SRI SATYA SAI UNIVERSITY OF TECHNOLOGY AND MEDICAL SCIENCES

SCHOOL OF ENGINEERING

Outcome based Curriculum for

Undergraduate Degree Courses in Engineering & Technology

Department of Mechanical Engineering

Vision

The Mechanical Engineering Department to be recognized globally for outstanding education and research leading to well qualified mechanical engineers, who are innovative, entrepreneurial and successful in advanced fields of mechanical engineering to provide the ever changing industrial demands and social needs.

Mission

1. To imparting highest quality education to the students to build their capacity and enhancing their skills to make them globally competitive mechanical engineers.
2. To maintaining state of the art research facilities to provide collaborative environment that stimulates faculty, staff and students with opportunities to create, examine, apply and disseminate knowledge.
3. To develop alliances with world class R&D organizations, educational institutions, industry and alumni for excellence in teaching, research and consultancy practices. academic environment of excellence, leadership, ethical guidelines and lifelong learning needed for a long productive career

Programme Educational Objectives:

PEO1: Practice Mechanical engineering in manufacture industries, public sector undertaking and as an entrepreneur for successful professional career.

PEO2: Pursue higher education for professional development

PEO3: Exhibit leadership qualities with demonstrable attributes in lifelong learning to contribute to the societal needs.

POs of the Programme :

POs.1.Mechanical Engineering knowledge: Students will have an ability to apply knowledge of mathematics, science, and engineering to mechanical engineering problems.

POs.2. Problem analysis: Identify, formulate, research literature, and analyze engineering problems in research and development of industries to arrive at substantiated conclusions using first principles of Mechanical engineering.

POs.3. Design/development of solutions: Design solutions for complex engineering problems and create innovative components by mechanical designing , processes to meet the specifications with consideration for the program execution

POs.4. Conduct investigations of complex problems: User research-based knowledge including design of experiments, analysis and interpretation of data by condition monitoring, and synthesis of the information to provide valid conclusions.

POs.5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering including prediction and modeling to complex mechanical engineering activities during production with an understanding of the limitations.

POs.6. The engineer and society: Apply reasoning informed by the appropriate knowledge to upgrade the machinery to assess technical issues and the consequent responsibilities relevant to the professional mechanical engineering practice.

POs.7. Environment and sustainability: Understand the impact of the professional engineering solutions in Mechanical, and demonstrate the knowledge of, and need for sustainable development of the Industries and buildup the nation.

POs.8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

POs.9. Individual and team work: Function effectively as an individual, and as a member or leader in teams, and in multidisciplinary settings.

POs.10. Communication: Communicate effectively with the engineering community and with society at large. Be able to comprehend and write effective reports documentation. Make effective presentations, and give and receive clear instructions.

POs.11. Project management and finance: Demonstrate knowledge and understanding of mechanical engineering and management principles and apply these to one's own work, as a member and leader in a team. Manage projects in multidisciplinary situations.

POs.12. Life-long 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.

PROGRAM SPECIFIC OUTCOMES (PSOs) OF THE PROGRAMME

These outcomes are specific to a program in addition to NBA defined POs

Mechanical Engineering can have PSOs as:

PSO1: Able to analyse and design and development of industrial systems.

PSO2: Able to provide model and analyse products, meeting quality and reliability standards.

PSO3: Able to identify and analyse industrial problems and provide solutions for the benefit of society.

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(06) Programme- PO's and PSO's Mapping

			PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO1 2			
S. No	**Prog ram**	**Courses Category**	Engine ering Knowl edge	Prob lem Anal ysis	Design/D evelopme nt of Solution	Investig ation	Moder n Tool Usage	The Engi neer and Soci ety	Envir onme nt and Sustai nabilit y	Ethi cs	Indivi dual and Team Work	Commun ication	Pr oje ct M an ag em ent	Life-Long Lear ning	**P S O 1**	**P S O 2**	**P S O 3**
1	BE(ME)	Humanities and Social Sciences including Management courses	*	*			*	*		*		*		*			
2		Basic Science courses	*	*	*	*	*		*								
3		Engineering Science courses including workshop, drawing, basics of electrical/mecha nical/computer etc.	*	*	*		*							*			
4		Professional core courses	*	*	*	*											
5		Professional Elective courses relevant to chosen specialization/br anch	*	*	*	*	*	*		*	*				*		
6		Open subjects – Electives from other technical and /or emerging *subjects	*	*	*	*	*	*	*	*	*			*		*	
7		Project work, seminar and internship in industry or elsewhere		*	*	*		*	*	*	*	*	*	*		*	
8		Specific core subject		*	*	*											
9		Mandatory Course (Non credit)						*	*	*	*	*		*			

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(07) Semester wise PO's and SPO's Mapping

Semester	Name of the Courses/POs(Basic, Core Electives, Projects, Internships etc.)	PO 1 Engineering Knowledge	PO2 Problem Analysis	PO3 Design/Development of Solution	PO4 Investigation	PO5 Modern Tool Usage	PO6 The Engineer and Society	PO7 Environment and Sustainability	PO8 Ethics	PO9 Individual and Team Work	PO10 Communication	PO 11 Project Management	PO 12 Life-Long Learning	PSO 1	PSO 2	PSO 3ss
Semester-Ist	Mathematics-I	*	*	*	*								*			
	Engineering Physics	*	*		*								*			
	Basic Computer Engineering	*	*	*	*	*			*		*		*			
	Basic Mechanical Engineering	*	*	*	*	*								*		*
	Basic Civil Engineering & Mechanics	*	*	*				*						*	*	*
	Language Lab					*			*	*	*		*			
	Self Study / GD Seminar	*	*	*	*	*			*	*		*	*			
Semester-IInd	Mathematics-II	*	*	*	*								*			
	Engineering Chemistry	*	*	*	*											
	English for Communication	*									*			*		
	Basic Electrical & Electronics Engineering	*	*	*	*											
	Engineering Graphics	*	*	*	*										*	
	Manufacturing Practices					*			*	*	*	*	*	*	*	*
	Industrial Training			*	*		*	*	*	*		*	*	*		*
Semester-IIIrd	Mathematics -III	*	*	*	*											
	Thermodynamics	*	*	*			*	*					*	*	*	
	Materials Technology	*	*	*	*		*	*				*	*		*	
	Manufacturing Process	*	*	*	*	*				*		*	*	*	*	
	Strength of Material	*	*	*				*	*		*	*	*	*	*	
	Thermal Engineering Lab g	*	*	*	*		*	*			*		*	*	*	
	Self Study / GD Seminar		*	*		*	*	*	*		*	*	*			
Semester-IVth	Energy , Ecology, Environment and Society						*	*		*				*		*
	Instrumentation &	*	*			*	*				*	*		*	*	*

	Control														
	Theory of Machines	*	*	*		*	*				*		*	*	*	
	Fluid Mechanics	*	*			*	*	*	*				*	*	*	
	Manufacturing Technology	*	*	*	*	*		*		*			*	*	*	*
	Software Lab			*	*	*							*			
	Industrial Training-I		*	*		*	*	*	*	*		*	*	*	*	*
Semester-Vth	Machine Component Design	*	*	*			*	*	*			*	*	*	*	
	Dynamics of Machines	*			*	*	*		*	*	*		*	*	*	
	Metal Cutting & CNC Machines	*		*		*	*		*		*	*	*	*	*	*
	Turbo Machinery	*			*	*	*		*		*	*			*	
	Production & Operation Management	*	*	*		*	*		*		*	*	*	*	*	*
	Work Study and Ergonomics	*	*		*		*	*	*		*			*	*	*
	Industrial Safety Engineering	*			*	*	*	*	*	*		*			*	*
	Industrial Training-I	*	*		*		*	*	*	*	*	*	*		*	*
Semester VIth	NC and CNC Machine tools	*		*		*	*	*	*	*		*	*	*	*	*
	Heat and Mass Transfer	*	*			*	*	*	*			*			*	*
	IC Engines	*				*	*	*	*			*			*	*
	Mechanical Measurement & Control	*	*		*	*	*				*			*		*
	Power Plant Engineering	*				*	*	*	*	*			*			*
	Renewable Energy System	*	*	*		*	*	*	*	*		*	*			*
	Operation Research		*		*	*	*			*		*	*			*
	Ergonomics Engineering	*	*		*		*	*	*							*
	Project -I(Minor)	*	*				*		*	*	*	*	*			*
Semester VIIth	Mechanical Vibration & Noise Engineering	*	*			*	*	*	*				*	*	*	*
	Automobile Engineering	*	*	*	*	*	*	*	*		*		*		*	*
	Design of Heat Exchanger	*	*			*	*	*	*				*	*		*

	Industrial Robotics	*	*	*		*	*		*	*	*		*	*	*	*
	Project Management	*	*	*		*	*			*	*	*	*			*
	Nano Manufacturing	*	*	*	*	*	*			*				*	*	*
	Project stage-I	*	*				*			*		*	*			*
	Self Study/GD/Seminar	*					*			*	*	*				
Semester VIIIth	Refrigeration & Air Conditioning	*	*	*	*	*	*	*					*	*	*	*
	Advance Machine Design	*	*	*			*			*			*			*
	Computer Integrated Manufacturing	*	*	*		*	*			*			*	*	*	*
	Industrial Organization & Management	*	*		*	*	*			*	*	*	*	*		*
	Computational Fluid dynamics	*	*		*	*	*			*			*			*
	Project stage-II	*	*		*		*		*	*	*	*	*			*
I/III/IV (prefered Semester)	Mandatory Courses															

(08) <u>Structure of Programme</u>: To fulfill the need of development of all the POs/ GAs, as per above mapping, the following semester wise programme structure are as under.

[L= Lecture, T = Tutorials, P = Practical's & C = Credits]

Total Credits*= 160

Structure of Undergraduate Engineering program:

S. No.	Course Category	Credits of the EE Curriculum
1.	Humanities and Social Sciences including Management	11
2.	Basic Sciences	24
3.	Engineering Sciences including workshop, drawing, basics of electrical/mechanical/computer etc.	19
4.	Professional Core Subjects	52
5.	Professional Subjects: Subjects relevant to chosen specialization/branch	18
6.	Open Subjects: Electives from other technical and/or emerging subjects	18

7.	Project work, seminar and internship in industry or elsewhere	18
8.	Mandatory Courses [Environmental Sciences, Induction Program, Indian Constitution, Essence of Indian Knowledge Tradition]	Non-credit
	Total	**160**

***Definition of Credit:**

1 Hr. Lecture (L) per week	1 Credit
1 Hr. Tutorial (T) per week	1 Credit
1 Hr. Practical (P) per week	0.5 Credit
2 Hours Practical (Lab)/week	1 Credit

(09) Scheme of Exanimation (Mechanical Engineering) Academic Year 2019-20

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I Semester – Bachelor of engineering–(Mechanical Engineering)

S. No.	Subject Code	Subject Name	Maximum Marks Theory Slot			Maximum Marks (Practical Slot)		Total Marks	Periods/ hour/ week			Credits
			End Sem. Exam.	Mid Tests	Assign-ments/Quiz	End Sem. Practical & Viva	Practical Record /Assignment/ Quiz / Presentation		L	T	P	
1	BEBSC-101	Mathematics-I	60	30	10	-	-	100	3		-	3
2	BEBSC- 202	Engineering Physics	60	30	10	30	20	150	2	1	2	4
3	BEESC-203	Basic Computer Engineering	60	30	10	30	20	150	3	-	2	4
4	BEESC-204	Basic Mechanical Engineering	60	30	10	30	20	150	2	-	2	3
5	BEESC-205	Basic Civil Engineering & Mechanics	60	30	10	30	20	150	3	-	2	4
6	BEHSMC-206	Language Lab	-	-	-	30	10	40	-	-	2	1
7	BELC-107	Self Study / GD Seminar					10	10			2	1
		Total	**300**	**150**	**50**	**150**	**100**	**750**	**13**	**1**	**12**	**20**

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II Semester – Bachelor of engineering–(Mechanical Engineering)

S. No.	Subject Code	Subject Name	Maximum Marks Theory Slot			Maximum Marks (Practical Slot)		Total Marks	Periods/ hour/ week			Credits
			End Sem. Exam.	Mid Tests	Assign-ments/Quiz	End Sem. Practical & Viva	Practical Record /Assignment/ Quiz / Presentation		L	T	P	
1	BEBSC-201	Mathematics-II	60	30	10	-	-	100	3		-	3
2	BEBSC-102	Engineering Chemistry	60	30	10	30	20	150	3		2	4
3	BEHSMC-103	English for Communication	60	30	10	30	20	150	3	-	2	4
4	BEESC-104	Basic Electrical and Electronics Engineering	60	30	10	30	20	150	2	-	2	3
5	BEESC-105	Engineering Graphics	60	30	10	30	20	150	2	1	2	4
6	BEESC-106	Manufacturing Practices	-	-	-	30	10	40	-	-	2	1
7	BELC-207	Industrial Training					10	**10**	**-**	**-**	**2**	**1**
		Total	**300**	**150**	**50**	**130**	**100**	**750**	**13**	**1**	**12**	**20**

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III Semester – Bachelor of engineering–(Mechanical Engineering)

		III Semester/ II Year										
S.No.	Subject Code	Subject Name	Maximum Marks Theory Slot			Maximum Marks (Practical Slot)		Total Marks	Periods/ hour/ week			Credits
			End Sem. Exam.	Mid Tests	Assign-ments/Quiz	End Sem. Practical & Viva	Practical Record /Assignment/ Quiz / Presentation		L	T	P	
1	BEA-301	Mathematics-III	60	0	10	-	-	100	3	-	-	**3**
2	MEA-302	Thermodynamics	60	0	10	-	-	100	3	1	-	**4**
3	MEA-303	Materials Technology	60	0	10	30	20	150	2	-	2	**3**
4	MEA-304	Manufacturing Process	60	0	10	30	20	150	3	-	2	**4**
5	MEA-305	Strength of Material	60	0	10	30	20	150	2	1	2	**4**
6	MEA-306	Thermal Engineering Lab	-	-	-	30	20	50	-	-	2	**1**
7	MEA-307	Self Study / GD Seminar	-	-	-	-	50	50			2	**1**
TOTAL			**300**	**50**	**50**	**120**	**130**	**750**	**13**	**2**	**10**	**20**

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IV Semester – Bachelor of engineering–(Mechanical Engineering)

		IV Semester/ II Year										
S.No.	Subject Code	Subject Name	Maximum Marks Theory Slot			Maximum Marks (Practical Slot)		Total Marks	Periods/ hour/ week			Credits
			End Sem. Exam.	Mid Tests	Assign-ments/Quiz	End Sem. Practical & Viva	Practical Record /Assignment/ Quiz / Presentation		L	T	P	
1	BEA- 401	Energy , Ecology, Environment and Society	60	30	10	-	-	100	3		-	3
2	MEA-402	Instrumentation & Control	60	30	10	30	20	150	2	1	2	4
3	MEA-403	Theory of Machines	60	30	10	30	20	150	2	1	2	4
4	MEA-404	Fluid Mechanics	60	30	10	30	20	150	3	-	2	4
5	MEA-405	Manufacturing Technology	60	30	10	30	20	150	3	-	2	4
6	MEA-406	Software Lab	-	-	-	30	20	50	-	-	2	1
7	MEA-407	Industrial Training-I	To be completed during fourth semester semester break. Its evaluation/credit to be added in fifth semester									
	TOTAL		300	150	50	150	100	750	13	2	10	20

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V Semester – Bachelor of engineering–(Mechanical Engineering)

S.No.	Subject Code	Subject Name	Maximum Marks Theory Slot			Maximum Marks (Practical Slot)		Total Marks	Periods/ hour/ week			Credits
			End Sem. Exam.	Mid Tests	Assign-ments/Quiz	End Sem. Practical & Viva	Practical Record /Assignment / Quiz / Presentation		L	T	P	
1	MEA-501	Machine Component Design	60	30	10	30	20	150	2	1	2	4
2	MEA-502	Dynamics of Machines	60	30	10	30	20	150	2	1	2	4
3	MEA-503	Metal Cutting & CNC Machines	60	30	10	30	20	150	2	1	2	4
4	MEA-504	Program Elective-I	60	30	10	-		100	3	1	0	4
5	MEA-505	Open Core Elective - I	60	30	10	-		100	3	1	0	4
6	MEA-506	Industrial Training-I				150	100	250			4	2
	TOTAL		**300**	**150**	**50**	**240**	**160**	**900**	**12**	**5**	**10**	**22**

Program Elective - I		
MEA-504	MEA-504 (A)Turbo Machinery	MEA-504 (B) Production & Operation Management
Open Core Elective-I		
MEA-505	MEA-505 (A)Work Study and Ergonomics	MEA-505 (B)Industrial Safety Engineering

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VI Semester – Bachelor of engineering–(Mechanical Engineering)

S.No.	Subject Code	Subject Name	Maximum Marks Theory Slot			Maximum Marks (Practical Slot)		Total Marks	Periods/ hour/ week			Credits
			End Sem. Exam.	Mid Tests	Assign-ments/Quiz	End Sem. Practical & Viva	Practical Record /Assignment/ Quiz / Presentation		L	T	P	
1	MEA-601	NC and CNC Machine tools	60	30	10	30	20	150	2	1	2	4
2	MEA-602	Heat and Mass Transfer	60	30	10	30	20	150	2	1	2	4
3	MEA-603	Program Elective-II	60	30	10			100	3	1	0	4
4	MEA-604	Program Elective-III	60	30	10	-		100	3	0	0	3
5	MEA-605	Open Core Elective - II	60	30	10	-		100	3	0	0	3
6	MEA-606	Minor Project	-	-	-	180	120	300	-	-	4	2
	TOTAL		**300**	**150**	**50**	**240**	**160**	**900**	**13**	**3**	**8**	**20**

Program Elective - II		
MEA-603	MEA-603 (A) IC Engines	MEA-603(B) Mechanical Measurement & Control
Program Elective - III		
MEA-604	MEA-604 (A) Power Plant Engineering	MEA-604(B)Renewable Energy System
Open Core Elective-II		
MEA-605	MEA-605 (A)Operation Research	MEA-605 (B) Ergonomics Engineering

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VII Semester – Bachelor of engineering–(Mechanical Engineering)

S.No.	Subject Code	Subject Name	Maximum Marks Theory Slot			Maximum Marks (Practical Slot)		Total Marks	Periods/ hour/ week			Credits
			End Sem. Exam.	Mid Tests	Assign-ments/Quiz	End Sem. Practical & Viva	Practical Record /Assignment/ Quiz / Presentation		L	T	P	
1	MEA-701	Mechanical Vibration & Noise Engineering	60	30	10	30	20	150	3	0	2	4
2	MEA-702	Automobile Engineering	60	30	10	30	20	150	3	0	2	4
3	MEA-703	Program Elective-IV	60	30	10			100	3	0	0	3
4	MEA-704	Open Core Elective - III	60	30	10		-	100	3	0	0	3
6	MEA-705	Project Stage-I	-	-	-	120	80	200	-	-	10	5
7	MEA-706	Self Study/GD/Seminar					200	200			2	1
	TOTAL		**240**	**120**	**40**	**180**	**320**	**900**	**12**	**0**	**16**	**20**

Program Elective - IV		
MEA-703	MEA-703 (A) Design of Heat Exchanger	MEA-703 (B) Industrial Robotics
Open Core Elective-III		
MEA-704	MEA-704 (A) Project Management	MEA-704 (B) Nano Manufacturing

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VIII Semester – Bachelor of engineering–(Mechanical Engineering)

S.No.	Subject Code	Subject Name	Maximum Marks Theory Slot			Maximum Marks (Practical Slot)		Total Marks	Periods/ hour/ week			Credits
			End Sem. Exam.	Mid Tests	Assign-ments/Quiz	End Sem. Practical & Viva	Practical Record /Assignment/ Quiz / Presentation		L	T	P	
1	MEA-801	Refrigeration & Air Conditioning	60	30	10	30	20	150	3	0	2	4
3	MEA-802	Program Elective-V	60	30	10			100	3	0	0	3
4	MEA-803	Open Core Elective - IV	60	30	10	-		100	3	0	0	3
6	MEA-804	Project Stage-II	-	-	-	240	160	400	-	-	16	8
	TOTAL		**180**	**90**	**30**	**270**	**180**	**750**	**9**	**0**	**18**	**18**

Program Elective - V		
MEA-802	MEA-802(A) Advance Machine Design	MEA-802 (B) Computer Integrated Manufacturing
Open Core Elective-IV		
MEA-803	MEA-803 (A)Industrial Organisation & Management	MEA-803 (B) Computational Fluid dynamics

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BE-SEMESTER-I SYLLABUS

BEBSC-101	Mathematics-I	3L:0T:0P	3 credits	3Hrs/Week

Course Preamble:

The Preamble of this foundational course is to review mathematical concepts already learnt in higher secondary. This course will also introduce fundamentals of mathematical functions, derivatives and aspects of calculus to students. This course deep understanding of matrix, differential equations, Sequences and series, Vector Space as well as a strong sense of how useful the subject can be in other disciplines of learning.

Course Outcome:-

Course work is designed to provide students the opportunity to learn key concepts of mathematical functions, key concepts of matrix , Vector Spaces as well as fundamentals and applications of integral calculus.

Unit-I

Calculus- Rolle's theorem, Mean Value theorems, Expansion of functions by Mc. Laurin's and Taylor's for one variable; Taylor's theorem for function of two variables, Partial Differentiation, Maxima & Minima (two variables), Method of Lagrange's Multipliers.

(9 hours)

Unit-II

Integral-Definite Integral as a limit of a sum and Its application in summation of series; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas, Multiple Integral, Change the order of the integration, Applications of multiple integral for calculating area and volumes of the curves.

(9 hours)

Unit-III

Sequences and series-Convergence of sequence and series, tests for convergence; Power series, Taylor's series, series for exponential, trigonometric and logarithm functions; Fourier series: Half range sine and cosine series, Parseval's theorem.

(10 hours)

Unit-IV

Vector Spaces- Vector Space,Vector Sub Space, Linear Combination of Vectors, Linearly Dependent, Linearly Independent, Basis of a Vector Space,Linear Transformations.

(9 hours)

Unit-V

Matrices-Rank of a Matrix, Solution of Simultaneous Linear Equations by Elementary Transformation, Consistency of Equation, Eigen Values and Eigen Vectors, Diagonalization of Matrices, Cayley-Hamilton theorem and its applications to find inverse.

