MADANAPALLE INSTITUTE OF TECHNOLOGY & SCIENCE

MADANAPALLE

(UGC-AUTONOMOUS)

www.mits.ac.in

DEPARTMENT OF MECHANICAL ENGINEERING

Course structure

For the students admitted to

B. Tech. Regular Four Year Degree Programme from the academic year 2020-21

and

B. Tech. Lateral Entry Scheme from the academic year 2021-22

B.TECH. MECHANICAL ENGINEERING

MADANAPALLE INSTITUTE OF TECHNOLOGY & SCIENCE, MADANAPALLE

B. Tech Four Year Curriculum Structure

Branch: MECHANICAL ENGINEERING

Total Credits	160 Credits for 2020(Regular) & 121 Credits for 2021(Lateral Entry) Admitted Batch
	163 Credits for 2021(Regular) & 124 Credits 2022(Lateral Entry) Admitted Batch onwards

I. Induction Program and Holistic Development Activities

Sl. No.	Title	Duration
1	Induction Program (Mandatory)	Three weeks' duration at the start of First Year (Refer Annexure - I)
2	Holistic Development Activities (Every Student from Semester 2 – 8 should register for at least one activity)	Three hours per week (Activity list is enclosed in Annexure - I)
3	Virtual Laboratory (Students are encouraged to choose and register for any of the Virtual laboratories he /she is interested)	As specified by the Virtual Laboratory

B. Tech. Mechanical Engineering

R20 - Curriculum Structure

I Year I Semester

S. No.	Category	Course Code	Course Title	Hours Per Week				Credits
				L	T	P	Total	
1	HSMC	20ENG101	Professional English	3	0	0	3	3
2	BSC	20MAT101	Engineering Calculus	3	1	0	4	4
3	BSC	20CHE101	Engineering Chemistry	3	0	0	3	3
4	ESC	20ME101	Engineering Graphics	2	0	2	4	3
5	ESC	20CSE101	Programming for Problem Solving (Python)	2	0	3	5	3.5
6	BSC	20CHE201	Chemistry Laboratory	0	0	3	3	1.5
7	ESC	20ME201	Workshop Practice	0	0	3	3	1.5
Total				**13**	**1**	**11**	**25**	**19.5**

I Year II Semester

S. No.	Category	Course Code	Course Title	Hours Per Week				Credits
				L	T	P	Total	
1	BSC	20MAT102	Linear Algebra and Differential Equations	3	0	0	3	3
2	BSC	20PHY101	Engineering Physics	3	1	0	4	4
3	ESC	20EEE101	Basic Electrical Engineering	3	1	0	4	4
4	ESC	20CSE102	C Programming and Data Structures	3	0	0	3	3
5	HSMC	20ENG201	English for Professional Purposes Laboratory	0	0	2	2	1
6	BSC	20PHY201	Physics Laboratory	0	0	3	3	1.5
7	ESC	20EEE201	Electrical Engineering Laboratory	0	0	3	3	1.5
8	ESC	20CSE201	C Programming and Data Structures Laboratory	0	0	3	3	1.5
Total				**12**	**2**	**11**	**25**	**19.5**

(L = Lecture, T = Tutorial, P = Practical, C = Credit)

B. Tech. Mechanical Engineering

II Year I Semester

S. No.	Category	Course Code	Course Title	Hours Per Week				Credits
				L	T	P	Total	
1	BSC	20MAT103	Numerical Methods	3	0	0	3	3
2	ESC	20ME102	Engineering Mechanics	2	1	0	3	3
3	PCC	20ME103	Basic Thermodynamics	2	1	0	3	3
4	PCC	20ME104	Materials Science and Engineering	3	0	0	3	3
5	PCC	20ME105	Fluid Mechanics and Hydraulic Machinery	2	1	0	3	3
6	PCC	20ME202	Materials Science and Engineering Laboratory	0	0	3	3	1.5
7	PCC	20ME203	Fluid Mechanics and Hydraulic Machinery Laboratory	0	0	3	3	1.5
8	PCC	20ME204	3-D Modelling Laboratory	0	0	3	3	1.5
9	SC		Skill Oriented Course-I (Annexure-IV)	1	0	2	3	2
10	MC	20CHE901	Environmental Science	2	0	0	2	0
Total				**15**	**3**	**11**	**29**	**21.5**

II Year II Semester

S. No.	Category	Course Code	Course Title	Hours Per Week				Credits
				L	T	P	Total	
1	HSMC	20HUM101	Economics and Financial Accounting for Engineers	3	0	0	3	3
2	BSC	20MAT108	Probability and Statistics	3	0	0	3	3
3	PCC	20ME106	Mechanics of Solids	2	1	0	3	3
4	PCC	20ME107	Theory of Machines	2	1	0	3	3
5	PCC	20ME108	Manufacturing Technology-I	3	0	0	3	3
6	PCC	20ME205	Manufacturing Technology-I Laboratory	0	0	3	3	1.5
7	PCC	20ME206	Mechanics of Solids Laboratory	0	0	3	3	1.5
8	PCC	20ME207	Dynamics and Electrical Machines Laboratory	0	0	3	3	1.5
9	SC		Skill Oriented Course –II (Annexure-IV)	1	0	2	3	2
10	MC	20HUM901	Indian Constitution	2	0	0	2	0
Total				**16**	**2**	**11**	**29**	**21.5**

(L = Lecture, T = Tutorial, P = Practical)

B. Tech. Mechanical Engineering

III Year I Semester

S. No.	Category	Course Code	Course Title	Hours Per Week				Credits
				L	T	P	Total	
1	PCC	20ME109	Design of Machine Elements	2	1	0	3	3
2	PCC	20ME110	Manufacturing Technology-II	3	0	0	3	3
3	PCC	20ME111	Heat Transfer	2	1	0	3	3
4	OE		Open Elective-I (Annexure-II)	3	0	0	3	3
5	PE		Professional Elective-I (Annexure-III)	3	0	0	3	3
6	PCC	20ME208	Manufacturing Technology-II Laboratory	0	0	3	3	1.5
7	PCC	20ME209	Thermal Engineering Laboratory	0	0	3	3	1.5
8	SC		Skill Oriented Course-III (Annexure-IV)	1	0	2	3	2
9	MC	20CE901	Disaster Management	2	0	0	2	0
10	PROJ	20ME701	Summer Internship - 1 *	0	0	3	3	1.5
Total				**16**	**2**	**11**	**29**	**21.5**

* 2 Months internship during 2nd year summer vacation and to be evaluated in III Year I Semester

III Year II Semester

S. No.	Category	Course Code	Course Title	Hours Per Week				Credits
				L	T	P	Total	
1	PCC	20ME112	CAD/ CAM	3	0	0	3	3
2	PCC	20ME113	Automation and Robotics	3	0	0	3	3
3	PCC	20ME114	Machine Learning for Mechanical Engineers	3	0	0	3	3
4	OE		Open Elective-II (Annexure-II)	3	0	0	3	3
5	PE		Professional Elective-II (Annexure-III)	3	0	0	3	3
6	PCC	20ME210	CAD/ CAM Laboratory	0	0	3	3	1.5
7	PCC	20ME211	Robotics Laboratory	0	0	3	3	1.5
8	PCC	20ME212	Engineering Metrology and Measurements Laboratory	0	0	3	3	1.5
9	SC		Skill Oriented Course-IV (Annexure-IV)	1	0	2	3	2
10	MC	20HUM902** / 20HUM102#	Universal Human Values	2/3	0	0	2/3	0/3
Total				**18/19**	**0**	**11**	**29/30**	**21.5/24.5**

** 20HUM902 Universal Human Values is offered as non-credit mandatory course for 2020 (Regular) & 2021 (Lateral Entry) Admitted Batch

20HUM102 Universal Human Values is offered as three credit course for 2021 (Regular) & 2022(Lateral Entry) Admitted Batch onwards

(L = Lecture, T = Tutorial, P = Practical)

B. Tech. Mechanical Engineering

IV Year I Semester

S. No.	Category	Course Code	Course Title	Hours Per Week				Credits
				L	T	P	Total	
1	PE		Professional Elective-III (Annexure-III)	3	0	0	3	3
2	PE		Professional Elective-IV (Annexure-III)	3	0	0	3	3
3	PE		Professional Elective-V (Annexure-III)	3	0	0	3	3
4	OE		Open Elective-III (Annexure-II)	3	0	0	3	3
5	OE		Open Elective-IV (Annexure-II)	3	0	0	3	3
6	OE-HSMC		Open Elective-V (Taken from Humanities & Social Science) (Annexure-II)	3	0	0	3	3
7	SC		Skill Oriented Course-V (Annexure-IV)	1	0	2	3	2
8	PROJ	20ME702	Summer Internship - 2*	0	0	6	6	3
Total				**19**	**0**	**8**	**27**	**23**

***** 2 Months' internship during 3nd year summer vacation and to be evaluated in IV Year I Semester

IV Year II Semester

S. No.	Category	Course Code	Course Title	Hours Per Week				Credits
				L	T	P	Total	
1	PROJ	20ME703	Project Work and Internship	0	0	24	24	12
Total				**0**	**0**	**24**	**24**	**12**

(L = Lecture, T = Tutorial, P = Practical)

ANNEXURE - I

THREE WEEK MANDATORY INDUCTION PROGRAMME

- **Yoga and Meditation**
- **Sports and Games**
- **NSS**
- **NCC**
- **MITS Social Responsibility**
- **ClubManagement module**
- **Design Thinking**
- **Spoken and Written Communication**

- *Proficiency modules*
    - Basic Computer Proficiency
    - Interpersonal Skills
    - Computer Graphics
    - Web Programming
    - Mobile Apps
    - Vocabulary Enhancement

HOLISTIC DEVELOPMENT ACTIVITIES

Description of Activities

1. Physical and Health
2. Culture
3. Literature and Media
4. Social Service
5. Self-Development
6. Nature and Environment
7. Innovation

B. Tech. Mechanical Engineering

ANNEXURE – II

OPEN ELECTIVE – I (To be offered under MOOC's Category from SWAYAM – NPTEL)			
Sl. No.	**Course Code**	**Course Title**	**Course Offered by Department of**
1	20HUM3M01	Project Management for Managers	Management Studies
2	20HUM3M02	Ethics in Engineering Practice	Management Studies
3	20HUM3M03	E – Business	Management Studies
4	20CE3M01	Integrated Waste Management for Smart City	Civil
5	20CE3M02	Soil and Water Conservation Engineering	Civil
6	20CE3M03	Plastic Waste Management	Civil
7	20CE3M04	Safety in Construction	Civil
8	20EEE3M02	Design of Photovoltaic Systems	EEE
9	20ECE3M01	Microprocessors and Interfacing	ECE
10	20ECE3M02	Microprocessors and Microcontrollers	ECE
11	20ECE3M03	Semiconductor Opto-Electronics	ECE
12	20ECE3M04	System Design Through Verilog	ECE
13	20CSE3M01	Online Privacy	CSE
14	20CSE3M02	Privacy and Security in Online Social Media	CSE
15	20CSE3M03	Computer Architecture	CSE
16	20CSE3M04	Computer Architecture and Organization	CSE
17	20IE3M01	Intellectual Property Rights and Competition Law	Multidisciplinary
18	20IE3M02	Introduction to Research	Multidisciplinary
19	20IE3M03	Roadmap for Patent Creation	Multidisciplinary
20	20IE3M04	Energy Conversion Technologies (Biomass And Coal)	Multidisciplinary
21	20IE3M05	Research Methodology	Multidisciplinary
Any new Interdisciplinary Course offered by SWAYAM NPTEL can be appended in future.			

B. Tech. Mechanical Engineering

OPEN ELECTIVE – II (To be offered under Conventional Mode)			
Sl. No.	**Course Code**	**Course Title**	**Course Offered by Department of**
1	20MAT302	Engineering Optimization	Mathematics
2	20PHY301	Optical Physics and its Applications	Physics
3	20PHY302	LASER Physics and Advanced LASER Technology	Physics
4	20CHE301	Introduction to Petroleum Industry	Chemistry
5	20CHE302	Green Chemistry and Catalysis for Sustainable Environment	Chemistry
6	20CE301	Ground Improvement Techniques	Civil
7	20CE302	Environmental Impact Assessment	Civil
8	20CE303	Watershed Management	Civil
9	20EEE301	Industrial Electrical Systems	EEE
10	20EEE302	Introduction to MEMS	EEE
11	20ECE301	Bio-Medical Electronics	ECE
12	20ECE302	VLSI Design	ECE
13	20CSE301	JAVA Programming	CSE
14	20CSE302	Multimedia Technologies	CSE
15	20CST301	Operating Systems	CST
Any new Interdisciplinary courses can be appended in future.			

B. Tech. Mechanical Engineering

OPEN ELECTIVE – III (To be offered under MOOC's Category from SWAYAM – NPTEL)			
Sl. No.	**Course Code**	**Course Title**	**Course Offered by Department of**
1	20HUM3M04	Management Information System	Management Studies
2	20HUM3M05	Business Analytics & Text Mining Modeling Using Python	Management Studies
3	20CE3M05	Remote Sensing and GIS	Civil
4	20CE3M06	Wastewater Treatment and Recycling	Civil
5	20CE3M07	Building Materials And Composites	Civil
6	20EEE3M03	Introduction to Smart Grid	EEE
7	20EEE3M04	Transducers For Instrumentation	EEE
8	20CSE3M05	Software Testing	CSE
9	20CSE3M06	Multi-Core Computer Architecture – Storage and Interconnects	CSE
10	20CSE3M08	Fundamentals of Artificial Intelligence	CSE
11	20CST3M01	Ethical Hacking	CST
12	20IE3M06	Learning Analytics Tools	Multidisciplinary
Any new Interdisciplinary Course offered by SWAYAM NPTEL can be appended in future.			

B. Tech. Mechanical Engineering

OPEN ELECTIVE – IV (To be offered under Conventional Mode)			
Sl. No.	**Course Code**	**Course Title**	**Course Offered by Department of**
1	20PHY303	Thin Film Technology and its Applications	Physics
2	20CHE303	Introduction to Nano Science and Technology	Chemistry
3	20CHE304	Computational Methods in Materials Science and Engineering	Chemistry
4	20CE304	Green Buildings and Energy Conservation	Civil
5	20CE305	Environmental Engineering	Civil
6	20EEE304	Electrical Safety	EEE
7	20ECE303	Embedded Systems	ECE
8	20ECE304	DSP Architecture	ECE
9	20ECE305	Community Radio Technology	ECE
10	20CSE303	Mobile Application Development	CSE
11	20CSE304	Software Project Management	CSE
12	20CST302	Cloud Computing	CST
Any new Interdisciplinary courses can be appended in future.			

B. Tech. Mechanical Engineering

OPEN ELECTIVE – V (HUMANITIES) (To be offered under Conventional Mode)			
Sl. No.	**Course Code**	**Course Title**	**Course Offered by Department of**
1	20HUM301	Principles of Management	Humanities
2	20HUM302	Human Resource Development	Humanities
3	20HUM303	Soft Skills	Humanities
4	20HUM304	National Cadet Corps	Humanities
Any new Interdisciplinary courses can be appended in future.			

B. Tech. Mechanical Engineering

ANNEXURE – III

List of Professional Electives

Professional Elective – I		
Sl. No.	**Course Code**	**Course Title**
1.	20ME401	Production Planning and Control
2.	20ME402	Computational Fluid Dynamics
3.	20ME403	Engineering Analysis and Computation
4.	20ME404	Fluid Power Systems
5.	20ME405	Finite Element Methods
6.	20ME406	Fundamentals of Automotive Engineering
Any advanced courses can be appended in future.		

Professional Elective – II (To be offered under MOOC's category from SWAYAM NPTEL)		
Sl. No.	**Course Code**	**Course Title**
1.	20ME4M01	Experimental Stress Analysis
2.	20ME4M02	System Design for Sustainability
3.	20ME4M03	Material Characterization
4.	20ME4M04	Design and Analysis of Experiments
5.	20ME4M05	Industrial Safety Engineering
6.	20ME4M06	Non-Conventional Energy Resources
7.	20ME4M07	Fundamental of Welding Science and Technology
8.	20ME4M08	Operations Management
9	20ME4M09	Introduction to Machining and Machining Fluids
Any other new Disciplinary Course offered by SMAYAM NPTEL which doesn't exist in the Curriculum can be appended in future.		

B. Tech. Mechanical Engineering

Professional Elective – III		
Sl. No.	**Course Code**	**Course Title**
1.	20ME407	Entrepreneurship and Project Management
2.	20ME408	Refrigeration and Air Conditioning
3.	20ME409	Internet of Manufacturing Things
4.	20ME410	Renewable Energy Systems
5.	20ME411	Carbon Footprint Estimation and Reduction Techniques
Any advanced courses can be appended in future.		

Professional Elective – IV		
Sl. No.	**Course Code**	**Course Title**
1.	20ME412	Electric Vehicle Technology
2.	20ME413	Additive Manufacturing
3.	20ME414	Fundamentals of Aerodynamics
4.	20ME415	Non Destructive Testing
5.	20ME416	Total Quality Management
Any advanced courses can be appended in future.		

Professional Elective – V		
Sl. No.	**Course Code**	**Course Title**
1.	20ME417	Mechanical Vibrations
2.	20ME418	Gas Dynamics and Jet Propulsion
3.	20ME419	Manufacturing of Composite Materials
4.	20ME420	Power Plant Engineering
5.	20ME421	Operations Research
Any advanced courses can be appended in future.		

ANNEXURE – IV

List of Skill Oriented Courses

Skill Oriented Course– I		
Sl. No.	**Course Code**	**Course Title**
1.	20ME601	Design Thinking and Product Innovation

Skill Oriented Course– II		
Sl. No.	**Course Code**	**Course Title**
1.	20ENG601	Corporate Communication
Any advanced courses can be appended in future.		

Skill Oriented Course– III		
Sl. No.	**Course Code**	**Course Title**
1	20ME602	Computer Modeling for Mechanical Engineering-I
Any advanced courses can be appended in future.		

Skill Oriented Course– IV		
Sl. No.	**Course Code**	**Course Title**
1.	20ME603	Computer Modeling for Mechanical Engineering-II
Any advanced courses can be appended in future.		

Skill Oriented Course– V		
Sl. No.	**Course Code**	**Course Title**
1.	20ME604	Advanced Manufacturing Technologies
Any advanced courses can be appended in future.		

