoddes and Stoughton, (1974)
3. Joshi P.H., “Press Tools – Design and Construction”, Wheels publishing, (1996)
4. Hoffman, “Jigs and Fixture Design”, Thomson Delmar Learning, Singapore, (2004)

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2		3										3	3		
CO2	3	2	2		2									3	2	
CO3	2		3		2									3		
CO4	3	2		2												2
CO5	1	1	2		1							1		3		
CO6	2			3										2		2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161MEE06	FIREWORKS SAFETY	L-T-P	C
		3-0-0	3

Programme: B.E. Mechanical Engineering **Sem:** -- **Category:** PE

Aim: To learn the properties, preparation of fireworks chemicals and safety in fireworks industry

Course Outcomes:

The students will be able to

CO1. Describe the properties of various chemicals used in fireworks industry
CO2. Recall the concepts of earthing and legal requirements
CO3. Categorize the various pollution and preventions
CO4. Improve the process safety in fireworks industry
CO5. Use the proper material handling techniques / equipments
CO6. Control the wastes and ensure the human safety in fireworks

PROPERTIES OF FIREWORKS CHEMICALS **9**

Fire properties – properties of chemicals used in fireworks – Aluminum powder, Ammonia, Antimony, Barium Carbonate, Barium Chlorate, Barium Nitrate , Boric Acid, Calcium sulfate, Carbon, Charcoal, Magnesium , Phosphorous, Potassium benzoate , Potassium Chlorate, Potassium Nitrate, Potassium per chloride, Sodium Nitrate, Strontium Nitrate, Sulphur – reactions – impact and friction sensitivity

STATIC CHARGE AND DUST **9**

Concept of static charge – reasons – prevention – earthing – types of earthing – lightning – causes and effects – concept, installation and maintenance of lightning arrestor – size of dust – non-respirable – biological barriers – personal protective equipments – pollution prevention

PROCESS SAFETY **9**

Process – quantity, mixing – filling – fuse cutting – fuse fixing – finishing – drying at various stages – packing storage – hand tools – materials, layout: building – distances – factories act – explosive act and rules

MATERIAL HANDLING **9**

Material handling – factors – types – fuse handling – paper caps handling – nitric acid handling in snake eggs manufacture – handling the mix inside factory –material movement – co-down-waste pit – transport restrictions – overhead power lines – fire extinguishers – loose chemicals handling and transport

WASTE CONTROL AND USER SAFETY **9**

Concepts of wastes – wastes in fireworks – disposal – spillages – storage of residues - hazards in display – restrictions in sales outlets – fire prevention and control – burns and scalds – role of fire service

Total Periods: 45

Text Books:

1. Ronald Lancaster, Roy E.A. Butler, J. Mark Lancaster and Takeo Shimizu, “Fireworks Principles and Practice”, Chemical Publishing Company, New York, (2006)
2. John Barton, “Dust Explosion Prevention and Protection”, Institution of Chemical Engineers, UK, (2002)

References:

1. Michael S. Russell, “The Chemistry of Fireworks”, Royal Society of Chemistry, UK, (2009)
2. Geoffrey Lunn, “Guide to Dust Explosion Prevention and Protection”, Institution of Chemical Engineers, UK, (1992)
3. Proceedings of National conference on “Pyro Tech 2013”, by Petroleum and Explosives Safety Organization (PESO), Ministry of Explosives, Government of India, (2013)
4. Bill Ofca, “Fireworks Safety Manual: A Collection of Essays”, Hyde Park, New York, (1990)

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1	1	1		1					1	2	2			
CO2	2	1	3	1		3	2			2			2			
CO3	2	2	3	1		3	3	2			2	1	2			1
CO4	2	1	3	2		3	2		1		2	1	2			2
CO5	2	1	1	2		1	1				2		2	2		2
CO6	2	2	3	2		3	3	2	1	1	2	1	2			1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161MEE07	FOUNDRY TECHNOLOGY	L-T-P	C
		3-0-0	3

Programme: B.E. Mechanical Engineering **Sem:** -- **Category:** PE

Aim: To understand the fundamentals, procedure and applications of various foundry processes

Course Outcomes:

The students will be able to

CO1. Understand the various casting processes
CO2. Know the alloy materials for casting processes
CO3. Familiarize the design of casting systems
CO4. Grasp the recent techniques in casting
CO5. Work in foundry shop material handling
CO6. Recognize the various testing and defects of castings

CASTING PROCESS **9**

Introduction to casting – pattern – materials allowances – coding – types – moulds – mould making, sand – properties, types and testing of sands – core making – type of cores – single box, two box and 3 box molding processes

CASTING METALLURGY **9**

Solidification of pure metal and alloys – shrinkage in cast metals – progressive and directional solidification – Degasification of the melt-casting defects – Castability of steel , Cast Iron, Al alloys , Babbit alloy and Cu alloy

DESIGN OF GATING SYSTEMS **9**

Gating systems and their characteristics; the effects of gates on aspiration; turbulence and dross trap; recent trends – Chvorinov's Rule Riser design; risering curves; NRL method of riser design; feeding distance; risering of complex casting

RECENT TRENDS IN CASTING AND FOUNDRY LAYOUT **9**

Shell molding, precision investment casting, CO_2 molding, centrifugal casting, Die casting, Continuous casting, Counter gravity low pressure casting, Squeeze casting and semisolid processes. Layout of mechanized foundry – sand reclamation – material handling in foundry pollution control in foundry – Computer aided design of casting

TESTING OF CASTINGS **9**

Causes and remedies for casting defects – Destructive testing – NDT – Dye penetrant – magnetic particle – X-ray, ultrasonic cell – studies in testing of joints & castings – methods of elimination and control of dissolved gases in castings – use of statistical quality control in foundry

Total Periods: 45

Text Books:

1. Jain P.L., "Principles of Foundry Technology", Tata McGraw Hill Publishers, (2013)
2. Heime, Looper and Rosenthal, "Principle of metal casting", Tata McGraw Hill, (2015)

References:

1. Taylor H.F., Fleming M.C., "Foundry Engineering", M.C. & Wiley Eastern Ltd., (1993)
2. Chalmers B., "Principles of Solidification", Volume 28 of Wiley Series on the Science and Technology of Materials, (1964)
3. Chakrabarti A.K., "Casting Technology and Cast Alloys", (2005)
4. ASM Handbook, Vol. 15, Casting, (2004)

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3		1			2	1		3			2				3
CO2	3		1			2	1		1			1				3
CO3	3		1			2	1		1			1				3
CO4	3		1		2	2	1		1			1				3
CO5	3		1			2	1		2			2				3
CO6	3		1			2	1		2			2				3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161MEE08 FUNDAMENTALS OF NANO TECHNOLOGY L-T-P C
3-0-0 3

Programme: B.E. Mechanical Engineering **Sem:** -- **Category:** PE

Aim: To learn about basis of nanomaterial science, preparation method, types and application

Course Outcomes:

The students will be able to

CO1. Familiarize about the science of nano materials
CO2. Prepare nano materials using various methods
CO3. Know the various nano materials and oxides
CO4. Identify the various characterization technique
CO5. Understand the applications of MEMS
CO6. Realize the nano information storage system

BASICS OF NANOSCIENCE 9

Nano scale Science and Technology – Implications for Physics, Chemistry, Biology and Engineering – Classifications of nano structured materials – nano particles – quantum dots, nanowires – ultra thinfilms multilayered materials – Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties

GENERAL METHODS OF PREPARATION 9

Bottom-up Synthesis – Top-down Approach: Co-Precipitation, Ultrasonication, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE.