(10 hours)

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6. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
7. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

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Department of Mechanical Engineering

BEBSC- 202	**Engineering Physics**	**2L:1T:0P**	**3 credits**	**3Hrs/Week**

Course Preamble:

1. A comprehensive, high-quality education in the physical sciences
2. A flexible curriculum with multiple concentrations that allows students to tailor their education according to their specific interests
3. The opportunity to experience the excitement of scientific discovery through direct participation in faculty research
4. An increased awareness of the physical processes in the surrounding world
5. The essential knowledge and analytical, mathematical and computational tools with which to pursue post-graduate education in a variety of physics-related and other fields
6. The foundation and practical skillsets for eventual success in any of a broad array of careers
7. The motivation for a lifelong love of learning

Course Outcome

1. An ability to apply knowledge of mathematics, science, and engineering.
2. An ability to design and conduct experiments, as well as to analyze and interpret data.
3. An ability to design a system, component, or process to meet desired needs within realistic constraints.
4. An ability to function on multidisciplinary teams.
5. An ability to identify, formulate, and solve engineering problems.
6. An understanding of professional and ethical responsibility.
7. An ability to communicate effectively.
8. The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.
9. A recognition of the need for, and an ability to engage in life-long learning.
10. A knowledge of contemporary issues.
11. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Unit I

Relativistic Mechanics-Frame of reference, Inertial & non-inertial frames, Galilean transformations, Michelson-Morley experiment, Postulates of special theory of relativity, Lorentz transformations, Length contraction, Time dilation, Velocity addition theorem, Variation of mass with velocity, Einstein's mass energy relation, Relativistic relation between energy and momentum, Massless particle.

(10 hours)

Unit II

Solid state & Nuclear physics-Free electron theory of metals, Qualitative discussion of Kronig-penny model and origin of energy bands. Intrinsic and Extrinsic Semiconductors. V-I Characteristics of PN junction diode, Zener

diode, Hall-effect. Introduction to Nuclear Physics , Static properties of Nucleus,Nuclear liquid drop model, Nuclear Shell Model, Linear particle accelelerator, Cyclotron, Betatron, Bainbridge mass sprectrograph.

(10 hours)

Unit III

Quantum Mechanics-Introduction to Quantum mechanics, Wave particle duality, Matter waves, Particle velocity, Phase velocity , Group velocity and their relation. Heisenberg's Uncertainty Principle. Time-dependent and time-independent Schrodinger wave equation, Solution to stationary state Schrodinger wave equation for one-Dimensional particle in a box, Compton effect.

(10 hours)

Unit IV

Wave Optics-Interference Coherent sources, Interference in uniform and wedge shaped thin films, Newton's Rings and its applications. Fraunhoffer diffraction at single slit and at double slit, Absent spectra, Diffraction grating, Spectra with grating, Dispersive power of grating, Rayleigh's criterion of resolution. Resolving power of grating and Prism.

(9 hours)

Unit V

Fibre Optics & Lasers: Fibre Optics-Introduction to fibre optics, Acceptance angle, Numerical aperture, Normalized frequency, Classification of fibre, Attenuation and Dispersion in optical fibres. Laser: Absorption of radiation, Spontaneous and stimulated emission of radiation, Einstein's coefficients, Population inversion, Various levels of Laser, Ruby Laser, He-Ne Laser, Laser applications.

(9 hours)

Reference Books: -

1. Concepts of Modern Physics - AurthurBeiser (Mc-Graw Hill)
2. Introduction to Special Theory of Relativity- Robert Resnick (Wiley)
3. Optics - Brijlal& Subramanian (S. Chand)
4. Engineering Physics: Theory and Practical- Katiyar and Pandey (Wiley India)
5. Applied Physics for Engineers- Neeraj Mehta (PHI Learning, New)
6. Engineering Physics-Malik HK and Singh AK (McGrawHill)

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BEBSC- 202	**Engineering Physics**	**0L:0T:1P**	**1 credits**	**2Hrs/Week**

List of Experiments: -

1. To determine the wavelength of sodium light by Newton's ring experiment.
2. To determine the wavelength of different spectral lines of mercury light using plane transmission grating.
3. To determine the energy band gap of a given semiconductor material.
4. To determine the plank's constant with help of photocell.
5. Resolving Power of Telescope.
6. V-I Characteristics of P-N Junction diode.
7. Zener diode characteristics.
8. To determine the dispersive power of prism.

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BTEESC-203	**Basic Computer Engineering**	**3L:0T:0P**	**3 credits**	**3Hrs/Week**

Course Preamble:

1. Successfully practice computer engineering to serve state and regional industries, government agencies, or national and international industries.
2. Work professionally in one or more of the following areas: computer hardware and software design, embedded systems, computer networks and security, system integration, and electronic design automation.
3. Achieve personal and professional success with awareness and commitment to their ethical and social responsibilities, both as individuals and in team environments.
4. Maintain and improve their technical competence through lifelong learning, including entering and succeeding in an advanced degree program in a field such as engineering, science, or business.

Course Outcome

1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
3. an ability to communicate effectively with a range of audiences
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.

Unit –I

Computer-Definition, Classification, Organization i.e. CPU, register, Memory & Storage Systems, I/O Devices, and System & Application Software. Computer application E-Business, Bio-Informatics, health Care, Remote Sensing & GIS, Meteorology and, Computer Gaming, Multimedia and Animation etc.

(9 hours)

Unit –II

Introduction to Algorithms-Complexities and Flowchart, Introduction to Programming, Categories of Programming Languages, Program Design, Programming Paradigms, Characteristics or Concepts of OOP, Procedure Oriented Programming VS object oriented Programming. Introduction to C, Character Set, Tokens, Precedence and Associativity, Program Structure, Data Types, Variables, Operators, Expressions, Statements and control structures, I/O operations, Array, Functions.

(9 hours)

Unit – III

Computer System Overview-Basic Elements, Instruction Execution, Interrupts, Memory Hierarchy, Cache Memory, Direct Memory Access, Multiprocessor and Multicore Organization. Operating system overview- Preambles and functions, Evolution of Operating System. - Computer System Organization- Operating System Structure and Operations- System Calls, System Programs, OS Generation and System Boot.

(9 hours)

Unit IV

Computer Networking-Introduction, Goals, OSI Model, Functions of Different Layers. Internetworking Concepts, Devices, TCP/IP Model. Topology, Introduction to Internet, World Wide Web, E• commerce Computer Security Basics: Introduction to viruses, worms, malware, Trojans, Spyware and Anti-Spyware Software, Different types of attacks like Money Laundering, Information Theft, Cyber Pornography, Email spoofing, Denial of Service (DoS), Cyber Stalking, ,Logic bombs, Hacking Spamming, Cyber Defamation, Security measures Firewall.

Unit V

Data base Management System-Introduction, File oriented approach and Database approach, Data Models, Architecture of Database System, Data independence, Data dictionary, DBA, Primary Key, Data definition language and Manipulation Languages. Cloud computing: definition, cloud infrastructure, cloud segments or service delivery models (IaaS, PaaS and SaaS), cloud deployment models/ types of cloud (public' private, community and hybrid clouds), Pros and Cons of cloud computing.

(10 hours)

Reference books:

1. Introduction of computers: Peter Norton, TMH
2. Object oriented programming with c++ :E.Balaguruswamy,TMH
3. Object oriented programming in C++: Rajesh k.shukla ,Wiley India
4. Computer network: Andrew Tananbaum,PHI
5. Data base management system,Korth,TMH

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BTEESC-203	**Basic Computer Engineering**	**0L:0T:1P**	**1 credits**	**2Hrs/Week**

List of Experiment:-

1. To Study of input and output devices of computer systems .
2. Write a program of addition, subtract, multiplication and division by using C.
3. Write a program to check weather a number is prime or not.
4. To Study of various types of Operating System.
5. To Study and practice of basic Linux commands-ls, cp, mv, rm, chmod kill, ps etc.
6. Design color coding of straight & crossover cable.
7. Installation of oracle 10g. Also create a employee table.

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BEESC-204	**Basic Mechanical Engineering**	**2L:0T:0P**	**2 credits**	**2Hrs/Week**

Course Preamble:

1. To provide a comprehensive knowledge of basic mechanical systems.
2. Basic concepts from mechanical engineering sciences,
3. Basic concepts I.C Engine
4. Modern engineering tools (machine-tools, laboratory instrumentation, Working principle of steam Engine), and related subjects to design mechanical engineering components

Course Outcome

1. After successful completion of this course students will able to
2. To describe and use basic engineering concepts
3. principles and components of mechanical equipment
4. measuring & testing method of physical quantities
5. Assessment of boiler component.

Unit I

Materials-Classification of engineering material, Composition of Cast iron and Carbon steels, Iron Carbon diagram. Alloy steels their applications. Mechanical properties like strength, hardness, toughness ductility, brittleness , malleability etc. of materials , Tensile test- Stress-strain diagram of ductile and brittle materials.

(9 hours)

Unit II

Measurement-Concept of measurements, errors in measurement, Temperature, Pressure, Velocity, Flow strain, Force and torque measurement, Vernier caliper, Micrometer, Dial gauge, Slip gauge, Sine-bar and Combination set. Production Engineering: Elementary theoretical aspects of production processes like casting, carpentry, welding etc Introduction to Lathe and Drilling machines and their various operations.

(9 hours)

Unit III

Fluids-Fluid properties pressure, density and viscosity etc. Types of fluids , Newton's law of viscosity , Pascal's law, Bernoulli's equation for incompressible fluids, Only working principle of Hydraulic machines, pumps, turbines, Reciprocating pumps.

(9 hours)

Unit IV

Thermodynamics-Thermodynamic system, properties, state, process, Zeroth, First and second law of thermodynamics, thermodynamic processes at constant pressure, volume, enthalpy & entropy.

Steam Engineering: Classification and working of boilers, mountings and accessories of boilers, Efficiency and performance analysis, natural and artificial draught, steam properties, use of steam tables.

(10 hours)

Unit V

Reciprocating Machines-Working principle of steam Engine, Carnot, Otto, Diesel and Dual cycles P-V & T-S diagrams and its efficiency, working of Two stroke & Four stroke Petrol & Diesel engines. Working principle of compressor.

(9 hours)

References: -

1- Kothandaraman & Rudramoorthy, Fluid Mechanics & Machinery, New Age . 2- Nakra & Chaudhary , Instrumentation and Measurements, TMH.
2- Nag P.K, Engineering Thermodynamics , TMH .
3- Ganesan , Internal Combustion Engines, TMH .
4- Agrawal C M, Basic Mechanical Engineering ,Wiley Publication. 6- Achuthan M , , Engineering Thermodynamics ,PHI.

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BEESC-204	**Basic Mechanical Engineering**	**0L:0T:1P**	**2 credits**	**2Hrs/Week**

List of Experiments:-

1- To Study of Universal Testing machines.
2- Linear and Angular measurement using, Micrometer, Slip Gauges, Dial Gauge and
3- To Study of Lathe Machine.
4- To Study of Drilling Machines.
5- Verification of Bernoulli's Theorem.
6- To Study of various types of Boilers.
7- To Study of different IC Engines.
8- To Study of different types of Boilers Mountings and accessories.

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BEESC-205	**Basic Civil Engineering & Mechanics**	**3L:0T:0P**	**3 credits**	**3Hrs/Week**

Course Preamble:

The goal of this Engineering Mechanics course is to expose students to problems in mechanics as applied to plausibly real-world scenarios. Problems of particular types are explored in detail in the hopes that students will gain an inductive understanding of the underlying principles at work; students should then be able to recognize problems of this sort in real-world situations and respond accordingly.

The civil engineering program will serve Connecticut and the nation by providing a quality engineering education that enables students to enter a profession that can improve the civil infrastructure, and economic welfare. Our civil engineering program will maintain a strong emphasis on undergraduate education with the goal that our program will be recognized for quality instruction in civil engineering analysis and design

Course Outcomes

1. Demonstrate knowledge of various surveying methods.
2. Conduct a chain survey.
3. Conduct a compass survey.
4. Conduct levelling survey and be able to do RL calculations.
5. Demonstrate knowledge of properties of various building materials.
6. Draw free body diagrams and determine the resultant of forces and/or moments.
7. Determine the centroid and second moment of area of sections.
8. Apply laws of mechanics to determine efficiency of simple machines with consideration of friction.
9. Analyse statically determinate planar frames.

Unit I

Building Materials & Construction-Stones, bricks, cement, lime, timber-types, properties, test & uses, laboratory tests concrete and mortar Materials: Workability, Strength properties of Concrete, Nominal proportion of Concrete preparation of concrete, compaction, curing. Elements of Building Construction, Foundations conventional spread footings, RCC footings, brick masonry walls, plastering and pointing, floors, roofs, Doors, windows, lintels, staircases – types and their suitability.

(9 hours)

Unit II

Surveying & Positioning-Introduction to surveying Instruments – levels, theodolites , plane tables and related devices. Electronic surveying instruments etc. Measurement of distances – conventional and EDM methods, measurement of directions by different methods, measurement of elevations by different methods. Reciprocal levelling.

(9 hours)

Unit III

Basics of Engineering Mechanics covering-Force Systems Basic concepts, Particle equilibrium in 2-D & 3-D; Rigid Body equilibrium; System of Forces, Coplanar Concurrent Forces ,Components in Space – Resultant- Moment of Forces and its Application; Couples and Resultant of Force System, Equilibrium of System of Forces, Free body diagrams, Equations of Equilibrium of Coplanar Systems and Spatial Systems; Static Indeterminacy.

(9 hours)

Unit IV

Centroid and Centre of Gravity covering-Centroid of simple figures from first principle, centroid of composite sections; Centre of Gravity and its implications; Area moment of inertia Definition, Moment of inertia of plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections and composite sections; Mass moment inertia of circular plate, Cylinder, Cone, Sphere, Hook.

(9 hours)

Unit V

Friction covering-Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction; Motion of Bodies, Basic Structural Analysis covering, Equilibrium in three dimensions; Method of Sections; Method of Joints; How to determine if a member is in tension or compression; Simple Trusses; Zero force members; Beams & types of beams; Frames.

(9 hours)

Reference Books:

1. S. Ramamrutam & R.Narayanan; Basic Civil Engineering, Dhanpat Rai Pub.
2. Prasad I.B., Applied Mechanics, Khanna Publication.
3. Punmia, B.C., Surveying, Standard book depot.
4. Shesha Prakash and Mogaveer; Elements of Civil Engg & Engg. Mechanics; PHI

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BEESC-205	**Basic Civil Engineering & Mechanics**	**0L:0T:1P**	**1 credits**	**2Hrs/Week**

List of Experiments:-

1. To perform traverse surveying with prismatic compass, check for local attraction and determine corrected bearings and to balance the traverse by Bowditch's rule.
2. To perform leveling exercise by height of instrument of Rise and fall method.
3. To measure horizontal and vertical angles in the field by using Theodolite.
4. To determine (a) normal consistency (b) Initial and Final Setting time of a cement Sample.
5. To determine the workability of fresh concrete of given proportions by slump test or compaction factor test.
6. To determine the Compressive Strength of brick .
7. To determine particle size distribution and fineness modulus of course and fine Aggregate.
8. To verify the law of Triangle of forces and Lami's theorem.
9. To verify the law of parallelogram of forces.
10. To verify law of polygon of forces
11. To find the support reactions of a given truss and verify analytically.
12. To determine support reaction and shear force at a given section of a simply Supported beam and verify in analytically using parallel beam apparatus.
13. To determine the moment of inertia of fly wheel by falling weight method.
14. To verify bending moment at a given section of a simply supported beam.

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BEHSMC-206	**Language Lab and Seminar**	**0L:0T:1P**	**1 credits**	**2Hrs/Week**

Course Preamble:

This course intends to impart practical training in the use of English Language for Communicative purposes and aims to develop students' personality through language Laboratory.

Topics to be covered in the Language laboratory sessions:

1. Introducing oneself, family, social roles.
1. Public Speaking and oral skills with emphasis on conversational practice, extempore speech, JAM(Just a minute sessions), describing objects and situations, giving directions, debate, telephonic etiquette.

2. Reading Comprehension: Intensive reading skills, rapid reading, and reading aloud (Reading material to be selected by the teacher).

3. To write a book review. Standard text must be selected by the teacher.

4. Role plays: preparation and delivery topic to be selected by teacher/faculty.

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BELC–107	**Self-Study / GD Seminar**	**0L:0T:1P**	**1 credits**	**2Hrs/Week**

Course Preamble:

To improve the mass communication and convincing / understanding skills of students and it is to give student an opportunity to exercise their rights to express themselves. Evaluation will be done by assigned faculty based on group discussion and power point presentation.

Course Outcomes

1. Analytical thinking
2. Lateral thinking
3. constructive argument
4. Communication skill
5. Presentation of views

Students will discuss the course related and interdisciplinary topics for problem solving. They will improve the mass communication and convincing / understanding skills about subject and their related problem in a group of students.

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BE-SEMESTER-II SYLLABUS

BEBSC-201	Mathematics-II	3L:0T:0P	3 credits	3Hrs/Week

Course Preamble:

1. To introduce the basic concepts required to understand, construct, solve and interpret differential equations.
2. To teach methods to solve differential equations of various types.
3. To give an ability to apply knowledge of mathematics on engineering problems

Course Outcomes

The students will be able to:

1. Classify differential equations according to certain features.
2. Solve first order linear equations and nonlinear equations of certain types and interpret the solutions.
3. Understand the conditions for the existence and uniqueness of solutions for linear differential equations
4. Solve second and higher order linear differential equations with constant coefficients and construct all solutions from the linearly independent solutions
5. Find series solutions about ordinary and regular singular points for second order linear differential equations.
6. Solve initial value problems using the Laplace transform.
7. Solve systems of linear differential equations with methods from linear algebra

Unit - I

Ordinary Differential Equations I-Differential Equations of First Order and First Degree (Leibnitz linear, Bernoulli's, Exact), Differential Equations of First Order and Higher Degree, Higher order differential equations with constants coefficients, Homogeneous Linear Differential equations, Simultaneous Differential Equations.

(9 hours)

UNIT-II

Ordinary differential Equations II-Second order linear differential equations with variable coefficients, Method of variation of parameters, Power series solutions; Legendre polynomials, Bessel functions of the first kind and their properties.

(9 hours)

Unit III

Partial Differential Equations -Formulation of Partial Differential equations, Linear and Non-Linear Partial Differential Equations, Homogeneous Linear Partial Differential Equations with Constants Coefficients.

(9 hours)

Unit IV

Functions of Complex Variable-Functions of Complex Variables: Analytic Functions, Harmonic Conjugate, Cauchy-Riemann Equations (without proof), Line Integral, theorem ,Cauchy Integral formula (without proof), Singular Points, Poles & Residues, Residue Theorem, Application of Residues theorem for Evaluation of Real Integral.

(9 hours)

Unit V

Vector Calculus- Differentiation of Vectors, Scalar and vector point function, Gradient, Geometrical meaning of gradient, Directional Derivative, Divergence and Curl, Line Integral, Surface Integral and Volume Integral, Gauss Divergence, Stokes and Green theorems.

(9 hours)

References: -

1. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
2. Erwin kreyszig , Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
3. W. E. Boyce and R. C. Dip Rima, Elementary Differential Equations and Boundary Value Problems, 9th End., Wiley India, 2009.
4. S. L. Ross, Differential Equations, 3rd Ed., Wiley India, 1984.
5. E. A. Codington, An Introduction to Ordinary Differential Equations, Prentice Hall India, 1995.
6. E. L. Inca, Ordinary Differential Equations, Dover Publications, 1958.
7. J. W. Brown and R. V. Churchill, Complex Variables and Applications, 7th Ed., McGraw Hill, 2004.
8. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
9. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

BEBSC-102	**Engineering Chemistry**	**3L:0T:0P**	**3 credits**	**3Hrs/Week**

Course Preamble:

1. To acquire knowledge about hardness of water and importance of water in industrial purpose.
2. To understand the concept of molecular spectroscopy.
3. To gain the knowledge of about polymeric material and biodegradable substances.
4. To understand the mechanism of lubricant and properties of lubricant.

Course Outcomes

1. Develop innovative methods to produce soft water for industrial use.
2. Identify the structure of unknown / new compounds with the help of spectroscopy.
3. Substitute metal with conducting polymers and produce cheaper biodegradable polymers to reduce environmental pollution.
4. Apply their knowledge for use and protect to industrial and domestic equipment.

UNIT-I

Atomic and molecular structure-Schrodinger equation. Particle in a box solutions and their applications for conjugated molecules and nanoparticles. Molecular orbitals of diatomic molecules and plots of the multicentre orbitals. Equations for atomic and molecular orbitals. water treatment-Introduction, hardness of water, Units of hardness, disadvantage of hard water, scale and sludge formation in boilers, boilers troubles.

(9 hours)

UNIT-II

Spectroscopic techniques and applications -Principles of spectroscopy and selection rules. Electronic spectroscopy. Fluorescence and its applications in medicine. Vibrational and rotational spectroscopy of diatomic molecules. Applications. Nuclear magnetic resonance and magnetic resonance imaging, surface characterisation techniques. Diffraction and scattering.

(9 hours)

UNIT-III

Intermolecular forces and potential energy surfaces-Ionic, dipolar and van Der Waals interactions. Lubricant-Introduction, mechanism of lubricant, classification of lubricant, properties of lubricating oils.

(9 hours)

UNIT-IV

Use of free energy in chemical equilibria-Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies. Free energy and emf. Cell potentials, the Nernst equation and applications. High Polymers-Introduction, nomenclature, types of polymerization, classification of polymers, plastics-important, thermo-plastic resins and thermo setting resin.

(9 hours)

UNIT-V

Periodic properties-Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries.

(9 hours)

REFRENCES:

1. University chemistry, by B. H. Mahan
2. Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane
   Fundamentals of Molecular Spectroscopy, by C. N. Banwell
3. Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S.
4. Physical Chemistry, by P. W. Atkins
5. engg. Chemistry jain.jain
6. engg. Chemistry shashi chawla.

BEBSC-102	**Engineering Chemistry**	**0L:0T:1P**	**1 credits**	**2Hrs/Week**

LIST OF EXPERIMENTS:

1. Determination of surface tension and viscosity
2. Determination of chloride content of water
3. Determine the change of viscosity of given lubricating oil with change in temperature by Redwood Viscometer No. 1.
4. Determine the change of viscosity of given lubricating oil with change in temperature by Redwood Viscometer No. 2.
5. To determine the flash and fire point of given lubricating oil by Cleveland's open cup apparatus.
6. To determine the flash and fire point of given lubricating oil by Abel's closed cup apparatus.
7. To determine the flash and fire point of given lubricating oil by Pensky Marten's apparatus.
8. To determine the total hardness of given water sample by titrating it against EDTA solution using EBT as an indicator.