B. Tech. Mechanical Engineering

ANNEXURE – V

Minor in Mechanical Engineering

(Applicable to CE, EEE, ECE, CSE, CST, CS – AI, CS – DS, CS – CSY & CS - IOT)

Stream Name: Digital Manufacturing

SI. No	Category	Course Code	Course Title	Hours Per Week				Credits
				L	T	P	Total Contact	
III Year I Semester								
1	**Professional Core Course**	20MDME101	Computer Aided Manufacturing Process	3	0	0	3	3
2	**Professional Core Course**	20MDME102	Product Design and Development	3	0	0	3	3
III Year II Semester								
3	**Professional Core Course**	20MDME103	Digital Manufacturing Planning and Control	3	0	0	3	3
4	**Professional Core Course**	20MDME104	Big Data Analytics for Manufacturing	3	0	0	3	3
5	**Professional Core Course**	20MDME201	Computer Aided Design and Manufacturing Laboratory	0	0	4	4	2
IV Year I Semester								
6	**Professional Core Course**	20MDME105	Smart Sensors and Industry 4.0	3	0	0	3	3
7	**Professional Core Course**	20MDME106	Lean Manufacturing	3	0	0	3	3
			Total	**18**	**0**	**4**	**22**	**20**

B. Tech. Mechanical Engineering

Minor in Mechanical Engineering

(Applicable to CE, EEE, ECE, CSE, CST, CS – AI, CS – DS, CS – CSY & CS - IOT)

Stream Name: Energy Engineering

SI. No	Category	Course Code	Course Title	Hours Per Week				Credits
				L	T	P	Total Contact Hours	
III Year I Semester								
1	**Professional Core Course**	20MDME107	Fluid Mechanics and Hydraulic Machinery	2	1	0	3	3
2	**Professional Core Course**	20MDME108	Applied Thermodynamics	2	1	0	3	3
III Year II Semester								
3	**Professional Core Course**	20MDME109	Heat Transfer	2	1	0	3	3
4	**Professional Core Course**	20MDME110	Computational Fluid Dynamics	2	1	0	3	3
5	**Professional Core Course**	20MDME202	Thermal Engineering Laboratory	0	0	4	4	2
IV Year I Semester								
6	**Professional Core Course**	20MDME111	Design of Gas Turbine Engines	2	1	0	3	3
7	**Professional Core Course**	20MDME112	Fluid Power System	2	1	0	3	3
			Total	**12**	**6**	**4**	**22**	**20**

B. Tech. Mechanical Engineering

ANNEXURE – VI

Honors in Mechanical Engineering

SI. No	Category	Course Code	Course Title	Hours Per Week				Credits
				L	T	P	Total Contact	
III Year I Semester								
1	**Professional Elective Course (Choose any two from three courses)**	20HDME101	Advanced Welding Technology	3	0	0	3	3
2		20HDME102	Design and Analysis of Welded Structures	3	0	0	3	3
3		20HDME103	Combustion and Emissions	3	0	0	3	3
	Sub			**6**	**0**	**0**	**6**	**6**
	III Year II Semester							
4	**Professional Elective Course (Choose any two from three courses)**	20HDME104	Ergonomics	3	0	0	3	3
5		20HDME105	Solar Energy for Process Heat and Power Generation	3	0	0	3	3
6		20HDME106	Fracture Mechanics	3	0	0	3	3
	Sub			**6**	**0**	**0**	**6**	**6**
	IV Year I Semester							
7	**Professional Elective Course (Choose any two from three**	20HDME107	Powder Metallurgy	3	0	0	3	3
8		20HDME108	Advanced Fluid Mechanics	3	0	0	3	3
9		20HDME109	Modelling of SI and CI Engines	3	0	0	3	3
10	**SOC**	20HDME601	Simulation and Analysis using ANSYS	1	0	2	3	2
			Sub Total	**7**	**0**	**2**	**9**	**8**
			Total	**19**	**0**	**2**	**21**	**20**

I Year I Semester

B. Tech. Mechanical Engineering

B. Tech I Year I Semester

20ENG101 PROFESSIONAL ENGLISH

L	T	P	C
3	0	0	3

Pre-requisite None

Course Description:
Communication takes place in many forms, however the major impact and effectiveness is in its professionalism. This course defines, enlightens and enables learners to engage in Professional Communication by addressing all the areas of communication – Listening, Speaking, Reading and Writing. This course also deals with various types of communication – Verbal, Non-verbal, Storytelling, Crucial Conversations, Written Communication, Vocalics, Eye Contact, Posture, etc.

Course Objectives: This course enables the student to –

1. Engage effectively in a professional environment
2. Understand the intricacies and implications of professional communication
3. Use linguistic skills in any given context
4. Conduct self in a learning environment
5. Be better prepared for employment

UNIT I GRAMMAR & VOCABULARY 9 hours

Grammar - Tense, Reported Speech, Modals, Conditionals; Vocabulary development - prefixes, suffixes, compound words, synonyms & antonyms.

UNIT II READING SKILLS & WRITTEN COMMUNICATION 9 hours

Reading - short comprehension passages, practice in skimming, scanning and predicting; Writing- completing sentences, developing hints; Paragraph writing- topic sentence, main ideas, coherence.

UNIT III VERBAL & NON-VERBAL ASPECTS 9 hours

Verbal - Introducing oneself, exchanging personal information, Using 'Wh'- Questions, asking and answering, yes or no questions- asking about routine actions and expressing opinions; Non-Verbal – Use of body language, combating nervousness.

UNIT IV CONVERSATIONS 9 hours

Listening-short texts & conversing, formal and informal conversations, short group conversations, speaking about oneself, sharing information of a personal kind speaking about one's friend.

UNIT V BUSINESS ENVIRONMENT & ETIQUETTES 9 hours

Greeting & taking leave; Writing e-mails, memos, reports, etc.

B. Tech. Mechanical Engineering

Course Outcomes:

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

1. Read articles and understand professional communication
2. Participate effectively in informal conversations
3. Introduce themselves and their friends and express opinions in English
4. Comprehend conversations and short talks delivered in English
5. Write short essays of a general kind and personal letters and emails in English.

Text Books:

1. Guy Brook Hart & Norman Whitby; Cambridge English-Business Benchmark: Pre-Intermediate to Intermediate; Published by: Cambridge University Press.
2. Adrian Doff, Craig Thaine, Herbert Puchta, et al; Empower: Intermediate (B1+); Published by: Cambridge University Press.

Reference Books

1. AJ Thomson & AV Martinet; A Practical English Grammar; Oxford University Press, 2015.
2. Raymond Murphy; English Grammar in Use with CD; Cambridge University Press, 2013.
3. K.S. Yadurajan; Modern English Grammar; Oxford University Press, 2014.
4. William Strunk Jr; The Elements of Style; ITHACA, N.Y.; W.P. HUMPHREY, 2006
5. Joseph Devlin; How to Speak and Write Correctly; ITHACA, N.Y.; W.P. HUMPHREY, 2006
6. Anjana Agarwal; Powerful Vocabulary Builder; New Age Publishers, 2011.
7. Writing Tutor; Advanced English Learners' Dictionary; Oxford University Press, 2012.
8. http://www.cambridgeenglish.org/in/
9. https://www.rong-chang.com/
10. https://www.rong-chang.com/

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination

B. Tech. Mechanical Engineering

B. Tech I Year I Semester

20MAT101 ENGINEERING CALCULUS

L	T	P	C
3	1	0	4

Pre-requisite: Mathematics at Intermediate or Equivalent Level

Course Description:
Communication takes place in many forms, however the major impact and effectiveness is in its professionalism. This course defines, enlightens and enables learners to engage in Professional Communication by addressing all the areas of communication – Listening, Speaking, Reading and Writing. This course also deals with various types of communication – Verbal, Non-verbal, Storytelling, Crucial Conversations, Written Communication, Vocalics, Eye Contact, Posture, etc.

Course Objectives: This course enables the student to –

1. To introduce the basic concepts of definite integrals, improper integrals, Beta and Gamma functions.
2. To acquire knowledge on mean value theorems in calculus.
3. To illustrate various techniques of testing the convergence of infinite series and introduces the functions of sine and cosine series.
4. To familiarize the knowledge of limit, continuity and the derivatives, extreme values in Multivariable.
5. To emphasize the role of Double and Triple integrals in dealing with area and volume of the regions.

UNIT I INTEGRAL CALCULUS 12 hours

Definite integrals; Applications of definite integrals to evaluate area and length of curves, surface areas and volumes of revolutions; Beta and Gamma functions and their properties.

UNIT II DIFFERENTIAL CALCULUS 12 hours

Rolle's Theorem, Mean value theorems, Taylor's and Maclaurin theorems with remainders (without proofs); indeterminate forms, Maxima and minima.

UNIT III SEQUENCE AND SERIES 12 hours

Sequence and Series, their Convergence and tests for convergence; Power series, Taylor's series, Series for exponential, trigonometric and logarithmic functions; Fourier series: Half range sine and cosine series, Parseval's theorem.

UNIT IV MULTIVARIABLE DIFFERENTIAL CALCULUS 12 hours

Limit, continuity and partial derivatives, directional derivatives, total derivative; Tangent plane and normal line; Maxima, minima and saddle points; Method of Lagrange multipliers.

UNIT V MULTIVARIABLE INTEGRAL CALCULUS 12 hours

Multiple Integration: double integrals (Cartesian and polar), change of order of integration in double integrals, Change of variables (Cartesian to polar), Applications: areas and volumes (double integration), triple integrals, gradient, curl and divergence, Green's, Stokes and Gauss divergence theorems (without proofs).

B. Tech. Mechanical Engineering

Course Outcomes:

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

1. Evaluate the definite integrals, Beta and Gamma functions and calculate length of curve and underlying area.
2. Relate the results of mean value theorems in calculus to Engineering problems.
3. Use the Power series and Fourier series for ascertaining the stability and convergence of various techniques.
4. Apply the functions of several variables to evaluate the rates of change with respect to time and space variables in engineering.
5. Compute the area and volume by interlinking them to appropriate double and triple integrals.

Text Books:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 42th Edition, 2012.
2. G. B. Thomas, Maurice D. Weir, Joel Hass, Frank R. Giordano, Thomas' Calculus Pearson education 11th Edition, 2004.

Reference Books:

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. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
4. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
5. D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
6. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination

B. Tech. Mechanical Engineering

B. Tech I Year I Semester

20CHE101 ENGINEERING CHEMISTRY

L	T	P	C
3	0	0	3

Pre-requisite: Basic Chemistry at Intermediate or equivalent level.

Course Description:
Deals with the basic principles of various branches of chemistry like physical, organic, inorganic, analytical and nanomaterial chemistry.

Course Objectives:
Students will

1. Understand, analyse and determine the impurities present in the water.
2. Appreciate the synthetic organic reactions used in daily life
3. Learn the principles of spectroscopies to analyse them.
4. Value the basic concepts of thermodynamics and electrochemistry.
5. Be exposed to the importance of nano and engineering materials used in their daily life and industry

UNIT I IMPURITIES PRESENT IN WATER AND WATER TREATMENT **9 hours**

Impurities present in Water: Impurities in water (BIS and WHO standards), Hardness of water-determination of hardness - EDTA Method (numerical problems), Alkalinity of water (numerical problems), Estimation of Dissolved Oxygen by Winkler's method and its importance and Chlorides. Disadvantages (industry level) of using hard water (Boiler corrosion, Caustic embrittlement, Scale and Sludges). Softening of water (Ion exchange method), Treatment of brackish water by Reverse Osmosis method. Water treatment for civic applications: coagulation, sedimentation, filtration, sterilization - chlorination and ozonation. Concept of break point chlorination.

UNIT II PERIODIC PROPERTIES AND ORGANIC REACTIONS **7 hours**

Periodic properties: Electronic configurations, atomic and ionic sizes, ionization energies, oxidation states, molecular geometries. Organic Reactions: Introduction to substitution (SN^1 and SN^2), elimination (E_1 and E_2) - Addition, Condensation and Free Radical Polymerization Reaction (only the mechanism).

UNIT III SPECTROSCOPY **8 hours**

Basic Principle and Applications of UV-Visible, FT-IR, Raman, Microwave and Nuclear Magnetic Resonance (NMR) Spectroscopy

UNIT IV THERMODYNAMICS AND ELECTROCHEMISTRY **11 hours**

Thermodynamics: Systems, State Functions, Thermodynamic Functions: Work, Energy, Entropy and Free energy. Estimations of Entropy in Isothermal, Isobaric and Isochoric processes. Electrochemistry: Free energy and EMF. Cell potentials, the Nernst equation and applications. Batteries (Lead-Acid and Lithium ion) and Fuel-Cells (H_2-O_2).

UNIT V ENGINEERING MATERIALS, NANOSCIENCE & NANOTECHNOLOGY **10 hours**

Engineering Materials: Cement Materials and Manufacturing Process. Reactions in setting and hardening of Cement. Lubricants – definition, Properties of lubricants – Viscosity, Viscosity Index, Flash Point and Pour Point. Nanomaterials: Introduction, Classes/Types, Chemical synthesis of Nanomaterials: Chemical Vapor Deposition method (Carbon Nanotubes), Characterization by powder XRD (Scherrer's equation). Applications of Nanomaterials: Solar Energy and Photocatalytic Dye Degradation (TiO_2).

Course Outcomes:

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

1. Analyse and determine the impurities in water such as hardness, alkalinity for sustainable development.
2. Prepare organic compounds/polymers for environmental, safety and society need.
3. Comprehend the principles and applications of spectroscopies.
4. Apply the concept of free energy in thermodynamics, electrochemistry for solving the problems evolve in the engineering processes.
5. Acquire spotlight to the nanomaterials and basic engineering materials used in academics, industry, and daily life.

Text Books:

1. P. W. Atkins & Julio de Paula, 'The Elements of Physical Chemistry', Ninth edition (Oxford University Press, Oxford 2010)
2. C. N. Banwell, Fundamentals of Molecular Spectroscopy, Fourth Edition, (Tata McGraw Hill, 2008).
3. C. N. Banwell, Fundamentals of Molecular Spectroscopy, Fourth Edition, (Tata McGraw Hill, 2008).
4. Dr. S. S. Dara and Dr. S. S. Umare, A Textbook of Engineering Chemistry,1 st Edition., (S. Chand & Company Ltd, 2000).
5. T. Pradeep, Nano: The Essentials, 1 st Edition, (Tata McGraw-Hill Publishing Company Limited, 2017).

Reference Books

1. 'Physical Chemistry', D. W. Ball, First Edition, India Edition (Thomson, 2007).
2. Perry's Chemical Engineers' Handbook, Don W. Green and Marylee Z. Southard, 9th Edition (McGraw Hill, 2018).
3. Engineering Chemistry, Dr. Suba Ramesh and others, 1st Edition (Wiley India, 2011).
4. Jain and Jain, Engineering Chemistry,16th Edition (Dhanpat Rai Publishing Company (P) Ltd, 2016).
5. Amretashis Sengupta, Chandan Kumar Sarkar (eds.), Introduction to Nano Basics to Nanoscience and Nanotechnology (Springer-Verlag, Berlin, Heidelberg, 2015)

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination

B. Tech. Mechanical Engineering

B. Tech I Year I Semester

20ME101 ENGINEERING GRAPHICS

L	T	P	C
2	0	2	3

Pre-requisite: None

Course Description:
Introduction to AutoCAD commands, simple drawings, orthographic projections, projection of points, lines, planes; auxiliary projections; projections and sections of solids; development and intersection of surfaces; isometric projections.

Course Objectives:
1. Engineering Graphics is the primary medium for development and communicating design concepts.
2. Through this course the students are trained in Engineering Graphics concepts with the use of AutoCAD.
3. The latest ISI code of practice is followed while preparing the drawings using AutoCAD.
4. Computerized drawing is an upcoming technology and provides accurate and easily modifiable graphics entities.
5. Storage and Retrieval of Drawings is also very easy and it takes very less time to prepare the drawings. Also enhances the creativity.

UNIT I INTRODUCTION TO AUTO CAD 12 hours

Introduction to AutoCAD commands, simple drawings using AutoCAD, Introduction to orthographic Projections – Theory, techniques, first angle projections and third angle projections.

UNIT II PROJECTIONS OF POINTS & LINES 12 hours

Projections of points: Positions, notation system and projections. Projections of lines: Positions, terms used, different cases, traces of lines and finding true length.

UNIT III PROJECTIONS OF PLANES & SOLIDS 12 hours

Projections of planes: Positions, terms used, different cases and projections procedure.
Projections of Solids: Projections of Regular Solids inclined to one plane (resting only on HP).

UNIT IV SECTIONS AND DEVELOPMENTS OF SOLIDS 12 hours

Section of solids: Sectional view of right regular solids (Prism and cylinder), true shapes of the sections.
Development of Surfaces: Development of surfaces of right regular solids (Prism, Cylinder and their Sectional Parts).

UNIT V INTERSECTIONS & ISOMETRIC PROJECTIONS 12 hours

Intersections of surfaces of solids: Intersection between prism Vs prism, prism Vs cylinder, cylinder Vs cylinder.
Isometric Projections: Theory of isometric drawing and orthographic views, Conversion of isometric view into orthographic views.

B. Tech. Mechanical Engineering

Course Outcomes:

Student will be able to

1. Identify various commands in AutoCAD software and apply AutoCAD skills to develop the new designs.
2. Draw the projections of points, straight lines using AutoCAD.
3. Draw the projections of the planes, solids using AutoCAD
4. Sketch the developments of solids, sections of solids using AutoCAD.
5. Draw the conversion of the isometric views to orthographic views and intersections of surfaces using AutoCAD.

Text Books:

1. D.M. Kulkarni, A.P. Rastogi and A.M. Sarkar., Engineering Graphics with AutoCAD, PHI Learning Private Limited, New Delhi 2009.
2. N D Bhat, Engineering Drawing, Charotar Publishing House, Gujarath,15th Edition, 2010.
3. K.L. Narayana, P. Kanniah, Engineering Drawing, Scitech Publishers, 2nd Edition, 2010.

Reference Books:

1. Dhananjay A Jolhe, Engineering Drawing: with an introduction to AutoCAD, Tata McGraw Hill, 2008.
2. Warren J. Luzadder & Jon M. Duff Fundamentals of Engineering Drawing, 11th edition, Prentice Hall of India, New Delhi.

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination

B. Tech. Mechanical Engineering

B. Tech I Year I Semester

20CSE101 PROGRAMMING FOR PROBLEM SOLVING (PYTHON)

L	T	P	C
2	0	3	3.5

Pre-requisite: None

Course Description:

Python is a language with a simple syntax, and a powerful set of libraries. It is an interpreted language, with a rich programming environment. While it is easy for beginners to learn, it is widely used in many scientific areas for data exploration. This course is an introduction to the Python programming language for students without prior programming experience.

This course provides knowledge on how to implement programs in python language and to solve computational problems using the various programming constructs including data structures, functions, string handling mechanisms and file handling concepts

Course Objectives:

This course enables students to

1. Learn Python programming constructs.
2. Implement Python programs with conditional structures and loops.
3. Use functions for structuring Python programs.
4. Handle compound data using Python lists, tuples, and dictionaries.
5. Manipulate data using files handling in Python.
6. Getting exposed to the basics of Object Oriented Programming using Python

UNIT I: INTRODUCTION 12 hours

Algorithms, building blocks of algorithms (flow chart), History of Python, features of Python Programming, Running Python Scripts, Variables, Assignment, Keywords, Input-Output, Indentation. Data Types - Integers, Strings, Boolean.

a) Develop a flowchart for the various arithmetic operations on numbers.
b) Develop a flowchart to check whether the number is positive or negative.
c) Develop a flowchart for finding whether a given number is even or odd.
d) Develop a flowchart for finding biggest number among three numbers.
e) Develop a flowchart for displaying reversal of a number.
f) Develop a flowchart to print factorial of a number using function.
g) Develop a flowchart to generate prime numbers series up to N using function.
h) Develop a flowchart to check given number is palindrome or not using function.
i) Alexa travelled 150 kms by train. How much distance in miles she actually covered?