NANOMATERIALS 9

Nanoforms of Carbon – Buckminster fullerene – graphene and carbon nanotube, Single wall carbon Nanotubes (SWCNT) and Multi wall carbon nanotubes (MWCNT) – methods of synthesis (arc-growth, laser ablation, CVD routes, Plasma CVD), structure – property relationships applications – Nanometal oxides – ZnO, TiO_2, MgO, ZrO_2, NiO, nanoalumina, CaO, $AgTiO_2$, Ferrites, Nano clays functionalization and applications

CHARACTERIZATION TECHNIQUES 9

X-ray diffraction technique, Scanning Electron Microscopy – environmental techniques, Transmission Electron Microscopy including high resolution imaging, Surface Analysis techniques – AFM, SPM, STM, SNOM, ESCA, SIMS – Nano indentation

APPLICATIONS 9

Nano InfoTech: Information storage – nanocomputer, molecular switch, super chip, nano crystal, Nano biotechlogy: nanoprobes in medical diagnostics and biotechnology, Nano medicines, Targetted drug delivery, Bioimaging – Micro Electro Mechanical Systems (MEMS), Nano Electro Mechanical Systems (NEMS) – Nano sensors, nano crystalline silver for bacterial inhibition, Nano particles for sun barrier products - In Photostat, printing, solar cell, battery

Total Periods: 45

Text Books:

1. Guozhong Cao, Ying Wang, "Nanostructures and Nanomaterials: Synthesis, Properties, and Applications", World Scientific Publications, Singapore, (2011)
2. Charles P. Poole and Frank J. Ownes, "Introduction to Nanotechnology", Wiley India, New Delhi, (2006)

References:

1. Vollath D., "Nanomaterials: An Introduction to Synthesis, Properties and Applications", Wiley India, New Delhi, (2013)
2. Jeremy Ramsden, "Nanotechnology: An Introduction", Elsevier, UK, (2008)
3. Edelstein A.S., Cammearata R.C., "Nanomaterials: Synthesis, Properties and Applications", Institute of Physics Publishing, Bristol and Philadelphia, (1996)
4. Manasi Karkere, "Nanotechnology: Fundamentals and Applications", I.K. International, New Delhi, (2009)

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3										3	3			
CO2	3	3		3	3							3				2
CO3		3		2								3		3		
CO4			2		3			1	2			3			3	
CO5	3			3	3	2	2					3		3		
CO6			3	2	3							3				2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161MEE09 INDUSTRIAL ENGINEERING & MANAGEMENT L-T-P C
3-0-0 3

Programme: B.E. Mechanical Engineering **Sem:** -- **Category:** PE

Aim: To provide students an insight into the concepts of industrial engineering and organization

Course Outcomes:

The students will be able to

CO1. Forecast the demand using various forecasting techniques
CO2. Know the costing methods
CO3. Understand the concepts of industrial organization.
CO4. Familiarize with principles of work-study and ergonomics
CO5. Study the various aspects of plant design
CO6. Understand the various manufacturing systems

DEMAND FORECASTING AND ELEMENTS OF COST 9

Macro and micro economics – Demand and supply – Factors influencing demand – Elasticity of demand – Demand forecasting – Time series – Exponential smoothing casual forecast – Delphi method – Correlation and Regression – Elements of cost – Determination of Material cost – Labour cost – Expenses – Types of cost – Cost of production – Over head expenses

INDUSTRIAL ORGANISATION 9

Introduction to Industrial Engineering – Concepts – History and Development of Industrial engineering – Roles of Industrial Engineer – Applications – Productivity – Factors affecting productivity – Increasing productivity of resources – Kinds of productivity measures

WORK DESIGN 9

Introduction to work study – Method study – Time study – stopwatch time study – Standard data – Method Time Measurement (M-T-M) – Work sampling – Ergonomics

PLANT LAYOUT 9

Plant location – Factors – Plant layout – Types – Layout design process – Computerized Layout Planning – Construction and Improvement algorithms – ALDEP – CORELAP and CRAFT – Scheduling

GROUP TECHNOLOGY 9

Group technology – Problem definition – Production flow analysis – Heuristic methods of grouping by machine matrices – Flexible Manufacturing System – FMS work stations – Material handling and Storage system – Cellular Manufacturing System

Total Periods: 45

Text Books:

1. Khanna O.P., “Industrial Engineering and Management”, Dhanpat Rai Publications, New Delhi, (2006)
2. Panneerselvam. R. “Production/Operations Management”, Prentice Hall of India, New Delhi, (2012)

References:

1. Patil S.B., Karad A.A. and Kushare P.B., “Industrial Engineering and Management”, Technical Publications, Pune, (2009)
2. Buffa E.S. and Sarin R.K., “Modern Production/Operational Management”, Wiley India, New Delhi, (2009)
3. Dan Reid R., Nada R. Sanders, “Operations Management: An Integrated Approach”, Wiley India, New Delhi, (2016)
4. Nigel Slack, Stuart Chambers, Robert Johnston., “Operation Management”, Pearson Education, New Delhi, (2010)

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	2						2		2	3			2
CO2		2		3	1		1	3				3	2			2
CO3	1			3	1			2	2	2		3		3		3
CO4	2	1			2			3		1		3	1	2		2
CO5	3	2	1	2	3		1	1				3		1		3
CO6	3	2		1	1			2				3			2	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161MEE10 NUCLEAR ENGINEERING L-T-P C
3-0-0 3

Programme: B.E. Mechanical Engineering **Sem:** -- **Category:** PE

Aim: To gain some fundamental knowledge about nuclear physics, nuclear reactor, nuclear fuels, reactors and safe disposal of nuclear wastes

Course Outcomes:

The students will be able to

CO1. Understand the Nuclear Physics
CO2. Identify the Nuclear Reactions and Reaction Materials
CO3. Recognize the Nuclear cycles
CO4. Differentiate Nuclear Fission and Fusion
CO5. Describe the fuel characteristics and types of waste and its disposal
CO6. Know the weapons proliferation

NUCLEAR PHYSICS 9

Nuclear model of an atom – Equivalence of mass and energy – binding – radio activity – half life – neutron interactions – cross sections

NUCLEAR REACTIONS AND REACTION MATERIALS 9

Mechanism of nuclear fission and fusion – radio activity – chain reactions – critical mass and composition – nuclear fuel cycles and its characteristics – uranium production and purification – zirconium, thorium, beryllium