BEHSMC-103	**English for Communication**	**3L:0T:0P**	**3 credits**	**3Hrs/Week**

Course Preamble:

1. To enhance Professional competence in reading, writing, listening and speaking.
2. To modify the tactic of providing information about the language by using several techniques.
3. To minimize the Grammar Translation Method of ELT by replacing it with Direct Learning Method.
4. To Introduce Communicative Method of ELT and focusing the teaching pedagogy to the student-centered learning rather than the teacher-centered learning.
5. To develop the skills to master three major forms of communications which are vital in academic and professional settings namely professional presentations, interviews and group communications respectively.
6. To provide a deep insight of techniques for delivering effective presentations, appealing job interviews, and actively participating in various forms of group communication.

Course Outcomes

At the end of this course students will have:

1. Ability to design a language component or process to meet desired need within Realistic, Constraints such as economic, environmental, social, political, ethical Scenario.
2. Ability to analyze the usage of English words in different contexts.
3. An understanding of technical and academic articles' comprehension.
4. The ability to present oneself at multinational levels knowing the type of different Standards of English

UNIT-I

Identifying Common errors in writing-Articles, Subject-Verb Agreement, Prepositions, Active and Passive Voice, Reported Speech: Direct and Indirect, Sentence Structure.

(9 hours)

UNIT-II

Vocabulary building and Comprehension-Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives, synonyms, antonyms, Reading comprehension.

(9 hours)

UNIT-III

Communication-Introduction, Meaning and Significance, Process of Communication, Oral and Written Communication, 7 c's of Communication, Barriers to Communication and Ways to overcome them, Importance of Communication for Technical students, nonverbal communication.

(10 hours)

UNIT-IV

Developing Writing Skills-Planning, Drafting and Editing, Precise Writing, Précis, Technical definition and Technical description. Report Writing: Features of writing a good Report, Structure of a Formal Report, Report of Trouble, Laboratory Report, Progress Report.

(9 hours)

UNIT-V

Business Correspondence-Importance of Business Letters, Parts and Layout; Application, Contents of good Resume, guidelines for writing Resume, Calling/ Sending Quotation, Order, Complaint, E-mail and Tender.

(9 hours)

References:-

1. 'Technical Communication : Principles and practice', Meenakshi Raman and Sangeeta Sharma (Oxford)
2. 'Effective Business Communication', Krizan and merrier (Cengage learning)
3. 'Communication Skill, Sanjay Kumar and pushlata, OUP2011
4. "Practical English Usage Michael Swan OUP, 1995.
5. "Exercises in spoken English Parts I-III CIEFL, Hyderabad, Oxford University Press
6. On writing well, William Zinsser, Harper Resource Book 2001.
7. Remedial English Grammar, F.T. Wood,Macmillan2007.

BEHSMC-103	**English for Communication**	**0L:0T:1P**	**1 credits**	**2Hrs/Week**

List of Experiments

1. Listening Comprehension.
2. Pronunciation, Intonation, Rhythm
3. Practicing everyday dialogues in English
4. Interviews.
5. Formal Presentation

BEESC-104	**Basic Electrical and Electronics Engineering**	**2L:0T:0P**	**2 credits**	**2Hrs/Week**

Course Preamble:

Impart a basic knowledge of electrical quantities such as current, voltage, power, energy and frequency to understand the impact of technology in a global and societal context and to provide students the working knowledge for the analysis of basic DC and AC circuits used in electrical and electronic devices. To impart basic knowledge of electronic devices and digital conversion.

Course Outcomes

1. To understand and analyze basic electric and magnetic circuits.
2. To study the working principles of electrical machines and power converters.
3. To introduce the components of low voltage electrical installations and safety devices.
4. To introduce with basic electronics devices and logic gates.

Unit-I

Electrical circuit elements-Electrical circuit elements (R, L and C), Concept of active and passive elements, voltage and current sources, concept of linearity and linear network, unilateral and bilateral elements, Kirchhoff‟s laws, Loop and-delta transformation, nodal methods, Superposition of a theorem, Thevenin theorem, Norton theorem.

(9 hours)

Unit-II

AC Circuits-Representation of Sinusoidal waveforms –Average and effective values, Form and peak factors, Concept of phasors, phasor representation of sinusoidally varying voltage and current. Analysis of single phase AC Circuits consisting of R, L, C, RL, RC, RLC combinations (Series and Parallel), Apparent, active & reactive power, Power factor, power factor improvement. Concept of Resonance in series & parallel circuits, bandwidth and quality factor. Three phase balanced circuits, voltage and current relations in star and delta connections.

(10 hours)

Unit-III

Magnetic circuit-Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections.

Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Importance of earthing. Types of Batteries, Important characteristics for Batteries. Elementary calculations for energy consumption and savings, battery backup.

(10 hours)

Unit-IV

Digital Electronics-Number systems used in digital electronics, decimal, binary, octal, hexadecimal, their complements, operation and conversion, floating point and signed numbers, Demorgan's theorem, AND, OR, NOT, NOR, NAND, EX-NOR, EX-OR gates and their representation, truth table, half and full adder circuits, R -S flip flop, J-K flip flop.

(8 hours)

Unit-V

Electronic Components And Circuits-Introduction to Semiconductors, Diodes, V -I characteristics, amplifiers,transistors,Bipolar junction transistors (BJT) and their working, introduction to CC, CB & CE transistor configurations, different configurations and modes of operation of BJT, DC biasing of BJT.

(8 hours)

Reference's: -

1. "Basic Electrical Engineering", Ritu Sahdev,
2. "Electrical Engineering S. Singh, P.V. Prasad,
3. E. Hughes, "Electrical Technology," Pearson Education, 2010.
4. I. J. Nagrath & D. P. Kothari, „Basic Electrical Engineering" TATA McGraw Hill Edu.
5. V. Del Toro, "Electrical Engg Fundamentals," PHI Learning.
6. B. Dwivedi & A. Tripathi "Fundamentals of Electrical Engineering" Wiley India.
7. D. A. Bell, "Electric Circuits," 7th Ed., Oxford Higher Education.
8. Graham Bell: Electronic Devices and Circuits, PHI

BEESC-104	Basic Electrical and Electronics Engineering	0L:0T:1P	1 credits	2Hrs/Week

Laboratory objectives:

1. Read and demonstrate the rating of basic equipments used in electrical engineering
2. Connections of different components as per the rules
3. Application different components in electrical field

Laboratory Outcomes

1. Get an exposure to common electrical components and their ratings.
2. Make electrical connections by wires of appropriate ratings.
3. Understand the usage of common electrical measuring instruments.
4. Understand the basic characteristics of transformers and electrical machines.

List of Experiments: -

1. Verification of Kirchhoff‟s laws
2. Verification of Superposition and Thevenin Theorem.
3. Measurement of power and power factor in a single phase ac series inductive circuit and study improvement of power factor using capacitor
4. To Study of phenomenon of resonance in RLC series circuit and obtain resonant frequency.
5. Connection and measurement of power consumption of a fluorescent lamp (tube light).
6. Measurement of power in 3- phase circuit by two wattmeter method and determination of its power factor for star as well as delta connected load.
7. Determination of parameters of ac single phase series RLC circuit
8. To observe the B-H loop of a ferromagnetic material in CRO.
9. Determination of (i) Voltage ratio (ii) polarity and (iii) efficiency by load test of a single phase transformer
10. Determination of efficiency of a dc shunt motor by load test
11. To study running and speed reversal of a three phase induction motor and record speed in both directions.
12. Demonstration of cut-out sections of machines: dc machine, three phase induction machine, single-phase induction machine and synchronous machine.
13. To study the V-I Characteristics of Transistors.
14. To study V-I characteristics of various Diodes.

BEESC-105	**Engineering Graphics**	**3L:0T:0P**	**3 credits**	**3Hrs/Week**

Course Preamble:

1. Increase ability to communicate with people.
2. Learn to sketch and take field dimensions.
3. Learn to take data and transform it into graphic drawings.
4. Learn basic Auto Cad skills.
5. Learn basic engineering drawing formats.
6. Prepare the student for future Engineering positions.

Course Outcomes

Student's ability to hand letter will improve.

1. Student's ability to perform basic sketching techniques will improve.
2. Students will be able to draw orthographic projections and sections.
3. Student's ability to use architectural and engineering scales will increase.
4. Students ability to produce engineered drawings will improve
5. Student's ability to convert sketches to engineered drawings will increase.
6. Students will become familiar with office practice and standards.
7. Students will become familiar with Auto Cad two dimensional drawings.
8. Students will develop good communication skills and team work.

UNIT-I

Introduction to Engineering Drawing-Principles of Engineering Graphics and their significance, usage of Drawing instruments, Lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involute; Scales –Plain, Diagonal and Venire Scales.

(9 hours)

UNIT-II

Orthographic Projections -Principles of Orthographic Projections-Conventions - Projections of Points and lines inclined to both planes; Projections of planes inclined Planes - Auxiliary Planes; Projections of

Regular Solids those inclined to both the Planes- Auxiliary Views; Draw simple annotation, dimensioning and scale.

(9 hours)

UNIT-III

Sections and Sectional Views of Right Angular Solids-Prism, Cylinder, Pyramid, Cone –Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone; Draw the sectional orthographic views of geometrical solids, objects from industry and dwellings (foundation to slab only).

(9 hours)

UNIT-IV

Isometric Projections-Principles of Isometric projection –Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions.

(8 hours)

UNIT-V

Overview of Computer Graphics-Listing the computer technologies that impact on graphical communication, Demonstrating knowledge of the theory of CAD software [such as: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Objects, Isometric Views of lines, Planes, Simple and compound Solids; Customization & CAD Drawing consisting of set up of the drawing page and the printer, including scale settings, Setting up of Units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerance.

(10 hours)

References:-

1. Bhatt N.D., Paschal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House
2. Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education
3. Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication
4. Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers
5. CAD Software Theory and User Manuals

BEESC-105	**Engineering Graphics**	**0L:0T:1P**	**1 credits**	**2Hrs/Week**

List of Experiments:-

1. Sketching and drawing of geometries and projections based on above syllabus
2. Term work: A min. of 30 hand drawn sketches (on size A4 graphic sketch Book) plus 5 CAD-printouts on size A4 sheets plus 10 sheets of size A2 or 6 sheets of size A1, (50% marks to be allotted for this record + 25% marks for attendance +25%marks for Teachers Assessment

Department of Mechanical Engineering

BEESC-106	**Manufacturing Practices**	**0L:0T:1P**	**1 credits**	**2Hrs/Week**

Course Preamble:

1. To understand process of cutting shaping.
2. To understand working principles for various machining processes.
3. To understand construction, working and applications of various machine tools.
4. To learn basic set up, working and applications of a few important non conventional machining processes to get hand on experience on various machine tools.

Course Outcomes

1. The students will be able to understand the details about machines used in production.
2. The students will be able to understand the mechanics behind metal cutting.
3. The students will be able to understand the finishing and super finishing processes.
4. The students will be able to understand the Physics of material removal behind the various non-conventional machining processes.

Manufacturing is fundamental to the development of any engineering product. The course on Engineering Workshop Practice is intended to expose engineering students to different types of manufacturing / fabrication processes, dealing with different materials such as metals, ceramics, plastics, wood, glass etc. While the actual practice of fabrication techniques is given more weightage, some lectures and video clips available on different methods of manufacturing are also included.

1. Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods
2. CNC machining, Additive manufacturing
3. Fitting operations & power tools
4. Carpentry
5. Plastic molding, glass cutting
6. Metal casting
7. Welding (arc welding & gas welding), brazing

List of Experiments:-

1. Carpentry Shop Experiment To Make a T-LAP joint with wood Pieces
2. Machine Shop Experiment To Perform Knurling on Iron Rod
3. WELDING SHOP (LAP Joint) , Tools, Accessories, Diagram And Explanation
4. SHEET METAL SHOP (Square Tray) , Parts, Accessories, Diagram And Explanation
5. FITTING SHOP (Make a Joint) , Parts, Accessories, Diagram And Explanation
6. CARPENTRY SHOP (T-Lap Joint) , Cutting Tools, Accessories, Diagram and Explanation
7. MACHINE SHOP (the lathe machine) , Parts, Accessories, Diagram and Explanation

BELC 207	**Industrial Training**	**0L:0T:1P**	**1 credits**	**2Hrs/Week**

1. Industrial environment and work culture.
2. Organizational structure and inter personal communication.
3. Machines/ equipment/ instruments - their working and specifications.
4. Product development procedures and phases.
5. Project planning, monitoring and control.

BE-SEMESTER-III SYLLABUS

BEA-301	Mathematics-III	3L:0T:0P	3 credits	3Hrs/Week

Course Preamble:

To enable the students to apply the knowledge of Mathematics in various engineering fields by making them

1. To understand the method of solving algebraic, transcendental equations and to determine the approximate value of the derivative & definite integral for a given data using numerical techniques.
2. Able to expand the given periodic function defined in the given range in terms of sine and cosine multiple of terms as a Fourier series and to extremise the functional using integration technique and to solve the partial differential equation using different analytical techniques.

Course outcomes

On completion of this course, students will be able to

1. Solve field problems in Engineering involving PDEs.
2. Use the root finding techniques to solve practical engineering problems.
3. To apply the concept of numerical analysis to find the relative strengths and weaknesses of each computation method and know which are most applicable for given problem.
4. To apply the analytical technique to express periodic function as a Fourier sine and cosine series.
5. Estimate Laplace and Fourier transform and z transform.

Unit I

Numerical Method-Solution of polynomial and transcendental equations – Bisection method, Newton-Raphson method and Regula-Falsi method. Finite differences, Relation between operators, Interpolation using Newton's forward and backward difference formulae. Interpolation with unequal intervals: Newton's divided difference and Lagrange's formula.

(9 hours)

Unit II

Numerical Methods-Numerical Differentiation, Numerical integration: Trapezoidal rule and Simpson's 1/3rd and 3/8 rules. Solution of Simultaneous Linear Algebraic Equations by Gauss's Elimination, Gauss's Jordan, Crout's methods, Jacobi's, Gauss-Seidal, and Relaxation method.

(9 hours)

Unit III

Numerical Methods-Ordinary differential equations: Taylor's series, Euler and modified Euler's methods. RungeKutta method of fourth order for solving first and second order equations, Milne's and Adam's predicator-corrector methods. Partial differential equations: Finite difference solution two dimensional Laplace equation and Poission equation, Implicit and explicit methods for one dimensional heat equation (Bender-Schmidt and Crank-Nicholson methods), Finite difference explicit method for wave equation.

(10 hours)

Unit IV

Transform Calculus-Laplace Transform, Properties of Laplace Transform, Laplace transform of periodic functions. Finding inverse Laplace transform by different methods, convolution theorem. Evaluation of integrals by Laplace transform, solving ODEs by Laplace Transform method, Fourier transforms.

(8 hours)

Unit V

Concept of Probability-Probability Mass function, Probability Density Function, Discrete Distribution: Binomial, Poisson's, Continuous Distribution: Normal Distribution, Exponential Distribution.

(8 hours)

References:

1. P. Kandasamy, K. Thilagavathy, K. Gunavathi, Numerical Methods, S. Chand & Company, 2nd Edition, Reprint 2012.
2. S.S. Sastry, Introductory methods of numerical analysis, PHI, 4th Edition, 2005.
3. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons,
4. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2010.
5. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
6. Veerarajan T., Engineering Mathematics, Tata McGraw-Hill, New Delhi, 2008.
7. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability Theory, Universal Book
8. S. Ross, A First Course in Probability, 6th Ed., Pearson Education India, 2002.
9. W. Feller, An Introduction to Probability Theory and its Applications, Vol. 1, 3rd Ed., Wiley, 1968. Statistic

MEA- 302	Thermodynamics	3L:1T:0P	4 credits	4Hrs/Week

Course Preamble:

1. Understand the applications of Engineering Thermodynamics in real life situations
2. Understand basics and use of various laws of Thermodynamics
3. Understand Vapor Power Cycles
4. Broaden the understanding of Steam Generators
5. Understanding the thermodynamics of Nozzles and Diffusers
6. Understanding the basics of Steam Turbines
7. Understanding the Steam Condensers Operations and uses

Course Outcomes:

By the end of the course the students shall be able to

1. Understand and can apply various laws of thermodynamics. He will be able to solve the problems related to various laws of thermodynamics
2. Understand Boilers function and its uses. He will be able to do boiler trail for preparing heat balance
3. Understand function, Types, utility of steam operated devices like nozzles, impulse turbine, reaction turbine and condenser. He will be able to calculate all thermodynamic quantities like work, efficiencies etc.

UNIT-I

Basic Concepts & Laws of Thermodynamics: Basic concepts Property, Equilibrium, State, Process, Cycle, Zeroth law of Thermodynamics, Heat and Work Transfer. First law of Thermodynamics- first law applied to various systems steady flow process, limitations of first law of Thermodynamics.

(9 hours)

UNIT-II

Second law of Thermodynamics, Heat Engine, Heat Reservoir, Refrigerator, Heat Pump, Carnot's Cycle, statements of second law Reversible and irreversible processes, consequence of second law, Clausious Inequality , Entropy, T-S diagrams, Available & Unavailable energy Availability Concept

(9 hours)

UNIT-III

Properties of Steam : Pure Substance, Phase, Phase-transformations, formation of steam, properties of steam, PVT surface, HS,TS,PV,PH,TV diagram, processes of vapor measurement of dryness fraction, Use of Steam Tables and Mollier chart.

(9 hours)

UNIT-IV

Air standard cycles: Carnot, Otto, Diesel, Dual cycles and their comparison, Brayton cycle, Non reactive gas mixture, PVT relationship, mixture of ideal gases, properties of mixture of ideal gases, internal energy, Enthalpy and specific heat of gas mixtures.

(9 hours)

UNIT-V

Fuels & combustion : Actual & theoretical Combustion processes , Enthalpy of formation & enthalpy of reaction, first law analysis of reacting systems, Adiabatic flame temperature , Basic concept of Third Law of thermodynamics . Steam Tables, Mollier Charts & tables connected to reactive systems are allowed in Examination

(9 hours)

References:

1. P.K.Nag; Engineering Thermodynamics; Mc Graw Hills Fifth Edition
2. Cengel Y; Thermodynamics; MC Graw Hills ,Eight Edition
3. Kross & Potter Thermodynamics for Engineers CENGAGE Learning
4. Moran, Shapiro ,Boettner Principles of Engineering Thermodynamics Wiley student edition
5. P Chattopadhya , Engineering Thermodynamics Second Edition,OXFORD University Press

6 Zemansky Heat & Thermodynamics , Eight Edition , Mc Graw Hills India Education

6. Achuthan M; Engineering Thermodynamics by, PHI India.
7. R.Yadav Applied Thermodynamics, Central Publishing house Allahaba

MEA- 303	Materials Technology	2L:0T: P	2credits	2Hrs/Week

Course Preamble:

1. Know different machine elements and mechanisms, composite material use instead of traditional heavy.
2. Understand Kinematics and Dynamics of different machines and mechanisms.
3. Select Suitable Drives and Mechanisms for a particular application.

Course Outcomes:

By the end of the course the students shall be able to

1. Familiarity with common mechanisms used in machines and everyday life.
2. Ability to calculate mobility (number of degrees-of- freedom) and enumerate rigid links and types of joints within mechanisms.
3. Ability to conduct a complete (translational and rotational) mechanism position analysis.

UNIT-I

Solidification of metals , Crystallization , Crystal and amorphous , different types of bonds in different metals, Crystallography. Stability and Meta stability of metals. Different mechanical properties of metals and other engineering materials like strength, hardness, elasticity, plasticity, Malleability, Ductility, Creep, Fatigue etc .Introduction to industrial metals, steels and prevailing manufacturing methods by manufacturers.

(9 hours)

UNIT-II

Cooling curves, Isomorphous, Utectic, Eutectoid , Eutectoid solid solution, Peritectic and other phase diagrams, Alloying , Characteristics of alloying elements, Iron – Carbon phase diagram, T-T-T diagrams, Types of Cast Iron. Types of Stainless Steels, Elastic, anelastic and Viscoelastic behaviour.

(9 hours)

UNIT-III

Heat treatment of metals, Based on phase diagram and T-T-T-Diagram the heat treatment of various metals, Bulk heat treatments, surface heat treatments, Case carburizing, Types of Annealing, Normalising, Spherodising, Phase Transformations like Pearlite, Cementite, Austenite, Troostite, Bainite, Hard and soft Martensite etc. Laser hardening, Cyniding, Boriding, Nitriding, Flame hardening, Ion implantation, Etc. Heat treatment cycles. Metallographic studies, Optical Microscope, Electron Microscope.

(9 hours)

UNIT-IV

Destructive and non-destructive testing methods, Tensile test, Compression test, shear test, bend test, Different types of Hardness tests, Impact tests, Fatigue tests, Hardenability test. Fracture analysis, NDT Methods. Different properties of Steels, Aluminium and it's alloys, Copper and it's alloys, Manganese and it's alloys, Chromium and it's alloys, Nickel and it's alloys.

(9 hours)

UNIT-V

Chemical Analysis of different alloying elements in commercial metals, C, Fe, Cr, Ni, Mn, Mg, S, P, Co, Mo, Etc. Different chemical reagents, Equipments , Volumetric and Gravimetric analysis, Spot test, Colorimetric methods, Optical and spectrophotometric analysis.

(9 hours)

References:

1. V. Raghwan, Material Science
2. G.E.Dieter, MechanicalMetallurgy
3. P Chalmers, Physical Metallurgy
4. R. C.Rollason, Metallurgy for mechanical engineers

MEA- 303	Materials Technology	2L:0T: 1P	1credits	2Hrs/Week

List of Experiments:

1. Metallographic studies – Study of Optical microscope, Optically flat surface preparation, etching reagents, Grain size- ASME no., micro structures, Image analysis, Standard specimen,
2. Carbon, sulphur, Phosphorus determination, Strauhlin's apparatus, Eggert's Method in different samples.
3. Hardness and Hardenability test, Jeremy Cony test. Soft and hard Martensite.
4. Different heat treatment cycles using electric furnace [Programmable preferred], Annealing, Case carburising, Normalising, etc.
5. Gravimetric / Volumetric - chemical analysis of alloying elements like, Cr, Ni, Mn, Si etc.
6. To Study of different instrumental method of analysis, Spectrophotometers, Differential Scanning calorimeter,
7. Spot test for quick assessment of alloying elements like Mn, Cr, Ni, etc.
8. Experiments / study of Non Destructive Methods, Ultrasonic test, Magnetic particle inspection, Dye penetration Test, Eddy current Test, Radiography Test. Cupping Test / Formability Test for sheet metal.