UNIT II: OPERATORS AND EXPRESSIONS 12 hours

Operators- Arithmetic Operators, Comparison (Relational) Operators, Assignment Operators, Logical Operators, Bitwise Operators, Membership Operators, Identity Operators, Expressions and order of evaluations. Control Flow - if, if-elif else, for, while, break, continue, pass.

a) Swapping of two number with and without using temporary variable.
b) If the age of Ram, Sam, and Khan are input through the keyboard, write a python program to determine the eldest and youngest of the three.
c) Develop a program that performs arithmetic operations (Addition, Subtraction, Multiplication, and Division) on integers. Input the two integer values and operator for performing arithmetic operation through keyboard. The operator codes are as follows:

- For code '+', perform addition.
- For code '-', perform subtraction.
- For code '*', perform multiplication.
- For code '/', perform division.

d) Implement the python program to generate the multiplication table.
e) Implement Python program to find sum of natural numbers
f) If the first name of a student is input through the keyboard, write a program to display the vowels and consonants present in his/her name.
g) The marks obtained by a student in 5 different subjects are input through the keyboard. Find the average and print the student grade as per the MITS examination policy as shown below.

% OBTAINED GRADE
90 - 100 O (Outstanding)
80 - 89 A+ (Excellent)
70 - 79 A (Very Good)
60 - 69 B+ (Good)
50 - 59 B (Above)
45 - 49 C (Average)
40 - 44 P (Pass)
< 40 F (Fail)

h) Implement Python Script to generate prime numbers series up to N.
i) Given a number x, determine whether it is Armstrong number or not. Hint: For example, 371 is an Armstrong number since 3**3 + 7**3 + 1**3 = 371. Write a program to find all Armstrong number in the range of 0 and 999.

UNIT-III: DATA STRUCTURES 12 hours

Lists - Operations, Slicing, Methods; Tuples, Sets, Dictionaries, Sequences. Comprehensions. Functions - Defining Functions, Calling Functions, Passing Arguments, variable in python-Global and Local Variables.

a) Write a Python script to
- create a list
- access elements from a list
- slice lists
- change or add elements to a list
- delete or remove elements from a list

b) Write a Python script to read the values from a list and to display largest and smallest numbers from list.
c) Write a Python script to compute the similarity between two lists.
d) Write a Python script to read set of values from a Tuple to perform various operations.
e) Write a Python script to perform basic dictionary operations like insert, delete and display.
f) Write a Python program to count the occurrence of each word in a given sentence.
g) Define a dictionary named population that contains the following data.

Keys	Values
Shanghai	17.8
Istanbul	13.3
Karachi	13.0
Mumbai	12.5

h) Write a Python script to create Telephone Directory using dictionary and list to perform basic functions such as Add entry, Search, Delete entry, Update entry, View and Exit.
i) Implement Python script to display power of given numbers using function.

B. Tech. Mechanical Engineering

j) Implement a Python program that takes a list of words and returns the length of the longest one using function.

UNIT-IV:

String Handling -Modules: Creating modules, import statement, from import statement, name spacing

Files and Directories:

a) Implement Python program to perform various operations on string using string libraries.

b) Implement Python program to remove punctuations from a given string.

c) Write a Python program to change the case of the given string (convert the string from lower case to upper case). If the entered string is "computer", your program should output "COMPUTER" without using library functions.

d) Implement Python program to capitalize each word in a string. For example, the entered sentence "god helps only people who work hard" to be converted as "God Helps Only People Who Work Hard"

e) Write a Python script to display file contents.

f) Write a Python script to copy file contents from one file to another.

g) Write a Python script to combine two text files contents and print the number of lines, sentences, words, characters and file size.

h) Write a Python commands to perform the following directory operations.

- List Directories and Files
- Making a New Directory
- Renaming a Directory or a File
- Removing Directory or File

UNIT-V:

Python packages: Predefined Packages and User-defined Packages, Package Creation.

Object Oriented Programming using Python: Introduction to OOP, Creating Classes and Objects in Python, Creating Methods in Python

Brief Tour of the Standard Library: Turtle

a) Create a package named Cars and build three modules in it namely, BMW, Audi and Nissan. Illustrate the modules using class. Finally we create the __init__.py file. This file will be placed inside Cars directory and can be left blank or we can put the initialization code into it.

b) Create a class by name Student with instance variables such as roll_no, name, year_of_study, branch, section, and marks in any five subjects. The class should also contain one method for calculating the percentage of marks and the other method for printing a report as follows:

Roll No.	Name	Year	Section	Branch	M1	M2	M3	M4	M5	Percentage
101	abc	I	A	CSE	58	68	95	47	56	64.8

b) Write a python script to display following shapes using turtle.

Course Outcomes:

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

1. Understand problem solving techniques and their applications
2. Understand the syntax and semantics of python.
3. Demonstrate the use of Python lists and dictionaries.
4. Demonstrate the use of Python File processing, directories.
5. Describe and apply object-oriented programming methodology and Standard Library.

Text Books:

1. Allen B. Downey, ``Think Python: How to Think Like a Computer Scientist'', 2nd edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016
(http://greenteapress.com/wp/thinkpython/)
2. Guido van Rossum and Fred L. Drake Jr, "An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011.

References:

1. Charles Dierbach, "Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2013.
2. John V Guttag, "Introduction to Computation and Programming Using Python'', Revised and expanded Edition, MIT Press , 2013.
3. Kenneth A. Lambert, "Fundamentals of Python: First Programs", CENGAGE Learning, 2012.
4. Paul Gries, Jennifer Campbell and Jason Montojo, "Practical Programming: An Introduction to Computer Science using Python 3", Second edition, Pragmatic Programmers,LLC,2013.
5. Robert Sedgewick, Kevin Wayne, Robert Dondero, "Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.

Mode of Evaluation: Continuous Internal Evaluation and End Semester Examination

B. Tech. Mechanical Engineering

B. Tech I Year I Semester

20CHE201 CHEMISTRY LABORATORY

L	T	P	C
0	0	3	1.5

Pre-requisite: Basic Chemistry at Intermediate or equivalent level.

Course Description:

It deals with basic principles of volumetric and instrumental analytical methods.

Course Objectives:

This Engineering Chemistry Laboratory is common to all branches of I Year B Tech. At the end of the course the student is expected to Students will

1. Learn to estimate the chemical impurities present in water such as hardness, alkalinity, chlorine, etc.
2. Understand and experience the formation of inorganic complex and analytical technique for trace metal determination.
3. Be trained to use the instruments to practically understand the concepts of electrochemistry.
4. Bridge theoretical concepts and their practical engineering applications, thus
5. highlighting the role of chemistry in engineering.

LIST OF EXPERIMENTS

1. Estimation of total, permanent and temporary hardness of water by EDTA method.
2. Estimation of alkalinity of water sample.
3. Estimation of dissolved oxygen by Winkler's method.
4. Determination of molecular weight of a polymer by using Ostwald's viscometer.
5. Determination of rate constant of an ester hydrolysis (Pseudo First Order reaction).
6. Determination of strength of a Strong acid (conc. H_2SO_4) by conductometric titration (Neutralisation Titration).
7. Conductometric titration of $BaCl_2$ Vs Na_2SO_4 (Precipitation Titration).
8. Dissociation constant of weak electrolyte by Conductometry.
9. Determination of percentage of Iron in Cement sample by colorimetry.
10. Estimation of ferrous ion by Potentiometric titration (Redox Titration).
11. Saponification value of oil.
12. Formation of Iron-1,10-phenanthroline complex and determination of iron by colorimetry.

Course Outcomes:

After the completion of the Engineering Chemistry Laboratory experiments, students will be able to

1. Develop and perform analytical chemistry techniques to address the water related problems (for e.g., hardness, alkalinity present in water) technically.
2. Handle electro-analytical instruments like digital conductivity meter and potentiometer to perform neutralization, precipitation, and redox titrations, respectively.
3. Acquire practical skills to handle spectro-photochemical methods to verify Beer Lambert's Law.
4. Operate various instruments for the analysis of materials and produce accurate results in a given time frame.
5. Think innovatively and improve the creative skills that are essential for solving engineering problems.

Textbook:

1. Engineering Chemistry Lab Manual (2017-18), Dept. of Chemistry, Madanapalle Institute of Technology and Science, Madanapalle – 517325, Chittoor Dist., Andhra Pradesh, India.
2. "Vogel's Textbook of Qualitative Chemical Analysis", Arthur Israel Vogel, Prentice Hall, 2000.
3. Laboratory Manual on Engineering Chemistry, by Dr Sudha Rani, Dhanpat Rai Publishing house, 2009.
4. A Textbook on Experiments and calculations in Engineering Chemistry, by SS Dara, S Chand publications, 2015.
5. Laboratory Manual of Organic Chemistry, by Raj K Bansal, Wiley Eastern Limited, New age international limited, 2009.

Mode of Evaluation: Continuous Internal Evaluation and End Semester Examination

B. Tech. Mechanical Engineering

B. Tech I Year I Semester

20ME201 WORKSHOP PRACTICE

L	T	P	C
0	0	3	1.5

Pre-requisite None

Course Description:
This course will provide students with a hands-on experience on various basic engineering practices. This course will also provide an opportunity to the students to experience the various steps involved in the industrial product fabrication.

Course Objectives:

1. Introduction to the use of Tools, Machinery and Power tools,
2. Hands on practice in Carpentry, Fitting, Forging, Tinsmith, Plumbing, Foundry, Welding, Fabrication of plastic components, Metrology, Fabrication of Polymer Composite materials, simple machine turning and wood turning, and basic electrical connections.
3. Introduction to 3 D Printing
4. Fabrication of final product at end of the semester

LIST OF TRADES

1. Carpentry (Cross half lap Joint and Miter Joint)
2. Fitting (Square and 'V' fit)
3. Turning (Ball pane hammer and handles)
4. Forging (S hook L hook)
5. Tin smithy (Square tray)
6. Plumbing (Wash basin and simple connection)
7. Foundry (Solid and Split pattern)
8. Welding (Arc and Gas welding)
9. Fabrication of plastic components (Pen Stand)
10. Metrology (Internal and External dimension)
11. Composite Material Sample Preparation (Demo Only)
12. Introduction of Power Tools and CNC (Demo Only)
13. Introduction to 3D Printing (Demo Only)

Course Outcomes:

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

1. Fabricate carpentry components with suitable joint and pipe connections including plumbing works.
2. Perform welding operation to join various structures.
3. Perform basic machining operations.
4. Create the models using sheet metal and plastic works.
5. Illustrate the operations of foundry, fitting and smithy
6. Fabricate a product using composite and plastic material
7. Design and fabricate a product using the tools and skills learned in the workshop

Suggested Text/Reference Books:

1. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements of Workshop Technology", Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.
2. Kalpakjian S. And Steven S. Schmid, "Manufacturing Engineering and Technology", 4th edition, Pearson Education India Edition, 2002.
3. Roy A. Lindberg, "Processes and Materials of Manufacture", 4th edition, Prentice Hall India, 1998. (v) Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata McGrawHill House, 2017.
4. Work shop Manual / P.Kannaiah/ K.L.Narayana/ SciTech Publishers
5. Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata McGrawHill House,2017.

Mode of Evaluation: Continuous Internal Evaluation and End Semester Examination

I Year II Semester

B. Tech. Mechanical Engineering

B. Tech I Year II Semester

20MAT102 LINEAR ALGEBRA AND DIFFERENTIAL EQUATIONS

L	T	P	C
3	0	0	3

Pre-requisite 20MAT101

Course Description:

The course is an introduction to Linear Algebra and Differential Equations. Methods for solving system of linear equations, ordinary and partial differential equations are covered. Basics of matrices and its applications are highlighted. The methods of solving first and second order ordinary differential equations and partial differential equations have been introduced.

Course Objectives:

1. To solve the system of linear equations and find the eigenvalues and eigenvectors.
2. To formulate and solve first order ordinary differential equations.
3. To solve second order differential equations of various kinds to familiarize the knowledge of Laplace transform.
4. To introduce Fourier series and the classical methods for solving boundary value problems
5. To obtain the solutions of partial differential equations representing initial and boundary value problems in engineering.

UNIT I LINEAR ALGEBRA 9 hours

Introduction to matrices -Rank and inverse of a matrix - system of linear equations, Eigenvalues and Eigen vectors - Cayley-Hamilton theorem, diagonalization of matrices.

UNIT II FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS 9 hours

Introduction - General Remarks on Solutions, Families of Curves, Orthogonal Trajectories - Homogeneous Equations - Exact equation, Integrating Factors - Linear differential equations and Bernoulli's equation.

UNIT III SECOND ORDER ORDINARY DIFFERENTIAL EQUATIONS 9 hours

Introduction of second order linear differential equations - General solution of the homogeneous equation, Wronskian, Homogeneous equation with constant coefficients - Euler's equidimensional equation - Method of variation of parameters - Operator methods for finding particular solutions.

UNIT IV LAPLACE TRANSFORMS 9 hours

Laplace Transform - Inverse Laplace transform - Convolution theorem - applications to solve Integral equations and ordinary differential equations.

UNIT V PARTIAL DIFFERENTIAL EQUATIONS 9 hours

Definition and formulation of partial differential equations - Eigen values and Eigen functions method of separation of variables, one dimensional wave equation; One dimensional heat flow, solution of the heat equation.

B. Tech. Mechanical Engineering

Course Outcomes:

At the end of the course, the students should be able to:

1. Solve the system of linear equations occurring in various fields of Engineering and obtain Eigen values and Eigenvectors.
2. Understand and solve first order ordinary differential equations.
3. Apply the knowledge of identifying, formulating and solving engineering problems represented by second order differential equations.
4. Analyze the Fourier series and apply partial differential equations for solving boundary value problems in engineering.
5. Represent the relevant engineering system into pertinent partial differential equation, solve it and interpret the results.

Text Books:

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 42nd Edition, 2012.
2. Simmons G.F., Differential Equations with Applications and Historical Notes, Tata McGraw Hill Edition 2003, Eighteenth reprint 2010.

Reference Books:

1. D. Poole, "Linear Algebra: A Modern Introduction", Brooks/Cole, 2005.
2. V. Krishnamurthy, V.P. Mainra and J.L. Arora, An introduction to Linear Algebra, Affiliated East–West press, Reprint 2005.
3. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
4. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination

B. Tech. Mechanical Engineering

B. Tech I Year I Semester

20PHY101 ENGINEERING PHYSICS

L	T	P	C
3	1	0	4

Pre-requisite Plus two level physics course

Course Description:

Engineering Physics for Civil and Mechanical Engineers is a physics course which provides fundamental knowledge to understand the concepts of mechanics, waves and oscillations, interference, diffraction, polarization, lasers and fiber optics.

Course Objectives:

1. Expose students to the fundamental principles and laws of mechanics in Physics to understand the types of motion.
2. Demonstrate the ability to identify and apply the appropriate analytic, numerical, and mathematical reasoning, to situations of the physical world.
3. Analyze the concepts of mechanics, oscillations, waves and optics to prepare the students for advanced level courses.
4. Expose students to theoretical and mathematical aspects of interference and diffraction of light for testing of materials.
5. Adaptability to new developments in science and technology.

UNIT I MECHANICS OF PARTICLES 11 hours

Vectors, Algebra of vectors Velocity and Acceleration, Motion in one dimension, several dimensions, formal solution of kinematical equations. Polar Co-ordinates, velocity and acceleration in polar coordinates. Newton's Laws, applications of Newton's laws (Constraint equations, Block on string, Conical Pendulum, Block and Wedge).

UNIT II MOMENTUM & WORK ENERGY 12 hours

Momentum, law of conservation of linear momentum, flow of mass, Rocket Equation, Rocket in free space and in a gravitational field. Integrating equation of motion in one-dimension-work energy theorem, orbital velocity and escape velocity, Potential energy, Potential energy of a uniform force field, potential energy of an inverse square force, stability, conservation laws and particle collisions.

UNIT III WAVES AND OSCILLATIONS 12 hours

Simple Harmonic Motion, damped harmonic oscillations, forced harmonic oscillations, resonance, and quality factor. Superposition of vibrations along same direction (equal frequency) and in perpendicular directions, Lissajous figures.

Transverse waves, solution of wave equation, velocity of a transverse wave along a stretched string, modes of vibration of stretched string, reflection and transmission waves at boundary, standing waves, standing wave ratio.

UNIT IV OPTICS 13 hours

Superposition of waves, interference of light by division of wavefront - Young's double slit experiment, interference of light by division of amplitude- interference in thin film by reflection, Newton's rings experiment.

Diffraction, Farunhofer diffraction due to single slit, double slit and Diffraction grating (N-slit). Polarization, Types of polarization, Polarization by reflection, refraction and double refraction, Nicol's prism. Half wave and Quarter wave plates

UNIT V LASERS & FIBER OPTICS 12 hours

Introduction to lasers, characteristics of laser, spontaneous and stimulated emission, Einstein's coefficients; population inversion, excitation mechanisms, solid-state lasers – ruby laser, gas Lasers - He-Ne Laser, applications of lasers.

Fiber Optics: Principle, Construction and working of optical fiber, Acceptance angle, Numerical aperture, Types of fiber, Fiber optic communication system.

Course Outcomes:

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

1. Describe and explain the fundamental physical principles and laws of Mechanics in Physics.
2. Explain the concepts conservation of momentum, energy, and predict the future state of a system based on its present state.
3. Apply the physical principles of waves together with logical and mathematical reasoning, to situations of the physical world of vibrations.
4. Define and evaluate the fundamentals of materials testing using Interference, Diffraction & Polarization techniques.
5. Acquire the basic knowledge of lasers and fiber optics.

Text Books:

1. An Introduction to Mechanics by D. Kleppner and R. Kolenkow, Tata McGraw-Hill Edition, 2007.

2. Engineering Physics –Dr. M.N. Avadhanulu & Dr. P.G. Kshirsagar, S. Chand and Company

3. Engineering Physics –K. Thyagarajan, McGraw Hill Publishers.

Reference Books:

1. Physics Vol I & II, Halliday/Resnick/Krane 5th Edition, John Wiley, 2003.

2. Concepts of Modern Physics by Arthur Beiser, 7th Edition, 2017.

3. Engineering Mechanics, 2nd ed. — MK Harbola.

4. Introduction to Mechanics — MK Verma.

5. Theory of Vibrations with Applications — WT Thomson.

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination

B. Tech. Mechanical Engineering

B. Tech I Year I Semester

20EEE101 BASIC ELECTRICAL ENGINEERING

L	T	P	C
3	1	0	4

Pre-requisite Intermediate Physics

Course Description:

This course equips the students with a basic understanding of Electrical circuits and machines for specific applications. In specific, the course covers basic of DC circuit & its analysis, introduction to single-phase and three-phase AC Systems, magnetic materials, transformers, DC & AC electrical machines, basic converters and Components of LT Switchgear.

Course Objectives:

1. To learn the basics of the D.C. circuit analysis.
2. To have an idea about single-phase and three-phase A.C. electrical circuits.
3. To gain knowledge about basic magnetic material and transformers.
4. To learn the construction and operation of D.C. and A.C. machines.
5. To understand the operation of basic rectifiers and various components of LT Switchgear.

UNIT I DC CIRCUIT ANALYSIS 12 hours

Electrical circuit elements, voltage and current sources, Series and parallel resistive circuits, Kirchhoff's current and voltage laws, Nodal and Mesh analysis of simple circuits with dc excitation. Source Transformation, Star-Delta Transformation, Superposition Theorem.

UNIT II AC CIRCUIT ANALYSIS 12 hours

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

UNIT III MAGNETIC MATERIALS AND TRANSFORMERS 12 hours

Magnetic materials, B-H characteristics, ideal and practical transformer, principle of operation, emf equation, equivalent circuit, losses in transformers, regulation and efficiency.