REPROCESSING 9

Nuclear fuel cycles – spent fuel characteristics – role of solvent extraction in reprocessing – solvent extraction equipment

NUCLEAR REACTOR 9

Types of fast breeding reactors – design and construction of fast breeding reactors – heat transfer techniques in nuclear reactors – reactor shielding – Fusion reactors

SAFETY AND DISPOSAL 9

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 Periods: 45

Text Books:

1. Thomas J. Cannoly, "Fundamentals of Nuclear Engineering", John Wiley publication, (1978)
2. Dan Gabriel Cacuci, "Handbook of Nuclear Engineering", Volume-I, Springer, (2010)

References:

1. Collier J.G., and Hewitt G.F, "Introduction to Nuclear power", Hemisphere publishing, New York, (1987)
2. Wakil M.M.El., "Power Plant Technology", McGraw-Hill International, (1984)
3. Ian Hore-Lacy, Stephen Tarlton, Brigita Praznik and Raf Damiaens, "Nuclear Energy in the 21st Century: World Nuclear University Primer", Springer, (2012)
4. Martin, Harbison, Beach and Cole, "An Introduction to Radiation Protection 6E", Springer, (2012)

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2		3	2		2						2	2			
CO2	2		2			2						2		2		
CO3	3													2		
CO4	3								3		1	1				3
CO5	3					3					1	2		3		
CO6	3					3					1	2	1			2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161MEE11	POLYMER TECHNOLOGY	L-T-P	C
		3-0-0	3

Programme: B.E. Mechanical Engineering **Sem:** -- **Category:** PE

Aim: To make the students learn about different plastic processing techniques and various compounding machinery

Course Outcomes:

The students will be able to

CO1. Distinguish various basic processing method employed for Plastics.
CO2. Familiarize injection moulding techniques
CO3. Make products using blow moulding
CO4. Demonstrate the thermoforming products manufacturing process
CO5. Know the calendaring processes and its applications
CO6. Work on extruders and press moulding machines

INJECTION MOULDING **9**

Introduction to polymer processing – plastics processing techniques – injection moulding – terminology – process description – theory of injection moulding – types injection moulding – plunger type injection moulding – screw type injection moulding – defects – causes and remedy

BLOW MOULDING **9**

Fundamentals of the process – complete blow moulding operation – accumulator based machines – extrusion blow moulding – parameters and their effect on product quality control – moulding defects – causes and remedy

THERMOFORMING **9**

Basic process – thermoforming machines and plants – thermoforming materials – simple vacuum forming – drape forming – air slip forming – pressure forming – process factors in thermoforming – defects in thermoformed articles and remedies

CALENDARING **9**

Basic process – types and sizes of typical machines – roll configurations – roll cambering – single rip and double rip arrangements for sheeting – equipments for coating of textile fabrics – friction coating – roll bending – defects – causes and remedy

EXTRUSION AND PRESS FORMING **9**

Ram type and screw type extruders – hot and cold feed extrusion – direct powder extruders – extruder drives – defects in extruded components – causes and remedy – hydraulic and mechanical press – compression moulding – transfer moulding

Total Periods: 45

Text Books:

1. Robert O. Ebewele, “Polymer Science and Technology”, CRC Press, New York, (2000)
2. Myer Kutz, “Applied Plastics Engineering Handbook: Processing and Materials”, Elsevier, UK, (2011)

References:

1. Sinha R., “Outlines of Polymer Technology: Manufacture of Polymers”, PHI, New Delhi, (2004)
2. Dominick V. Rosato, Donald V. Rosato, Matthew V. Rosato, “Plastic Product Material and Process Selection Handbook”, Elsevier, UK, (2004)
3. Michael L. Berins, “Plastic Engineering Handbook of the Society of the Plastics Industry”, Kluwer Academic Publishers, Netherland, (1991)
4. Charles A. Harper, “Handbook of Plastic Processes”, John Wiley, NJ, (2006)

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1			2			1			1	2	2	1			2
CO2	1			2			1			1	2	2	1	1		2
CO3	1				1		1					2	1	1		2
CO4	1			1	1		1					1	2	1		1
CO5	1			2	1		2					1	2	1		2
CO6	1			3	1		3					1	2	1		2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161MEE12 PROCESS PLANNING AND COST ESTIMATION L-T-P C

3-0-0 3

Programme: B.E. Mechanical Engineering **Sem:** -- **Category:** PE

Aim: To impart clear knowledge about process planning, costing and estimation of machining time

Course Outcomes:

The students will be able to

CO1. Demonstrate the importance of Work study and Ergonomics
CO2. Describe the different approaches of Process Planning
CO3. Illustrate manufacturing logic and knowledge
CO4. Know the different cost and its components
CO5. Estimate the cost in fabrication shops
CO6. Find machining time calculation for different process

WORK STUDY AND ERGONOMICS 9

Method study – definition – objectives – motion economy – principles – Tools and Techniques – applications – work measurements – tools and techniques – standard time – ergonomics – principles – applications

PROCESS PLANNING 9

Definition – objective – scope – approaches to process planning – Process planning activities – Finished part requirements – operating sequences – machine selection – material selection parameters – documents for process planning – developing manufacturing logic and knowledge – production time calculation

COSTING AND ESTIMATION 9

Aims of costing and estimation – introduction to costs – cost accounting – classification of cost – elements of cost – types of estimates – methods of estimates – data requirements and sources – collection of cost – allowances in estimation – depreciation – analysis of depreciation

ESTIMATION IN FABRICATION SHOPS 9

Estimation in foundry shop – Pattern cost – Casting cost – Estimation in Forging shop – Losses in forging – Forging cost – Estimation in welding shop – Gas cutting – Electric welding

ESTIMATION OF MACHINING TIME AND COST 9

Estimation of machining time for lathe operations – Estimation of machining time for drilling, boring, shaping, planning, milling and grinding operations

Total Periods: 45

Text Books:

1. Banga T.R and Sharma S.C, “Estimating and Costing”, Khanna publishers, New Delhi, (2012)
2. Khanna O.P., “Industrial Engineering and Management”, Dhanpat Rai & Sons, (2010)

References:

1. Russell R.S and Tailor, B.W, “Operations Management”, PHI, (2008)
2. Chitale A.V. and Gupta R.C., “Product Design and Manufacturing”, PHI, (2003)
3. Tailor B., Willip F. Ostwalal and Jairo Munez, “Manufacturing Processes and Systems”, John wiley, (1998)
4. Nadha Muni Reddy C., “Industrial Engineering and Management”, New Age International (P) Limited, New Delhi, (2011)

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1					3											2
CO2					3					2	2					2
CO3							1	1					2			
CO4	2				2										2	
CO5												1				2
CO6								2			1					2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161MEE13	PRODUCTION PLANNING AND CONTROL	L-T-P	C
		3-0-0	3