MEA- 304	Manufacturing Process	3L:0T:0 P	3credits	3Hrs/Week

Course Preamble:

1. To state the importance and need to Manufacturing processes
2. To choose among various tool materials.
3. To aware the students about various Manufacturing processes
4. To give them practical exposure of various Manufacturing processes
5. To tell them about applications of various Manufacturing processes.

Course Outcomes:

By the end of the course the students shall be able to

1. The Fundamentals of Engineering Materials
2. The principle working and controlling parameters of metal forming processes and the principle working and controlling parameters of welding
3. The principle working and controlling parameters of foundry and the process of mould making

UNIT-I

Casting : Types of casting process .Molding and Foundry core sands and their properties, gating, runners, risers, solidification, defects and elimination, molding machines, centrifugal casting, dye casting, Shell molding; Lost wax molding; continuous casting; Cupola description and operation.

(9 hours)

UNIT-II

Welding: Types of welding ,Gas welding method, Various types of oxy-acetylene gas flames, Gas Cutting, Electric arc welding, AC and DC welding machines and their characteristics, flux, electrodes, submerged arc welding, TIG & MIG welding; pressure welding; electric resistance welding spot, seam and butt welding; Thermit Chemical welding; brazing and soldering, welding defects & remedies along with safety precautions .

(9 hours)

UNIT-III

Pattern Making: Types of patters, Pattern and pattern making, pattern allowances; pattern design considerations, core, core boxes . Forging: types of forging operations Theory and application of forging processes description; , drop and horizontal forging machines .

(9 hours)

UNIT-IV

Press working: Description and operation of processes, process of shearing, punching, piercing, blanking, trimming, perfecting, notching, lancing, embossing, coining, bending, forging and drawing; press, tool dies, auxiliary equipment, safety devices, stock feeders, scrap cutters, forces, pressure and power requirements . Rolling: Types of Rolling operations, General description of machines and

process; rolling of structural section plates and sheets; hot and cold rolling techniques.

(9 hours)

UNIT-V

Metal Machining : Basics of Lathe machines , operations & components ,working principle of Shaper & planner ,Introduction to milling ,grinding and drilling machines .

(9 hours)

References:

1. Anderson and Tetro; Shop Theory; Mc Graw Hills
2. Kaushish JP; Manufacturing Processes; PHI Learning.
3. Kalpakjian Producting Engineering PEARSON Education
4. Chapman; Workshop Technology
5. Philip F Ostwald ; Manufacturing Process & systems : John Wiley
6. Raghuvanshi; Workshop Technology ; Dhanpat Rai.
7. Hajra Choudhary; Workshop Technology:, Vol I

MEA- 304	**Manufacturing Process**	**0L:0T:1P**	**1credits**	**3Hrs/Week**

List of Experiments:

1. To study of tools used for various manufacturing processes, study includes application & live demonstration of hand and machine tools .
2. To study of the Pattern Making
3. To study of Metal Casting of Simple component
4. To study of gas welding
5. To study of different welding process
6. To study of the die Casting
7. To study and perform various operation of forging machine .

MEA- 305	Strength of Material	2L:1T:0P	3credits	3Hrs/Week

Course Preamble:

1. Provide clear understanding of principles, assumptions, and limitations underlying the mechanics of deformable solids in equilibrium.
2. Apply above principles to engineering design based on strength, stiffness, and stability criteria.

Course Outcomes

1. Given a physical situation the student should be able to develop a physical understanding of the problem.
2. The student should then be able to construct an idealized model.
3. Using equilibrium, compatibility, and force-deformation relation the student should be able to generate the solution to the problem.
4. The student should be able to analyze and design an element Using the above principles.

UNIT-I

Stress and strain: stresses in members of a structure, axial loading, normal stress, shear stress, analysis of simple structures, stepped rods, members in series and parallel: stress strain diagram, Hooke's law, stress due to temperature, Poisson's ratio, Bulk modulus, shear strain, relation among elastic constants, residual stress, fiber reinforced composite materials, strain energy under axial loads and stresses due to impact of falling weights. Transformation of stress and strain, principal stresses, normal and shear stress, Mohr's circle and its application to two and three dimensional analysis.

(9 hours)

UNIT-II

Bending: pure bending, symmetric member, deformation and stress, bending of composite sections, Eccentric Axial loading, Shear Force and BM diagram, relationship among load, shear and BM, shear stresses in beams, Strain Energy in bending, Deflection of Beams, Equation of Elastic Curve, Macaulay's method and Area moment method for deflection of beams.

(9 hours)

UNIT-III

Torsion in shafts: Tensional stresses in a shafts, deformation in circular shaft, angle of twist, stepped and hollow transmission shafts.

(6 hours)

UNIT-IV

Theories of failures: Maximum Normal Stress & Shear stress theory; Maximum Normal and Shear

Strain Energy Theory; Maximum Distortion Energy Theory; application of theories to different materials and loading conditions.

(9 hours)

UNIT-V

Columns & struts : Stability of Structures, Euler's formula for columns with different end conditions, Rankine's formula.

(8 hours)

References:

1. Beer FP, Johnson Mechanics of Materials ,Sixth Edition ;Mc Graw Hills
2. Debabrata Nag & Abhijet Chanda :Strength of Materials : Wiley
3. Rattan; Strength of materials;Second Edition , Mc Graw Hills
4. Nash William; Schaum's Outline Series; forth Edition Strength of Materials;Mc GrawHills
5. Singh Arbind K; Mechanics of Solids; PHI
6. Sadhu Singh; Strength of Materials; Khanna Pub.
7. R Subramannian , Strength of materials OXFORD University Press ,Third Edition.
8. 8 S Ramamurthum , Strength of materials , Dhanpat Rai

MEA- 305	Strength of Material	0L:0T:1P	1credits	2Hrs/Week

List of Experiments

1. To perform Standard Tensile Test on MS and CI test specimen with the help of UTM
2. To perform direct/ cross Shear test on MS and CI specimen
3. To perform transverse bending test on wooden beams to obtain modulus of rupture
4. To perform fatigue test
5. To perform Brinell Hardness tests
6. To perform Vicker Hardness test
7. To perform Izod/Charpy test
8. To perform Rockwell Hardness test.

MEA- 306	Thermal Engineering Lab	0L:0T:1P	1credits	2Hrs/Week

Course Preamble:

1. Heat transfer (Micro, Macro and Nano scale)
2. Combustion Engineering and Flame Dynamics
3. Renewable Energy Systems and Conventional Power Cycles
4. Thermodynamic Energy and Exergy optimization
5. HVAC & Cryogenics
6. Micro and Nano scale fluid transport
7. Optical methods in flow visualization
8. Turbulent Dynamics
9. Gas dynamics

List of Experiments:

1. To determine volumetric and isothermal efficiencies of a single stage compressor.
2. To Study of two stages Air Compressor with intercooler.
3. To determine volumetric and isothermal efficiencies of a two stage compressor.
4. To Study of different types of boilers and their classifications.
5. To Study of different types of high pressure boilers.
6. To determine the performance of boiler.
7. Temperature measurements, Pyrometers andthermography.
8. Thermocouples, Temperature sensors,study andcalibration.
9. To Study and experiments on ORSAT apparatus.
10. Experiments on calorific value of different fuels and analysis of exhaust gases.

MEA-307	**Self-Study / GD Seminar**	**0L:0T:1P**	**1 credits**	**2Hrs/Week**

Course Preamble:

To improve the mass communication and convincing / understanding skills of students and it is to give student an opportunity to exercise their rights to express themselves. Evaluation will be done by assigned faculty based on group discussion and power point presentation.

Course Outcomes

1. Analytical thinking
2. Lateral thinking
3. constructive argument
4. Communication skill
5. Presentation of views

The main Preamble is to improve the mass communication and convincing/understanding skills of students, And to give the students an opportunity to exercise their rights to express themselves. The evaluation will be done based on their presentation work and group discussion.

BE-SEMESTER-IV SYLLABUS

BEA-401	**Energy, Ecology, Environment & Society**	**3L:0T:0P**	**3 credits**	**3Hrs/Week**

Course Preamble:

1. To understand the basic principles of Energy, its availability and its economical utilisation.
2. To acquire proficiency in using & calibrating various energy.
3. To understand the problems in society towards environment degradation due to conventional energy.
4. Society, Ethics & Human values regarding energy.

Course Outcomes:

Students will be able to

1. Understand the fundamental science and engineering principles relevant to energy.
2. Understand the relationship between various energy, characteristic, properties and its economical use.
3. Processing and energy efficiency achievement.

UNIT -1

Sources of Energy: Renewable & Non Renewable, Fossil fuel, Biomass Geothermal, Hydrogen, Solar, Wind, hydro, nuclear sources.

(9 hours)

UNIT-2

Segments of Environment: Atmosphere, hydrosphere, Lithosphere, biosphere. Cycles in Ecosystem - Water, Carbon, Nitrogen. Biodiversity: Threats and conservation.

(8 hours)

UNIT-3

Air Pollution: Air pollutants, classification, (Primary & secondary Pollutants) Adverse effects of pollutants. Causes of Air pollution chemical, photochemical, Green house effect, ozone layer depletion, acid Rain. Sound Pollution: Causes, controlling measures, measurement of sound pollution (deciblage), Industrial and non – industrial.

(10 hours)

UNIT-4

Water Pollution– Water Pollution: Pollutants in water, adverse effects. Treatment of Domestic & Industrial water effluent. Soil Pollution – Soil Profile, Pollutants in soil, their adverse effects, controlling measures.

(8 hours)

UNIT-5

Society, Ethics & Human values– Impact of waste on society. Solid waste management Nuclear, Thermal, Plastic, medical, Agriculture, domestic and e-waste). Ethics and moral values, ethical situations, objectives of ethics and its study . Preliminary studies regarding Environmental Protection Acts, introduction to value education, self exploration, sanyam & swasthya.

(9 hours)

REFERENCES:

1. Harris, CE, Prichard MS, Rabin's MJ, "Engineering Ethics"; Cengage Pub.
2. Rana SVS ; "Essentials of Ecology and Environment"; PHI Pub.
3. Raynold, GW "Ethics in information Technology"; Cengage.
4. Svakumar; Energy Environment & Ethics in society; TMH
5. AK De "Environmental Chemistry"; New Age Int. Publ.
6. BK Sharma, "Environmental Chemistry" ; Goel Publ. House.
7. Bala Krishnamoorthy; "Environmental management"; PHI
8. Gerard Kiely, "Environmental Engineering" ; TMH
9. Miller GT JR; living in the Environment Thomson/cengage
10. Cunninghan WP and MA; principles of Environment Sc; TMH
11. Gandhiji M.K.- My experiments with truth

MEA-402	Instrumentation & Control	2L:1T:0P	3 credits	3Hrs/Week

Course Preamble:

1. To understand the basic principles, construction and working of engineering mechanical measurement science.
2. To acquire proficiency in using, calibrating various measurement systems.
3. To understand the problems in measurement system and develop the competency to resolve the problems.
4. To know all the measuring instruments and to measure different parameters in day-today work.

Course Outcomes:

1. After going through basic study of generalized measurement system, students will be able to understand the stepwise working of all instruments and will be able to find out the output factors.
2. They will be able to know the importance of all factors affecting on output of instruments i.e. errors.
3. They can suggest some points in the design & working of instruments after studying the basics if metrology.
4. Students will be able to differentiate between all types of measurements i.e. Direct & indirect type, contact & non-contact type as well as they can design the components with provisions of tolerance in manufacturing.

Unit-1

Introduction to instrumentation systems, classifications, functional elements of a measurement system, standards and calibration, static performance characteristics, measurement errors and uncertainties, analysis, sequential and random test, specifications of instrument static characteristics, data acquisition, reduction, data outliner detection.

(9 hours)

Unit-2

Dynamic characteristics of the instruments, formulation of system equations, dynamic response, compensation, and periodic input, harmonic signal non harmonic signal, Fourier transform, response to the transient input, response to random signal input, first and second order system compensation.

(9 hours)

Unit-3

Introduction to instrument systems- (a) Temperature measurements, thermometry based on thermal expansion, liquid in glass, bimetallic, electric resistance- thermometry, thermocouples, thermistors, detectors, (b) pressure and velocity measurements, barometer, manometer, dead weight tester, pressure gauges and transducers, dynamic measurements,(c) flow measurements, pressure differential meters, orifice meter, venturi meter, rota-meter.

(9 hours)

Unit-4

Strain gauges, strain and stress measurements, electrical circuits, compensations, motion force and torque measurements, displacement measurements, potentiometers, linear and rotary variable differential transformers, velocity measurements, electromagnetic technique, stroboscope, load cell, measurement of torque on rotating shaft, power estimation from rotating shaft.

(9 hours)

Unit-5

Control systems, open loop and close loop control, mathematical modeling of dynamic systems – mechanical systems, electrical systems, fluid systems, thermal systems, transfer function, impulse response function, block diagrams of close loop systems, system modeling using software.

(9 hours)

Reference:

1. Nakra B.C.Chaudhary K.K, Instrumentation measurement and analysisTata McGraw Hill,
2. Richard S, Figiola & Donal E. Beasley, John Wiley, Theory and design of mechanical measurements.

MEA-402	**Instrumentation & Control**	**0L:0T:1P**	**1 credits**	**2Hrs/Week**

List of Experiments

1. To determine the functional elements of a measurement system.
2. To Study of Dynamic characteristics of the instruments
3. To Study of Temperature measurements instruments
4. To Study of strain gauges, strain and stress measurements.
5. To Study of Control systems.
6. To Study of open loop and close loop control systems.

MEA-403	Theory of Machines	2L:1T:0P	3 credits	3Hrs/Week

Course Preamble:

1. This course aims at the fundamental science and engineering principles relevant to machines.
2. The course will present systematic approaches for the mechanical working of machines.
3. Various machine working principles and how to raise their efficiency.

Course Outcomes:

Students will be able to

1. Understand the fundamental science and engineering principles relevant to machines.
2. Understand the relationship between dynamic and static forces involved on machines.
3. Processing and economical design of machines.

Unit-1

Introduction, kinematics and kinetics, mechanisms and machines, degree of freedom, types of motions, kinematic concept of links, basic terminology and definitions, joints and kinematic chains, inversions, absolute and relative motions, displacement, velocity and acceleration diagrams, different mechanisms and applications.

(9 hours)

Unit-2

kinematic synthesis of linkages, dynamic motion analysis of mechanisms and machines, D'Alembert's principle, number synthesis, free body diagrams, kinematic and dynamic quantities and their relationships, analytical method and graphical method.

(9 hours)

Unit-3

Cams, introduction, classifications of cams and followers, nomenclature, analysis of cam and follower motion, analytical cam design with specific contours, pressure angle, radius and undercutting, motion constrains and program, critical path motion, torque on cam shaft.

(9 hours)

Unit-4

Power transmission, kinematics of belt- pulley, flat and v –belt, rope, condition of maximum power transmission, efficiency, friction, friction devices, pivot and collars, power screw, plate and cone clutch, brakes, classifications, bock, band, internal and external, friction circle, friction axis.

(9 hours)

Unit-5

Gears, laws of gearing, classification and basic terminology, tooth profiles, kinematic considerations, types of gears, spur, bevel, worm, helical, hypoid etc, Gear Trains, Epicyclic, Compound, balancing-static and dynamic, in same/ different planes, Introduction to vibration, single degree of freedom.

(9 hours)

Reference:

1. R.L.Norton,kinematics& dynamics of machinery,Tata McGraw Hill, ISBN13
2. A.Ghosh & A.Malik, Theory of Mechanisms and Machines,EWP Pvt Ltd,ISB
3. Rao JS and Dukkipati; Mechanism and Machine Theory; NewAge Delhi.
4. Dr.Jagdish Lal; Theory of Machines; Metropolitan Book Co; Delhi – 5.Ghosh,A,.Mallik,AK; Theory of Mechanisms & Machines, 2e,

MEA-403	Theory of Machines	0L:0T:1P	1 credits	2Hrs/Week

List of Experiments

1. To Study of cam and follower and finding velocity and acceleration of follower.
2. To. Study of slider crank mechanism
3. To. Study of different kinematic pairs.
4. Generation of involute teeth profile for different gears.
5. Performance of interference and undercutting of tooth (by plotting)
6. To Study of Gyroscopic Effect while using Gyroscope.
7. To study working of Differential Gear Mechanism.
8. To study working of sun and planet epicycle gear train mechanism using.

MEA-404	Fluid Mechanics	2L:1T:0P	3 credits	3Hrs/Week

Course Preamble:

1. To understand the structure and the properties of the fluid.
2. To understand the behavior of fluids at rest or in motion and the complexities involved in solving the fluid flow problems.
3. To solve different type of problems related to fluid flow in pipes and do the prototype study of different type of machines

Course Outcomes:

1. Explain the concept of fluid, stability of bodies in fluid and different types of fluid flows.
2. Use Bernoulli's theorem to solve basic problems involving pressure losses through pipes and pipe bends and its application
3. Explain the importance of Dimensional Analysis techniques and dimensionless parameters in fluid mechanics; Reynolds number; Mach number.
4. Lean the concept of potential flow, viscous flow considering viscous forces

Unit-1

Introduction, fluid and the continuum, fluid properties, surface tension, bulk modulus and thermodynamic properties, Newton's laws of viscosity and it's coefficients, Newtonian and non Newtonian fluids, hydrostatics and buoyancy, meta center and metacentric height, stability of floating bodies.

(9 hours)

Unit-2

Fluid kinematics, Langragian and Eularian mrthod, description of fluid flow, stream line, path line and streak line, types of flow and types of motion, local and connective acceleration, continuity equation, potential flow, circulation, velocity potential, stream function, laplace equation, flow nets.

(9 hours)

Unit-3

Fluid dynamics, system and control volume, Reynold transport theorem, Euler's equation, Bernoulli's equation, momentum and moment of momentum equation, their applications, forces on immersed bodies, lift and drag, streamlined and bluff bodies, flow around circular cylinder and aerofoils.

(9 hours)

Unit-4

Flow through pipes, Reynold number, laminar and turbulent flow, viscous flow through parallel plates and pipes, Navier Stoke's equation, pressure gradient, head loss in turbulent flow (Darcey's equation), friction factor, minor losses, hydraulic and energy gradient, pipe networks.

(9 hours)

Unit-5

Introduction to boundary layer theory, description of boundary layer, boundary layer parameters, Von Karman momentum equation, laminar and turbulent boundary conditions, boundary layer separation, compressible flow, Mach number, isentropic flow, stagnation properties, normal and oblique shocks, Fanno and Reyleigh lines, flow through nozzles.

(9 hours)

Reference:

1. Massy B.S., Mechanics of fluid, Routledge Publication
2. 2.Shames, Fluid Mechanics, Tata McGraw Hills
3. Fluid Mechanics- Yunush A. Cengel, John M. Cimbala- TMH,Delhi
4. Fluid Mechanics and Fluid Power Engineering – D.S. Kumar– Kataria & Sons –
5. 5.A text of Fluid Mechanics – R. K. Rajput – S. Chand & Company Ltd., Delhi

MEA-404	**Fluid Mechanics**	**0L:0T:1P**	**1 credits**	**2Hrs/Week**

List of Experiments:

1. To determine the meta-centric height of a ship model.
2. To verify Impulse Momentum Principle.
3. To calibrate a Venturimeter and study the variation of coefficient of discharge.
4. To calibrate an orifice-meter.
5. To Flow measurement using Pitot tube.
6. To determine the hydraulic coefficients (Cc, Cd and Cv) of an orifice.
7. To determine the coefficient of discharge of a mouth piece.
8. To study the variation of friction factor for pipe flow.

MEA- 405	Manufacturing Technology	2L:1T:0P	3 credits	3Hrs/Week

Course Preamble:

1. The primary objective of this course is to help the student gain the knowledge about traditional manufacturing machine like lathe, drilling, milling, grinding and welding machines.
2. To understand various tools and tool signature used on these machines
3. To understand importance of measurement and process of measurement.

Course Outcomes:

1. Identify the different components and operations of traditional machines.
2. Select and apply different manufacturing processes to machine a component.

Unit-1

Analysis of Machining processes, introduction, tool geometry, tool materials, wear characteristics, cutting forces, , cutting fluids, failure of cutting tools, broaching operation, types of broaching machines, design of broaching tools, centre less grinding, thread chaser, thread grinding boring, super finishing processes like honing, lapping, electroplating and buffing.

(9 hours)

Unit-2

Gear machining, types of gears, elements of gears, different methods of gear production, gear cutting on milling machine, gear machining by generation method, principles of generation of surfaces – hobbing, shaping and basic rack cutting, gear finishing by shaving and gear grinding, tooth profile grinding, suitable gear treatments.

(9 hours)

Unit-3

Plastics, composition of plastic materials, moulding method- injection moulding, compression moulding, transfer moulding, extrusion moulding, calendaring, blow moulding, laminating and reinforcing, welding of plastics.

(9 hours)

Unit-4

Unconventional machining processes, introduction, abrasive jet machining, ultrasonic machining, electrochemical machining, electro discharge machining, electron beam machining, laser beam machining, plasma arc machining, non destructive testing of machined surfaces and tools.

(9 hours)

Unit-5

Extrusion, principles, hot and cold extrusion processes, tube extrusion, sawing, power hacksaw, band saw, circular saw, Introduction to numerical control machining, NC Machine tools, NC tooling ,part programming, functions, coordinate systems.

(9 hours)

Reference:

1. Ghosh A., Mallik A.K.,Manufacturing science,EWP Pvt Ltd, ISBN 81 85095 85
2. R.K.Jain, Production Technology, Khanna Publishes, ISBN 81 7409 099 1
3. Campbell J.S., Principles of Manufacturing Materials and Processes.
4. CMTI Handbook
5. Rao P.N., Manufacturing Technology, Tata McGraw Hill

MEA- 405	Manufacturing Technology	0L:0T:1P	1 credits	2Hrs/Week

List of Experiments:

1. To Study of different methods of gear production.
2. To Study of different grinding machines.
3. To Study of Processing Plastics-Injection Molding.
4. To Study the manufacturing of different methods of gear.
5. To Study of hot and cold extrusion processes

MEA- 406	Software Lab	2L:1T:0P	3 credits	3Hrs/Week

Course Preamble:

1. To introduce field of Intelligent CAD/CAM with particular focus on engineering product design and manufacturing.
2. To develop a holistic view of initial competency in engineering design by modern computational methods.
3. To understand concepts of geometric modelling.
4. Provide theoretical background of CAD/CAM. v) Introduce Rapid Prototyping techniques.

Course Outcomes:

A learner will be able to….

1. Identify proper computer graphics techniques for geometric modelling.
2. Transform, manipulate objects, store and manage data.
3. Prepare computer assisted part program and post process.
4. Prepare part programming applicable to CNC machines.
5. Use rapid prototyping and tooling concepts in any real life applications.