UNIT IV DC AND AC MACHINES 12 hours

Construction, working, emf equation of DC generator, methods of excitation, speed control of dc motor. Introduction to different types of AC motors, Three Phase Induction Motors - Generation of rotating magnetic fields, construction, working and starting methods: D.O.L, Autotransformer starter. Introduction to Alternators.

UNIT V RECTIFIERS AND ELECTRICAL INSTALLATIONS 12 hours

PN junction diode, half wave, full wave and bridge rectifiers. Components of LT Switchgear: switch fuse unit (SFU), MCB, ELCB, MCCB, types of wires and cables – Current carrying capability, Insulation Strength; Earthing.

B. Tech. Mechanical Engineering

Course Outcomes:

Upon successful completion of the course, students will be able to

1. To understand and analyze basic DC electric circuits.
2. To measure and analyze various electrical quantities of single phase and three AC electric circuits.
3. To understand magnetic materials and to analyze the transformers.
4. To study the working principles of electrical machines.
5. To create power converters for domestic applications with LT switchgear.

Text Books:

1. E. Hughes, "Electrical and Electronics Technology", Pearson, 2010.
2. D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 2010.
3. D. C. Kulshreshtha, "Basic Electrical Engineering", McGraw Hill, 2009.
4. L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press, 2011.
5. V. D. Toro, "Electrical Engineering Fundamentals", Prentice Hall India, 1989.

Reference Books:

1. Abhijit Chakrabarti, "Circuit Theory : Analysis and Synthesis", Dhanpat Rai & Co., 2014.
2. J.B. Gupta, "Theory & Performance of Electrical Machines", S. K. Kataria & Sons, 2013.
3. John Bird, "Electrical Circuit Theory and Technology", Fourth edition, Elsevier Ltd., 2010.

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination

B. Tech. Mechanical Engineering

B. Tech I Year II Semester

20CSE102 C PROGRAMMING AND DATA STRUCTURES

L	T	P	C
3	0	0	3

Pre-requisite: 20CSE101

Course Description:
This course includes C program basics, control structures, arrays, files, pointers and data structures.

Course Objectives:

1. To make the student understand fundamentals of C programming language and problem solving.
2. To understand the syntax and semantics of C programming language.
3. To develop algorithms for sorting, searching techniques.
4. To design and implement operations on stack, queue, and linked list.

UNIT I INTRODUCTION TO C PROGRAMMING 9 hours

Structure of C Program, C Tokens: Variables, Data types, Constants, Identifiers, key words and Operators, Expressions.

Control Structures: Conditional Statements (Simple if, if-else, Nested -if-else, Switch). Iterative Statements (for, While, Do-While), Jump Statements (break, Continue).

UNIT II FUNCTIONS & ARRAY 9 hours

Functions Introduction, User defined function, Function prototype, Function Definition and Function Call, Storage classes, Recursion **Arrays**: Defining an array, processing an array, one dimensional arrays, two dimensional arrays. Passing array as an argument to function. **Sorting:** Bubble Sort, Insertion Sort, selection sort. **Searching:** Linear and binary search.

UNIT III STRINGS & POINTERS 9 hours

Strings: Declaring and defining a string, Initialization of strings, Strings Library functions.

Pointers: Fundamentals of pointer, Pointer Declarations, Parameter passing: Pass by value, Pass by reference, Dynamic memory allocation.

UNIT IV STRUCTURES & FILES 9 hours

Structures: Defining a structure, processing a structure, Pointer to Structure, Unions.

Files: Opening and closing a data file, Reading and Writing a data file, File I/O Functions.

UNIT V DATA STRUCTURES 12 hours

Stack: stack operations, stack implementations using arrays.

Queue: queue operations, queue implementations using array, Applications of stack and queue.

Linked List: Single linked list operations.

Course Outcomes:

Upon successful completion of the course, students will be able to

1. Understand fundamentals of C programming language and its constructs.
2. Design and implement applications using functions, arrays, sorting and searching techniques.
3. Design and implement applications using strings and pointers.
4. Design and implement applications using structures and File processing.
5. Choose appropriate linear data structure depending on the problem to be solved.

Text Books:

1. The C Programming Language, Brian W. Kernighan and Dennis M. Ritchie, 2nd Edition, Prentice Hall, India 1988.
2. Alfred V. Aho, John E. Hopcroft and Jeffry D. Ullman, Data Structures and Algorithms, Pearson Education, New Delhi, 2006.

Reference Books:

1. Let us C, Yashavant Kanetkar, 15th Edition, BPB Publications, 2016.
2. Problem Solving & Program Design in C, Hanly, Jeri R and Elliot. B Koffman, Pearson Education, 5th edition, 2007.
3. K. N. King ,"C Programming ": A Modern Approach, 2nd Edition 2nd Edition.
4. Byron Gottfried , Jitender Chhabra , Programming with C (Schaum's Outlines Series)

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination

B. Tech. Mechanical Engineering

B. Tech I Year II Semester

20ENG201 ENGLISH FOR PROFESSIONAL PURPOSES LABORATORY

(Common to all branches)

L	T	P	C
0	0	2	1

Pre-requisite None

Course Description:

English language communication is a social phenomenon and students need to be able to function in the society at large as the communicators before entering the professional world. The present course equips the students with the basic functions of English language communication, which are required not only in their day-to-day lives but also profoundly significant for their future professional, academic training and their careers in the industry. The course mainly focuses on the achievement of communicative proficiency of the students coupled with the necessary linguistic inputs.

Course Objectives:

This course enables the student to –

1. Get aquatinted with the basic communicative functions.
2. Engage effectively in learning various functions of English language communication.
3. Enhance their narration abilities in past experiences and future plans and goals/events.
4. Develop their abilities in expressing opinion.
5. Provide speaking practice in speech.

Course contents:

Greeting and Introductions (L & S)

- Greeting on different occasions and responding to greetings **(L & S)**
- Wishing on various occasions, taking leave and saying goodbye **(L & S)**
- Introducing oneself and others **(L & S)**
- Asking for introduction and responding to introduction **(L & S)**
- Developing a short personal profile **(R &W)**

Describing: (L, S, R & W)

- Using adjectives **(Vocab)**
- Degrees of comparison **(Grammar)**
- Common words, phrases, and expressions used for description **(Vocab)**
- Describing people, places and objects **(L, S, R & W)**
- Reading and writing descriptive paragraphs **(R &W)**

Narrating (L, S, R & W)

- Talking about past experiences and events **(L & S)**
- Talking about memorable incidents or events **(L & S)**
- Techniques of narration and narrative tenses **(Grammar)**
- Composing and narrating a story **(R &W)**

Planning and Predicting (L, S, R & W)

- Talking about future events **(L & S)**
- Making promises and giving assurances **(L & S)**
- Predicting future events **(L & S)**
- Writing and organising a short plan of an event **(R &W)**

B. Tech. Mechanical Engineering

Instructions and directions (L, S, R & W)
- Forming imperative sentences (Grammar)
- Reading and writing short instruction manuals **(R &W)**
- Writing a recipe/ procedure **(R &W)**
- Giving directions

Enquiring: (L, S, R & W)
- Open and closed ended questions **(Grammar)**
- Asking for information and giving information **(L & S)**
- Telephonic enquiry **(L & S)**
- Official enquiries through emails and letters **(R &W)**

Requesting: (L, S, R & W)
- Polite expressions
- Modal verbs and key phrases for requesting **(Grammar and vocab)**
- Official requests through emails and letters **(R &W)**

Comparing and contrasting: (L, S, R & W)
- Words and phrases used for comparison and contrast **(Vocab)**
- Comparing qualities/properties/quantities of people, places and objects **(L & S)**
- Composing comparison and contrast paragraphs **(R &W)**

Expressing opinion: (L, S, R & W)
- Language expressions used for expressing opinions **(Vocab)**
- Developing opinion based paragraphs **(R &W)**
- Discourse markers and linkers used in opinion based paragraphs **(R &W)**

Public Speaking: (L, S, R & W)
- Techniques and strategies required for public speaking **(L & S)**
- Developing and organising a short speech **(R &W)**
- Presentation skills required for public speaking **(L & S)**

Course Outcomes:

At the end of the course, students will be able to
1. Develop their confidence while giving introduction, describing a place, & giving directions. (3,4,5)
2. Use various functions of English like asking for & giving information**,** inviting people for events/occasions, & requesting people. (3,4,5)
3. Narrate the past experiences and events in speaking and wring (3,4,5)
4. Express their views and opinions logically and appropriately in spoken and written format. (3,4,5,6)
5. Deliver logically organized speeches and present them without hesitations. (3,4,5, 6)

Text Books:

1. Leo Jones; Functions of English, Published by: Cambridge University Press.
2. Leo Jones; Let's Talk Level 1, 2, 3, Published by: Cambridge University Press.
3. Adrian Doff, Craig Thaine, Herbert Puchta, et al; *Empower: Intermediate (B1+)*; Published by: Cambridge University Press.

References:

1. AJ Thomson & AV Martinet; A Practical English Grammar; Oxford University Press,2015.
2. Raymond Murphy; English Grammar in Use with CD; Cambridge University Press 2013.
3. K.S. Yadurajan; Modern English Grammar; Oxford University Press, 2014.
4. William Strunk Jr; The Elements of Style; ITHACA, N.Y.; W.P. HUMPHREY, 2006
5. Joseph Devlin; How to Speak and Write Correctly; ITHACA, N.Y.; W.P.HUMPHREY, 2006
6. Anjana Agarwal; Powerful Vocabulary Builder; New Age Publishers, 2011.
7. Writing Tutor; Advanced English Learners' Dictionary; Oxford University Press, 2012
8. www.cambridgeenglish.org/in/
9. https://learnenglish.britishcouncil.org/en/english-grammar
10. https://www.rong-chang.com/

Mode of Evaluation: Continuous Internal Evaluation and End Semester Examination

B. Tech. Mechanical Engineering

B. Tech I Year II Semester

20PHY201 PHYSICS LABORATORY

L	T	P	C
0	0	3	1.5

Course Description:

Physics Practical course is meant for making the students to gain practical knowledge to co relate with the theoretical studies. It covers experiments on Principles of Mechanics and Optics, Measurement of Magnetic field and studying Resonance using LCR Circuit.

Course Objectives:

1. Elucidate the concepts of Physics through involvement in the experiment by applying theoretical knowledge.
2. Illustrate the basics of mechanics, waves and optics to analyze the behavior and characteristics of various materials for its optimum utilization.
3. Develop an ability to apply the knowledge of physics experiments in the later studies.

LIST OF EXPERIMENTS:

{Out of 17 experiments any 12 experiments (minimum 10) must be performed in a semester}

1. Spring constant - Coupled Pendulums.
2. Study of resonance effect in series and parallel LCR circuit.
3. Determination of radius of curvature of a curved surface - Newton's Rings.
4. Wavelength of a laser - Diffraction Grating
5. Wavelength of the spectral lines - Diffraction Grating.
6. Magnetic field along the axis of a current carrying coil - Stewart Gees' Apparatus
7. Thickness of a given wire - Wedge Method.
8. Dispersive power of prism – Spectrometer.
9. Frequency of the tuning fork - Melde's apparatus.
10. Determination of particle size using Laser.
11. Width of single slit - Diffraction due to Single Slit.
12. Torsional Pendulum.
13. Determination of the numerical aperture of a given optical fiber and hence to find its acceptance angle.
14. Measurement of *e/m* of electron (Thomson's method)
15. Energy gap of a material of p-n junction.
16. Determination of Planck's constant.
17. Ferroelectric hysteresis (B-H Curve).

Course Outcomes:

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

1. Apply the scientific process in the conduct and reporting of experimental investigations.
2. Understand measurement technology, usage of new instruments and real time applications in engineering studies.
3. Verify the theoretical ideas and concepts covered in lecture by doing hands on in the experiments.
4. Know about the characteristics of various materials in a practical manner and gain knowledge about various optical technique methods.
5. Acquire and interpret experimental data to examine the physical laws.

Reference Books:

1. Physics Laboratory Manual
2. Optics, A. Ghatak, 4th Edition, Tata McGraw-Hill, New Delhi 2011.
3. Fundamentals of Optics, F. A. Jenkins and H. E. White, 4th edition, McGraw-Hill Inc., 1981.
4. Engineering Mechanics, 2nd ed. — MK Harbola
5. Introduction to Electrodynamics- David J Griffiths

Mode of Evaluation: Continuous Internal Evaluation and End Semester Examination

B. Tech. Mechanical Engineering

B. Tech I Year I Semester

20EEE201 ELECTRICAL ENGINEERING LABORATORY

L	T	P	C
0	0	3	1.5

Prerequisite: None

Course Description:

The laboratory facilitates the students to deal with electrical instruments, which further strengthen the concepts & operation of various AC & DC circuits, and machines, and their characteristics. The lab also reinforce the concepts discussed in class with a hands-on approach which enable the students to gain significant experience with electrical instruments such as ammeter, voltmeter, digital multimeter, oscilloscopes, tachometer, switches, fuses and power supplies.

Course Objectives:

1. To provide hands on experience in setting up simple electrical circuits (DC and AC).
2. To get exposure to handle different electrical equipment's.
3. To measure various electrical parameters with different measuring instruments.
4. To get hands on experience in operating DC and AC machines.
5. To understand the operation of basic converters and various components of LT Switchgear..

LIST OF LABORATORY EXPERIMENTS/DEMONSTRATIONS:

DEMONSTRATIONS:

1. Basic safety precautions. Introduction and use of measuring instruments – voltmeter, ammeter, wattmeter, multi-meter, oscilloscope. Study of passive components - resistors, capacitors and inductors.
2. Demonstration of voltage and current relationships (line-line voltage, phase-to-neutral voltage, line and phase currents). In star and delta connections.
3. Demonstration of cut-out sections of transformer and DC & AC machines.
4. Demonstration of induction machine. Motor operation and generator operation of an induction machine driven at super-synchronous speed.
5. Wavelength of the spectral lines - Diffraction Grating.
6. Familiarization of (i) different types of cables/wires and switches and their uses, (ii) different types of fuses & fuse carriers; MCB, ELCB, MCCB their ratings and uses (components of LT switchgear).

EXPERIMENTS:

1. Wiring of a simple circuit for controlling (1) a lamp/fan point, (2) Staircase or Corridor Winding.
2. Wiring of a power circuit for controlling an electrical appliance (16A Socket).
3. Verification of Kirchhoff's current and voltage laws (KCL & KVL).
4. Verification of superposition theorem
5. Sinusoidal steady state response of R-L, and R-C circuits (impedance calculation and verification).
6. Measurement of voltage, current and power in a single-phase circuit using voltmeter, ammeter and wattmeter. Also, calculate the power factor of the circuit.
7. Measurement of voltage, current and power in a single-phase circuit using voltmeter, ammeter and wattmeter. Also, calculate the power factor of the circuit.
8. Open-circuit and short-circuit test on a single-phase transformer.
9. Speed control of separately excited DC motor.

10. Wiring of a power distribution arrangement using single-phase MCB distribution board with ELCB, main switch and energy meter (or residential house wiring).
11. Regulated power supply for generating a constant DC Voltage.
12. Fabrication of a given electronic circuit on a PCB and test the same.

Course Outcomes:

Upon successful completion of the course, the students are expected to

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.
5. Get an exposure to the working of various power electronic converters.

Mode of Evaluation: Continuous Internal Evaluation and End Semester Examination

B. Tech. Mechanical Engineering

B. Tech I Year II Semester

20CSE201 C PROGRAMMING AND DATA STRUCTURES LABORATORY

L	T	P	C
0	0	3	1.5

Prerequisite: 20CSE101

Course Description:

This course includes C program basics, control structures, arrays, files, pointers and data structures.

Course Objectives:

1. To make the student understand fundamentals of C programming language and problem solving.
2. To get hands-on practices with the syntax and semantics of C programming language.
3. To develop algorithms for sorting, searching techniques.
4. To design and implement operations on stacks, queues, and linked lists.

LIST OF EXPERIMENTS

1. a) Write a C program to swap the two numbers.
b) Write a C Program to find the eligibility of admission for a Professional course based on the following criteria:

i. Marks in Maths >=65
ii. Marks in Physics >=55
iii. Marks in Chemistry>=50
OR
iv. Total in all three subject >=180

2. a) Write a C program to compute the factorial of a given number.
b) Write a program that reads numbers which are in the range 0 to 100, till it encounters -1. Print the sum of all the integers that you have read before you encountered -1.

3. a) Write a C program to accept a coordinate point in a XY coordinate system and determine in which quadrant the coordinate point lies.
b) The digital root (also called repeated digital sum) of a number is a single digit value obtained by an iterative process of summing digits. Digital sum of 65536 is 7, because 6+5+5+3+6=25 and 2+5 = 7.Write a program that takes an integer as input and prints its digital root.

4. a) Write a C program to find the series of prime numbers in the given range.
b) Write a C program to generate Tribonacci numbers in the given range.

5. a) Write a C program to find sum of digits, Decimal to Binary conversion, reversal of numbers using functions.
b) Write a C program to find Factorial, Greatest Common Divisor, and Fibonacci using recursion.

6. Your program should take as input: dimension of a square matrix N, two matrices of size N x N with integer values, and one operator symbol (+, - ,*). It must perform the corresponding operation given below;
a) Matrix Addition b) Matrix Subtraction c) Matrix Multiplication

7. Implement the following sorting techniques.
a) Bubble sort b) Insertion sort c) Selection sort.

8. Implement the following searching techniques.
a) Linear Search b) Binary Search

9. a) Write a program in C to find the frequency of characters in a string.
b) Write a C program to implement all string operations (string length, string copy, string compare, string concatenation and string reverse) without using string library functions.

10. a) Write a C program to get *N* elements in an array and sort it using Pointer.

b) Write a C program to swap two integers using pass by reference.
c) Write a C program to find the largest element using Dynamic Memory Allocation.

11. a) Write a program in C to count the number of vowels, consonants, digits, special symbols, words in a string using a pointer.
b) Write a C program to print all permutations of a given string using pointers.

12. a) Write a C program to add two distances in the inch-feet system using structures.
b) Write a C program to calculate difference between Two Time Periods (in *Hours, Minutes, Seconds* format) using structures.

13. Develop an application to match parenthesis of a given expression using Stack.

14. Develop an application to identify Palindrome string using Stack and Queue.

15. Develop an application to add two Polynomial equations using Linked List.

Course Outcomes:

Upon successful completion of the course, students will be able to

1. Understand fundamentals of C programming language and its constructs.
2. Design applications using functions, arrays, sorting and searching techniques.
3. Design and implement solutions using strings and pointers.
4. Design and develop solutions using structures and File processing.
5. Design and develop applications on stack, queue, and linked list depending on the problems to be solved.

Mode of Evaluation: Continuous Internal Evaluation and End Semester Examination

II YEAR I SEMESTER

B. Tech. Mechanical Engineering

B. Tech II Year I Semester

20MAT103 NUMERICAL METHODS

L	T	P	C
3	0	0	3

Course Prerequisite: 20MAT101 & 20MAT102

Course Description:

This course reviews and continues the study of computational techniques for solving system of algebraic and transcendental equations, interpolating the polynomials, evaluating the derivatives, integrals, ordinary differential equations and curve fitting. The course emphasizes on numerical and mathematical methods of solutions.