Programme: B.E. Mechanical Engineering **Sem:** -- **Category:** PE

Aim: To realize the various components and functions of product planning, process planning, production scheduling and inventory Control

Course Outcomes:

The students will be able to

CO1. Familiarize in production control and its development
CO2. Understand the concepts of work study and work measurement
CO3. Familiarize the product planning and process planning
CO4. Acquire knowledge in production scheduling
CO5. Realize the need of inventory control
CO6. Know the recent trends in PPC

PRODUCTION CONTROL AND DEVELOPMENT **9**

Objectives and benefits of planning and control – Functions of production control – Types of production – Product development and design – Marketing, Functional, Operational, aesthetic, Durability and dependability aspect – Profit consideration – Standardization, Simplification & specialization – Break even analysis

WORK STUDY AND WORK MEASUREMENT **9**

Method study, basic procedure – Selection – Recording of process – Critical analysis, Development – Implementation – Micro motion and memo motion study – work measurement – Techniques of work measurement – Time study – Production study – Work sampling – Predetermined motion time standards

PRODUCT PLANNING AND PROCESS PLANNING **9**

Product planning – Extending the original product information – Value analysis – Problems in lack of product planning – Process planning and routing – Pre requisite information needed for process planning – Steps in process planning – Quantity determination in batch production – Machine capacity, balancing – Analysis of process capabilities in a multi product system

PRODUCTION SCHEDULING **9**

Production Control Systems – Loading and scheduling – Master Scheduling – Scheduling rules – Gantt charts – Perpetual loading – Basic scheduling problems – Line of balance – Flow production scheduling – Batch production scheduling – Product sequencing – Production Control systems – Periodic batch control – Dispatching – Progress reporting and expediting – Manufacturing lead time – Techniques for aligning completion times and due dates

INVENTORY CONTROL AND RECENT TRENDS IN PPC **9**

Inventory control – Purpose of holding stock – Effect of demand on inventories – Ordering procedures – Two bin system – Ordering cycle system – Determination of Economic order quantity and economic lot size – ABC analysis – Recorder procedure – Introduction to computer integrated production planning systems

Total Periods: 45

Text Books:

1. Martand Telsang, “Industrial Engineering and Production Management”, S. Chand and Company, (2006)
2. James B. Dilworth, “Operations Management: Providing Value in Goods and Services”, Dryden Press, (2000)

References:

1. Mukhopadhyay S.K., “Production Planning Control, Text and Cases”, PHI Publishers, (2015)
2. Mahajan M., “Industrial Engineering and Production Management”, Dhanpat Rai Publisher, (2010)
3. Elwood S. Buffa, and Rakesh K. Sarin, “Modern Production/Operations Management”, Wiley India edition, (2009)
4. Kanishka Bedi, “Production and Operations management”, Oxford university press, Edition (2016)

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2		2	3						2	2		2		3
CO2	2	2	2	3	2						2	2		2		3
CO3	2	3		3	2						2	2		2	3	3
CO4	2	2	3	3	2						2	3		2	3	3
CO5	2	3		2	2						2	2		2		3
CO6	2	2		3	2						2	2		2	3	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161MEE14	RAPID PROTOTYPING	L-T-P	C
		3-0-0	3

Programme: B.E. Mechanical Engineering **Sem:** -- **Category:** PE

Aim: To provide knowledge on different types of Rapid Prototyping systems and its applications in various fields

Course Outcomes:

The students will be able to

CO1. Gain depth knowledge in different types of Rapid Prototyping systems and its applications in various fields
CO2. Understand the various geometric modeling and meshing techniques
CO3. Recognize the data formats and interface
CO4. Expose in liquid and solid based engineering and digitization techniques
CO5. Know the powder sintering processes and its application
CO6. Design and generate supporting structures for any component

BASICS OF RAPID PROTOTYPING **9**

Need – Development of RP systems – RP process chain – Impact of Rapid Prototyping on Product Development – Digital prototyping – Virtual prototyping – Rapid Tooling – Benefits – Applications

REVERSE ENGINEERING **9**

Model Reconstruction – Data Processing for Rapid Prototyping: geometric modeling techniques: Wire frame, surface and solid modeling – data formats – Data interfacing, Part orientation and support generation, Support structure design, Model Slicing and contour data organization, direct and adaptive slicing, Tool path generation

LIQUID BASED AND SOLID BASED RAPID PROTOTYPING SYSTEMS **9**

Stereolithography: Apparatus: Principle, per-build process, part-building, post-build processes, photo polymerization of SL resins, part quality and process planning, recoating issues, materials, advantages, limitations and applications. Working principle, process, strengths, weaknesses and applications of Fused deposition Modeling, Solid Ground Curing, Laminated object manufacturing – Case studies

POWDER BASED RAPID PROTOTYPING SYSTEMS **9**

Selective Laser Sintering(SLS): Principle, process, Indirect and direct SLS – powder structures, modeling of SLS, materials, post processing, post curing, surface deviation and accuracy, Applications – Laser Engineered Net Shaping: Processes, materials, products, advantages, limitations and applications – Case Studies

OTHER RAPID PROTOTYPING TECHNOLOGIES **9**

Three dimensional Printing: Principle, basic process, Physics of 3DP, types of printing, process capabilities, material system. Solid based, Liquid based and powder based 3DP systems, strength and weakness, Applications and case studies. Shape Deposition Manufacturing: Introduction, basic process, shape decomposition, mold SDM and applications. Selective Laser Melting, Electron Beam Melting – Rapid manufacturing

Total Periods: 45

Text Books

1. Chua C.K., Leong K.F., and Lim C.S., “Rapid prototyping: Principles and applications”, World Scientific Publishers, (2010)
2. Andreas Gebhardt, “Rapid prototyping”, Hanser Gardener Publications, (2003)

References

1. Liou W. Liou, Frank W. Liou, “Rapid Prototyping and Engineering applications: A tool box for prototype development”, CRC Press, (2007)
2. Ali K. Kamrani, Emad Abouel Nasr, “Rapid Prototyping: Theory and practice”, Springer, (2006)
3. Peter D.Hilton Hilton/Jacobs, Paul F.Jacobs, “Rapid Tooling: Technologies and Industrial Applications”, CRC press, (2000)
4. Chee Kai Chua, Kah Fai Leong, “3D-Printing and Additive Manufacturing: Principles and Applications”, World Scientific, (2014)

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	3	1	2	3	2	1					1	1	2	2	3
CO2	2	2	1	3	3	2	2					1	1	3	2	3
CO3	1	2	1	3	3	2	3					1		2	3	2
CO4	2	2	1	3	3	2	1					1		2	2	2
CO5	1	2	1	3	3	2	1					1		2	2	2
CO6	1	3	2	3	3	3	1					1		2	2	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161MEE15 REFRIGERATION AND AIR CONDITIONING L-T-P C
3-0-0 3