Role of computers in design and manufacture. Drawing software, configuration, function and facilities, parametric representation, examples of drawings and systems
Surface modeling, curves and surface representation – composite surfaces, case studies in CAD, parametric representation analytic and synthetic curves, surface manipulation, design and engineering applications, Current developments in CAD, feature based modeling, design by feature, Solid modeling, boundary representation, analytic solid modeling, constructive solid geometry, sweep representation, design and engineering applications,
Strategic plan of CAD system design and development, graphic exchange, features recovery, etc.

Reference:

1. Donald H, Paulin M, Computer graphics, Prentice Hall, Ibrahim z., CAD/CAM, Theory and Practice, McGraw Hill,
2. Mc mohan C, Browne, CAD/ CAM Principles- practice and manufacturing management, Pearson Education AsiaLtd,

MEA- 406	**Software Lab**	**0L:0T:1P**	**1 credits**	**2Hrs/Week**

List of Experiments

1. 2D sketching on CAD software
2. 3D modeling on CAD software
3. Modeling of IC Engine components
4. Modeling of hand tools
5. Modeling of modern Furniture using CAD software
6. Modeling and Assembling components for a project on CAD software
7. A case study on Product Design using CAD software

MEA-407	Industrial Training –I	0L:0T:1P	1 credits	2Hrs/Week

Course Preamble:

Industrial Training is imparted with the following in mind-

1. To provide comprehensive learning platform to students where they can enhance their employ ability skills and become job ready along with real corporate exposure.
2. To enhance students' knowledge in electrical technology.
3. To Increase self-confidence of students and helps in finding their own proficiency
4. To cultivate student's leadership ability and responsibility to perform or execute the given task.
5. To provide learners hands on practice within a real job situation

Course Outcomes:

At the end of the training, a student will be able to:

1. acquire and apply fundamental of engineering aspects learned during training.
2. Become updated with all the latest changes in technological world.
3. Ability to communicate efficiently.
4. Ability to identify, formulate and model problems in real practical field and find engineering solution based on a systems approach.
5. Awareness of the social, cultural, global and environmental responsibility as an engineer.

Duration:- 2 weeks after the IV semester in the summer break, Assessment in V semester.

Students must observe following to enrich their learning during industrial training:

- Industrial environment and work culture.
- Organizational structure and inter personal communication.
- Machines/ equipment/ instruments - their working and specifications.
- Product development procedures and phases.
- Project planning, monitoring and control.

BE-SEMESTER-V SYLLABUS

MEA-501	**MACHINE COMPONENT DESIGN**	**2L:1T:0P**	**03 credits**	**3Hrs/Week**

Course Preamble:

1. To familiarize the various steps involved in the Design process
2. To understand the principals involved in evaluating the shape and dimensions of a
3. Complete to satisfy function and strength requirements.
4. Students shall gain a thorough understanding of the different types of failure modes and
5. Criteria. They will be conversant with various failure theories and be able to judge which
6. Criterion is to be applied for a particular situation.
7. Student shall gain design knowledge of the different types of elements used in
8. the machine design process, for e.g. fasteners, shafts, couplings etc. and will be able to design these elements for each application.

Course Outcomes:

1. Ability to analyze the stress and strain of mechanical components and understand,
2. Identify and quantify failure modes for mechanical part.
3. Ability to decide optimum design parameters for mechanical systems.
4. Ability to design mechanical system for fluctuating loads.
5. . Acquire skill in preparing production drawing pertaining to various designs.

UNIT 1

Design Against Fluctuating Load : causes of stress concentration; stress concentration in tension, bending and torsion; Fluctuating Stresses, notch sensitivity, fatigue stress concentration factor, cyclic loading, endurance limit, S-N Curve, loading factor, size factor, surface factor. Design consideration for fatigue, Goodman and modified Goodman's diagram, Soderberg Equation, Gerber Parabola, Fatigue Design under Combined Stresses.

(9 hours)

UNIT 2

Design of components subject to static loads: riveted joints, welded joints threaded joints, pin, key knuckle, and cotter joints, Types of cotter Joint, Dimension of Various part of the knuckle Joint.

(9 hours)

UNIT 3

Springs: Design of helical compression and tension springs, consideration of dimensional and functional constraints, leaf springs and torsion springs; fatigue loading of springs, surge in spring; special springs.

(9 hours)

UNIT 4

Brakes & Clutches: Materials for friction surface, uniform pressure and uniform wear theories, Design of friction clutches: Disk , plate clutches, cone & centrifugal clutches. Design of brakes: Rope, band & block brake, Internal Expanding Brakes, Disk Brakes.

(9 hours)

UNIT 5

Spur and Helical Gears: Force analysis of Gear Tooth, modes of failure, Beam Strength, Lewis Equation, Form Factor, Formative Gear and Virtual number of teeth; Gear materials; Surface strength and wear of teeth; strength against wear; Design of straight tooth spur and Helical Gears. Bevel Gears: Application of bevel, formative gear and virtual number of teeth; Force analysis; Lewis equation for bevel gears; Strength against wear; Design of bevel gear.

(9 hours)

References:

1. Shingley J.E; Machine Design; TMH
2. Sharma and Purohit; Design of Machine elements; PHI
3. Wentzell Timothy H; Machine Design; Cengage learning
4. Mubeen; Machine Design; Khanna Publisher
5. Ganesh Babu K and Srithar k; Design of Machine Elements; TMH
6. Sharma & Agrawal; Machine Design; Kataria & sons
   Maleev; Machnine Design.

MEA-501	**MACHINE COMPONENT DESIGN**	**0L:0T:2P**	**1 credits**	**2Hrs/Week**

List of Experiments:-

Designing and sketching of components contained in the syllabus.

1. To study design procedure of Knuckle Joint with detailed drawing
2. To study design procedure of cotter joint with detailed drawing
3. To study design procedure of helical and torsion spring with detailed drawings
4. To study design procedure of brake with detailed drawings.
5. To study design procedure of clutch with detailed drawings.
6. To study design procedure of spur and helical gear with detailed drawings.

MEA–502	**DYNAMICS OF MACHINES**	**2L:1T:0P**	**03 credits**	**3Hrs/Week**

Course Preamble:

1. To understand the concept of balancing of rotating and reciprocating masses.
2. To understand the Force analysis of Reciprocating Engine.
3. To study different types of Gear Trains.
4. To understand the concept of Vibrations, Single Degree of Freedom systems and the Forced Vibrations.
5. To study different types of Governors and its functions.

Course Outcomes:

After completion of the course, the student will be able to:

1. Apply mathematical principles to perform dynamic force analysis on machine components.
2. Establish methods for balancing of machine components.
3. Analyze free vibration of various systems.
4. Analyze forced vibration of various systems.

UNIT 1

Dynamics of Engine Mechanisms: Displacement, velocity and acceleration of piston, turning moment on crankshaft, turning moment diagram.

(9 hours)

UNIT 2

Governor Mechanisms: Types of Governors, Characteristics of Centrifugal Governors, Gravity and Spring Controlled Centrifugal Governors, Hunting of Centrifugal Governors, Inertia Governor.

(10 hours)

UNIT 3

Balancing of Inertia Forces and Moments in Machines: Balancing of Rotating Masses, Two plane balancing, determination of balancing masses (graphical and analytical methods), balancing of rotors, balancing of I.C. engine.

(9 hours)

UNIT 4

Friction: Frictional Torque in Pivots and Collars by Uniform Wear and Uniform Pressure, Boundary and Fluid Film Lubrication, Friction in journal and thrust bearings, rolling friction, Clutches.

(8 hours)

UNIT 5

Belt : Belt drives; Velocity ratio, limiting ratio of tension; power transmitted; centrifugal effect on belts, maximum power transmitted by belt, initial tension, chain and rope drives; Brakes: Band brake, Block brakes, Internal and External Shoe brakes, braking of vehicles. Dynamometer types and uses. Analysis of Cams, Response of Un-damped Cam Mechanism.

(9 hours)

References:

1. Rattan SS; Theory of machines; TMH
2. Dr.R.K.Bansal& Dr.Brar; Theory of Machines LP
3. Ghosh and Mallik; Theory of Mechanisms and Machines; Affiliated East-West Press, Delhi
4. Norton RL; kinematics and dynamics of machinery; TMH
5. Grover; Mechanical Vibrations
6. Thomson; Theory of Vibrations

MEA–502	DYNAMICS OF MACHINES	0L:0T:2P	1 credits	2Hrs/Week

List of Experiment

1. To Study of various models of governors.
2. To Study of gyroscopic motion and calculation of value of gyroscopic couple.
3. To Study of various types of Cams and followers.
4. To Study of various first order vibration systems.
5. To study working of friction clutches using models
6. To study working of internal expanding brake

MEA-503	**Metal Cutting & CNC Machines**	**2L:1T:0P**	**03 credits**	**3Hrs/Week**

Course Preamble:

The main learning objective of this course is to prepare the students for:

1. Applying fundamental knowledge, principles in material removal processes and importance of metal cutting parameters.
2. Applying the fundamentals of turning and automatic machine tools.
3. Applying the principles of reciprocating, milling and gear cutting machines.
4. Applying the principles of abrasive processes and broaching processes.
5. Applying the CNC machine tools and programming manufacturing processes.

Course Outcomes:

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

1. Apply fundamental knowledge, principles in material removal processes and importance of metal cutting parameters.
2. Apply the fundamentals of turning and automatic machine tools
3. Apply the principles of reciprocating, milling and gear cutting machines.
4. Apply the principles of abrasive processes and broaching processes
5. Apply the CNC machine tools and programming manufacturing processes

UNIT I

Lathe: Classification of machine tools and their basic components; lathe- specification, components & accessories, various operations on lathes, capstan & turret lathes, tool layout, methods of thread production, machining time, single point cutting tools, tool signature and nomenclature.

(8 hours)

UNIT II

Grinding: Types of grinding machines, surface, cylindrical and internal grinding, grinding wheels, specifications, wheel turning and dressing without eccentricity, centre-less grinding.

(8 hours)

UNIT III

Milling: Vertical, horizontal and universal type machines, specifications and classifications of milling machines, universal dividing head plain and different indexing, gear cutting, milling cutters.
Drilling & Broaching: Fixed spindle, radial and universal drilling machines, drilling time, broaching principle, broaches and broaching machines.

(9 hours)

UNIT IV

Shapers: Classification and specifications, principle parts, quick return mechanism, shaper operations, speed feed, depth of cut, machining time. Surface qualities, equipment used for rating surfaces, rms. CLA value, causes for surface irregularities. **Gear Cutting**: Die casting, methods of forming gears, generating process, Gear shaping, gear shaving, gear grinding gear testing.

(10 hours)

UNIT V

Mechatronics: Introduction to control systems, analog control, transfer function, procedure for writing transfer function, signal flow diagram, introduction to electronic components like switches, magnetic type, electromagnetic type, transducers and other sensors, servo motors, basics of CD-ROM players, PLC, applications, CNC machines.

(9 hours)

References:

1. Rao PN; Manufacturing Technology vol I and II; TMH
2. Hazra Chadhary; Workshop Tech.II; Media Promoter and Pub
3. Lindberg RA; Processes and Materials of Manufacturing; PHI.
4. Raghuvanshi;BS; Work shop technology Vol-I, II; Dhanpat Rai Delhi
5. Alciatori DG, Histand MB; Introduction to Mechatronics and Measurement system;
6. HMT; Production Processes; TMH

MEA-503	**Metal Cutting & CNC Machines**	**0L:0T:2P**	**1 credits**	**2Hrs/Week**

List of Experiment:

1. To make a job on lathe machine with all operations.
2. To Study of center less grinding machine/ tool and cutter type grinding machine.
3. To Study of horizontal/ universal milling machine, diving head and indexing mechanism of it.
4. To cut a spur gear on milling machine using rapid indexing method.
5. To Study of radial drilling machine and preparing a job on it.
6. To study a sapping machine to learn about working of quick return mechanism.

MEA-504 (A)	**Turbo Machinery**	**3L:1T:0P**	**04 credits**	**3Hrs/Week**

Course Preamble:

The purpose of the course is to introduce the means by which the energy transfer is achieved in the main types of turbo machines and the different behaviors of individual types in operation. The course aims at introducing preliminary design fundamentals of turbo machines including axial and radial flow turbines and axial and centrifugal flow compressors.

Course Outcomes:

Demonstrate a basic understanding of laws of fluid flow and thermodynamics in association with the turbo machinery Course Learning Outcomes:
II- Tackle turbo machinery problems associated with industry
III- Design some parts in gas turbine systems.
IV- Develop computational skills to analyze and design of components such compressor intake, diffusers, and gas turbine exits

UNIT 1

Energy transfer in turbo machines: Application of first and second laws of thermodynamics to turbo machines, Moment of momentum equation and Euler turbine equation, Principles of impulse and reaction machines, Degree of reaction, Energy equation for relative velocities.

(8 hours)

UNIT 2

Steam turbines: Impulse staging: Velocity and pressure compounding, Include qualitative analysis, Effect of blade and nozzle losses on vane efficiency, Stage efficiency, Analysis for optimum efficiency, Mass flow and blade height. **Reactions staging:** Parson's stages, Degree of reaction, Nozzle efficiency, Velocity coefficient, Stator efficiency, Carry over efficiency, Stage efficiency, Vane efficiency, Conditions for optimum efficiency, Axial thrust, Reheat factor in turbines, Free and forced vortex types of flow, Governing and performance characteristics of steam turbines.

(10 hours)

UNIT 3

Water turbines: Classification, Pelton, Francis and Kaplan turbines, vector diagrams and work done, draft tubes, governing of water turbines.

(8 hours)

UNIT 4

Centrifugal Pumps: Classification, Advantage over reciprocating type, Definition of mano- metric head, Gross head, Static head, Vector diagram and work done. Performance and characteristics: Application of dimensional analysis and similarity to water turbines and centrifugal pumps, Selection of machines, Hydraulic, volumetric, Mechanical and overall efficiencies.

(10 hours)

UNIT 5

Compressors: Centrifugal Compressor – Vector diagrams, Work done, Temp and pressure ratio, Slip factor, Work input factor, Pressure coefficient, Dimensions of inlet eye, Impeller and diffuser. Axial flow Compressors Vector diagrams, Work done factor, Temp and pressure ratio, Degree of reaction.

(9 hours)

References:

1. Venkanna BK; turbomachinery; PHI Csanady; Turbo machines
2. Kadambi V Manohar Prasad; An introduction to EC Vol. III Turbo machinery
3. Bansal R. K; Fluid Mechanics & Fluid Machines;
4. Rogers Cohen &SarvanMulto Gas Turbine Theory
5. Kearton W. J; Steam Turbine: Theory & Practic

MEA-504 (B)	**Production & Operation Management**	**3L:1T:0P**	**04 credits**	**3Hrs/Week**

Course Preamble:

1. To introduce the students to the types of productions in the industries as well as
   - they should be familiar with the functions of PPC used in the shop floor of the
   - industry.
2. To introduce the students to the design and development of the product as well as
   - importance of product characteristic for the design and development of product.
3. To familiarize the students with the batch production of the shop floor for
   - optimization for the cost or profit .
4. To introduce the students by using the multi activity chart for calculation of
5. machine cycle efficiency also familiarize with line balancing problems of shop
   - floor.
6. To introduce with calculation of cost of the product as well as replacing the
   - machine after its life time.
7. To introduce the students the necessity of maintaining the inventory.

Course Outcomes:

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

1. Illustrate the types of production and use of functions of PPC on the shop floor.
2. Illustrate the design and development of the product on the shop floor.
3. Illustrate the optimization technique used in batch production.
4. To calculate the idle time and machine cycle efficiency to improve the
5. To develop the balanced line of production with minimum idle time.
6. To understand how to maintain the inventory for shop floor.

UNIT 1

Introduction : System concept of production; Product life cycle; Types and characteristics of production system; Productivity; Process and product focused organization structures; Management decisions – strategic, tactical and operational.

(8 hours)

UNIT 2

Forecasting : Patterns of a time series – trend , cyclical, seasonal and irregular; Forecasting techniques : moving average, simple exponential smoothing, linear regression; Forecasting a time series with trend and seasonal component.

(8 hours)

UNIT 3

Materials Management and Inventory Control : Components of materials management; Inventory control : EOQ model, Economic lot size model, Inventory model with planned shortages, Quantity discounts for EOQ model; ABC analysis; Just-in-time inventory management. **Materials Requirement Planning** : MRP concept – bill of materials (BOM), master production schedule; MRP calculations.

(10 hours)

UNIT 4

Machine Scheduling : Concept of Single machine scheduling – shortest processing time (SPT) rule to minimize mean flow time, Earliest due date (EDD) rule to minimize maximum lateness, Total tardiness minimizing model; Minimizing makespan with identical parallel machines; Johnson's rule for 2 and 3 machines scheduling.

(9 hours)

UNIT 5

Project Scheduling : Activity analysis; Network construction; critical path method (CPM); Crashing of project network. **Quality Assurance** : Meaning of Quality; Quality assurance system; choice of process and quality; Inspection and control of quality; Maintenance function & quality; Process control charts : x-chart and Rchart, p-chart and c-chart; Acceptance sampling : Operating characteristic (O.C) curve, Single sampling plan, Double sampling plan, Acceptance sampling by variables; concept of Six Sigma.

(9 hours)

References :

1. Buffa and Sarin, Modern Production/Operations Management, John Wiley & Sons.
2. R. Panneerselvam, Production and Operations Management, PHI.
3. Russell & Taylor, Operations Management, PHI.
4. Adam and Ebert, Production and Operations Management, PHI.
5. Production & Operations Management by Starr, Cenage Learning India.

MEA-505 (A)	Work Study and Ergonomics	3L:1T:0P	04 credits	3Hrs/Week

Course Preamble:

This course introduces the role of Work Study in the industry and how productivity issues in the industry can be addressed by the application of Work Study, while stimulating critical thinking on the techniques of Method Study and Work Measurement. The course also introduces the concept of conducting time studies and production studies to assess time standards and production standards for fulfilling production goals in an organization. The course further introduces the scope of ergonomics and the application of ergonomic principles to workplace design and work organization and culminates with the concept of evaluating the impact of various human factors to design of safe workplace environment.

Course Outcomes:

The students will be able to:

1. develop a case for productivity improvement in any manufacturing or service industry scenario
2. independently conduct a method study in any organization with the objective of improving a process, material movement system or design of a work place
3. develop time standards for operations, identify production bottlenecks and improvise operations
4. apply principles of good ergonomic design of work areas and equipment
5. identify, explain and evaluate the impact of various personal attributes (anatomical, physiological and anthropometric) on proper safe working practice

UNIT 1

Method study: purpose of work study, its objectives, procedure and applications; method study definition and basic procedure, selection of job, various recording techniques like outline process charts, flow process charts, man machine charts, two handed process charts, string diagram, flow diagram, multiple activity chart, simo, cyclographs and chrono-cyclographs; critical examination, development, installation and maintenance of improved method; principles of motion economy and their application in work design; micro motion study, memo motion study and their use in methods study.

(10 hours)

UNIT 2

Work measurement: Introduction & definition, objectives and basic procedure of work measurement; application of work measurement in industries; time study: basic procedure, equipments needed, methods of measuring time, selection of jobs, breaking a job into elements; numbers of cycles to be

timed; rating and methods of rating, allowances, calculation of standard time.
Work sampling: Basic procedure, design of work sampling study conducting work sampling study and establishment of standard-time.

(9 hours)

UNIT 3

Job evaluation and incentive schemes: Starlight line, Tailor, Merrick and Gantt incentive plans **Standard data system;** elemental and non-elemental predetermined motion systems, work factors system; Methods Time Measurement (MTM), MOST.

(8 hours)

UNIT 4

Human factor engineering: Definition and history of development of human factors engineering, types & characteristics of man-machine-system, relative capabilities of human being and machines; development and use of human factor data; information input and processing: Introduction to information theory; factors effecting information reception and processing; coding and selecting of sensory inputs.

(8 hours)

UNIT 5

Display systems and anthropometric data: Display- types of visual display, visual indicators and warning signals; factorial and graphic display; general principles of auditory and tactral display, characteristics and selection.

(8 hours)

References:

1. ILO; work-study; International Labour Organization
2. Khan MI; Industrial Ergonomics; PHI Learning
3. Barrnes RM; Motion and Time Study; Wiley pub
4. Megaw ED; Contenmprory ergonomics; Taylor & fracis
5. Sandera M and Mc Cormick E; Human Factors in Engg and design; MGHill
6. Currie RM; Work study; BIM publications
7. Mynard; Hand book of Industrial Engg;

MEA-505 (B)	**Industrial Safety Engineering**	**3L:1T:0P**	**04 credits**	**3Hrs/Week**

Course Preamble:

1. Possess a mastery of Health safety and environment knowledge and safety management skills, to reach higher levels in their profession.
2. Knowledgeable safety Engineer rendering professional expertise to the industrial and societal needs at national and global level subject to legal requirements.
3. Well communicate the information on Health safety and environment facilitating collaboration with experts across various disciplines so as to create and execute safe methodology in complex engineering activities

Course Outcomes:

1. Apply knowledge of Mathematics, Science, Engineering fundamentals and an engineering Specialization for hazard identification, risk assessment, analysis the source of incidents and control of occupational Dieses & hazards.
2. Design, Establish, Implement maintain and continually improve an occupation health and safety management system to improve safety.
3. Conduct investigations on unwanted incidents using e.g. (Root cause analysis, what if analysis) and generate corrective and preventive action to prevent repetition and happening of such incidents.

UNIT 1

Safety management-Need for safety, safety and productivity, planning for safety, formulation of safety policy, safety management techniques-job safety analysis, safety sampling technique, incident recall technique, plant safety inspection, safety organizations and its functions.

(8 hours)

UNIT 2

Accident prevention-Nature and causes of accidents, accident proneness, cost of accidents, accident preventionmethods, accident reporting and investigation, personal protective equipment's, safety education and training, damage control and disaster control.

(8 hours)

UNIT 3

Operational Safety

General safety considerations in material handling – manual and mechanical, safety in machine shop, safety in use of hand and portable (power) tools, safety in use of electricity, safety in welding and cutting, principles of guarding, safety in grinding, safety in heat treatment shop, safety in gas furnace operation.

(9 hours)

UNIT 4

Occupational Health and Hygiene-Concept and spectrum of health, levels of prevention, functional units of occupational health service, activities of occupational health unit, occupational and work related diseases such as silicosis, asbestosis, lead, nickel, chromium and manganese toxicity, prevention and control, gas poisoning, effects and prevention, hearing conservation programme - physical and chemical hazards - control measures.