Course Objectives:

1. To introduce computation methods of solving algebraic and transcendental equations.
2. To familiarize the knowledge of interpolation.
3. To avail the basics of numerical techniques in calculus
4. To use numerical methods for solving ordinary differential equations.
5. To introduce the empirical techniques for fitting the various curves.

UNIT I: SOLUTIONS OF ALGEBRAIC AND TRANSCENDENTAL EQUATIONS

9 hours

Introduction-Bisection method - Regula-falsi method - Iterative method - Newton Raphson method, System of Algebraic equations: Gauss Jordan method - Gauss Seidal method.

UNIT II: FINITE DIFFERENCES AND INTERPOLATION 9 hours

Finite differences, Newton's forward and backward interpolation formulae - Lagrange's and Newton's divided difference formulae - Gauss forward and backward formulae, Stirling's formula, Bessel's formula.

UNIT III: NUMERICAL DIFFERENTIATION AND INTEGRATION 9 hours

Formulae for derivatives, Maxima and minima of a tabulated function. Numerical Integration: Trapezoidal rule - Simpson's 1/3 Rule - Simpson's 3/8 Rule

UNIT IV: NUMERICAL SOLUTIONS TO ORDINARY DIFFERENTIAL EQUATIONS 9 hours

Picard's Method - Taylor's series method - Euler's method - Modified Euler's Method - Runge-Kutta Method.

UNIT V: CURVE FITTING 9 hours

Introduction - Graphical method - Principle of least squares - Method of least squares - Fitting of straight line and parabola - Fitting of exponential and power curves

B. Tech. Mechanical Engineering

Course Outcomes:

At the end of this course, students should be able to

1. Solve the system of algebraic and transcendental equations.
2. interpolate the equal and unequal spaced arguments of function.
3. Apply the numerical techniques to find derivatives and integrals in the field of Engineering
4. Find the approximate numerical solutions to ordinary differential equations representing some Engineering problems.
5. Estimate the model parameters using the principles of least squares to a curve of best fit for the experimental observations.

Text Books:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 42th Edition, 2012.

Reference Books:

1. Curtis F. Gerald, Patrich O. Wheatley, Applied Numerical Analysis, Pearson Education, 7th Edition, 2003.
2. S.S. Sastry, Introductory methods of numerical analysis, PHI, 4th Edition, 2005Burden and Faires, Numerical Analysis 7th ed., Thomson Learning, 2001.
3. Advanced Engineering Mathematics by E. Kreyszig, 10th ed., Wiley, 2010.
4. M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Methods for Scientific and Engineering, New Age International Ltd., 5th Edition, 2010.
5. Applied Numerical Methods with MATLAB for Engineers and Scientists by Steven C. Chapra, 3rd ed., Mc Graw Hill, 2012.

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination

B. Tech. Mechanical Engineering

B. Tech. II Year I Semester

20ME102 ENGINEERING MECHANICS

Course Prerequisite: Engineering Calculus

L	T	P	C
2	1	0	3

Course Objectives:

1. Determine the resultant force and moment for a given system of forces
2. To determine the forces in members of trusses, frames and problems related to friction.
3. To show the location of the center of gravity, centroid and moment of inertia for a system of discrete particles and a body of arbitrary shape.
4. To study particle motion along a straight line and curved line.
5. To develop the principle of work and energy, impulse and momentum for a rigid body and apply it to solve problems that involve force, velocity, and time.

UNIT-I: STATICS OF PARTICLES **9 hours**

Introduction to Mechanics - System of Units - Laws of mechanics - Lame's theorem - Parallelogram and triangular Law of forces - Resolution of coplanar forces - Free body diagram- Equilibrium of particles. Statics of Rigid Body: Moment of a force - Varignon's theorem - Moments and Couples - Equivalent system of forces - Requirements of stable equilibrium - Equilibrium of Rigid bodies subjected to two, three and four force system.

UNIT-II: ANALYSIS OF PIN JOINTED TRUSSES **9 hours**

Classification of trusses –Reactions at supports and connections –Types of loading - Reaction for simply supported and over hanging beams - Analysis of Trusses (Simply supported and cantilever beams) Friction: Classification of friction – Laws of friction – Angle of repose – Force required to move a body along horizontal and inclines planes – Analysis of ladder, wedge and belt friction.

UNIT- III: CENTROIDS, CENTER OF GRAVITY AND MOMENTS OF INERTIA **9 hours**

Center of Gravity and Centroid - Area and polar moment of inertia - Radius of Gyration – Parallel and Perpendicular Axis Theorems - Mass Moment of inertia – Problems on centroid and area moment of inertia of plane figures and buildup sections

UNIT –IV: KINEMATICS OF PARTICLES **9 hours**

Displacements - Velocity and acceleration - their relationship, relative motion – Rectilinear Motion, Curvilinear motion - Projectile motion

UNIT V: DYNAMICS OF RIGID BODIES **9 hours**

General plane motion - Velocity and Acceleration - Absolute and Relative motion method - Linear and angular momentum - Equations of motion, Equilibrium of rigid bodies in plane motion - D'Alembert's Principle - Principle of Work and Energy Principle for a rigid body - Principle of impulse momentum for rigid bodies in plane motion.

B. Tech. Mechanical Engineering

Course outcome:

Student will be able to

1. Solve the engineering problems in case of equilibrium conditions.
2. Calculate the reaction forces of various supports of different structures and frictions.
3. Determine centroid, center of gravity and moment of inertia of various surfaces and solids.
4. Calculate the characteristics of a particles subjected to a given motion
5. Solve the problems involving dynamics of rigid bodies

Textbook:

1. Ferdinand P. Beer, E. Russell Johnston (2010), Vector Mechanics for Engineers: Statics and Dynamics (9th Edition), Tata McGraw-Hill International Edition.

References:

1. S.S. Bhavikatti, (2008), Engineering Mechanics, New Age International.
2. Irving H. Shames, (2003), Engineering Mechanics – Statics and Dynamics, Prentice Hall of India Private limited.
3. S. Timoshenko D.H. Young J.V. Rao, Sukumar Pati, Engineering Mechanics, McGraw Hill Education; 5 edition

Mode of evaluation: Assignments, Mid Term Tests, End Semester Examination

B. Tech. Mechanical Engineering

B. Tech. II Year I Semester

20ME103 BASIC THERMODYNAMICS

L	T	P	C
2	1	0	3

Course Prerequisite: Physics

Course Description:
Thermodynamics is one of the fundamental courses in the study of mechanical engineering. The principles of thermodynamics are applicable to a wide range of problems encountered in all branches of engineering. Also thermodynamics is an essential pre-requisite for subsequent courses in mechanical engineering like fluid mechanics, applied thermodynamics, heat transfer, gas dynamics, refrigeration and air conditioning, etc. This course is designed to equip the students with a thorough understanding of basic concepts of thermodynamics and with necessary skills and techniques to solve problems in thermodynamics through a systematic analysis using fundamental principles. The specific topics to be covered in the course include concepts of system and surroundings, energy, energy transfer by work and heat, properties of substances and property changes, first and second laws of thermodynamics.

Course Objectives:
1. To introduce the concepts of system, surroundings, energy interactions, thermodynamics properties of substances and to teach different techniques used for estimating the properties like gas laws and property tables
2. To explain the principles of work and energy.
3. To introduce the fundamentals of thermodynamic laws, concepts and principles.
4. To teach the systematic approach to be employed for effectively solving the problems in thermodynamics.
5. To explain the principles of various cycles and to apply the thermodynamic concepts in various applications like IC engines and Refrigeration and Air conditioning systems.

UNIT 1: THERMODYNAMIC BASICS **9 hours**
Macroscopic versus Microscopic viewpoint, Thermodynamic system and control volume, Thermodynamic properties, processes and cycles, Homogeneous and heterogeneous systems, Thermodynamic equilibrium, Quasi-static process, Concept of continuum, Zeroth law of thermodynamics, temperature scale, Ideal gas, Work transfer, Heat transfer, First law of thermodynamics, Specific heat, Enthalpy, Internal energy, Steady flow energy equation and application, PMM1.

UNIT 2: PROPERTIES OF PURE SUBSTANCES **9 hours**
Pure substance, Vapor-Liquid-Solid-Phase equilibrium in a pure substance, Independent properties of a pure substance, Phase boundaries, tables of thermodynamic properties, Thermodynamic surfaces, p-v and p-T diagram for a pure substance, p-v-T surface, T-s and h-s or Mollier diagram for a pure substance, dryness fraction, Steam Tables, Charts of Thermodynamic properties.

UNIT 3: SECOND LAW OF THERMODYNAMICS AND ENTROPY 9 hours

Limitations of the first law of thermodynamics, Qualitative difference between heat and work, cyclic heat engine, Kelvin-Planck statement of second law, Clausius' statement of second law, Refrigerator and heat pump, Equivalence of Kelvin-Planck and Clausius statement, Reversibility and Irreversibility, Carnot cycle, Carnot's Theorem, Corollary of Carnot's theorem, absolute thermodynamic temperature scale and Efficiency of heat engine, Entropy, Inequality of Clausius, Temperature-Entropy diagram, Entropy generation in an open and closed system and Entropy change in an Irreversible process.

UNIT 4: THERMODYNAMIC PROPERTY RELATIONS AND GAS MIXTURES 9 hours

Equation of state, Ideal gas, Real gas, Compressibility chart, Internal energy, enthalpy, entropy, specific heats and Gibbs free energy of gas mixture, Maxwell's Equations, TdS equation, Difference in heat capacities, Ratio of heat capacities, Joule-Kelvin Effect, Clausius-Clapeyron equation, Properties of atmospheric air, Psychrometric chart and Psychrometric process.

UNIT 5: THERMODYNAMIC CYCLES 9 hours

Rankine cycle, Actual vapour cycle processes, Comparison of Rankine and Carnot cycles, Air standard cycles - Otto, Diesel, dual and Brayton cycles, Reversed heat engine cycle, Vapour compression refrigeration cycles.

Course Outcomes:

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

1. Define the fundamentals of the zeroth and first laws of thermodynamics and explain their application to a wide range of systems.
2. Apply the properties of steam to design steam systems.
3. Apply the second law of thermodynamics for the design of heat engines, heat pumps and refrigerators. The student will also be able to evaluate entropy changes in a wide range of processes and determine the reversibility or irreversibility of a process from such calculations.
4. Explain the cycles on which IC engines, Gas turbines, and refrigerator works.
5. Explain the importance of Tds relations and be able to use psychometric charts for the design of air conditioning systems.

Text Books:

1. Cengel, Y.A and Boles, M.A, Thermodynamics: An Engineering Approach, 5th ed., McGraw-Hill, 2006.

References:

1. Sonntag, R.E., Borgnakke, C., and Van Wylen, G.J., Fundamentals of Thermodynamics, 6th ed., John Wiley, 2003.
2. Nag, P.K., Engineering Thermodynamics, 3rd ed., Tata McGraw-Hill, 2005.

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination

B. Tech. Mechanical Engineering

B. Tech. II Year I Semester

20ME104 MATERIALS SCIENCE AND ENGNEERING

L	T	P	C
3	0	0	3

Course Prerequisite: None

Course Description:
The purpose of this course is to introduce the student to enrich their knowledge on the materials science field. Begin with the microscopic level the structure at the atomic and their impact on the material properties are discussed. The relation between heat treatment, phases and alloying elements properties of materials is also highlighted. The course mainly discusses about the different types testing methods for materials. Final part of the course covers non-metallic materials such as ceramics and polymers.

Course Objectives:
1. To understand the relation between structure and properties of metallic materials.
2. To understand the strengthening mechanism of metals
3. To know the concept of phase transformation, phase diagrams and its influence on the properties of metals.
4. To learn the methods of improving properties by thermo, mechanical treatment.
5. To identify the importance of non-metallic materials like polymers, ceramics and composites, material standards and their applications.

UNIT I: STRUCTURE OF MATERIALS 9 hours

Introduction: Historical prospective - importance of materials - Classification of Materials and its Properties. Bonding in solids: bonding forces and energies - primary and secondary bonding. Crystallography and Metallic structures: Unit cell - Crystallographic directions and planes, FCC, BCC, HCP, SC and other structure – miller indices, Linear and planar densities - close-packed crystal structures. Packing of atoms in solids. Packing factor

UNIT II: CRYSTAL IMPERFECTIONS AND DIFFUSION 9 hours

Crystal Imperfections: Types, Vacancies and interstitials, Dislocations and grain boundaries. Diffusion: Fick's Law of diffusion – Diffusion mechanism – Steady state and non-steady state, factors affecting diffusion. Dislocations: Dislocations and strengthening mechanisms of metals – Solid solution hardening – Precipitate and dispersion strengthening – Work hardening – The dislocation yield strength

UNIT III: HEAT TREATMENT PROCESS AND MECHANICAL PROPERTIES OF MATERIALS. 10 hours

Introduction and Concepts: Classification of metal working process- Mechanical Properties of Metals: Mechanical properties of materials: Elasticity and Plasticity, Stress–Strain curve, Young's modulus – The yield strength, Tensile strength, Ductility, Brittleness, Malleability, Rigidity, Toughness, Resilience, Hardenability, Hardness, Hooke's Law – Linear and non-linear elasticity; True stress – strain curves for plastic flow – Plastic work – Tensile testing, the hardness test, compression testing, creep, fatigue and other testing methods.

Various Heat Treatment Process: Annealing, Normalizing, Quenching. Effect of Heat Treatment on material properties, Stress relief. Various stages of quenching and effect of quenching medium: Water, Oil and Air. Austempering, Martempering and Age Hardening. Case Hardening: Carburizing, Nitriding, Cyaniding, Carbo-nitriding, flame and induction hardening, vacuum and plasma hardening. Solidification, Nucleation and crystal growth.

UNIT IV: PHASE DIAGRAMS AND PHASE TRANSFORMATIONS 9 hours

Phase diagrams: Solubility, Phases- Phase rule, and microstructure - phase equilibrium - Binary phase diagrams - Phase Transformations. Lever Rule and Gibbs phase rule. Fe-Fe_3C Phase diagram Phase Transformations: Isothermal transformation - TTT diagrams - Continuous cooling transformation.

UNIT V: FERROUS, NONFERROUS & NONMETALLIC MATERIALS 8 hours

Ferrous Materials: Effect of alloying additions in Steel (Mn, Si, Cr, Mo, V, Ti & W), Stainless steels and types, Tool Steels, HSLA, Types, structure and properties of Cast iron: White, Grey, Ductile, Malleable, CGI and Alloy cast iron. Nonferrous Materials: Brass, Bronze; Al, Cu, Zn and Pb and respective alloys. Industrial Applications.

Introduction to non-metallic materials- classification of polymers, ceramics and composites-structure and application of non-metallic materials

Course Outcomes:

At the end of the course students will be able:

1. To develop deep knowledge of crystal structure and effect of structure on the properties of the materials.
2. To understand various imperfections in crystal, dislocation mechanisms and diffusion mechanism in materials.
3. Student will be able understand various mechanical properties of materials and its testing and need for heat treatment process in materials.
4. To understand the concept of phases and to construct the equilibrium diagrams, Fe-Fe_3C phase diagram and TTT diagrams
5. To recognize the properties and applications of nonmetallic materials and Ferrous materials.

Text Books:

1. W. Callister, “Materials Science and Engineering”, Wiley, 7^{th} Edition, 2007.
2. S. H. Avner, “Introduction to physical Metallurgy”, McGraw Hill Education, 2^{nd} Edition, 2007.

References:

1. George E. Dieter, Mechanical Metallurgy, SI Metric Edition McGraw Hill Book Company, London.

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination

B. Tech. Mechanical Engineering

B. Tech. II Year I Semester

20ME105 FLUID MECHANICS AND HYDRAULIC MACHINERY

	L	T	P	C
Course Prerequisite: Physics	**2**	**1**	**0**	**3**

Course Description:

Modelling and predicting the behaviour of fluid flow is an important part of many scientific and technological problems. Flow of fluid is an important aspect of atmospheric and oceanic circulation, combustion in engines, biological processes such as the flow of blood. From the days of Isaac Newton to the present day world, considerable progress has been made in the mathematical modelling of fluid flow. With the advent of enhanced computational ability, computational fluid dynamics has played a major role in solving complex fluid flow problems. In this course, the students are introduced to various fluid properties and to model fluids at rest. Flow of fluids is introduced to the students in two forms, namely, the Lagrangian and the Eulerian form. Eventually, both the integral and differential form of the governing equations of fluid dynamics are derived. Flow of fluids in closed conduits and over various geometries is also introduced. Basic design of hydraulic turbines and pumps are introduced to the students.

Course Objectives:

1. To provide a basic understanding of the properties and behavior of matter (fluids) by means of analytical equations.
2. To develop an understanding about hydrostatic law, principle of buoyancy and stability of a floating body and application of mass, momentum and energy equation in fluid flow.
3. To determine the losses in a flow system, flow through pipes, boundary layer flow and flow past immersed bodies.
4. Determine the force applied by a jet on stationary and moving vanes.
5. To understand the working principle of hydraulic machinery like turbines and pumps.

UNIT I: FLUID PROPERTIES AND KINEMATICS OF FLUID FLOW 9 hours

The Concept of a Fluid, Classification of fluid flows, System & Control volume, Density, Specific gravity, Thermodynamic Properties of a Fluid, Viscosity, Surface Tension, Capillarity, Vapor pressure and Cavitation. Lagrangian and Eulerian descriptions, material derivative, velocity and acceleration field, streamlines, path lines and streak lines.
Fluid statics: Barometer and atmospheric pressure, Manometry, Buoyancy and stability

UNIT II: GOVERNING EQUATIONS OF FLUID FLOW 8 hours

Reynold's transport theorem, Integral form of the conservation of mass for moving or deforming control volumes and steady flow processes, Integral form of Energy equation, Integral form of linear momentum equation, Integral form of angular momentum equation. Derivation of the Bernoulli equation

UNIT III: INTERNAL AND EXTERNAL FLOW 9 hours

Laminar and Turbulent flows, Entrance region, Laminar flow in pipes, Turbulent flow in pipes, Minor and Major losses. Orifice meter and Venturimeter. Flow over flat plate, Boundary layer equations, Displacement, Momentum and Energy thicknesses, Momentum integral technique for boundary layers, Boundary layers with pressure gradients.

UNIT IV: IMPACT OF JET VANES & HYDRAULIC TURBINES 10 hours

Hydrodynamic force of jet striking stationary and moving vanes, flat and curved vanes, jet impinging centrally and tangentially.

Classification of hydraulic turbines- Impulse and reaction turbines; Basic equation of energy transfer in rotodynamic machines, specific speed; Components of Pelton turbine, Velocity triangles and power for Pelton turbine, Maximum efficiency of Pelton turbine; Types of reaction turbines, Components of Francis turbine, Velocity triangles, power and efficiency of Francis turbine. Kaplan turbine.

UNIT V: HYDRAULIC PUMPS 9 hours

Working principle and main parts of a centrifugal pump; Classification of centrifugal pumps; Static and Manometric head of a centrifugal pump; Efficiencies of centrifugal pump.

Main parts and working of reciprocating pump; Discharge, work done and power required to drive a reciprocating pump; Slip of a reciprocating pump;

Course Outcomes:

The students after completing the course will be able to:

1. Interpret the properties of fluids and their applications, determine differential pressure using manometric principles, calculate the buoyant forces and estimate the stability of floating and immersed bodies.
2. Distinguish between a system and control volume approach and will be able to use the governing equations based on integral approach for solving fluid flow problems.
3. Have a clear understanding of internal flow physics and capable of estimating the major and minor losses observed in pipe flows. Similarly, they will be able to assess various flow parameters in external flows with and without pressure gradients.
4. Assess the forces acting on vanes with varied geometries and point of jet impact. Further, they can differentiate different turbines and estimate the performance parameters of various turbine used in hydraulic power plants.
5. Differentiate different pumps and calculate their performance characteristics.