Programme: B.E. Mechanical Engineering **Sem:** -- **Category:** PE

Aim: To provide knowledge on various refrigeration cycles, components, refrigerants and Refrigeration and Air conditioning systems

The students will be able to

CO1. Construct the fundamentals of air conditioning & refrigeration cycle and C.O.P.
CO2. Distinguish the types of compressor and classifications of refrigerants
CO3. Relate the psychrometric processes using psychrometric charts
CO4. Analyze the performance of summer and window air conditioning and cooling load calculation of air conditioning system
CO5. Determine the duct design using friction method, air quality concept
CO6. Know the application of storage plants

REFRIGERATION CYCLE 9

Review of thermodynamic principles of refrigeration – Air Refrigeration cycles – Carnot refrigeration cycle – Vapour compression refrigeration cycle – use of P.H. charts – multistage compression and multiple evaporator systems – cascade system – COP comparison

REFRIGERANTS AND SYSTEM COMPONENTS 9

Refrigerants – properties – selection of refrigerants, Alternate Refrigerants, Cycling controls – Compressors – reciprocating and rotary (elementary treatment), Types of condensers, evaporators, cooling towers – Functional aspects

PSYCHROMETRY 9

Psychrometric processes use of psychrometric charts – Grand and Room Sensible Heat Factors – bypass factor – air washers, Cooling load calculation of air conditioning system

AIR CONDITIONING SYSTEMS 9

Comfort air conditioning – summer and Winter Air conditioning – working principles of centralized air conditioning systems, Split, Ductable split, Packaged Air conditioning, VAV & VRV Systems – Duct Design by equal friction method, Indoor Air quality concepts – Environmental effects

UNCONVENTIONAL REFRIGERATION CYCLES 9

Vapour Absorption system – Ejector jet, Steam jet refrigeration and thermo electric refrigeration – Applications – ice plant – food storage plants – milk – chilling plants – petroleum refineries

Total Periods: 45

Text Books:

1. Khurmi R.S. & Gupta J.K., "Refrigeration and Air Conditioning", S.Chand Publication, (2009)
2. Arora C.P., "Refrigeration and Air Conditioning", Tata McGraw Hill, New Delhi, (2008)

References:

1. Roy J. Dossat, "Principles of Refrigeration", Pearson Education, (2007)
2. Jordon and Priester, "Refrigeration and Air Conditioning", Prentice Hall of India Pvt. Ltd., New Delhi, (2015)
3. Stoecker N.F. and Jones, "Refrigeration and Air Conditioning", TMH, New Delhi, (2011)
4. Jones, "Air Conditioning Engineering", Edward Amold Publication (2010)

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	1	3	1		2	2		1			2	2	2		3
CO2	1	1	2	1		2	2		1			2	2	2		3
CO3	2	2	1	3								1	2	2		3
CO4	3	2	3	2		2	2		1			2	2	2		3
CO5	3	2	3	2		1			1			2	2	2		3
CO6	1	1	3	1		2	2		1			1	1	2		3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161MEE16 WELDING TECHNOLOGY L-T-P C
3-0-0 3

Programme: B.E. Mechanical Engineering **Sem:** -- **Category:** PE

Aim: To learn the concepts of metal joining and inspection

Course Outcomes:

The students will be able to

CO1. Understand the basic concepts, working principles of welding
CO2. Know the special welding processes
CO3. Learn different welding methods and its applications
CO4. Acquire knowledge about welding automation
CO5. Examine the welding defects
CO6. Learn destructive, non destructive testing and inspection of welded joints

BASICS AND PRINCIPLES OF WELDING PROCESS 9

Welding – weldability – classification of welding – types of weld joints – weld position – edge preparation – fluxes – filler – safety aspects in welding – gas welding – arc welding – electrode: types, selection – coding – welding symbols

SPECIAL WELDING PROCESSES 9

Shielded metal arc welding, GTAW, GMAW, SAW, Resistance welding (spot, seam, projection, percussion, flash types) – atomic hydrogen arc welding – Thermit welding

ADVANCED WELDING PROCESSES 9

Electron beam and Laser beam welding – plasma arc welding – stud welding – friction welding – explosive welding – ultrasonic welding – welding of plastics – brazing and soldering

AUTOMATED WELDING 9

Automation – welding automation – welding operation, structure analysis – classification of welding automation – Introduction to welding robots – robotic welding system – types of welding robots – Robot selection mechanics – Design of welding robots – Joint tracking system – welding fixtures

WELD DEFECTS AND INSPECTION AND TESTING OF WELDING 9

Weld defect – Surface defects, subsurface defect – Sources of weld defect – Introduction to inspection and testing of welds – Types of testing & inspection: Visual inspection and measurement, Destructive Testing – Tensile Tests, Impact Tests, Bend Tests, Break Tests, Etch Tests – Non-Destructive Testing – Liquid Penetrant Testing, Magnetic Particle Testing, Eddy Current Testing, Radio Graphic Testing, Magneto Graphic Testing, Ultrosonic Testing – Acceptance levels of arc welding defects

Total Periods: 45

Text Books:

1. Little, "Welding technology", Tata McGraw Hill Publishing Company Pvt. Ltd., New Delhi, (2004)
2. Khanna O.P., "A text book of Welding Technology", Dhanpat rai publications, New Delhi, (2002)

References:

1. Parmer R.S., "Welding Engineering & Technology", Khanna Publishers, New Delhi, (2008)
2. Baldev Raj, V. Shankar, A. K. Bhaduri, "Welding Technology for Engineers", Alpha Science International, USA, (2006)
3. Rizvi S.A., "Advanced Welding Technology", S. K. Kataria & Sons, New Delhi, (2010)
4. William A. Bowditch, Kevin E. Bowditch, Mark A. Bowditch, "Welding Technology Fundamentals", Goodheart Willcox Publisher, USA, (2009)

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3		2			2	1		2			3				3
CO2	3		2			2	1		2			3				3
CO3	3		1			2	1		2			2				3
CO4	3		1			2	1		2			2				3
CO5	3		1			2	1		2			2				3
CO6	3		1			2	1		2			2				3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161MEE17 ADDITIVE MANUFACTURING L-T-P C
3-0-0 3

Programme: B.E. Mechanical Engineering **Sem:** -- **Category:** PE

Aim: To familiar with the characteristics of the different materials those are used in AM

Course Outcomes:

The students will be able to

CO1. Understand the basic concepts of additive manufacturing
CO2. Collect and manipulate the data from manufacturing field
CO3. Know the software's for additive manufacturing technology
CO4. Learn liquid and solid based additive manufacturing and its applications
CO5. Gain knowledge in powder based additive manufacturing
CO6. Examine the possibilities and limitations in medical and bio additive manufacturing

BASICS OF AM 9

Overview – History – Need – Classification – Additive Manufacturing Technology in product development – Materials for Additive Manufacturing Technology – Tooling – Applications