(10 hours)

UNIT 5

Fire engineering and explosion control-Fire triangle, classification of fires, fire properties of solid, liquid and gas, building evaluation for fire safety, fire load, fire resistance materials and fire testing, structural fire protection, exits and egress - industrial fire protection systems, sprinkler – hydrants, portable extinguishers - fire suppression systems, detection systems, principles of explosion - detonation and blast waves, explosion venting, explosion parameters, explosion suppression systems based on CO2 and halogen.

(10 hours)

References:

1. Heinrich H. W, "Industrial accident prevention", McGraw Hill Company, New York, 1980
2. Frank P. Lees, "Loss prevention in process industries", Vol. I, II & III, Butterworth, London, 1980
3. Brown D. B, "System analysis and design for safety" Prentice Hall, New Jercy, 1976
4. Derek James, "Fire prevention hand book", Butter Worths and Company, London, 1986
5. "Accident prevention manual for industrial operations", National Safety Council, Chicago, 1989
6. Clayton and Clayton, "Patty's industrial hygiene and toxicology", Vol. I, II & III, Wiley.

SRI SATYA SAI UNIVERSITY OF TECHNOLOGY AND MEDICAL SCIENCES
SCHOOL OF ENGINEERING
Outcome based Curriculum for
Undergraduate Degree Courses in Engineering & Technology

Department of Mechanical Engineering

BE-SEMESTER-VI SYLLABUS

MEA-601	**NC and CNC Machine tools**	**3L:1T:0P**	**03 credits**	**3Hrs/Week**

Course Preamble:

This course covers Fundamentals and concepts of CNC machining centers, NC part programming, Programming through CAD/CAM (Master CAM), and Maintenance and Troubleshooting the CNC machine tools. This course offers more hands on experience through which the participants will be developing CNC programs and machining complicated shapes by using the CNC machine tools.

Course Outcomes:

The participants will be able to:

1. Understand fundamentals of NC/CNC
2. Learn and Write NC Part Programming
3. Learn NC Programming through CAD/CAM
4. Hands –on experience on Master CAM
5. Learn Tooling for NC/CNC
6. Understand machines like Chucking and Turning Centres, Machining Centres
7. Learn Maintenance and Trouble Shooting of CNC Machine Tools

UNIT - I:

Introduction: Fundamentals of numerical control, advantages limitations of N.C systems - classification of N.C systems. **Computer Numerical Control:** Nomenclature, types and features of CNC machine tools, machine control unit, position control and its significance, engineering analysis of NC positioning systems, open loop and closed loop systems, precision in NC positioning systems-control resolution, accuracy and repeatability. Actuators: servomotors, stepper motors, transducers and feedback elements.

(9 hours)

UNIT - II

Features of N.C. Machine tools: Design consideration of N.C machine tools - increasing productivity with N.C machines, tooling for CNC machine. **System Device:** Feed back system-counting devices digital analog converters. **Interpolations:** DDA integrators, simple and symmetrical DD reference word CNC interpolators. **(8 hours)**

UNIT - III

Part Programming: Process planning and flow chart for part programming, systems nomenclature and tool geometries, Tool presetting & modular tooling. Selection of tools based on machining capacity, accuracy and surface finish, elements of programming for turning and milling, part programming. Preparatory codes G, miscellaneous functions M, Interpolation, tool compensations, cycles for simplifying programming, typical part programming **Control Loops for N C Systems:** Introduction-control loops for point and counting systems.

(10 hours)

UNIT - IV

Computerized Numerical Control: CNC concepts-advantage of CNC reference planes, sampled data techniques, microcomputers in CNC. **Adaptive Control Systems:** Adaptive control with optimization and constraints-variable gains AC systems.

(8 hours)

UNIT - V

Modern CNC machines: CNC lathes, turning centers, machining centres, automatic pallet changers, automatic tool changers, direct numerical control and applications, CNC machine design features.

(8 hours)

REFERENCE :

1. Numerical control of machine tool – Koren & Ben Uri – Khanna Publisher,Delhi
2. Automation, Production Systems and Computer Integrated Manufacturing - Groover – PHI.
3. CNC Programming - S.K. Sinha - Galgotia
4. Mechatronics - HMT –TMH,Delhi
5. Numerical Control and Computer Aided Manufacturing -Tewari, Rao, Kundra- TMH, Delhi
6. Machine Tool Design and Numerical Control – N.K.Mehta – TMH Delhi
7. Fundamentals of Computer Numerical Control – NIIT – Prentice Hall, Delhi

MEA-601	**NC and CNC Machine tools**	**0L:0T:2P**	**1 credits**	**2Hrs/Week**

List of Experiment:

1. To make a Program on cnc lathe machine with all operations like turning, step turning, drilling, tapper turning, thread cutting and knurling .
2. To make a job on cnc lathe machine with all operations like turning, step turning, drilling, tapper turning, thread cutting and knurling.
3. To Study of different control systems and NC codes.
4. To Study of different control systems and CNC codes.
5. To make a Program for circular interpolation,
6. To make a program on cnc milling machine gear teeth
7. To make a job on cnc milling machine gear teeth

MEA – 602	Heat and Mass Transfer	3L:1T:0P	03 credits	3Hrs/Week

Course Preamble:
The main learning objective of this course is to prepare the students for:

1. Applying the principle mechanism of heat transfer under steady state and transient conditions.
2. Applying the fundamental concept and principles in convective heat transfer.
3. Applying the theory of phase change heat transfer and design of heat exchangers.
4. Applying the fundamental concept and principles in radiation heat transfer.
5. Analyzing the relation between heat and mass transfer and to solve simple mass transfer problems.

Course Outcomes:

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

1. Apply the principle mechanism of heat transfer under steady state and transient conditions.
2. Apply the fundamental concept and principles in convective heat transfer.
3. Apply the theory of phase change heat transfer and design of heat exchangers.
4. Apply the fundamental concept and principles in radiation heat transfer.
5. Analyze the relation between heat and mass transfer and to solve simple mass transfer problems.

Unit-1

Basic Concepts: Modes of heat transfer, Fourier's law, Newton's law, Stefan Boltzman law; thermal resistance and conductance, analogy between flow of heat and electricity,combined heat transfer process; **Conduction:** Fourier heat conduction equation, its form in rectangular, cylindrical and spherical coordinates, thermal diffusivity, linear one dimensional steady state conduction through a slab, tubes, spherical shells and composite structures, electrical analogies, critical-insulation-thickness for pipes, effect of variable thermal conductivity.

(10 hours)

Unit 2

Extended surfaces (fins): Heat transfer from a straight and annular fin (plate) for a uniform cross section; error in measurement of temperature in a thermometer well, fin efficiency, fin effectiveness,

applications; **Unsteady heat conduction:** Transient and periodic conduction, heating and cooling of bodies with known temperatures distribution, systems with infinite thermal conductivity, response of thermocouples.

(10 hours)

Unit 3

Convection: Introduction, free and forced convection; principle of dimensional analysis ,Buckingham 'pie' theorem, application of dimensional analysis of free and forced convection ,empirical correlations for laminar and turbulent flow over flat plate and tubular geometry; calculation of convective heat transfer coefficient using data book.

(8 hours)

Unit 4

Heat exchangers: Types- parallel flow, counter flow; evaporator and condensers, overall heat transfers coefficient, fouling factors, log-mean temperature difference (LMTD), method of heat exchanger analysis, effectiveness of heat exchanger, NTU method;
Mass transfer: Fick's law, equi-molar diffusion, diffusion coefficient, analogy with heat transfer, diffusion of vapor in a stationary medium.

(8 hours)

Unit 5

Thermal radiation: Nature of radiation, emissive power, absorption, transmission, reflection and emission of radiation, Planck's distribution law, radiation from real surfaces; radiation heat exchange between black and gray surfaces, shape factor, analogical electrical network, radiation shields. **Boiling and condensation:** Film wise and drop wise condensation; Nusselt theory for film wise condensation on a vertical plate and its modification for horizontal tubes; boiling heat transfer phenomenon, regimes of boiling, boiling correlations.

(10 hours)

References:

1. Sukhatme SP; Heat and mass transfer; University Press Hyderabad
2. Holman JP; Heat transfer; TMH
3. Nag PK; heat and Mass Transfer; TMH
4. Dutta BK; Heat Transfer Principles And App; PHI Learning
5. Mills AF and Ganesan V; Heat transfer; Pearson
6. Cengel Yunus A; Heat and Mass transfer;TMH
7. Yadav R; Heat and Mass Transfer; Central India pub-Allahabad
8. Baehr HD;Stephan K; Heat and Mass Transfer; MacMillan

MEA– 603	**Heat and Mass Transfer**	**0L:0T:2P**	**1 credits**	**2Hrs/Week**

List of Experiments:

1. Conduction through a rod to determine thermal conductivity of material
2. Forced and free convection over circular cylinder
3. Free convection from extended surfaces
4. Parallel flow and counter flow heat exchanger effectiveness and heat transfer rate
5. Calibration of thermocouple
6. Experimental determination of Stefen-Boltzman constant

MEA-603 (A)	**IC Engines**	**3L:1T:0P**	**04 credits**	**3Hrs/Week**

Course Preamble:

1. To make students familiar with the design and operating characteristics of modern internal combustion engines
2. To apply analytical techniques to the engineering problems and performance analysis of internal combustion engines
3. To study the thermodynamics, combustion, heat transfer, friction and other factors affecting engine power, efficiency and emissions
4. To introduce students to the environmental and fuel economy challenges facing the internal combustion engine
5. To introduce students to future internal combustion engine technology and market trends

Course Outcomes:

1. Differentiate among different internal combustion engine designs
2. Recognize and understand reasons for differences among operating characteristics of different engine types and designs
3. Given an engine design specification, predict performance and fuel economy trends with good accuracy
4. Based on an in-depth analysis of the combustion process, predict concentrations of primary exhaust pollutants

UNIT I

Internal Combustion Engine: S.I. and C.I. engines of two and four stroke cycles, real cycle analysis of SI and CI engines, determination of engine dimensions, speed, fuel consumption, output, mean effective pressure, efficiency, factors effecting volumetric efficiency, heat balance, performance characteristics of SI and CI engines, cylinder arrangement, firing order, power balance for multi-cylinder engines, valve timing.

(10 hours)

UNIT 2

Combustion in SI engines: Flame development and propagation, ignition lag, effect of air density, temperature, engine speed, turbulence and ignition timings, physical and chemical aspects of detonation, effect of engine and fuel variables on knocking tendency, knock rating of volatile fuels, octane number, H.U.C.R., action of dopes, pre-ignition, its causes and remedy, salient features of

various type combustion chambers, valve timing and firing order.

(9 hours)

UNIT 3

Combustion in C.I. Engines: Times base indicator diagrams and their study, various stages of combustion, delay period, diesel knock, octane number, knock inhibitors, salient features of various types of combustion chambers, fuel, ignition, cooling, exhaust and lubrication systems; Simple problems on fuel injection, various types of engines, their classification and salient features. Rotary I. C. engines, their principles of working.

(9 hours)

UNIT 4

I.C. Engine System: Fuels, ignition systems, cooling, exhaust/scavenging and lubrication system. Fuel metering in SI engine: Fuel injection in SI engine (MPFI & TBI), Theory of carburetion, simple problems on carburetion. Fuel metering in CI engines: Fuel injection in CI engine and simple problems, various types of engines, their classification and salient features. Fuels: Conventional fuels and alternate fuels, engine exhaust emission, carbon monoxide, unburnt hydro carbon, oxides of nitrogen, smoke, density, measurement and control, hydrogen as alternate fuel.

(10 hours)

UNIT 5

Supercharging: Effect of attitude on mixture strength and output of S.I. engines, low and high pressure super charging, exhaust, gas turbo-charging, supercharging of two stroke engines.

(8 hours)

References:

1. Ganeshan V; Internal Combusion engines; TMH
2. Mathur ML & Sharma RP; A. Course in IC engines; DhanpatRai
3. Gupta HN; Fundamentals of IC Engines; PHI
4. Srinivasan S; Automotive Engines; TMH
5. Halderman JD and Mitchell CD; Automotive Engines theory and servicing; Pearson
6. DomKundwar; Internal Combustion Engines ; Dhanpat Rai Publications
7. Taylor GF; Internal Combustion Engines Theory & Practice; MIT Press
8. Richard Stone; Introduction to IC Engines; Society of Automotive Engr (Palgrave Mc Millan)

MEA-603 (B)	**MECHANICAL MEASUREMENT AND CONTROL**	**3L:1T:0P**	**04 credits**	**3Hrs/Week**

Course Preamble:

1. To understand the basic principles, construction and working of engineering mechanical measurement science.
2. To acquire proficiency in using, calibrating various measurement systems
3. To understand the problems in measurement system and develop the competency to resolve the problems.
4. To know all the measuring instruments and to measure different parameters in day-today work.

Course Outcomes:

After going through basic study of generalized measurement system, students will be able

1. To understand the stepwise working of all instruments and will be able to find out the output factors.
2. They will be able to know the importance of all factors affecting on output of instruments
3. They can suggest some points in the design & working of instruments after studying the basics if metrology.
4. Students will be able to differentiate between all types of measurements i.e. Direct & indirect type, contact & non-contact type as well as they can design the components with provisions of tolerance in manufacturing through the concepts of metrology.

UNIT 1

Measurement: Significance of Mechanical Measurements, Classification of measuring instruments, generalized measurement system, types of inputs: Desired, interfering and modifying inputs. Static characteristics: Static calibration, Linearity, Static Sensitivity, Accuracy, Static error, Precision, Reproducibility, Threshold, Resolution, Hysteresis, Drift, Span & Range etc. Errors in measurement: Types of errors, Effect of component errors, Probable errors. **(10 hours)**

UNIT 2

Displacement Measurement : Transducers for displacement, displacement measurement, potentiometer, LVDT, Capacitance Types, Digital Transducers (optical encoder) **Strain Measurement :** Theory of Strain Gauges, gauge factor, temperature Compensation, Bridge circuit, orientation of strain gauges for force and torque, Strain gauge based load cells and torque sensors **Measurement of Angular Velocity:** Tachometers, Tachogenerators, Digital tachometers and Stroboscopic Methods, Acceleration Measurement.

(9 hours)

UNIT 3

Pressure Measurement: Elastic pressure transducers viz. Bourdon tubes, diaphragm, bellows and piezoelectric pressure sensors, High Pressure Measurements. Vacuum measurement: Vacuum gauges viz. McLeod gauge, Ionization and Thermal Conductivity gauges. Flow Measurement: Bernoulli's flow meters, Ultrasonic Flowmeter, Magnetic flow meter, rotameter. Temperature Measurement: Electrical methods of temperature measurement Resistance thermometers, Thermistors and thermocouples, Pyrometers.

(10 hours)

UNIT 4

Introduction to control systems, Classification of control system, Open loop and closed loop systems, Mathematical modelling of control systems, concept of transfer function, Block diagram algebra.

(8 hours)

UNIT 5

Transient and steady state analysis of first and second order system . Time Domain specifications. Step response of second order system. Steady-state error ,error coefficients, steady state analysis of different type of systems using step, ramp and parabolic inputs.

(8 hours)

References:

1. Measurement Systems (Applications and Design) 5th ed.- E.O. Doebelin - McGraw Hill.
2. Mechanical Engineering Measurement - Thomas Beckwith, N.Lewis Buck, Roy Marangoni Narosa Publishing House, Bombay.
3. Mechanical Engineering Measurements - A. K. Sawhney - DhanpatRai& Sons, New Delhi.
4. Instrumentation Devices & Systems - C.S. Rangan&G.R.Sarrna - Tata McGraw Hill.
5. Instrumentation & Mechanical Measurements - A.K. Thayal.
6. Control System Engineering: by Nagrath IJ. and Gopal .

MEA-604 (A)	Power Plant Engineering	3L:0T:0P	03 credits	3Hrs/Week

Course Preamble:

1. To develop an ability to apply knowledge of Mathematics and Thermal Sciences
2. To develop an ability to design a system component and processes to meet the desired needs of Power Plant.
3.

Course Outcomes:

1. Ability to have adequacy with design, erection and development of Power Plant
2. Optimization of Power Plants with respect to available resources.

Unit I

Introduction to methods of converting various energy sources to electric power, direct conversion methods renewable energy sources, solar, wind, tidal, geothermal, bio-thermal, biogas and hybrid energy systems, fuel cells, thermoelectric modules, MHD-Converter.

(9 hours)

Unit II

Fossil fuel steam stations: Basic principles of sitting and station design, effect of climatic factors on station and equipment design, choice of steam cycle and main equipment, recent trends in turbine and boiler sizes and steam conditions, plant design and layout, outdoor and indoor plant, system components, fuel handling, burning systems, element of feed water treatment plant, condensing plant and circulating water systems, cooling towers, turbine room and auxiliary plant equipment., instrumentation, testing and plant heat balance.

(10 hours)

UNIT III

Nuclear Power Station: Importance of nuclear power development in the world and Indian context, Review of atomic structure and radio activity, binding energy concept, fission and fusion reaction, fissionable and fertile materials, thermal neutron fission, important nuclear fuels, moderators and coolants, their relative merits, thermal and fast breeder reactors, principles of reactor control, safety and reliability features.

(9 hours)

Unit IV

Hydro-Power Station: Elements of Hydrological computations, rainfall run off, flow and power duration curves, mass curves, storage capacity, salient features of various types of hydro stations, component such as dams, spillways, intake systems, head works, pressure tunnels, penstocks, reservoir, balancing reservoirs, Micro and pico hydro machines, selection of hydraulic turbines for power stations, selection of site.

(9 hours)

Unit V

Power Station Economics: Estimation and prediction of load. Maximum demand, load factor, diversity factor, plant factor and their influence on plant design, operation and economics; comparison of hydro and nuclear power plants typical cost structures, simple problems on cost analysis, economic performance and tariffs, interconnected system and their advantages, elements of load dispatch in interconnected systems.

(9 hours)

References:

1. Nag PK; Power plant Engg; TMH
2. Al-Wakil MM; Power plant Technology; TMH
3. Sharma PC; Power plant Engg; Kataria and sons, Delhi
4. Domkundwar; Power Plant Engg; Dhanpatrai & sons.
5. Rajput RK; A text book of Power plant Engg.; Laxmi Publications.
6. Yadav R; Steam and gas turbine and power plant engg.

MEA-604 (B)	Renewable Energy System	3L:0T:0P	03 credits	3Hrs/Week

Course Preamble:

The course should enable the students to:

1. Understand the various forms of conventional energy resources.
2. Learn the present energy scenario and the need for energy conservation
3. Explain the concept of various forms of renewable energy
4. Outline division aspects and utilization of renewable energy sources for both domestics and industrial application
5. Analyze the environmental aspects of renewable energy resources.

Course Outcome:

Upon completion of the course, the student will be able to:

1. Describe the environmental aspects of non-conventional energy resources. In Comparison with various conventional energy systems, their prospects and limitations.
2. Know the need of renewable energy resources, historical and latest developments.
3. Describe the use of solar energy and the various components used in the energy production with respect to applications like - heating, cooling, desalination, power generation, drying, cooking etc.
4. Appreciate the need of Wind Energy and the various components used in energy generation and know the classifications.
5. Understand the concept of Biomass energy resources and their classification, types of biogas Plants- applications
6. Compare Solar, Wind and bio energy systems, their prospects, Advantages and limitations.
7. Acquire the knowledge of fuel cells, wave power, tidal power and geothermal principles and applications.

UNIT-I

Solar Radiation: Extra-terrestrial and terrestrial, radiation measuring instrument, radiation measurement and predictions. **Solar thermal conversion**: Basics, Flat plate collectors-liquid and air type. Theory of flat plate collectors, selective coating, advanced collectors, Concentrators: optical design of concentrators, solar water heater, solar dryers, solar stills, solar cooling and refrigeration. **Solar photovoltaic**: Principle of photovoltaic conversion of solar energy; Technology for fabrication of photovoltaic devices; Applications of solar cells in PV generation systems; Organic PV cells.

(10 hours)

UNIT-II

Wind energy characteristics and measurement: Metrology of wind speed distribution, wind speed statistics, Weibull, Rayleigh and Normal distribution, Measurement of wind data, Energy estimation of wind regimes;

Wind Energy Conversion: Wind energy conversion principles; General introduction; Types and classification of WECS; Power, torque and speed characteristics; power curve of wind turbine, capacity factor, matching wind turbine with wind regimes; Application of wind energy wind turbine with wind regimes;

(9 hours)

UNIT-III

Production of biomass- photosynthesis-C3 & C4 plants on biomass production; Biomass resources assessment; Co2 fixation potential of biomass; Classification of biomass; Physicochemical characteristics of biomass as fuel **Biomass conversion** routes: biochemical, chemical and thermo chemical Biochemical conversion of biomass to energy: anaerobic digestion, biogas production mechanism, technology, types of digesters, design of biogas plants, installation, operation and maintenance of biogas plants, biogas plant manure-utilization and manure values. Biomass Gasification: Different types, power generation from gasification, cost benefit analysis of power generation by gasification.

(10 hours)

UNIT-IV

Small Hydropower Systems: Overview of micro, mini and small hydro system; hydrology; Elements of turbine; Assessment of hydro power; selection and design criteria of turbines; site selection and civil works; speed and voltage regulation; Investment issue load management and tariff collection; Distribution and marketing issues. **Ocean Energy:** Ocean energy resources, ocean energy routs; Principle of ocean thermal energy conversion system, ocean thermal power plants. Principles of ocean wave energy and Tidal energy conversion.

(8 hours)

UNIT-V

Geothermal energy: Origin of geothermal resources, type of geothermal energy deposits, site selection geothermal power plants; **Hydrogen Energy**: Hydrogen as a source of energy, Hydrogen production and storage. **Fuel Cells**: Types of fuel cell, fuel cell system and sub- system, Principle of working, basic thermodynamics.

(8 hours)

References:

1. Kothari, Singal & Rajan; Renewable Energy Sources and Emerging Technologies, PHI Learn
2. Khan, B H, Non Conventional Energy, TMH.
3. Sukhatme and Nayak, Solar Energy, Principles of Thermal Collection and Storage, TMH.
4. Tiwari and Ghosal, Renewable Energy Resources: basic principle & application, Narosa Publ
5. Koteswara Rao, Energy Resources, Conventional & Non-Conventional, BSP Publication.
6. Chetan Singh Solanki, Solar Photovoltaics: Fundamental, technologies and Application,PHI L
7. Abbasi Tanseem and Abbasi SA; Renewable Energy Sources; PHI Learning
8. Ravindranath NH and Hall DO, Biomass, Energy and Environment, Oxford University Press.
9. Duffie and Beckman, Solar Engineering of Thermal Process, Wiley.