Text Books:

1. Cengel, Y.A, Cimbala, John, M., “Fluid Mechanics, Fundamentals and Applications”, McGraw Hill Education; Third edition (1 July 2017)
2. B.K. Venkanna, “ Fundamentals of Turbomachinery”, PHI Learning Private Limited,2018

References:

1. R. K. Bansal, "A Textbook of Fluid Mechanics and Hydraulic Machines", Laxmi Publications, Ltd., 2005
2. Robert W. Fox and Alan T. Mc Donald, "Introduction to Fluid Mechanics", John Wiley & Sons Private Ltd., 2009, 7th Edition.
3. James R. Welty, Charles E. Wicks and Robert E. Wilson, "Fundamentals of Momentum, Heat and Mass transfer", John Wiley & Sons (Asia) private limited., 2008, 5th Edition.
4. Frank M White, "Fluid Mechanics", Tata McGraw-Hill, 7th Edition, 2012.
5. Milton Van Dyke, "An Album of Fluid Motion", Parabolic Press, 12th Edition.

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination

B. Tech. Mechanical Engineering

B. Tech. II Year I Semester

20ME202 MATERIALS SCIENCE AND ENGINEERING LABORATORY

L	T	P	C
0	0	3	1.5

Course Prerequisite: None

Course Objectives:

The objective of this course is to expose the students to a broad knowledge of experimental and analyzing techniques useful in Mechanical as well as a metallurgical engineering field. The subject introduces the correlation of properties of materials and their structure. It revises student's knowledge of crystal structure and phase diagrams of various alloy systems. This laboratory course offers practical knowledge of heat treatment applicable to ferrous materials and studies microstructural changes and hardness evaluation.

LIST OF EXPERIMENTS

1. Preparation and study of the micro-structure of various cast irons: White Cast Iron, Gray Cast Iron, Ductile Cast Iron and Malleable Cast Iron
2. Preparation and study of the micro-structure of metals like Iron, Al and their alloys and measurement of grain sizes.
3. Preparation and study of the microstructure of low carbon steels, Medium carbon and high carbon steels.
4. Experimentally analyzing the effect of quenching mild steel in air, water and oil on the hardness of the materials.
5. Experimentally analyzing the microstructure and hardness of various heat treatment process for steel: Annealing, Normalizing and Quenching.
6. Experimentally analyzing the hardenability of the mild steel by Jominy End Quench Apparatus.
7. Experimentally analyzing the effect of work hardening on steel by hardness measurements and its reversal by annealing.
8. Synthesis of Al_2O_3 pellet via powder metallurgy route, and microstructure study.
9. Synthesis of SiC single point lathe tool insert via powder metallurgy route.
10. Synthesis of Al – SiC Metal Matrix compounds via powder metallurgy process and microstructure study.

Course Outcomes:

1. The student will obtain knowledge on the microstructural analysis of various metals and alloys with regard to sample preparation via polishing and etching and use and analysis of optical microscopy.

2. This lab enables the student to select an analytical technique to evaluate and analyze the samples.

Students learn to use the instruments and get exposed to specimen preparation, validation of the instrument, precise use of an instrument to accurately estimate the given samples.

3. Ability to perform different heat treatment operation and characterize the microstructure

4. Perform simple calculations to qualify materials properties and microstructural characteristics.
5. Synthesis of various ceramic and MMC via powder metallurgy.

Text Book:

1. Lab manual provided by the department

References:

1. Brandon D. G, "Modern Techniques in Metallography", VonNostrand Inc. NJ, USA, 1986.
2. Prabhudev. K. H. "Handbook of Heat Treatment of Steels", Tata McGraw-Hill Publishing Co., New Delhi, 1988
3. Sydney H. Avner, "Introduction to Physical Metallurgy", Tata McGraw Hill, New Delhi, 1997.
4. William D. Callister, "Materials Science and Engineering" John Wiley and Sons, 8th Edition, 2009.

Mode of Evaluation: Continuous Internal Evaluation and End Semester Examination.

B. Tech. Mechanical Engineering

B. Tech. II Year I Semester

20ME203 FLUID MECHANICS AND HYDRAULIC MACHINERY LABORATORY

L	T	P	C
0	0	3	1.5

Course prerequisite: 18ME108

Course Description:

It is intended that the student would learn to use different techniques to measure discharge and measure head losses through straight and bent pipes. He would also learn the performance evaluation of centrifugal and reciprocating pumps along with Pelton Wheel and Francis turbine

Course Objectives:

1. **To impart practical exposure on the performance evaluation methods of various flow measuring equipment and hydraulic turbines and pumps.**

Fluid Mechanics Practicals:

1. Calibration of Venturimeter
2. Calibration of Orificemeter
3. Impact of jet on vanes
4. Determination of friction factor for a given pipe line.
5. Determination of loss of head due to sudden contraction in a pipe line.
6. Turbine flow meter.
7. Flow through notches (Rectangular & V-type)
8. Verification of Bernoulli's theorem

Fluid Machines Practicals

1. Performance test on Pelton wheel.
2. Performance test on Francis turbine.
3. Performance test on Kaplan turbine.
4. Performance test on single stage centrifugal pump.
5. Performance test on multi stage centrifugal pump.
6. Performance test on reciprocating pump.

Course outcomes:

After completion of the course students will be able to

1. Verify the Bernoulli's theorem for incompressible flows.
2. Determine the co-efficient of discharge for a flow measuring devices like Venturimeter and Orificemeter.
3. Determine the co-efficient of vanes like flat and curved vanes.
4. Determine the performance and draw operating characteristic curves for Pelton wheel, Reciprocating pump and Multi-stage Centrifugal pump.
5. Determine the loss of head in pipe lines due to friction, sudden contraction, enlargement, bends and elbows.

Mode of evaluation: Continuous Internal Evaluation and End Semester Examination.

B. Tech. Mechanical Engineering

B. Tech. II Year I Semester

20ME204 3-D MODELLING LABORATORY

L	T	P	C
0	0	3	1.5

Course Prerequisite: Engineering Graphics

Course Description:

The course is about the theory and technique of three-dimensional (3D) modelling utilizing appropriate software. Topics include the creation and modification of 3D geometric shapes; and rendering techniques; and use of camera light sources, texture, and surface mapping.

Course Objectives:

1. During the term of the course, students will learn to work within virtual 3-D space.
2. Build volumetric objects including: vertices, splines, polygons, primitive shapes and Sub Patch geometry.
3. Students will use these tools to build complex objects then learn the basic 3-D rendering tools and techniques.
4. The student will able to produce 2D drawing from the 3D part geometry to assure the proper dimensioning of the parts.
5. To make the students to understand and draw assemblies of machine parts and to draw their sectional views.

List of Experiments

1. Introduction to 3D modelling
2. Assembly of Sleeve and Cotter Joint
3. Assembly of Socket and Spigot Joint
4. Assembly of Shaft Coupling
5. Assembly of Gib & Cotter Joint
6. Assembly of Knuckle Joint
7. Assembly of Universal Joint
8. Assembly of Screw Jack
9. Assembly of Plummer Block
10. Assembly of Simple Eccentric
11. Assembly of Machine Vice
12. Introduction to Drafting
13. Introduction to Sheet Metal

Course Outcomes:

The students after completing the course will be able to:

1. Identify of different types of bolts, nuts, welding joints screw threads, keys and fasteners.
2. Visualize and prepare detail drawing of a given object.
3. Draw details and assembly of mechanical systems.
4. Read and interpret given drawing.
5. Create 3-D models using any standard CAD software.

Text Books:

Lab manual provided by the department

References:

1. Gopalakrishnan K.R, “Machine Drawing”, Subhas Stores, 2007

Mode of Evaluation: Continuous Internal Evaluation and End Semester Examination.

B. Tech. Mechanical Engineering

Mandatory Course
B. Tech. II Year I Semester

20CHE901 ENVIRONMENTAL SCIENCE

L	T	P	C
2	0	0	0

Pre-requisite Basic knowledge about sciences up to intermediate or equivalent level.

Course Description:
The course deals with basic concepts of environment, its impact on human, universe, consumption of energy sources, effects, controlling methods for pollution and the environmental ethics to be followed by human beings.

Course Objectives:
1. To make the students aware about the environment and its inter-disciplinary nature and to emphasize the importance of the renewable energy sources.
2. To familiarize the concept of Ecosystem and their importance.
3. To bring the awareness among students about the importance of biodiversity and the need for its conservation.
4. To make the students understand the adverse effects of environmental pollution, its causes and measures to control it.
5. To introduce the environmental ethics and emphasize the urgency of rain water harvesting along with water shed management.

UNIT I MULTIDISCIPLINARY NATURE OF ENVIRONMENTAL STUDIES **6 hours**

Definition, Scope and Importance – Need for Public Awareness. Renewable energy Resources: Solar energy - solar cells, wind energy, tidal energy. Non-renewable energy resources: LPG, water gas, producer gas. Overgrazing, effects of modern agriculture – fertilizer and pesticides.

UNIT II ECOSYSTEMS **6 hours**

Concept of an ecosystem. Structure – functions – Producers, Consumers and Decomposers – Ecological succession – Food chains, Food webs and Ecological pyramids – Introduction, types, characteristic features, structure and function of the following ecosystems: Forest, Desert and Lake.

UNIT III BIODIVERSITY AND ITS CONSERVATION **6 hours**

Introduction, Definition: Value of biodiversity: consumptive use, productive use, social, ethical and aesthetic values. Biogeographical zones of India. Threats to biodiversity: habitat loss, poaching of wildlife, Endangered and Endemic species of India – Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

UNIT IV ENVIRONMENTAL POLLUTION 6 hours

Definition, Cause, effects and control measures of pollution – Air, Water, Soil and Noise. Solid Waste Management: Effects and control measures of urban and industrial wastes.

UNIT V SOCIAL ISSUES AND THE ENVIRONMENT 6 hours

Urban problems related to Water conservation, rain water harvesting and watershed management; Climate changes: global warming, acid rain, ozone layer depletion, nuclear accidents. Case Studies: Population growth, variation among nations and population explosion.

Course Outcomes:

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

1. Ability to understand the natural environment, its relationship with human activities and need of the day to realize the importance of the renewable energy sources.
2. The knowledge of various ecosystems and their importance along with the concepts of food chains, food webs and ecological pyramids.
3. Familiarity with biodiversity, its importance and the measures for the conservation of biodiversity.
4. The knowledge about the causes, effects and controlling methods for environmental pollution, along with disaster management and solid waste management.
5. Awareness about the sustainable development, environmental ethics, social issues arising due to the environmental disorders.

Text Books:

1. Text book of Environmental Studies for Undergraduate Courses by Erach Bharucha for University Grants Commission, Universities Press, 2005.
2. Environmental Studies by R. J. Ranjith Daniels and Jagdish Krishnaswamy, (Wiley Re- print version 2014).
3. Chemistry for Environmental Engineering/C.N. Sawyer, P.L. McCarty, G.F. Parkin (TataMcGraw Hill, Fifth Edition, 2003).
4. Environmental Chemistry by B.K. Sharma, (Goel Publishing House, 2014).
5. Environmental Studies by Benny Joseph (TataMcGraw Hill, Second Edition, 2009).

Reference Books:

1. Environmental Science & Engineering by Dr. A. Ravikrishnan, Hitech Publishing Company Pvt. Ltd. 2013.
2 Perspectives in Environmental Studies, Second edition, Anubha Koushik and C.P. Koushik, New Age International (P) Limited, Publishers, 2004.
3 R.N. Sharma, "Indian Social Problems ", Media Promoters and Publishers Pvt. Ltd.

Mode of Evaluation: Assignments, Mid Term Tests.

II Year II Semester

B. Tech. Mechanical Engineering

B. Tech II Year II Semester

20HUM101 ECONOMICS AND FINANCIAL ACCOUNTING FOR ENGINEERS

L	T	P	C
3	0	0	3

Course Prerequisite: None

Course Description:
The Engineering Economics and Financial Accounting aims to provide an insight into production, cost analysis, market structure, Accounting Basic concepts and financial Statement Analysis. The course is designed to give emphasis on the application of real life examples on various fundamental issues of economics and accounts. This course introduces the accounting system, principles, types of accounts, and financial statements etc. The ratio analysis and financial analysis are useful to know the position of financial statements. Funds flows statements and cash flow statements are explained to know the analysis of financial matters.

Course Objectives:
The course is intended to

1. Describe the nature of engineering economics in dealing with the issues of scarcity;
2. Know the supply, demand, production and cost analysis to analyze the impact of economic events on markets;
3. Explain the performance of firms under different market structures and Price determination in various market conditions.
4. Explain the accounting principles, types of accounting and preparation of final accounts; and
5. Describe the financial analysis through ratios, funds flow and cash flow statements.

UNIT I: DEMAND ANALYSIS **10 hours**

Scope and Significance of Economics- Understanding the problem of scarcity and choice - Elements of market Economy: Demand, Supply and Market Equilibrium- Theory of Demand, Elasticity of Demand, Supply and Law of Supply.

UNIT II: PRODUCTION AND COST ANALYSIS **9 hours**

Production Function – Short-run and long- run production – Cost Analysis: Cost concepts - Cost Structure of Firms and output decision- Break-Even Analysis (BEA) – Managerial significance and limitations of BEA - Determination of Break Even Point (Simple Problems).

UNIT III: MARKET STRUCTURE: **8 hours**

Classification of Markets - General Equilibrium and efficiency of Perfect competition, Monopoly, Monopolistic, Oligopoly, Duopoly – Price determination and various market conditions

UNIT IV: BASICS OF ACCOUNTING: **9 hours**

Uses of Accounting - Book Keeping Vs Accounting - Double Entry System - Accounting Principles - Classification Of Accounts - Rules Of Debit & Credit. Accounting Cycle: Journal, Ledger, Trial Balance. Final Accounts: Trading Account - Profit & Loss Account - Balance Sheet with Adjustments, (Simple Problems).

UNIT V: BASICS OF FINANCIAL ANALYSIS **9 hours**

Ratio Analysis - Liquidity, Leverage, Solvency and Profitability Ratios - Interpretation of Financial Statements - Funds Flow Statement - Capital Budgeting

Course Outcomes:

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

1. Understand Engineering economics basic concepts,
2. Analyze the concepts of demand, elasticity, supply, Production, Cost Analysis and its essence in floating of an organization,
3. Compare different market structures and identify suitable market,
4. Demonstrate an understanding and analyzing the accounting statements, and
5. Demonstrate the ability to apply knowledge of accounting concepts through Financial Statements Analysis.

Text Books:

1. Case E. Karl & Ray C. Fair, "Principles of Economics", Pearson Education, 8th Edition, 2007
2. Financial Accounting, S.N.Maheshwari, Sultan Chand, 2009
3. Financial Statement Analysis, Khan and Jain, PHI, 2009
4. Financial Management, Prasanna Chandra, T.M.H, 2009

References:

1. Lipsey, R. G. & K. A. Chrystal , "Economics", Oxford University Press, 11th Edition, 2007
2. Samuelson P. A. &Nordhaus W. D. "Economics", Tata McGraw-Hill 18th Edition, 2007
3. Financial Management and Policy, Van Horne, James,C., Pearson ,2009.
4. Financial Management, I.M.Pandey, Vikas Publications

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination

B. Tech. Mechanical Engineering

B. Tech. II Year II Semester

20MAT108 PROBABILITY AND STATISTICS

L	T	P	C
3	0	0	3

Course Prerequisite: 20MAT101, 20MAT107.

Course Description:

This course provides probability concepts, Univariate distributions, and Chebychev's inequality, Reliability of systems, linear regression, hypothesis testing and Design of experiments.

Course Objectives:

1. To understand the concepts of probability, random variables and their importance in engineering.
2. To solve real time problems in engineering by using discrete and continuous probability distributions.
3. To study the problems related to Reliability system and Joint random variables.
4. To apply classical inference involving confidence intervals and hypothesis testing in engineering problems.
5. To analyze the statistical experimental designs.

UNIT I: **PROBABILITY AND RANDOM VARIABLES** **9 hours**

Probability-Classical and axiomatic, theorems on probability, conditional probability, Multiplication rule and Bayes' rule.

Random Variables: Discrete random variable, discrete density function, Continuous random Variable, continuous density function cumulative distribution.

UNIT II: **UNIVARIATE PROBABILITY DISTRIBUTIONS** **9 hours**

Expectation of a random variable, moment generating function, geometric, binomial and Poisson distributions. Gamma, exponential, normal distributions; Chebyshev's inequality.

UNIT III: RELIABILITY AND JOINT DISTRIBUTIONS **9 hours**

Weibull distribution, Reliability, Hazard rate function, Reliability of Series and Parallel systems

Joint densities: discrete and continuous joint densities, marginal densities, independence, expectation and covariance.

UNIT IV: LINEAR REGRESSION AND TESTS OF HYPOTHESIS **9 hours**

Correlation and linear regression. Sampling distribution, tests of significance: Null and alternative hypothesis, errors in sampling, critical region and level of Significance. Large sample tests - single and difference of means. Small sample tests: *t*- test for single mean, and difference of means. Test for ratio of variances.

UNIT V: **ANALYSIS OF VARIANCE AND DESIGN OF EXPERIMENTS** **9 hours**

Analysis of Variance: One-way and two-way classifications. Principles experimental design, Randomized Block Design (RBD) and Latin Square Design.

B. Tech. Mechanical Engineering

Course Outcomes:
At the completion of the course, students should able to

1. Understand the probability and random variables and its applications in mechanical engineering.
2. Get the importance of and discrete and continuous probability distributions in engineering.
3. Solve real time problems in Reliability engineering and study about joint probability distributions.
4. Apply classical inference involving confidence intervals and hypothesis testing in engineering problems.
5. Analyze the statistical experimental designs.

Text Books:

1. J.S. Milton and J.C. Arnold, Introduction to Probability and Statistics, 4th edition (2003), Tata McGraw-Hill Publications.
2. B.S. Grewal, Higher Engineering Mathematics, 43rd Edition (2014), Khanna Publishers.

Reference Books:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons,2006.
2. S. C. Gupta and V. K. Kapoor, Fundamentals of Applied Statistics, 4th Edition, Sultan Chand & Sons.
3. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability Theory, Universal Book
   Stall, 2003 (Reprint).
4. S. Ross, A First Course in Probability, 6th edition, Pearson Education India, 2002.

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination

B. Tech. Mechanical Engineering

B. Tech. II Year II Semester

20ME106 MECHANICS OF SOLIDS

L	T	P	C
2	1	0	3

Course Prerequisite: Engineering Mechanics

Course Description: Fundamental principles of stress and stains, Temperature relations; Principal stresses and strains; Shear Forces and Moments diagrams for various types of beams with different types of loads; Flexural Stresses and Deflection of Beams**;** Torsion, deflections due to bending; Stability of equilibrium.