CAD & REVERSE ENGINEERING 9

Basic Concept – Digitization techniques – Model Reconstruction – Data Processing for Additive Manufacturing Technology: CAD model preparation – Part Orientation and support generation – Model Slicing – Tool path Generation – Softwares for Additive Manufacturing Technology: MIMICS, MAGICS

LIQUID BASED AND SOLID BASED ADDITIVE MANUFACTURING SYSTEMS 9

Classification – Liquid based system – Stereolithography Apparatus (SLA) – Principle, process, advantages and applications – Solid based system – Fused Deposition Modeling – Principle, process, advantages and applications – Laminated Object Manufacturing

POWDER BASED ADDITIVE MANUFACTURING SYSTEMS 9

Selective Laser Sintering – Principles of SLS process – Process, advantages and applications – Three Dimensional Printing – Principle, process, advantages and applications – Laser Engineered Net Shaping (LENS), Electron Beam Melting

MEDICAL AND BIO-ADDITIVE MANUFACTURING 9

Customized implants and prosthesis: Design and production – Bio-Additive Manufacturing – Computer Aided Tissue Engineering (CATE) – Case studies

Total Periods: 45

Text Books:

1. Chua C.K., Leong K.F., and Lim C.S., "Rapid prototyping: Principles and applications", World Scientific Publishers, (2010)
2. Gebhardt A., "Rapid prototyping", Hanser Gardener Publications, (2003)

References:

1. Liou L.W. and Liou F.W., "Rapid Prototyping and Engineering applications : A tool box for prototype development", CRC Press, (2007)
2. Kamrani A.K. and Nasr E.A., "Rapid Prototyping: Theory and practice", Springer, (2006)
3. Hilton P.D. and Jacobs P.F., "Rapid Tooling: Technologies and Industrial Applications", CRC press, (2000)
4. Ian Gibson, David Rosen and Brent Stucker, "Additive Manufacturing Technologies: 3D printing, Rapid prototyping and Direct Digital Manufacturing", Springer, (2014)

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	3	1	2	3	2	1					1	1	2	2	3
CO2	2	2	1	3	3	2	2					3	1	3	2	3
CO3	2	2	1	3	3	2	1					3		2	2	2
CO4	2	2	1	3	3	2	1					1		2	2	2
CO5	1	2	1	3	3	2	1					1		2	2	2
CO6	1	2	1	3	3	2	1					1		2	2	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

OPEN ELECTIVES

161OE601 MAINTENANCE ENGINEERING L-T-P C
3-0-0 3

Programme: B.E. Mechanical Engineering **Sem:** -- **Category:** OE

Aim: To understand the principles, functions and practices adapted in industry for the successful management of maintenance activities

Course Outcomes:

The students will be able to

CO1. Know the principles of maintenance planning
CO2. Gain knowledge in maintenance organization and economics
CO3. Understand the maintenance policies – preventive maintenance
CO4. Familiarize the condition monitoring
CO5. Identify the repair methods for basic machine elements
CO6. Understand the repair methods for material handling equipment

PRINCIPLES AND PRACTICES OF MAINTENANCE PLANNING 9

Basic Principles of maintenance planning – Objectives and principles of planned maintenance activity – Importance and benefits of sound Maintenance systems – Reliability and machine availability – MTBF, MTTR and MWT – Factors of availability – Maintenance organization – Maintenance economics

MAINTENANCE POLICIES–PREVENTIVE MAINTENANCE 9

Maintenance categories – Comparative merits of each category – Preventive maintenance, maintenance schedules, repair cycle – Principles and methods of lubrication – TPM

CONDITION MONITORING 9

Condition Monitoring – Cost comparison with and without CM – On-load testing and off- load testing – Methods and instruments for CM – Temperature sensitive tapes – Pistol thermometers – wear-debris analysis

REPAIR METHODS FOR BASIC MACHINE ELEMENTS 9

Repair methods for beds, slideways, spindles, gears, lead screws and bearings – Failure analysis – Failures and their development – Logical fault location methods – Sequential fault location

REPAIR METHODS FOR MATERIAL HANDLING EQUIPMENT 9

Repair methods for Material handling equipment – Equipment records – Job order systems – Use of computers in maintenance

Total Periods: 45

Text Books:

1. Srivastava S.K., “Industrial Maintenance Management”, - S. Chand and Co., (1981)
2. Bhattacharya S.N., “Installation, Servicing and Maintenance”, S. Chand and Co., (1995)

References:

1. White E.N., “Maintenance Planning”, Gower Press, (1979)
2. Garg M.R., “Industrial Maintenance”, S. Chand & Co., (1986)
3. Higgins L.R., “Maintenance Engineering Hand book”, McGraw Hill, (1988)
4. Davies, “Handbook of Condition Monitoring”, Chapman & Hall, (1996)

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	1	2	2	2	2	1	3		2		2		2
CO2		2	2	3	1	1	2	1	1	2	2	2		2		2
CO3	1	2	2	2	2	2	2	2	2		2	2	1	2		2
CO4	1	3	2	2	2		1	2	2	1		2	1	2		2
CO5	1	3	2	2	2	2	2		2			2	1	2		2
CO6	2	3	2	3	3				3	2		2		2	2	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161OE602 NON DESTRUCTIVE TESTING AND MATERIALS L-T-P C
3-0-0 3

Programme: B.E. Mechanical Engineering **Sem:** -- **Category:** OE

Aim: To study and understand the various Non Destructive Evaluation and Testing methods, theory and their industrial applications

Course Outcomes:

The students will be able to

CO1. Differentiate various defect types and select the appropriate NDT methods for better evaluation
CO2. Explain basic knowledge of surface NDE techniques
CO3. Handle various inspection instrument with established procedures
CO4. Demonstrate their understanding of non-destructive testing principles
CO5. have a basic knowledge of ultrasonic testing which enables them to perform inspection of samples
CO6. Know the radiographic testing, interpretation and evaluation

OVERVIEW OF NDT **9**

Overview of the Non Destructive Testing NDT Versus Mechanical testing, Methods for the detection of manufacturing defects as well as material characterization, Relative merits and limitations, Various physical characteristics of materials and their applications in NDT., Visual inspection

SURFACE NDE METHODS **9**

Liquid Penetrant Testing – Principles, types and properties of liquid penetrants, developers, advantages and limitations of various methods, Testing Procedure, Interpretation of results – Magnetic Particle Testing – Theory of magnetism, inspection materials Magnetization methods, Interpretation and evaluation of test indications, Principles and methods of demagnetization, Residual magnetism

THERMOGRAPHY AND EDDY CURRENT TESTING **9**

Thermography – Principles, Contact and non contact inspection methods, Techniques for applying liquid crystals, Advantages and limitation – infrared radiation and infrared detectors, Instrumentations and methods, applications – Eddy Current Testing – Generation of eddy currents, Properties of eddy currents, Eddy current sensing elements, Probes, Instrumentation, Types of arrangement, Applications, advantages, Limitations, Interpretation/Evaluation