MEA-605 (A)	Operation Research	3L:0T:0P	03 credits	3Hrs/Week

Course Preamble:

1. Identify and develop operational research models from the verbal description of the real system.
2. Understand the mathematical tools that are needed to solve optimization problems.
3. Use mathematical software to solve the proposed models.
4. Develop a report that describes the model and the solving technique, analyze the results and propose recommendations in language understandable to the decision-making processes in Management Engineering.

Course Outcome

1. Methodology of Operations Research.
2. Linear programming: solving methods, duality, and sensitivity analysis.
3. Integer Programming.
4. Network flows.
5. Multi-criteria decision techniques.
6. Decision making under uncertainty and risk.
7. Game theory.
8. Dynamic programming.

UNIT 1

Linear system and distribution models: Mathematical formulation of linear systems by LP, solution of LP for two variables only, special cases of transportation and assignment and its solution, Vogel's forward looking penalty method, cell evaluation degeneracy, use of SW Lindo, Tora, Excell.

(8 hours)

UNIT 2

Supply chain (SCM): Definition, importance, expenditure and opportunities in SCM; integration of inbound, outbound logistics and manufacturing to SCM, flow of material money and information, difficulties in SCM due to local v/s system wide (global) optimization and uncertainties in demand and transportation; Bull-whip effect; customer value; IT, info-sharing and strategic partnerships; plant and warehouse-network configuration; supply contracts and revenue sharing; outsourcing; transportation, cross docking and distribution, forecasting models in SCM; coordination and

leadership issues; change of purchasing role and vendor rating, variability from multiple suppliers.

(10 hours)

UNIT 3

Inventory models: Necessity of inventory in process and safety stock, problem of excess inventory and cycle time (=WIP/ Throughput), JIT/ lean mfg; basic EOQ/ EPQ models for constant review Q-system(S,s); periodic review, base stock P-system; service level, lead time variance and safety stock; ABC, VED and other analysis based on shelf life, movement, size, MRP technique and calculations, lot sizing in MRP, linking MRP with JIT; evolution of MRP to ERP to SCM and e-business.

(9 hours)

UNIT 4

Waiting Line Models Introduction, Input process, service mechanism, Queue discipline, single server (M/M/1) average length and times by Littles formula, optimum service rate; basic multiple server models (M/M/s) (b) **Competitive strategy**: concept and terminology, assumptions, pure and mixed strategies, zero sum games, saddle point, dominance, graphical, algebraic and LP methods for solving game theory problems.

(9 hours)

UNIT 5

Decision analysis: decision under certainty, risk probability and uncertainty; Hurwicz criteria; AHP-assigning weight and consistency test of AHP **(**b**) Meta-heuristics** Definition of heuristic and meta-heuristic algorithms; introduction to Tabu search, Simulated Annealing and Genetic algorithms and solution of traveling salesman and non linear optimization problems.

(9 hours)

References:

1. Hillier FS and Liberman GJ; Introduction to Operations Research concept and cases; TMH
2. Simchi-Levi, Keminsky; Designing and managing the supply chain; TMH.
3. Srinivasan G; Quantitative Models In Operations and SCM; PHI Learning
4. Mohanty RP and Deshmukh SG; Supply Chain Management; Wiley India
5. Taha H; Operations research; PHI
6. Sen RP; Operations Research-Algorithms and Applications; PHI Learning
7. Sharma JK; Operations Research; Macmillan
8. Ravindran , Philips and Solberg; Operations research; Wiley India
9. Vollman, Berry et al; Manufacturing planning and control for SCM; TMH.
10. Bowersox DJ, Closs DJ, Cooper MB; Supply Chain Logisti Mgt; TMH
11. Burt DN, Dobler DW, StarlingSL; World Class SCM; TMH

12. Bronson R ;Theory and problems of OR; Schaum Series; TMH

MEA-605 (B)	Ergonomics Engineering	3L:0T:0P	03 credits	3Hrs/Week

Course Preamble:

This course introduces the role of Work Study in the industry and how productivity issues in the industry can be addressed by the application of Work Study, while stimulating critical thinking on the techniques of Method Study and Work Measurement. The course also introduces the concept of conducting time studies and production studies to assess time standards and production standards for fulfilling production goals in an organization. The course further introduces the scope of ergonomics and the application of ergonomic principles to workplace design and work organization and culminates with the concept of evaluating the impact of various human factors to design of safe workplace environment.

Course Outcome:

The students will be able to:

1. develop a case for productivity improvement in any manufacturing or service industry scenario
2. Independently conduct a method study in any organization with the objective of improving a process, material movement system or design of a work place
3. develop time standards for operations, identify production bottlenecks and improvise operations
4. apply principles of good ergonomic design of work areas and equipment
5. Identify, explain and evaluate the impact of various personal attributes (anatomical, physiological and anthropometric) on proper safe working practice

UNIT 1

General: Man in industrial work environments, Ergonomics as multidisciplinary fields, Importance and justification and ergonomics problems, Man-machine-environment system.

(8 hours)

UNIT 2

Anthropometry: Significance of human body measurement in design of equipment, Facilities, Work place and operation, Static and dynamic anthropometry, Anthropometric data. **Task Analysis:** Task description, Posture measurement, RULA & REBA analysis and evaluation, Lifting & lowering tasks, Lifting index, Lifting & carrying tasks, NIOSH lifting equation.

(9 hours)

UNIT 3

Biomechanics: Introduction to levers of Human Body, Ligaments & Tendons, Joints. Kinetics to include forces producing motion.

(8 hours)

UNIT 4

Man-Environment Interface: Environmental factors of temperature, Humidity, Lighting and noise in industry, Effect of environmental factors on human performance, Measurement and mitigation of physical and mental fatigue, Basics of environment design for improved efficiency.

(9 hours)

UNIT 5

Design of Display and Control: Need for information display, Elements of information theory, Reaction time, Methods and types of displays, Design of audio and visual displays, Design of hand and foot operated control device, Design of human-computer interface.

(9 hours)

References:

1. Bridger, R.S., Introduction to Ergonomics, McGraw Hill (2008).
2. Sanders, M. and McCormick E., Human Factors in Engineering & Design, McGraw Hill (1993).
3. Maynard, H. B., Industrial Engineering Hand Book, McGraw Hill (1992).
4. David, A., Practice & Management of Industrial Ergonomics, Prentice Hall (1986).
5. Singleton, W. T., Introduction to Ergonomics, WHO, Geneva (1972).

BE-SEMESTER-VII SYLLABUS

MEA-701	**MECHANICAL VIBRATION AND NOISE ENGINEERING**	**3L:0T:0P**	**03 credits**	**3Hrs/Week**

Course Preamble:

1. To state the importance Mechanical Vibrations
2. To make the students aware about various modeling techniques helpful in imitating a Mechanical system.
3. To give them practical exposure of Elements of a Vibrating system
4. To tell them about applications of Elements of a Vibrating system
5. To make students learn the harmful effects of vibrations and techniques required to make system safe from its ill effects.

Course Outcomes

1. The principle and working of Elements of a Vibrating system
2. Formulation of Workable model of a Vibrating system
3. Formulations and solution of equations of motion for various types of vibrating systems
4. Methods to bring reduction in the levels of vibration in system to which they are harmful by learning to design vibration controlling Mechanical systems

Unit I

Fundamental Aspects of Vibrations: Vibration, main causes, advantages and disadvantages; engineering applications of vibration and noise; vector method of representing harmonic motion; characteristics of vibration, harmonic analysis and beats phenomenon, work done by harmonic forces on harmonic motion; periodic, non-harmonic functions- Fourier series analysis; evaluation of coefficients of Fourier series; elements of vibratory system; lumped and distributed parameter systems.
Undamped Free Vibrations: Derivation of differential equation of motion: the energy method, the method based on Newton's second law of motion, and Rayleigh's method. Solution of differential equation of motion: Natural frequency of vibration. Systems involving angular oscillations: the compound pendulum.

(10 hours)

Unit II

Damped Free Vibrations: Viscous damping: coefficient of damping; damping ratio-Under damped, over damped and critically damped systems; logarithmic decrement; frequency of damped free vibration; Coulomb or dry friction damping; frequency, decay rate and comparison of viscous and Coulomb damping; solid and structural damping; slip or interfacial damping.

(9 hours)

Unit III

Harmonically excited Vibration: One degree of freedom- forced harmonic vibration; vector representation of forces; excitation due to rotating and reciprocating unbalance; vibration Isolation, force and motion transmissibility; absolute and relative motion of mass (Seismic Instruments). Whirling Motion and Critical Speed : Whirling motion and Critical speed : Definitions and significance .Critical - speed of a vertical. Critical speed of a shaft carrying multiple discs (without damping), Secondary critical speed.

(9 hours)

Unit IV

Systems With Two Degrees of Freedom : Principal modes of vibration; torsion vibrations; Forced, Un-damped vibrations with harmonic excitation ; Coordinate coupling; Dynamic vibration absorber; torsion Vibration Absorber; Pendulum type of dynamic vibration.

(8 hours)

Unit V

Noise Engineering -Subjective response of sound: Frequency and sound dependent human response; the decibel scale; relationship between, sound pressure level (SPL), sound power level and sound intensity scale; relationship between addition, subtraction and averaging,

Noise: Sources, Isolation and Control: Major sources of noise on road and in industries, noise due to construction equipments and domestic appliances, industrial noise control, strategies- noise control at source (with or without sound enclosures)

(9 hours)

References Book :

1. Ambekar A.G.,' Mechanical Vibrations and Noise Engineering; PHI
2. Meirovitch Leonard; Element of Vibration Analysis; TMH
3. Dukikipati RV Srinivas J Text book of Mechanical Vibrations; PHI
4. Kelly SG and kudari SK; Mechanical Vibrations; Schaum Series;TMH

5. Thomson , W.T., Theory of Vibration with Applications , C.B.S Pub & distributors . Grading System 2013 – 14
6. Singiresu Rao, "Mechanical Vibrations , Pearson Education .

MEA-701	**MECHANICAL VIBRATION AND NOISE ENGINEERING**	**0L:0T:2P**	**1 credits**	**2Hrs/Week**

List of Experiments:-

1- To find out effect of load on natural frequency of vibrations of a lever pin supported at one end carrying adjustable load on a vertical screwed bar and spring supported at some intermediate point (i) When the dead weight of rods is neglected and (ii) when their dead weight is taken into account .

2- To find out frequency of damped free vibration and rate of decay of vibration-amplitude in the system.

3- To find out natural frequency and damped free frequency of a torsion pendulum and , hence to find out coefficient of damping of the oil ;

4- To observe the phenomenon of whirl in a horizontal light shaft and to determine the critical speed of the shaft.

5- To observe the mode shapes of a spring-connected, double pendulum and hence to demonstrate the phenomenon of beats.

6- To demonstrate the principle of tuned Undamped Dynamic Vibration Absorber and to determine the effect of mass-ratio (of main and auxiliary mass) on the spread of the resulting natural frequencies ;

7- To take measurements of sound Pressure Level (SPL) and to carry out octave band analysis of a machine using Noise Level Meter.

MEA-702	**AUTOMOBILE ENGINEERING**	**3L:0T:0P**	**03 credits**	**3Hrs/Week**

Course Preamble:

1. To understand the basic concepts about automobile and performance parameters.
2. To understand the working of engine and its sub-systems.
3. To understand about function, necessity and working of various types of clutches. Selection for different application.
4. To understand power transmission from engine to tyres. Conversions at different stages, understanding working of different sub-systems in transmission to understand the power flow.
5. To understand working of various control systems like suspension, steering and brakes.
6. To understand the environmental impacts and study various means emission control from automobile.

Course Outcomes

1. Basic understanding about working of automobile
2. Understanding, importance of various sub-systems in performance of automobile
3. Understand importance of control in automobile
4. 4.Environmental friendly automobiles

Unit-I:

Chassis & Body Engg : Types, Technical details of commercial vehicles, types of chassis, lay out, types of frames, testing of frames for bending & torsion on unutilized body frame, vehicle body and their construction, drivers visibility and methods for improvement, safety aspects of vehicles, vehicle aerodynamics, optimization of body shape, drivers cab design, body materials, location of engine, front wheel and rear wheel drive, four wheel drive.

(10 hours)

Unit-II

Steering System: front axle beam, stub axle, front wheel assembly, principles of types of wheel alignment, front wheel geometry viz. camber, Kingpin inclination, castor, toe-in and toe out, condition for true rolling motion, center point steering, directional stability of vehicles, steering gear, power steering, slip angle, cornering power, over steer & under steer, gyroscopic effect on steering gears.

(9 hours)

Unit-III

Transmission System: Function and types of clutches, single plate, multi-plate clutch, roller & spring clutch, clutch lining and bonding, double declutching, types of gear Boxes, synchroniser, gear materials, determination of gear ratio for vehicles, gear box performance at different vehicle speed, automatic transmission, torque converters, fluid coupling, principle of hydrostatic drive, propeller shaft, constant velocity universal joints, differential gear box, rear axle construction.

(9 hours)

Unit-IV

Suspension system : Basic suspension movements, Independent front & rear suspension, shock absorber, type of springs: leaf spring, coil spring, air spring, torsion bar, location of shackles, power calculations, resistance to vehicle motion during acceleration and breaking, power & torque curve, torque & mechanical efficiency at different vehicle speeds, weight transfer, braking systems, disc theory, mechanical, hydraulic & pneumatic power brake systems, performance, self-energisation, airbleeding of hydraulic brakes, types of wheels and tyres, tyre specifications, construction and material properties of tyres & tubes.

(10 hours)

Unit-V

Electrical and Control Systems: storage battery, construction and operation of lead acid battery, testing of battery, principle of operation of starting mechanism, different drive systems, starter relay switch, regulator electric fuel gauge, fuel pump, horn, wiper, Lighting system, head light dazzling, signaling devices, battery operated vehicles, choppers. importance of maintenance, scheduled and unscheduled maintenance, wheel alignment, trouble Shooting probable causes & remedies of various systems, microprocessor based control system for automobile, intelligent automobile control systems.

(10 hours)

Unit-VI

Emission standards and pollution control: Indian standards for automotive vehicles- Bharat I and II, Euro-I and Euro-II norms, fuel quality standards, environmental management systems for automotive vehicles, catalytic converters, fuel additives, and modern trends in automotive engine efficiency and emission control. **(8 hours)**

References Books:

1. Crouse , Automotive Mechanics TMH.
2. Srinivasan S; Automotive engines; TMH
3. Gupta HN; Internal Combustion Engines; PHI;
4. Joseph Heitner, Automotive Mechanics, Principles and Practices, CBS Pub.
5. Kripal Singh, Automotive Engineering Khanna Pub.

6. Newton & Steeds , Automotive Engineering
7. Emission standards from BIS and Euro I and Euro-III

MEA-702	**AUTOMOBILE ENGINEERING**	**0L:0T:2P**	**1 credits**	**2Hrs/Week**

List of Experiments

1. To study the working principles and operation of the chassis,
2. To study the working principles and operation of the suspension,
3. To study the working principles and operation of the steering mechanisms,
4. To study the working principles and operation of the transmission,
5. To study the working principles and operation of the gear-box,
   Differential systems, and electrical systems of various light and heavy automotive vehicles;

MEA-703 (A)	**DESIGN OF HEAT EXCHANGERS**	**3L:0T:0P**	**03 credits**	**3Hrs/Week**

Course Preamble:

1. Introducing of various types of heat exchangers providing heat transfer between two or more fluids and acquiring necessary information for the design of heat exchangers.

Course Outcomes:

At the end of this course students will have the ability of:

1. Learning the essentials and basic concepts of heat exchangers,
2. Learning heat exchanger types and selection criteria of heat exchanger according to usage area,
3. Capability to do thermal, pressure drop, strength, and cost analysis of heat exchangers

Unit I

Introduction: Types of heat exchangers heat transfer laws applied to heat exchangers convection Coefficients, resistance caused by the walls and by fouling, overall heat transfer coefficient.

(10 hours)

Unit II

Thermal & hydraulic design of commonly used heat exchangers : LMTD & NTU Methods, correction factors, Double pipe heat exchangers , shell and tube heat exchangers, condensers , Evaporators ,Cooling and dehumidifying coils, cooling towers, evaporative condensers ,design of air washers, desert coolers.

(10 hours)

Unit III

TEMA standard: Tubular heat exchangers TEMA standard heat-exchanger nomenclature, selection criteria for different types of shells and front and rear head ends; geometrical characteristics of TEMA heat exchangers.

(8 hours)

Unit IV

Review of mechanical Design, Materials of Construction, corrosion damage, testing and inspection.

(7 hours)

Unit V

Heat Pipe: Basics & its mathematical model, micro Heat Exchangers , Use of Software in heat exchanger design.

(7 hours)

References Books:

1. Kern D Q, Kraus A D; Extended Surface Heat Transfer; TMH.
2. Kays, Compact Heat Exchangers and London, TMH.
3. Kokac, Heat Exchangers- Thermal Hydraulic fundamentals and design;TMH.
4. Tubular Exchanger Manufacturer Association (TEMA), and other codes

MEA-703 (B)	Industrial Robotics	3L:0T:0P	03 credits	3Hrs/Week

Course Preamble:

1. To understand the basic concepts associated with the design and Functioning and applications of Robots
2. To study about the drives and sensors used in Robots To learn about analyzing robot kinematics and robot programming.

Course Outcomes:

1. Upon completion of this course, the students can able to apply the basic engineering
2. To learn about knowledge for the design of robotics.
3. Will understand robot kinematics and robot programming.
4. Will understand application of Robots
5. To learn about force and torque sensing
6. To learn about application of robot.

Unit I
INTRODUCTION: Need and importance, basic concepts, structure and classification of industrial robots, terminology of robot motion, motion characteristics, resolution, accuracy, repeatability, robot applications.

(8 hours)

Unit II
END EFFECTORS AND DRIVE SYSTEMS: Drive systems for robots, salient features and comparison, different types of end effectors- Mechanical - Magnetic -Vacuum – Adhesive - Drive systems and controls; design and applications of end effectors.

(10 hours)

Unit III
SENSORS: Sensor evaluation and selection, Piezoelectric sensors, linear position and Displacement, sensing, revolvers, encoders, velocity measurement, proximity, tactile, compliance and range sensing, Image Processing and object recognition.

(8 hours)

Unit IV
INDUSTRIAL APPLICATIONS : Application of robots in manufacturing, processing operations

like Welding, painting, Assembly, machining, Welding, Assembly, Material transfer and machine loading/unloading, CIM and hostile and remote environments - safety considerations.

(10 hours)

Unit V

SAFETY AND ECONOMY OF ROBOTS: Work cycle time analysis, economics and effectiveness of robots, safety systems and devices, concepts of testing methods and acceptance rule for industrial robots.

(8 hours)

References:

1. Mittal RK, Nagrath IJ; Robotics and Control; TMH
2. Groover M.P,Weiss M, Nagel,OdreyNG; Industrial Robotics-
3. Groover M.P; CAM and Automation; PHI Learning
4. Spong Mark and Vidyasagar; Robot Modelling and control; Wiley India
5. Yoshikava ; Foundations of Robotics- analysis and Control; PHI Learning;
6. Murphy ; Introduction to AI Robotics; PHI Learning
7. FU KS, Gonzalez RC, Lee CSG; Robotics
8. Shimon, K; Handbook of Industrial Robots; John Wiley & Sons,.
9. Ghosal Ashitava; Robotics Fundamental concepts and analysis; Oxford
10. Saha S; Introduction to Robotics; TMH

MEA-704 (A)	PROJECT MANAGEMENT	3L:0T:0P	03 credits	3Hrs/Week

Course Preamble:

The objectives of this course are to:

1. To make them understand the concepts of Project Management for planning to execution of projects.
2. To make them understand the feasibility analysis in Project Management and network analysis tools for cost and time estimation.
3. To enable them to comprehend the fundamentals of Contract Administration, Costing and Budgeting.
4. Make them capable to analyze, apply and appreciate contemporary project management tools and methodologies in Indian context

Course Outcomes:

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

1. Understand project characteristics and various stages of a project.
2. Understand the conceptual clarity about project organization and feasibility analyses – Market, Technical, Financial and Economic.
3. Analyze the learning and understand techniques for Project planning, scheduling and Execution Control.
4. Apply the risk management plan and analyze the role of stakeholders.
5. Understand the contract management, Project Procurement, Service level Agreements and productivity.
6. Understand the How Subcontract Administration and Control are practiced in the Industry.

Unit I

Concepts of project management:: Meaning, definition and characteristics of a project, technical and socio-cultural dimensions; project life cycle phases, project planning and graphic presentation; work breakdown structure, manageable tasks; size of network; blow down NW; identity and logic dummy activity; Fulkerson rule for numbering NW; time-scaled NW.

(10 hours)

Unit-II

NW analysis: PERT network; mean time and variances; probability to complete PERT project in specified time; CPM network; Event Occurrence Time (EOT); activity start/ finish times; forward and reverse path calculations, concept and calculation of floats; resource allocation and critical-chain; overview of MS-project-2000.

(9 hours)

Unit-III

Project duration and control: Importance and options to accelerate project completion; timecost tradeoff; fixed variable and total costs; use of floats and cost optimization; project performance measures; project monitoring info and reports; project control process; Gant chart and control chart; cost-schedule S-graph; planned cost of work schedule (PV).

(9 hours)

Unit-IV

Project organization, culture and leadership: projects within functional organization; dedicated project/ task-force teams; staff, matrix and network organization; choosing appropriate project organization; Organization culture; ten characteristics; cultural dimensions supportive to projects; social network and management by wandering around (MBWA); different traits of a manager and leader; managing project teams; five stage team development model.

(9 hours)

Unit-IV

Strategic planning and project appraisal: Capital allocation key criteria; Porters competitive strategy model; BCG matrix; Strategic Position Action Evaluation (SPACE); time value of money; cash flows; payback period; IRR; cost of capital; NPV; social cost benefit analysis; UNIDO approach; project risks and financing.

(9 hours)

References Books:

1. Prasana Chandra: Projects: planning Implementation control; TMH.
2. Gray Clifford F And Larson EW; Project The managerial Process; TMH
3. Panneerselven and Serthil kumar; Project management, PHI
4. Burke ; Project Management-Planning and control technics; Wiley India
5. Kamaraju R; Essentials of Project Management; PHI Learning
6. Jack R. Meredith, Project Management: a managerial approach, Wiley.
7. Choudhary ;Project Management; TMH

MEA-704 (B)	**NANO MANUFACTURING**	**3L:0T:0P**	**03 credits**	**3Hrs/Week**

Course Preamble:

1. To understand the scope of micro and nano technology:
2. To understand the concepts and Applications of micro- and nanofabrication
3. To understand Nano technology in India
4. To understand the scope for Micro fabrication
5. To understand commercialization Issues of Micro-Nano Technology

Course outcome:

1. Students will have a complete understanding of scope, concepts and applications
2. Micro and Nano technology in the field of manufacturing.