Course Objectives:

1. Student will understand the fundamental concepts of stress, strain and deformation of solids with applications to bars and beams
2. Student will understand the theory of elasticity including strain/displacement Hooke's law relationships
3. Student will understand shear forces and bending moments in various beams with different loads.
4. To create clear awareness to the student to concept of design of columns.
5. The knowledge of this subject will help in understanding the Design & Theory of Machines courses

UNIT I: FUNDAMENTALS OF STRESSES & STRAINS 9 hours

Simple Stresses & Strains: Elasticity and plasticity, Types of stresses & strains, Hooke's law, stress, strain diagram for mild steel, Working stress, Factor of safety, Lateral strain, Poisson's ratio & volumetric strain, Bars of a varying section, Factor of Safety, composite bars, Temperature stresses. Strain energy, Resilience, Gradual, sudden, impact, and shock loadings. Principal Stresses: Principal Stresses, Strains with uni-axial and bi-axial conditions. Mohr's circle concepts, Mohr's circle for uni-axial and bi-axial stresses.

UNIT II: SHEAR FORCE AND BENDING MOMENT 9 hours

Shear Force (SF) and Bending Moment (BM): Definition of a beam, Types of beams, Concept of shear force, and bending moment. SF and BM diagrams for cantilever, simply supported and overhanging beams subjected to Point loads, UDL, UVL and combination of these loads, Point of contraflexure. Relation between S.F., B.M., and rate of loading at a section of a beam.

UNIT III: FLEXURAL STRESSES & DEFLECTION OF BEAMS 9 hours

Flexural Stresses: Theory of simple bending, Assumptions, Derivation of bending equation: $M/I = f/y = E/R$, Neutral axis, Determination bending stresses, section modulus of rectangular, circular sections (Solid and Hollow), I, T, Angle and Channel sections, Design of simple beam sections. Deflection of Beams (Statically Indeterminate Beams): Introduction of deflection of beams, slope, deflection, and radius of curvature, a Differential equation for the elastic line of a beam, Double integration and Macaulay's methods Determination of slope and deflection for cantilever and simply supported beams subjected to point load uniformly varying load, Mohr's theorems.

UNIT IV: TORSION **9 hours**

Introduction, Torsion of Circular Bars, Pure Shear, Relationship Between Moduli of Elasticity E and G, Transmission of Power by Circular Shafts, Statically Indeterminate Torsional Members, Strain Energy in Pure Shear and Torsion.

UNIT V: BUCKLING

Buckling and Stability, Columns with Pinned Ends, Columns with Other Support Conditions (Derivations and Numerical Problems).

ENERGY METHODS

Introduction, Principle of Virtual Work, Strain-Energy Methods, Castigliano's Theorem (Derivations and Numerical Problems).

Course Outcomes:

The students after completing the course will be able to:

1. Estimate the fundamental stresses, strains, and principal stresses by analytical and Mohr's circle.
2. Analyze the distribution of shear force and bending moment for various types of beams under different load conditions.
3. Evaluate bending stresses in beams and calculate the deflection and slope of beams with different types of load.
4. Design shafts for pure torsion.
5. Analyze the elastic stability of flexible columns.

Text Book:

1. Mechanics of Materials by Gere and Timoshenko, C B S Publishers & Distributors, 2^{nd}Edition,2004.

Reference Books:

1. Mechanics of Materials by Ferdinand P. Beer and E.Russel Johnston, McGraw Hill Education (India) publicationsEdition,2004.
2. Strength of Materials by S. Ramamrutham, Dhanpat Rai Publishers
3. Strength of Materials by R.K. Bansal, Laxmi Publishers, 5^{th} Edition,2012.
4. Strength of Materials by R.K. Rajput, S.Chand& Company, 5^{th} Edition,2012.
5. Strength of Materials by Dr. Sadhu Singh, Khanna Publishers, 10^{th} Edition,2013.
6. Mechanics of solids and structures by Dr. R. Vidyanathan and Dr. P. Perumal, Laxmi Publishers

Mode of evaluation: Assignments, Mid Term Tests, End Semester Examination

B. Tech. Mechanical Engineering

B. Tech. II Year II Semester

20ME107 THEORY OF MACHINES

L	T	P	C
2	1	0	3

Course Prerequisite: Engineering Mechanics, Mathematics (Calculus and equations)

Course Description: The objective of this course is to understand the theory involved behind the design of a machine/mechanism. After an introduction about the structure (links, joints), degrees of freedom (DOF), inversions of kinematic chains; the commonly used mechanisms derived from the 4-bar chain are then dealt. The graphical methods for performing velocity and acceleration analyses of the constituent links of lower pair mechanisms are included. The theory of gears, kinematics of gear trains, gyroscopic motion and its application, and governors, are also studied. Cam profile synthesis corresponding to different combinations of follower motions is included and so is balancing of rotating masses in machinery. Lastly, the course gives an insight into the basic concepts of vibration analysis in mechanical systems.

Course Objectives:

1. To introduce basic definitions, commonly used mechanisms and their applications.
2. To understand the kinematic analysis (velocity and acceleration analysis) of lower pair mechanisms.
3. To synthesize cam profiles; and to perform balancing calculation for rotating masses.
4. To learn the theory of gearing and kinematic analysis of gear trains; and understand about the practical application of gyroscopic couple and also working of governors.
5. To learn to formulate the equation of motion and solving same for analyzing mechanical vibrations.

UNIT I: SIMPLE MECHANISMS 9 hours

Classification of mechanisms – Basic kinematic concepts and definitions – Degree of freedom– Grashof law; kinematic inversions of four bar chain and slider crank chains; Limit positions – Mechanical advantage- Transmission angle; Description of some common mechanisms- Quick return mechanism, straight line generators.

UNIT II: VELOCITY & ACCELERATION ANALYSIS 9 hours

Displacement, velocity and acceleration analysis of simple mechanisms, graphical velocity analysis using instantaneous centers, velocity and acceleration analysis using loop closure equations-kinematic analysis of simple mechanisms - Coriolis component of acceleration.

UNIT III: GYROSCOPE, GOVERNORS & GEARS 9 hours

Gyroscopic effect - Principle and applications; Governors.

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

UNIT IV: BALANCING & CAMS 9 hours

Balancing of Rotating masses: Need for balancing, balancing of single mass and several masses in different planes, using analytical and graphical methods.

Cams: Classification of cams and followers- Terminology and definitions- Displacement diagrams- Uniform velocity, parabolic, simple harmonic and cycloidal motions- derivatives of follower motions-cam profile synthesis - pressure angle and undercutting

UNIT V: VIBRATION **9 hours**

Introduction, degree of freedom, types of vibrations, free natural vibrations, Newton method and energy method for single degree of freedom. Damped vibrations- under damped, critically damped; and over damped systems; forced vibrations with and without damping in single degree of freedom; Vibration isolation and transmissibility.

Course Outcomes:

The students after completing the course will be able to:

1. Identify the different mechanisms and their inversions in real life applications.
2. Calculate the velocity and acceleration of simple mechanisms by graphical methods.
3. Understand the principle of working of a gyroscope and governors; and classify gears and gear trains and compute velocity ratio.
4. Estimate the unbalance mass in rotating machines using analytical and graphical methods and able to sketch the cam profiles for different follower motions.
5. To study the free and forced vibrations of single degree freedom systems.

Text Book:

1. S S Rattan ,Theory of Machines, 5th edition, Mc Graw Hill, 2019

Reference Books:

1. R.S. Khurmi, Theory of Machines, S.Chand, 2020.
2. J.E.Shigley, Theory of Machines and Mechanisms, 4/e, Oxford, 2014
3. Sadhu Singh, Theory of Machines: Kinematics and Dynamics, Pearson, 2011.
4. P.L.Ballaney, Theory of Machines & Mechanisms, 25/e, Khanna Publishers, Delhi, 2003.
5. Norton, R.L., Design of Machinery - An introduction to Synthesis and Analysis of Mechanisms and Machines, 2/e, McGraw Hill, New York, 2000.
6. William T. Thomson, Theory of vibration with applications, 4/e, Englewood Cliffs, N.J. : Prentice Hall, 1993.
7. F. Haidery, Dynamics of Machines, 5/e, Nirali Prakashan, Pune, 2003

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination

B. Tech. Mechanical Engineering

B. Tech. II Year II Semester

20ME108 MANUFACTURING TECHNOLOGY- I

	L	T	P	C
Course Prerequisite: None	**3**	**0**	**0**	**3**

Course Description:

Manufacturing is the creation, through one or several processing operations, of components or products from basic raw materials. The effectiveness of process selection will be based on the inter-related criterion of design parameters, material selection and process economies.

Course Objectives:

1. Working principle of different metal casting processes and gating system.
2. Classification of the welding processes, working of different types of welding processes and welding defects.
3. Nature of plastic deformation, cold and hot working process, working of a rolling mill and types, extrusion processes.
4. Principles of forging, tools and dies, working of forging processes.
5. Classification, applications and manufacturing methods of plastics, ceramics and powder metallurgy

UNIT I: METAL CASTING PROCESS **9 hours**

Casting & Moulding Process: Introduction & types of casting process. Sand casting, principles of gating, gating ratio, function of risers & runners. Die casting – Types of die casting, centrifugal casting & Investment casting. Defects in casting. Melting Furnaces: Induction furnace, Electric arc furnace. Testing of cast products.

UNIT II: METAL JOINING PROCESS **9 hours**

Fabrication methods, Physics of welding, type of joints, edge preparations, types of welding process, electric arc, gas welding, bracing, soldering, inert gas welding, special type of welding – resistance welding, spot welding, thermit welding, plasma arc welding laser beam welding, TIG and MIG welding, submerged arc welding, friction stir welding, welding defects, Heat Affected Zone, Non-destructive testing methods, and applications of welding. Calculations of welding parameters.

UNIT III: SHEET METAL PROCESS **9 hours**

Introduction, Shearing, sheet metal characteristics and formability, blanking, piercing, forming, bending, drawing, deep drawing, spinning, rubber forming, hydro forming, superplastic forming, hot stamping, stretch forming, calculation of forces, spring back, progressive die, compound die, combination die, working of mechanical press, hydraulic press.

UNIT IV: BULK DEFORMATION PROCESS **9 hours**

Forging – Introduction hot forging and cold forging, open die forging, impression die forging, closed die forging, upset forging, extrusion forging, calculation of forces. **Extrusion** –Introduction – Hot extrusion, backward and forward extrusion, cold extrusion, extrusion defects, impact extrusion, design of extrusion dies, design considerations, extrusion equipment, and application of extrusion.

Rolling –Introduction – Flat rolling, friction forces, roll force and power requirements, different types of rolling process, defects in rolling, Types of rolling mills, die design and design considerations, Application of rolling, calculation of rolling forces.
Drawing – Introduction – Calculation for drawing force, wire drawing, flat drawing, lubrication, die design for drawing, drawing process, die design, die materials, defects, residual stresses, types of drawing equipment, Application of drawing, advantages and limitations, calculation of drawing forces.

UNIT V: POWDER METALLURGY **9 hours**

Introduction – Characteristics of engineering powders. Production of metallic powders – atomization, chemical reduction, electrolysis, conventional pressing and sintering, secondary operation, sintering techniques, isostatic pressing, powder injection molding, power rolling, application of powder metallurgy. Plastics and Composite Materials - Injection molding, injection molding, rotational molding, compression molding, processing polymer-matrix composites, processing metal-matrix and ceramic-matrix composites

Course Outcomes:

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

1. Selection of suitable manufacturing process for a given product by pattern making, design of gating systems, preparation of molding and poring of molten metal for casting and defects etc.
2. Selection of metal joining process for different metal using different welding techniques and production of defect free products.
3. Production of components on sheet metal by using processes like blanking, piercing, forming, bending, deep drawing process.
4. Compare cold working and hot working processes using rolling, extrusion process, rolling and drawing process.
5. Making products from powder form by employing different techniques.

Text Books:

1. Kalpakjain S and Schmid S.R., Manufacturing Engineering and Technology, 7/e, Pearson, 2018.
2. Rao P.N., Manufacturing Technology – Volume I, 5/e, McGraw-Hill Education, 2018.

Reference Books:

1. Millek P. Groover, Fundamentals of Modern Manufacturing: Materials, Processes and Systems, 4/e, John Wiley and Sons Inc, 2010.
2. Sharma P.C., A Text book of Production Technology, 8/e, S Chand Publishing, 2014.
3. Ian Gibson, David W. Rosen, Brent Stucker, Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, 1st Edition, Springer, 2010.

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination

B. Tech. Mechanical Engineering

B. Tech. II Year II Semester

20ME205 MANUFACTURING TECHNOLOGY– I LABORATORY

Course Prerequisite: None

L	T	P	C
0	0	3	1.5

Course Description:

Production Techniques practical lab contains Metal casting, Welding, Mechanical Press working and processing of Plastics. These practical inculcates the skill to the students starting from preparing a wooden pattern to completion of a casting which also comprises different Sand testing techniques. Students will also get good skill on Welding, mechanical press working, processing of plastics & composite which will be helpful to get an employment in Industries.

LIST OF EXPERIMENTS

1. METAL CASTING LAB:
   a. Pattern Design and making – for one casting drawing.
   b. Sand properties testing - Exercise - for strengths, and permeability
   c. Molding: Melting and Casting
2. WELDING LAB:
   Arc Welding: Lap & Butt Joint
   a. Spot Welding b. TIG Welding c. MIG welding d. Brazing
3. MECHANICAL PRESS WORKING:
   a. Blanking & Piercing operation and study of simple, compoundand progressive press tool.
   b. Hydraulic Press: Operation –Forming exercise.
   c. Bending and other operations.
4. PROCESSING OF PLASTICS & COMPOSITE:
   a. Injection Molding b. Fabrication of Composite plate

Course Outcomes:

This practical course is designed to enrich practical knowledge about common production techniques used in manufacturing. The students after completing the course will be able to:

1. Produce real time casting on their own
2. Prepare various joints by using various welding process
3. Perform blanking, piercing and forming operations on the sheet metal.
4. Prepare bottle with cape by using injection and vacuum forming.
5. Bend a pipe to the required angle.

Text Book:

1. Manual provided by the department

Reference Book:

1. Kalpakjain S and Schmid S.R., Manufacturing Engineering and Technology, 7/e, Pearson, 2018.

Mode of Evaluation: Continuous Internal Evaluation and End Semester Examination.

B. Tech. Mechanical Engineering

B. Tech. II Year II Semester

20ME206 MECHANICS OF SOLIDS LABORATORY

L	T	P	C
0	0	3	1.5

Course Prerequisite: None

Course Objectives:

The objective of this course is to expose the students to a broad knowledge of experimental methods and measurement techniques useful in Mechanical engineering. Following is the list of experimental set ups on which experiments shall be conducted. Complete modalities of operation of the laboratory such as the exact titles of experiments, reports submission and evaluation methodology etc. shall be announced at the beginning of laboratory session.

LIST OF EXPERIMENTS

1. Rockwell Hardness Testing & Brinell Hardness Testing
2. Tensile Test
3. Impact Testing
4. Torsion Test
5. Bending test on
   1.Simply supported beam
   2. Cantilever beam
6. Test on springs.
7. Compression test on UTM
8. Double shear test on UTM

Course Outcomes:

The students after completing the course will be able to:

1. Evaluate hardness value for various materials using Rockwell hardness tester
2. Plot the stress stain curve of a ductile material under tensile and compressive load using universal testing machine
3. Calculate the slope and deflection of simply supported beam under point load
4. Experiment on a spring to interpret the stiffness and shear modulus.
5. Apply the concept of impact loading and to determine impact values for various materials.

Text Book:

Lab manual provided by the department

Reference Book:

1. Mechanics of Materials by Gere and Timoshenko, C B S Publishers & Distributors, 2^{nd}Edition,2004.

Mode of Evaluation: Continuous Internal Evaluation and End Semester Examination.

B. Tech. Mechanical Engineering

B. Tech. II Year II Semester

20ME207 DYNAMICS AND ELECTRICAL MACHINES LABORATORY

L	T	P	C
0	0	3	1.5

Course Prerequisite: Electrical Engineering Laboratory

Course Objectives:

1. To equip students with understanding of the fundamental principles and techniques for Identify different types of dynamic systems and classify them by their governing equations
2. To develop a model of a mechanical system using a free body diagram
3. To develop equations of motion for translational and rotational mechanical systems
4. To develop an understanding of how property data is generated and reported.
5. To create a bridge between theoretical knowledge and application.

List of experiments - Dynamics Lab Practicals:

1. Study of gyroscopic effect and determination of gyroscopic couple
2. Watt governor
3. Proell governor
4. Porter governor
5. Hartnell governor.
6. Static and dynamic balancing of rotating masses
7. To verify the relation $t = 2 \pi \sqrt{l/g}$ for a simple pendulum
8. Forced vibration of equivalent spring mass system
9. Longitudinal vibration
10. Torsional vibration of single rotor shaft system
11. Torsional vibration of two rotor shaft system
12. Single rotor system with viscous damping
13. Whirling speed of shaft
14. Determination of jump speed of cam-follower system

List of experiments – Electrical Machines Practicals:

1. Magnetization Characteristics of DC Shunt Generator. Determination of Critical Field Resistance and Critical Speed.
2. Brake Test on DC Shunt Motor. Determination of Performance Curves.
3. Load Test on DC Compound Generator. Determination of Characteristics.
4. Hopkinson’s Test on DC Shunt Machines. Predetermination of Efficiency.
5. Fields Test on DC Series Machines. Determination of Efficiency.
6. Swinburne’s Test and Speed Control of DC Shunt Motor. Predetermination of Efficiencies.

Additional Experiments:

1. Load Test on DC Series Generator. Determination of Characteristics.
2. Retardation Test on DC Shunt Motor. Determination of Losses at Rated Speed.
3. Separation of Losses In DC Shunt Motor.

Course Outcomes:

The students after completing the course will be able to:

1. Analyze the motion and response of free, forced and damped vibration systems.
2. Experiment with the static and dynamic balancing of rotating mass system
3. Assess the effect of Gyroscopic couple in a dynamic body.
4. Examine the phenomenon of whirling in shafts.
5. Experiment with Governors and cam-follower systems.

Text Books:

Manual provided by the department

Reference Book:

1. S.S.Rattan ,Theory of Machines, 4/e, Tata Mc-Graw Hill, 2014

Mode of Evaluation: Continuous Internal Evaluation and End Semester Examination.

B. Tech. Mechanical Engineering

Mandatory Course
B. Tech. II Year II Semester

20HUM901 INDIAN CONSTITUTION

L	T	P	C
2	0	0	0

Pre-requisite NIL

Course Description:

The Constitution of India is the supreme law of India. Parliament of India can not make any law which violates the Fundamental Rights enumerated under the Part III of the Constitution. The Parliament of India has been empowered to amend the Constitution under Article 368, however, it cannot use this power to change the "basic structure" of the constitution, which has been ruled and explained by the Supreme Court of India in its historical judgments. The Constitution of India reflects the idea of "Constitutionalism" – a modern and progressive concept historically developed by the thinkers of "liberalism" – an ideology which has been recognized as one of the most popular political ideology and result of historical struggles against arbitrary use of sovereign power by state.

Course Objectives:

The course is intended to:

1. To know about Indian constitution;
2. To know about central and state government functionalities in India; and
3. To know about Indian society.

UNIT I INTRODUCTION **6 hours**

Historical Background – Constituent Assembly of India – Philosophical foundations of the Indian Constitution – Preamble – Fundamental Rights – Directive Principles of State Policy – Fundamental Duties – Citizenship – Constitutional Remedies for citizens.