ULTRASONIC TESTING AND ACOUSTIC EMISSION **9**

Ultrasonic Testing – Principle, Transducers, transmission and pulse-echo method, straight beam and angle beam, instrumentation, data representation, A/Scan, B-scan, C-scan – Phased Array Ultrasound, Time of Flight Diffraction – Acoustic Emission Technique-Principle, AE parameters, Applications

RADIOGRAPHY **9**

Principle, interaction of X-Ray with matter, imaging, film and film less techniques, types and use of filters and screens, geometric factors, Inverse square, law, characteristics of films – graininess, density, speed, contrast, characteristic curves, Penetrameters, Exposure charts, Radiographic equivalence. Fluoroscopy-Xero-Radiography, Computed Radiography, Computed Tomography

Total Periods: 45

Text Books:

1. Baldev Raj, Jayakumar T., Thavasimuthu M., “Practical Non Destructive Testing”, Narosa Publishing House, (2009)
2. Ravi Prakash, “Non Destructive Testing Techniques”, New Age International Publishers, (2010)

References:

1. Gnanaguru R. and Hari Balaji V., “Non Destructive Testing and Materials”, Sams Publishers, Chennai, (2016)
2. Paul E. Mix, “Introduction to Non Destructive testing: a training guide”, Wiley, (2005)
3. Charles J. Hellier, “Handbook of Non Destructive evaluation”, McGraw Hill, New York, (2001)
4. ASM Metals Handbook, “Non Destructive Evaluation and Quality Control”, American Society of Metals, Metals Park, Ohio, USA, (2001)

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3		2	2	2	2	1		2	2	1			2	2	3
CO2	2	1	2		2	2	2		2	1			2	1		3
CO3	2			1	2	1	2		2						2	3
CO4	2	3	2	1	2				1		2	3	2			3
CO5	3	2	1	1			2	1	1		3		3	2		3
CO6		3	2	1	1		2	2		3	2	1		2	2	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161OE603 **OPERATIONS RESEARCH** **L-T-P C**
3-0-0 3

Programme: B.E. Mechanical Engineering **Sem:** -- **Category:** OE

Aim: To understand the various techniques of optimization in utilization of resources, operations research techniques for industrial real world problems

Course Outcomes:

The students will be able to

CO1. Gain knowledge on Operations Research for industrial solutions
CO2. Apply L.P.P. in industrial optimization problems
CO3. Solve transportation problems using various OR methods
CO4. Solve assignment problems using various algorithms
CO5. Analyze the shortest route and critical path in a network
CO6. Apply OR methods in replacement strategy

LINEAR MODELS **9**

Origin of Operations Research – The phases of O.R – Applications – Linear Programming: Formulation – Graphical method – Simplex method – Artificial Variable techniques: Big M Method

TRANSPORTATION MODELS **9**

Transportation Problems: Optimal solution by North West corner method – Vogel's Approximation method – Least cost method – MODI method

ASSIGNMENT MODELS **9**

Assignment Problems: Formulation – Unbalanced Assignment Problem – Hungarian algorithm – Traveling Salesman Problem

NETWORK MODELS **9**

Network models – Shortest route – Minimal spanning tree – Maximum flow models – Project network – CPM and PERT networks – Critical path scheduling

REPLACEMENT MODELS **9**

Replacement Models: Replacement of items that deteriorate with time – Value of money changing with time & not changing with time – Optimum replacement policy: Individual & Group replacement

Total Periods: 45

Text Books:

1. Natarajan A.M., Balasubramani P., Tamilarasi A., "Operations Research", Pearson Publications., New Delhi, (2009)
2. Hamdy A. Taha, "Operation Research - An Introduction", Pearson Publications., New Delhi, (2009)

References:

1. Ravindran A., Phillips Don T., Solberg James J., "Operations Research: Principles and Practice", John Wiley & Sons, New Delhi, (2011)
2. Panneerselvam R., "Operations Research", Prentice Hall of India., New Delhi, (2010)
3. Prem Kumar Gupta and Hira D.S., "Introduction to Operations Research", S. Chand and Co., New Delhi, (2004)
4. Frederick S. Hiller, Gerald J. Liberman, "Operations Research–Concepts and Cases", Tata McGraw-Hill Publishing Company Pvt. Ltd., New Delhi, (2010)

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	2	1		1			2		2	3	2	2	2
CO2	3	2	2	2	2		1			2		3	3			2
CO3	3	2	2	2	2		1			2		3	3	2		2
CO4	3	2	2	2	2		1			2		3	3			2
CO5	3	2	2	2	2		1			2		3	3	2		2
CO6	3	2	2	2	2		1			2		3	3	2	2	2

: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161OE604 RENEWABLE SOURCES OF ENERGY L-T-P C
3-0-0 3

Programme: B.E. Mechanical Engineering **Sem:** -- **Category:** OE

Aim: To study the renewable energy resources and its economics of the utilization and environmental merits

Course Outcomes:

The students will be able to

CO1. Clarify the different renewable energy sources and its applications
CO2. Explain the wind energy systems with hybrid systems
CO3. Group the bio energy sources and its environmental merits
CO4. Illustrate the various power plants and their environmental issues
CO5. Propose the new power generation systems
CO6. Do research in fuel cells

SOLAR ENERGY **9**

Solar Radiation – Measurements of solar Radiation and sunshine – Solar Thermal Collectors – Flat Plate and Concentrating Collectors – Solar Applications – fundamentals of photo Voltaic Conversion – solar Cells – PV Systems – PV Applications

WIND ENERGY **9**

Wind Data and Energy Estimation – wind Energy Conversion Systems – Wind Energy generators and its performance – Wind Energy Storage – Applications – Hybrid systems

BIO – ENERGY **9**

Biomass, Biogas, Source, Composition, Technology for utilization – Biomass direct combustion – Biomass gasifier – Biogas plant – Digesters – Ethanol production – Bio diesel production and economics

OTEC, TODAL, GEOTHERMAL AND HYDEL ENERGY **9**

Tidal energy – Wave energy – Data, Technology options – Open and closed OTEC Cycles – Smallhydro, turbines – Geothermal energy sources, power plant and environmental issues

NEW ENERGY SOURCES **9**

Hydrogen, generation, storage, transport and utilization, Applications: power generation, transport – Fuel cells – technologies, types – economics and the power generation

Total Periods: 45

Text Books:

1. Gupta A., "Non-Conventional Energy Resources", Umesh Publication, (2012)
2. Rai G.D., "Non-Conventional Sources of Energy", Khanna Publisher, New Delhi, (2009)

References:

1. Godfrey Boyle, "Renewable Energy, Power for a Sustainable Future", Oxford University Press, U.K., (2000)
2. Twidell J.W. & Weir A., "Renewable Energy Sources", EFN Spon Ltd., UK, (1986)
3. Tiwari G.N., "Solar Energy – Fundamentals Design, Modelling and applications", Narosa Publishing House, New Delhi, (2002)
4. Freris L.L., "Wind Energy Conversion systems", Prentice Hall, UK, (2002)