Unit-I

Introduction to Nano-manufacturing and Nanotechnology, Advantages, disadvantages and applications of Nanotechnology and Nano-manufacturing, Top-down and Bottom-up techniques.

(9 hours)

Unit-II

Self-Assembly, self-assembled monolayer. Characterization Techniques: Scanning Electron Microscope, Transmission Electron Microscope, Atomic force microscopy (AFM), Scanning Probe Microscope (SPM).

(8 hours)

Unit-III

Scanning Tunneling Microscope (STM), X-ray Diffraction (XRD). Nano-lithography: Photolithography:

UV Photolithography, X-ray Lithography, Electron Beam Lithography, Particle Beam Lithography's, Probe lithography's.

(10 hours)

Unit-IV

Micro and Nano machining, Focused Ion beam machining. Chemical methods in Nano manufacturing, Si processing methods: Cleaning /etching, Epitaxy, Molecular-beam epitaxial, chemical beam epitaxial.

(8 hours)

Unit-V

Metal-organic CVD (MOCVD), Plasma enhanced CVD (PECVD), Sol-gel Technique. Properties and application of Nano Materials: Fullerene Structure, Carbon nano tubes, Nano Particles, Processing of Nano composites, Micro & Nano Electromechanical Systems (MEMS, & NEMS).

(10 hours)

References Books:

1. Introduction to nanotechnology by Charles P. Poole Jr. & Frank J. Owens Publisher: John Wiley & Sons (Asia) Pvt. Ltd.
2. Nanotechnology: Introduction to Nanostructuring Technoques by Michael Kohler, Publisher: John Wiley & Sons (Asia) Pvt. Ltd.
3. Magnetic Microscopy of Nanostructures by H. Hopster & H. P. Oepen, Publisher:Springer
4. Micro-engineering, MEMS and Interfacing: A practical Guide by Danny Banks, Publisher: Taylor & Francis
5. Nanomaterials Chemistry Recent Developments and New Directions by C. N. R. Rao, Publisher: John Wiley & Sons (Asia) Pvt. Ltd.

BE-SEMESTER-VIII SYLLABUS

MEA-801	REFRIGERATION & AIR CONDITIONING	3L:0T:0P	03 credits	3Hrs/Week

Course Preamble:

1. To know about the different refrigeration cycles
2. Understand the hardware related to the refrigeration systems
3. Understand how the different components harmonize together
4. Understand the importance of the auxiliary systems.

Course Outcomes:

Upon successful completion of the course, students should be able to:

1. Have a review of refrigeration cycles and alternate refrigeration system to enhance their knowledge of refrigeration, and will be able to explain them,
2. Understand and solve the problem of component selection, refrigerant related issues and system balancing and control
3. Apply their knowledge to appraise different refrigeration system components and environmental issues caused by refrigerant.
4. Analyze a refrigeration problem to carryout necessary calculation.

Unit-I

Introduction: Principles and methods of refrigeration, freezing; mixture cooling by gas reversible expansion, throttling, evaporation, Joule Thomson effect and reverse Carnot cycle; unit of refrigeration, coefficient of performance, vortex tube & thermoelectric refrigeration, adiabatic demagnetization; air refrigeration cycles- Joule's cycle Boot-strap cycle, reduced ambient cycle and regenerative cooling cycles.

(10 hours)

Unit-II

Vapour compression system: Vapor compression cycle, p-h and t-s diagrams, deviations from

theoretical cycle, sub-cooling and super heating, effects of condenser and evaporator pressure on cop; multi- pressure system: removal of flash gas, multiple expansion & compression with flash inter cooling; low temperature refrigeration: production of low temperatures, cascade system, dry ice, production of dry ice, air liquefaction system.

(10 hours)

Unit-III

Vapour absorption system: Theoretical and practical systems such as aqua- ammonia, electrolux & other systems; (b) Steam jet refrigeration: Principles and working, simple cycle of operation, description and working of simple system, (c) refrigerants: nomenclature & classification, desirable properties, common refrigeration, comparative study, leak detection methods, environment friendly refrigerants and refrigerant mixtures, brine and its properties.

(9 hours)

Unit-IV

Psychrometric: Calculation of psychrometric properties of air by table and charts; psychrometric processes: sensible heating and cooling, evaporative cooling, cooling and dehumidification, heating and humidification, mixing of air stream, sensible heat factor; principle of air conditioning, requirements of comfort air conditioning, ventilation standards, infiltrated air load, fresh air load human comfort, effective temperature & chart, heat production & regulation of human body.

(8 hours)

Unit-V

Air conditioning loads: calculation of summer & winter air conditioning load, bypass factor of coil, calculation of supply air rate & its condition, room sensible heat factor, grand sensible heat factor, effective sensible heat factor, dehumidified air quantity. Problems on cooling load calculation. Air distribution and ventilation systems.

(8 hours)

References Books:

1. Arora CP; Refrigeration and Air Conditioning; TMH
2. Sapali SN; Refrigeration and Air Conditioning; PHI
3. Ananthanarayan; Basic Refrigeration and Air conditioning; TMH.
4. Manohar Prasad; Refrigeration and Air Conditioning; New Age Pub
5. Ameen; Refrigeration and Air Conditioning; PHI

MEA-801	**REFRIGERATION & AIR CONDITIONING**	**0L:0T:2P**	**1 credits**	**2Hrs/Week**

List of Experiments:-

1. General Study of vapor compression refrigeration system.
2. General Study of Ice Plant
3. General Study and working of cold st
4. General Study One tone Thermax refrigeration unit.
5. General Study of Water cooler
6. General Study of Psychrometers (Absorption type)
7. General Study of window Air Conditioner.
8. General Study and working of Vapor compression Air conditioning Test rig.
9. Experimentation on Cold Storage of Calculate COP & Heat Loss.
10. Experimentation on Vapor compression Air Conditioning test rig.

MEA-802 (A)	**ADVANCE MACHINE DESIGN**	**3L:0T:0P**	**03 credits**	**3Hrs/Week**

Course Preamble:

To familiarize the various steps involved in the design process of mechanical drives such

1. As belt, chain, rope and gear.
2. To understand the procedure of selection of machine elements from manufacturers
3. Catalogue.
4. To get knowledge of different types of bearings and their selection for a particular
5. Application.
6. Student shall apply design knowledge of the different types of elements used in the
7. Machine design process, for a design project.

Course outcomes

1. Design and analyze belts, brakes, clutches.
2. Understand gear drives and their applications; design procedure and introduction to gear
3. Design standard practices.
4. The construction, working, important features and selection process from manufacturers
5. Catalogue for rolling contact bearings
6. Analyze the pressure distribution and design of journal bearings..
7. Acquire skill in preparing production drawing pertaining to various designs.

Unit I

Design of Belt, Rope and Chain Drives: Methods of power transmission, selection and design of flat belt and pulley; Selection of V-belts and sleeve design; Design of chain drives, roller chain and its selection; Rope drives, design of rope drives, hoist ropes.

(8 hours)

Unit II

Spur and Helical Gears: Force analysis of gear tooth, modes of failure, beam strength, Lewis equation, form factor, formative gear and virtual number of teeth; Gear materials; Surface strength and wear of teeth; strength against wear; Design of straight tooth spur and Helical Gears.

Bevel Gears: Application of bevel, formative gear and virtual number of teeth; Force analysis; Lewis equation for bevel gears; Strength against wear; Design of bevel gear.

(8 hours)

Unit III

Design of I.C. Engine Components: General design considerations in I C engines; design of cylinder; design of piston and piston-rings; design of connecting rod; design of crankshaft.

(8 hours)

Unit IV

Design of Miscellaneous Components: design of Flanged coupling; Rigid coupling, Design of Pressure vessels subjects to internal pressure, external pressure, design of penetration, design of flanges, cone cylinder junctions ,Materials, Fabrication.

(9 hours)

Unit V

Optimization: Basic concept of optimization, classification of optimization, optimization techniques, engineering applications of optimization. Classical optimization techniques: unconstrained optimization single-variable optimization, multivariable optimization, solution by direct search method, solution by Lagrange-multipliers method.

(10 hours)

Note: PSG Design data book and/ or Mahadevan and Reddy's Mechanical design data book are to be provided/ permitted in exam hall (duly verified by authority).

MEA-802 (B)	**COMPUTER INTEGRATED MANUFACTURING**	**3L:0T:0P**	**03 credits**	**3Hrs/Week**

Course Preamble:

1. Students will be introduced to CAD/CAM/CAE concepts.
2. Student will learn steps in upgrading from FMS to CIM.
3. Students will learn about importance of data generation and management in CIMS.

Course outcomes:

1. Students will be able to apply knowledge about Computer Aided Quality control and Process Planning Control.
2. Students will be able to Design Flexible manufacturing cell after carrying out Group technology study and finally creating FMS.
3. Students will be able to apply knowledge about various methods of communication in CIMS.
4. They will able apply data management and its importance for decision making in CIMS environment.

Unit I

Introduction C. N.C. System : Definition, applications, Historical background Role of Computers in Manufacturing. Computer Numerical control in CAM: Definition, basic components of CAM system, Procedure, Co-ordinate system, motion control systems, Advantages of CNC system.

(9 hours)

Unit II

Introduction of CNC Machine tools, Application of CNC systems, Economics of CNC machining centers, Part Programming : CNC part programming : manual part programming.

(9 hours)

Unit III

Introduction computer aided part programming Robot Technology: Introduction, Industrial Robots, Robot physical Configuration, Basic Robot motions, Technical features, such as work volume,

precision of movement speed o movement, weight carrying capacity, type of drive systems, Programming of the robot, Introduction to robot languages, End erectors, work cell control and interlocks, Robotic sensors, Robot applications & economics, Intelligent robots, interfacing of a vision system with a Robot.

(10 hours)

Unit IV

Introduction Definition and broad characteristics of Flexible Manufacturing Cells, , Group technology Systems FMS hardware CNC machines tools, robots, AGVs, ASRs, Inspection and Cleaning stations - Control aspects of FMS-DNC of machine tools, cutting tools, Types of Flexibility in FMS, Flexible and Dynamic Manufacturing Systems, Computer Aided Inspection.

(9 hours)

Unit V

Introduction Principles and interfacing, software metrology. Applications of Lasers in precision measurements - Laser interferometer, speckle measurements, laser scanners. Coordinate Measuring Machine - Types of CMM - Probes used - Applications - Non contact CMM using Electro optical sensors for dimensional metrology - Non contact sensors for surface finish measurements. Image processing and its application in inspection.

(8 hours)

References Books:

1. Shigley J.E.; Machine Design; TMH
2. BhandariVB; Design of Machine Elments; TMH
3. Sharma CS and Purohit K; Design of Machine Elements; PHI Learning.
4. Hall and Somani; Machine Design; Schaum Series; TMH
5. Wentzell TH; Machine Design; Cegage Learning
6. Sharma & Agrawal; Machine Design; Katson

MEA-803 (A)	**INDUSTRIAL ORGANISATION & MANAGEMENT**	**3L:0T:0P**	**03 credits**	**3Hrs/Week**

Course Preamble:
This course introduces the basic concepts of management and organization structure of an industry, concept of Entrepreneurship, Material management cost analysis, engineering economics and project management

Course Outcomes:

Student shall be able to:

1. Demonstrate the concepts of Management and organizational structure

2. Understand the economic and operations management concepts useful in the production process.

3. Apply the project management tools in effective development and implementation of the business activities.

4. Develop the entrepreneurial spirit and plan to start their own enterprise.

Unit-I
Industrial Evolution in India: Downfall of early industries, evolution of modern industry, effects of partition, industrial policy and progress after independence. Forms of Industrial Organization: Single Proprietorship, Partnership, Joint Stock companies., Cooperatives and State Enterprises.

(8 hours)

Unit-II

Growth of Industry and Management: Meaning of industrial management, functions and tools of management, growth of management concepts. Principles of Management: Management, different functions of management: Planning, organizing, coordination and control, Structure of an industrial organization.

(8 hours)

Unit-III

Functions of different departments. Relationship between individual departments. Human and Industrial Relations, Human relations and performance in organization. Understand self and others for effective behavior, Behavior modification techniques, Industrial relations and disputes, Relations with sub-ordinates, peers and superiors, Characteristics of group behavior and trade unionism.

(10 hours)

Unit-IV

Professional Ethics: Concept of ethics, Concept of professionalism, Need for professional ethics. Code of professional ethics, Typical problems of professional engineers, Professional bodies and their role.. Motivation: Factors determining motivation, Characteristics of motivation, Methods for improving motivation, Incentives, pay, promotion, rewards, Job satisfaction and job enrichment.

(9 hours)

Unit-V

Leadership: Need for leadership, Functions of a leader, Factors for accomplishing effective leadership, Manager as a leader. Human Resource Development: Introduction, Staff development and career development, Training strategies and methods. Accidents and Safety: Classification of accidents; according to nature of injuries i.e. fatal, temporary; according to event and according to place.

(9 hours)

References Books:-

1. Industrial Organization Pepall L., Richards D., and Norman G.
2. The Theory of Industrial Organization. Tirole, J.
3. Industrial Engineering and Management TR Banga.
4. Industrial Engineering and Management OP Khanna,
5. Industrial Management VK Sharma, OP Harkut.

MEA-803 (B)	**COMPUTATIONAL FLUID DYNAMICS**	**3L:0T:0P**	**03 credits**	**3Hrs/Week**

Course Preamble:
To provide brief introduction of Computational Fluid Dynamics along with chemical engineering application specifically, analysis of fluid mechanics and heat transfer related problems.

Course Outcomes:

Upon completion of this course, the students will be able to: 1. Solve PDE. 2. Use Finite Difference and Finite Volume methods in CFD modeling 3. Generate and optimize the numerical mesh 4. Simulate simple CFD models and analyze its results.

Unit-I
Introduction: Mathematical Background: Classification of differential equations, representative differential equations for heat transfer and fluid flow; Boundary and initial condition; Integral forms. Survey of Numerical Methods Used in Heat Transfer and Fluid Mechanics.

(8 hours)

Unit-II

Finite Difference Methods Basic concepts, Direct approximation approach, Taylor series, Control Volume approach, Truncation error, Discretization and round off errors; convergence, numerical stability, Solution of simultaneous equations, Transient diffusion. Finite Element Methods: Steps for FEM solution, Fundamentals, Assembly, Steady Diffusion, Transient Diffusion Finite Volume Methods: Problem formulation for one-dimensional convection diffusion equations.

(10 hours)

Unit- III

Simulation of Transport Process Conduction Heat Transfer: Steady and unsteady state one & two dimensional problems. Explicit, Implicit and Crank-Nicolson scheme, ADI and ADE methods. Convection Heat Transfer: Boundary Layer Flows, Similarity solutions, Derived Variables, Patankar/Spalding Methods for two-dimensional flows.

(8 hours)

Unit- IV

Elliptic Solutions: Control Volume formulation. Energy and other scalar equations, Momentum equations, Segregated Solution method; SIMPLE & SIMPLER schemes, Stream Function – Vorticity.

(8 hours)

Unit-V

Transport method. Turbulence: Examples of turbulent flows, Stress relations, Reynolds stresses, turbulence model computations, Analogy between Heat Transfer and Momentum, Linearization of source terms.

(9 hours)

References Books:-

1. Computational Fluid Dynamics" by Anderson J D
2. Numerical Computation of Internal and External Flows" by Hirsch C
3. Computational Fluid Dynamics and Heat Transfer" by Tenehill J C and Pletcher R H
4. An Introduction to Computational Fluid Dynamics: The Finite Volume Method" by H Versteeg
5. Computational Fluid Dynamics" by Tapan Sen Gupta

MANDATORY COURSES

Sr. No.	Course Code	Course Title	Credits	Preferred Semesters
1	MC	[Environmental Sciences, Induction Program, NSS/NCC] Constitution of India	Nil	I, III, IV,
		Total		0

Induction Program

MC	**Induction Program**	**0L:0T:0P**	**Nil**	**2Hrs/Week**

Induction program (mandatory)	**3 weeks duration** (Please refer Appendix-A for guidelines & also details available in the curriculum of Mandatory courses)
Induction program for students to be offered right at the start of the first year.	• Physical activity • Creative Arts • Universal Human Values • Literary • Proficiency Modules • Lectures by Eminent People • Visits to local Areas • Familiarization to Dept./Branch & Innovations

A student has to undergo this induction program after joining the institute and before the commencement of classes. Normal classes of the engineering program shall begin after the students have undergone a three-weeks induction program. The Induction program for students comprises of Physical activities; Learning an art form; Literature & Cinema; Social Awareness; Lectures &Visits; Universal Human Values; Familiarization to Department/ Branch, College& Innovations.

MEA-308-NSS/NCC

MEA-308	**NSS/NCC**	**0L:0T:0P**	**Nil**	**2Hrs/Week**

Course Preamble

- To develop qualities of Character, Courage, Comradeship, Discipline, Leadership, Secular Outlook, Spirit of Adventure and the ideals of Selfless Service amongst the Youth of the Country.
- To Create a Human Resource of Organized, Trained and Motivated Youth, to Provide Leadership in all Walks of life and be always available for the Service of the Nation
- To Provide a Suitable Environment to Motivate the Youth to Take Up a Career in the Armed Forces.

Course Outcomes:

- To develop student's personality through community services
- Instilling discipline in the souls of the cadets,
- Imparting leadership, discipline, integration, adventure, military, physical and community development training

Course Content :

The National Cadet Corps (India)) was formed under NCC Act of 1948 and is open to school and college students on voluntary basis. The Cadets are given basic military training in small arms and parades. The motto of NCC is "Unity and Discipline". One week long NSS camp is organized every year where students undertake various social welfare activities like Blood Donation Camp, Tree Plantation and awareness programs on drug de-addiction, AIDS, Swine-flu and campaign for saving water and cleanliness.

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Constitution of India

MC	**Constitution of India**	**0L:0T:0P**	**Nil**	**2Hrs/Week**

Unit 1. Introduction

Concept of liberty; Concept of positive and negative obligations

Unit 2 The Premises of Social Revolution:

Intellectual and historical origins of the concept of Social Economic Justice in India.

Unit 3 Sixty years of civil rights movement in India:

Moderate nationalism and the emergence of the politics of socio-economic justice; Annie Besant, the Theosophical Society and the Home Rule League Movement,

Unit 4 Impact of Socialism on the Writing of the Indian Constitution [I], [1914-31]:

From the First World War to the Karachi Resolution: [a] Jawaharlal Nehru's arrival in national politics and his initiation in municipal politics; [b] The Bolshevik Revolution [1917] and its impact on growth of Indian socialism; [c] Growth and influence of Fabian socialists on Indian nationalism; [d] Commonwealth of India Bill [1925]; [e] National Demand or the Motilal Nehru Report [1927-8] and the Calcutta Congress [1928]; [f] Karachi Resolution of the Indian National Congress [1931]

Unit 5 Impact of Socialism on the Writing of the Indian Constitution [II], [1932-52]:

From the Demand for Adult Suffrage to Passing of the Constitution of India: [a] Growth of the Congress Socialist Party and the demand for the adoption of adult suffrage; [b] Panchayati Raj and empowerment in the Indian Constitution; [c] The National Plan [1938], the Bombay Plan [1944] and proposals for large-scale industrialisation in India; [d] The August Offer [1940], Cripps Mission [1942] and the Cabinet Mission proposals [1946]; [e] The establishment of

Indian Constituent Assembly [1946], the Indian Independence Act [1947], the working of the Constituent Assembly and the Assembly debates and the role of the Oligarchy comprising of Jawahaharlal Nehru, Vallabhbhai Patel, Maulana Abul Kalam Azad and Rajendra Prasad in it; [f] Social reforms and State Security v. 'Due Process of Law'; [g] The introduction, passage and development of the Hindu Code Bill, 1956

References:

1. Bagehot, Walter, An Introduction to English Legal History, [London, 1990]
2. Berlin, Isaiah, Henry Hardy and Ian Harris, Liberty: Incorporating Four Essays on Liberty, [Oxford, 2002]
3. Austin, Granville, The Indian Constitution: Cornerstone of a Nation, [Oxford, 1966] –, Working of a Democratic Constitution: A History of the Indian Experience, [New Delhi, 2003]
4. Bagchi, Amiya Kumar, Private Investment in India, 1900-1939, [London, 1972]
5. Bakshi, P.M., The Constitution of India: With Comments and Subject Index, [Delhi, 1991]
6. Basu, Durgadas, Introduction to the Constitution of India, [New Delhi, 1995] –, Shorter Constitution of India, [Calcutta, 1959]
7. Chandra, Bipan, [et al.], India's Struggle for Independence, [New Delhi, 1991]
8. Coupland, Reginald, The Indian Problem, Three Volumes, [London, 1944]
9. Dutta, Nilanjan, 'From Subject to Citizen: Towards a History of Indian Civil Rights Movement', in Michael Anderson and Sumit Guha, Changing Concepts of Rights and Justice in South Asia, [New Delhi, 2000]
10. Dhavan, Rajeev and Thomas Paul, Nehru and the Constitution, [Bombay, 1992]
11. Forbes, Geraldine, Women in India, [Cambridge, 1996] Gauba, O.P., Constitutionalism in a Changing Perspective, [New Delhi, 1996]
12. Mohanty, Manoranjan, 'Does India Need a New Constitution? [A Democratic Right Perspective on Constitutional Discourse]', in Surya Narayan Misra, Subhas Chandra

13. Hazary and Amareshwar Misra, [ed.], Constitution and Constitutionalism in India, [New Delhi, 1999]

(09) Assessment

PO/Course Assesment Tools Types	PO/Course Assesment Tools	PO 1	PO 2	PO3	PO 4	PO 5	PO 6	PO7	PO 8	PO9	PO 10	PO 11	PO12
		Engineering Knowledge	Problem Analysis	Design/ Development of Solution	Investigation	Modern Tool Usage	The Engineer and Society	Environment and Sustainability	Ethics	Individual and Team Work	Communication	Project Management	Life-Long Learning
Direct Tools	Test	□	□	□	□				□		□	□	
	Assignments	□	□			□				□			
	lab /seminar/industrial training /projects(Rubrics)	□	□	□		□		□	□	□	□	□	□
Indirect Tools	Course end survey	□				□		□					
	Exit survey	□	□										□
	Faculty Survey		□	□	□			□					
	Alumni Survey	□			□		□		□	□	□		□
	Program Statistics	□			□				□			□	

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