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1		2			3	2	3	2		2	3	3	2	2	2	
CO2	2	2	2	2	3	3	3	2		2	3	3	2	3	3	2
CO3			1				3	3		3	3	3		3		
CO4	3		2			3	3	3		2	2	3	1	2		3
CO5	2		2	3	2	2	3	3	2	2	3	3	2	2		1
CO6	1	2	2	3		2		2	3	3	2	2	2	2		3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161OE605	ROBOTICS	L-T-P	C
		3-0-0	3

Programme: B.E. Mechanical Engineering **Sem:** -- **Category:** OE

Aim: To understand the basic concepts associated with the design and functioning and applications of Robots and robot programming

Course Outcomes:

The students will be able to

CO1. Explain the robot anatomy, robot parts and functions
CO2. Define robot drive systems and end effectors
CO3. Identify the concept of sensors and actuators
CO4. Know the image processing and analysis for inspection and identification
CO5. Demonstrate the robot kinematics and programming principles for robot control
CO6. Illustrate the implementation and robot economics

FUNDAMENTALS OF ROBOT **9**

Robot – Definition – Robot Anatomy – Co-ordinate Systems, Work Envelope, types and classification – Specifications – Pitch, Yaw, Roll, Joint Notations, Speed of Motion, Pay Load – Robot Parts and Functions – Need for Robots – Different Applications

ROBOT DRIVE SYSTEMS AND END EFFECTORS **9**

Pneumatic Drives – Hydraulic Drives – Mechanical Drives – Electrical Drives – D.C. Servo Motors, Stepper Motor, A.C. Servo Motors – Salient Features, Applications and Comparison of Drives End Effectors – Grippers – Mechanical Grippers, Pneumatic and Hydraulic Grippers, Magnetic Grippers, Vacuum Grippers – Two Fingered and Three Fingered Grippers– Internal Grippers and External Grippers– Selection and Design Considerations

SENSORS AND MACHINE VISION **9**

Requirements of a sensor – Position of sensors (Piezo Electric Sensor, LVDT, Resolvers, Optical Encoders, Pneumatic Position Sensors), Range Sensors (Triangulation Principle, Structured, Lighting Approach, Time of Flight Range Finders, Laser Range Meters), Proximity Sensors (Inductive, Hall Effect, Capacitive, Ultrasonic and Optical Proximity Sensors), Touch Sensors, Wrist Sensors, Compliance Sensors, Slip Sensors – Camera, Frame Grabber, Sensing and Digitizing Image Data – Signal Conversion, Image Storage, Lighting Techniques – Image Processing and Analysis – Algorithms – Inspection

ROBOT KINEMATICS AND ROBOT PROGRAMMING **9**

Forward Kinematics, Inverse Kinematics and Differences – DH parameters – Forward Kinematics and Reverse Kinematics of Manipulators with Two, Three Degrees of Freedom, Four Degrees of Freedom (In 3 Dimensional) – Deviations and Problems – Teach Pendant Programming, Lead through programming, Robot programming Languages – VAL Programming – Motion Commands, Sensor Commands, End effector commands, and Simple programs

IMPLEMENTATION AND ROBOT ECONOMICS **9**

RGV, AGV – Implementation of Robots in Industries – Various Steps – Safety Considerations for Robot Operations – Economic Analysis of Robots – Pay back Method, EUAC Method, Rate of Return Method

Total Periods: 45

Text Books:

1. Groover M.P., “Industrial Robotics–Technology, Programming and Applications”, McGraw-Hill, (2001)
2. Fu K.S., Gonzalz R.C., and Lee C.S.G., “Robotics Control, Sensing, Vision and Intelligence”, McGraw-Hill Book Co., (1987)

References:

1. Deb S.R., “Robotics Technology and Flexible Automation”, Tata McGraw-Hill Publication, (2008)
2. Yoram Koren, “Robotics for Engineers”, McGraw-Hill Book Co., (1992)
3. Janakiraman P.A., “Robotics and Image Processing”, Tata McGraw-Hill, (1995)
4. Saha S., “Introduction to Robotics”, Tata McGraw-Hill Publication, (2008)

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	1	3	2	1							3	3	2		2
CO2	3	3	2		2		2	2			1	3	3	2		2
CO3	3	3	2		2		2	2			1	3	3	2		2
CO4	3	3	2	1	2		2	2			1	3	3	2		2
CO5	3	3	2	2	2		3	3			1	3	3	2	2	2
CO6	3	2			1	2	2	2	2	2	3	3	3	2		2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161OE606	PROFESSIONAL ETHICS IN ENGINEERING	L-T-P	C
		3-0-0	3

Programme: B.E. Mechanical Engineering **Sem:** 8 **Category:** PE

Aim: To create an awareness on Engineering Ethics and human values. To instill moral and social values and loyalty and to appreciate the rights of others

Course Outcomes:

The students will be able to

CO1. Summarize the various concepts and theories of Ethics
CO2. Illustrate the role of Engineers in experimentation
CO3. Estimate risk factors and analyze the various ways of reducing the risk
CO4. Outline the rights and responsibility of engineers in bargaining and conflict Management
CO5. Know how to get patent rights
CO6. Analyze the ethical issues in global level

ENGINEERING ETHICS **9**

Senses of Engineering Ethics – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Professions and Professionalism – Professional Ideals and Virtues – Uses of Ethical Theories.

ENGINEERING AS SOCIAL EXPERIMENTATION **9**

Engineering as Experimentation – Engineers as responsible Experimenters – Research Ethics – Codes of Ethics – Industrial Standards – A Balanced Outlook on Law – The Challenger Case Study.

ENGINEER'S RESPONSIBILITY FOR SAFETY **9**

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis – Reducing Risk – The Government Regulator's Approach to Risk – Chernobyl Case Studies and Bhopal.

RESPONSIBILITIES AND RIGHTS **9**

Collegiality and Loyalty – Respect for Authority – Collective Bargaining – Confidentiality– Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination.

GLOBAL ISSUES **9**

Multinational Corporations – Business Ethics – Environmental Ethics – Computer Ethics – Role in Technological Development – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Honesty – Moral Leadership – Sample Code of Conduct.

Total Periods: 45

Text Books:

1. Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw Hill, New York (2012)
2. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, "Engineering Ethics Concepts and Cases", Thompson Learning, (2014)

References:

1. Charles D. Fleddermann, "Engineering Ethics", Prentice Hall, New Mexico, (2012).
2. John R. Boatright, "Ethics and the Conduct of Business", Pearson Education, (2013)
3. Edmund G. Seebauer and Robert L. Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, (2014)
4. David Ermann and Michele S. Shauf, "Computers, Ethics and Society", Oxford University Press, (2013)

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1						2		3		1	2					3
CO2				3	1			3					2	2		3
CO3	1			2	2								3	3	3	3
CO4								3			3	2				3
CO5								3			3	3	3	3		3
CO6								3								3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)