UNIT II STRUCTURE AND FUNCTION OF CENTRAL GOVERNMENT **6 hours**

Union Government – Structures of the Union Government and Functions – President – Vice President – Prime Minister – Cabinet – Parliament – Supreme Court of India – Judicial Review.

UNIT III STRUCTURE AND FUNCTION OF STATE GOVERNMENT **6 hours**

State Government – Structure and Functions – Governor – Chief Minister – Cabinet – State Legislature –Judicial System in States – High Courts and other Subordinate Courts.

UNIT IV CONSTITUTION FUNCTIONS **6 hours**

Indian Federal System – Center – State Relations – President's Rule – Constitutional Amendments –Constitutional Functionaries - Assessment of working of the Parliamentary System in India.

UNIT V INDIAN SOCIETY **6 hours**

Society: Nature, Meaning and definition; Indian Social Structure; Caste, Religion, Language in India Constitutional Remedies for citizens – Political Parties and Pressure Groups; Right of Women, Children and Scheduled Castes and Scheduled Tribes and other Weaker Sections.

B. Tech. Mechanical Engineering

Course Outcomes:

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

1. Understand the functions of the Indian government; and

2. Understand and abide the rules of the Indian constitution.

Text Books:

1. Durga Das Basu, "Introduction to the Constitution of India ", Prentice Hall of India, New Delhi..
2. R.C.Agarwal, (1997) "Indian Political System", S.Chand and Company, New Delhi.
3 Maciver and Page, " Society: An Introduction Analysis ", Mac Milan India Ltd., New Delhi.
4 K.L.Sharma, (1997) "Social Stratification in India: Issues and Themes", Jawaharlal Nehru University, New Delhi.

Reference Books:

1. **S**harma, Brij Kishore, " Introduction to the Constitution of India:, Prentice Hall of India, New Delhi.
2 U.R.Gahai, "Indian Political System ", New Academic Publishing House, Jalaendhar.
3 R.N. Sharma, "Indian Social Problems ", Media Promoters and Publishers Pvt. Ltd.

Mode of Evaluation: Assignments, Mid Term Tests

III Year I Semester

B. Tech. Mechanical Engineering

III Year I Semester

20ME109 DESIGN OF MACHINE ELEMENTS

L	T	P	C
2	1	0	3

Pre-requisite: 20ME102,20ME106

Course Description:
This course is an introduction to the basic principles of modern engineering. It provides the students with fundamental skills of engineering, and the ability to apply the theories of science to practice. The course focuses on the fundamentals and principles of basic mechanical elements, failure theories and design criteria, and structures of basic mechanical systems. The goal of the course is to learn how to design simple mechanical elements.

Course Objectives:

1. To understand the fundamental concepts of Machine Design under simple and combined loading conditions.
2. To analyze failure of machine elements subjected to static and cyclic loading.
3. To design Threaded fasteners and knuckle joint.
4. To design welded joints and shafts.
5. To design helical and Leaf springs and gears.

UNIT I INTRODUCTION TO MACHINE DESIGN 10 hours

Machine design introduction: General considerations of design, design process, Preferred sizes, Selection of engineering materials, properties, Manufacturing considerations in the design, Fits and Tolerances.
Design against static load: Factor of safety, Stress-Strain relation, Simple stresses, Torsional and bending Stresses, Design of simple machine parts, Design of components subjected to Combined stresses.

UNIT II THEORIES OF FAILURE FOR DESIGN UNDER STATIC AND CYCLIC LOADING CONDITIONS 9 hours

Theories of failure for static loading: Maximum principal stress theory, Maximum shear stress theory, Maximum Distortion energy theory.
Design against fluctuating against load: Stress concentration factor, Fluctuating stresses, Endurance limit, Design for infinite and finite life: Goodman, Soderberg and Gerber equations, fatigue design under combined stresses.

UNIT III DESIGN OF JOINTS/FASTENERS 8 hours

Design of threaded joints: Types of threaded joints, Terminology of Screw threads, Design of bolted joints for Simple and eccentric loads. Design of knuckle joints.

UNIT IV DESIGN OF WELDED JOINTS & SHAFTS 9 hours

Welded joints: Stresses in Welded Joints, Design equations for parallel and transverse fillet welds, Design of welded joints subjected to Axial, Eccentric and torsional loads.
Shafts: Design of shafts based on strength considerations and torsional rigidity.

UNIT V DESIGN OF SPRINGS AND GEARS 9 hours

Mechanical Springs: Spring materials, Stress and deflections of helical Springs, Design of helical springs for static and dynamic loading, Surge in springs. Leaf springs - Multi leaf springs, Equalized stresses in spring leaves (nipping) - Design Of Spur Gears: Selection of gear material, Lewis equation - Estimation of module based on beam strength, Buckingham's equation - Estimation of module based on wear strength.

Course Outcomes:

The students after completing the course will be able to:

1. Describe general design principles like design process, material selection and manufacturing considerations. Design for simple, bending, and torsional stresses.
2. Evaluate failure criteria for machine components subjected to static load and also analyse the life of components under cyclic loading.
3. Design of bolted joints subjected to direct and eccentric loading. Design of knuckle joints.
4. Design of welded joints subjected to axial, bending and torsional loading. Design of shafts.
5. Design helical and leaf springs based on stress-deflection relations and fatigue loading. Design of spur gears.

Text Books:

1. V.B. Bhandari, Design of Machine Elements, 4th edition, McGraw Hill Education (India), New Delhi.

Data Book

1. V.B. Bhandari, Machine Design Data Book, McGraw Hill Education (India), New Delhi.

Reference Books:

1. R.S. Khurmi & J.K. Gupta. A Textbook of Machine Design, S. Chand publishers, 2020.
2. Budynas R. G. and Nisbett J. K. Shigley's Mechanical Engineering Design, McGraw Hill, 9th SI Edition, New Delhi, 2011.
3. Norton Robert L., Machine Design: An Integrated Approach, Second Edition, Pearson Education Asia, New Delhi, 2001.
4. Hall A. S., Holowenko A. R. and Bennett M. D., Machine Design, McGraw Hill (Schaum's Outline Series), (SI Units), New Delhi, 2008.
5. M. F. Spotts, Design of Machine Elements, Prentice Hall of India, New Delhi.

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination

B. Tech. Mechanical Engineering

III Year I Semester

20ME110 MANUFACTURING TECHNOLOGY-II

L	T	P	C
3	0	0	3

Pre-requisite: 20ME108

Course Description:

The main objectives of this course are to present advanced information about metal cutting theory to students and to enhance the students' knowledge in production technology. The course includes basic concepts and definitions, tool materials, chip formation, mechanics of metal cutting, cutting forces, heat generation and dissipation, tool life, cutting fluids, surface roughness, machining process planning, machining economy, introduction of Automation and metrology concepts.

Course Objectives:

1. Provide the basic concepts in mechanics of metal cutting, chip formation, various tool materials and tool life.
2. To train the students in the metal cutting domain so as to equip themselves with adequate knowledge about the various operations such as turning, shaping, planning, drilling, milling and grinding machines.
3. To apply knowledge to calculate the machining parameters for different machining processes and economics.
4. To develop fundamental knowledge on Advanced machining process.
5. Provide basic concepts in metrology and various measuring instruments.

UNIT I THEORY OF METAL CUTTING 9 hours

Overview of metal cutting, chip formation, chip thickness ratio, shear angle and its relevance, orthogonal and oblique cutting processes, types of chips, chip breakers, forces and energy calculations (merchant's analysis), power consumed, tool wear, tool life, tool materials, cutting fluids, numerical problems.

UNIT II MACHINE TOOLS AND MACHINING OPERATIONS 9 hours

Turning, Milling, Planning, Shaping, Broaching, Sawing, Filing, Drilling, Grinding and other operations Machining time calculations, High speed machining.

UNIT III ADVANCED MACHINING PROCESSES 8 hours

Need for advanced machining processes, classification, EDM, ECM, UM, AJM, LBM, EBM, IBM, CM and Hybrid machining - Process principle and mechanism of material removal, Process Parameters, Process Capabilities, Applications, Operational characteristics, Limitations.

UNIT IV ECONOMICS IN MACHINING AND AUTOMATION TECHNOLOGIES 9 hours

Economic considerations in machining, cost of single pass turning operation, optimum cutting speed in turning for minimum cost, optimum cutting speed in turning for maximum production rate & profit rate, numerical problems. Introduction about Automation fundamentals, Computer Numerical Control, Industrial Robotics.

UNIT V METROLOGY AND MEASUREMENTS 9 hours

Systems of limits and fits: Introduction, normal size, tolerance, deviations, allowance, fits and their types. Measurement - Dial indicator, micrometres, Bevel protractor - angle slip gauges - spirit levels - sine bar - Sine plate. Profile measurements - Tool maker's microscope. Surface measurements - profilograph, Talysurf. Gear Measurement - Gear tooth profile measurement. Alignment tests on lathe, milling, drilling machine tools. Limits, Fits and Tolerances

Course Outcomes:

The students after completing the course will be able to:

1. Evaluate the cutting forces, power and specific energy and tool life in machining
2. Identify and select suitable machining operations for specific applications
3. Select an advanced machining process based on the effect of various process parameters on the required performance criteria.
4. Evaluate cutting speed to minimize production cost and maximize production rate and understand the recent developments in Automation.
5. Understanding the basic concept of metrology and measurements instruments.

Text Books:

1. Groover, Mikell P., Fundamentals of Modern manufacturing: materials, processes and systems, 4th ed. John Wiley & sons, INC, 2010.
2. S. K. Hajra Choudhury, Nirjhar Roy, Elements of Workshop Technology: Machine Tools (Vol - 2), A. K. Hajra Choudhury, Media Promoters and Publishers Pvt. Ltd.
3. Serope Kalpakjian and Steven R. Schmid, "Manufacturing Engineering and Technology," Pearson Education, 7/e, 2013, New Delhi.
4. R.K. Jain &S.C. Gupta, Production Technology, Khanna Publishers.
5. Jain R. K., "Engineering Metrology", Khanna Publications, 2010.

Reference Books:

1. Roy A. Lindberg, "Processes and Materials of Manufacture," PHI, New Delhi, 2004.
2. P.N. Rao, Manufacturing & Technology: Foundry Forming and Welding, 3rd Ed., Tata McGraw Hill, 2003.
3. Gupta. LC., "Engineering Metrology", Dhanpat Rai and Sons, 2000.
4. Beckwith T.G, and N. Lewis Buck, Mechanical Measurements, Addison Wesley, 1991,5th edition, ISBN:81- 7808-055-9

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination

B. Tech. Mechanical Engineering

III Year I Semester

20ME111 HEAT TRANSFER

L	T	P	C
2	1	0	3

Pre-requisite: 20ME103

Course Description:
Fundamental concepts of heat transfer; steady-state and unsteady-state heat conduction; analytical and empirical relations for forced and free convection heat transfer; heat exchanger analysis and design; and Heat transfer by radiation.

Course Objectives:
1. To elucidate the fundamental mechanisms of heat transfer
2. To teach the governing laws of heat transfer by conduction, convection and radiation
3. To train the students in using the analytical and empirical methods for estimating heat transfer under different conditions.
4. To explicate the rudimentary aspects in heat transfer with phase change.
5. To introduce different approaches for solving sizing and rating problems in Heat Exchanger and mass transfer.

UNIT I CONDUCTION HEAT TRANSFER 9 hours

General Differential equation of Heat Conduction– Cartesian and Polar Coordinates – One Dimensional Steady State Heat Conduction - plane and Composite Systems. Conduction with Internal Heat Generation – Extended Surfaces – Unsteady Heat Conduction – Lumped Analysis – Semi Infinite and Infinite Solids –Use of Heisler's charts.

UNIT II CONVECTION HEAT TRANSFER 9 hours

Free and Forced Convection - Hydrodynamic and Thermal Boundary Layer. Free and Forced Convection during external flow over Plates and Cylinders and Internal flow through tubes.

UNIT III PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGERS 8 hours

Nusselt's theory of condensation – Regimes of Pool boiling and Flow boiling. Correlations in boiling and condensation. Heat Exchanger Types – Overall Heat Transfer Coefficient – Fouling Factors – Analysis – LMTD method – NTU method.

UNIT IV RADIATION HEAT TRANSFER 9 hours

Black Body Radiation – Grey body radiation - Shape Factor – Electrical Analogy – Radiation Shields. Radiation through gases.

UNIT V MASS TRANSFER 9 hours

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

B. Tech. Mechanical Engineering

Course Outcomes:

The students after completing the course will be able to:

1. Apply heat conduction equations to different surface configurations under steady state and transient conditions and solve problems
2. Apply free and forced convective heat transfer correlations to internal and external flows through/over various surface configurations and solve problems
3. Explain the phenomena of boiling and condensation, apply LMTD and NTU methods of thermal analysis to different types of heat exchanger configurations and solve problems
4. Explain basic laws for Radiation and apply these principles to radiative heat transfer between different types of surfaces to solve problems
5. Apply diffusive and convective mass transfer equations and correlations to solve problems for different applications

Text Books:

1. F. P. Incropera & D. P. Dewitt, Fundamentals of Heat and Mass Transfer, John Wiley & Sons, 2001, 5th edition.
2. P K Nag, Heat and Mass Transfer, McGraw Hill, 3rd edition

Data Books:

1. C P Kothandaraman & S Subramanyan, Heat and Mass Transfer data book, New Age International Publishers, Eight Edition.

Reference Books:

1. Yunus Cengel, Heat and Mass Transfer: Fundamentals and Application, McGraw Hill
2. J.P. Holman, Heat Transfer, McGraw Hill, 10th Edition.

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination

B. Tech. Mechanical Engineering

III Year I Semester

20ME208 MANUFACTURING TECHNOLOGY-II LABORATORY

L	T	P	C
0	0	3	1.5

Pre-requisite: 20ME108

Course description:

Parts manufactured by casting, forming, and various shaping processes often require further operations before they are ready for use or assembly. This lab involves various machining processes to remove some of material from the workpiece with machining allowances in order to produce a specific geometry at a definite degree of accuracy and surface quality.

Course objectives:

1. To familiar of construction and working principles of different machine tools.
2. To study and acquire knowledge on various basic machining operations in different machines.
3. To know the applications of machines in real life manufacturing of components.
4. To train the students for producing complex components using different machines.
5. To identify different types of chips produced during machining.

LIST OF EXPERIMENTS: **45 hours**

1. Study of construction, working principle and operations of general-purpose machines: Lathe, drilling, milling, shaper, planer, slotter, surface grinder and tool and cutter grinder.

2. Job on step turning and taper turning on lathe machine.

3. Job on thread cutting and knurling on lathe machine.

4. Job on drilling and tapping.

5. Shaping a V- block on a given work piece using Shaping machine.

6. Keyway cutting using slotting.

7. Forming spur gear on a milling machine.

8. Grinding of single point cutting tool using tool and cutter grinder.

9. Grinding plane surface on a surface grinding machine.

10. Introduction to Process Capability Analysis - Cp, Cpk, Pp, Ppk.

Additional experiment

1. Job on facing, turning, taper turning and chamfering operations on a CNC lathe machine.

B. Tech. Mechanical Engineering

Course outcomes:

The students after completing the course will be able to:

1. Handle different machine tools and perform different operations.
2. Explain the field of application and working of various machines.
3. Differentiate conventional machines with CNC machines.
4. Fabricate various mechanical components by using different operations.
5. Understand the importance of surface finishing and material removal rate.

Text books:

Lab manual provided by the department

Mode of Evaluation: Internal Evaluation & End Semester Examination.

B. Tech. Mechanical Engineering

III Year I Semester

20ME209 THERMAL ENGINEERING LABORATORY

L	T	P	C
0	0	3	1.5

Pre-requisite: 20ME103 & 20ME111

Course description:

The primary purpose this course is to show students the experimental methods-on thermal energies on various engines and demonstrate their operational procedures. These values can be further be used to determine other fuel properties. In order that students have a good understanding of the theory underlying the experiments, the entire course is designed such that classroom lectures precede lab-work.

Course objectives:

1. To demonstrate and conduct experiments, interpret and analyze results of internal combustion engine testing
2. To impart practical exposure of thermal engineering systems namely air compressor and heat exchanger
3. To provide fundamental knowledge on modes of heat transfer and to apply the principles of heat transfer to determine various heat transfer and fluid flow parameters

LIST OF EXPERIMENTS **45 hours**

A) IC ENGINES

1. Valve timing diagram of four stroke engine
2. Performance test on two stroke engine
3. Performance test on four stroke engine
4. Heat balance test on four stroke diesel engine
5. Morse test on multi cylinder internal combustion engine
6. Performance test on two stage reciprocating air compressor

B) HEAT TRANSFER

1. Determination of heat transfer coefficient of unsteady state heat conduction
2. Determination of convective heat transfer coefficient in natural convection
3. Determination of convective heat transfer coefficient in forced convection
4. Determination of Stefan Boltzmann constant for radiation heat transfer
5. Determination of effectiveness of parallel flow and counter flow heat exchanger

OTHER EXPERIMENTS

1. Dismantling and assembling of internal combustion engine and identification of parts
2. Port timing diagram of two stroke engine
3. Retardation and motoring test on four stroke engine
4. Air fuel ratio and volumetric efficiency of an internal combustion engine
5. Performance test on Variable Compression Ratio engine

6. Determination of thermal conductivity of metal bar
7. Determination of thermal conductivity of insulating powder
8. Determination of thermal conductivity of insulation using lagged pipe apparatus
9. Determination of overall heat transfer coefficient of composite wall
10. Determination of effectiveness and efficiency pin-fin
11. Determination of emissivity of gray body
12. Determination of critical heat flux during pool boiling
13. Determination of heat transfer coefficient during two phase heat transfer
14. Determination of heat transfer coefficient in dropwise and film wise condensation

Course outcomes:

The students after completing the course will be able to:

1. Calculate the performance of internal combustion engines and air compressor
2. Draw and analyze performance curves of these machines and system
3. Evaluate the volumetric efficiency of two stage reciprocating compressor
4. Gain knowledge on various modes of heat transfer and determine thermal conductivity, heat transfer coefficient, efficiency and effectiveness of pin-fin, surface emissivity of test plate, Stefan Boltzmann constant.
5. Determine heat transfer coefficient and critical heat flux in two phase heat transfer, condensation, heat exchanger and pool boiling heat transfer

Text books:

Lab manual provided by the department

Mode of Evaluation: Internal Evaluation & End Semester Examination.

B. Tech. Mechanical Engineering

Mandatory Course

III Year I Semester

20CE901 DISASTER MANAGEMENT

L	T	P	C
2	0	0	0

Pre-requisite: None

Course Description:

The goal of this course is to expose the under graduate students regarding different types of disasters and preparedness needed to mitigate their effects. The course matrix will cover various natural, biological, chemical and emerging hazards and risks that may cause property, loss of lives, and livestock's. Thus, the future engineers will understand the social responsibility for the preparedness and mitigation of the damages caused by the disasters.

Course Objectives:

1. To make aware the students about disasters and their impact on living beings.
2. 2. To ensure the students for the understanding on vulnerability, disasters, disaster prevention
3. and risk reduction.
4. To gain a preliminary understanding of approaches for the Disaster Risk Reduction (DRR)
5. To enhance awareness of institutional processes available in the country for the disaster risk mitigation.

UNIT I INTRODUCTION 6 hours

Introduction, Etymology of disaster, Concepts and definitions: disaster, hazard, vulnerability, risks, Resilience, prevention and mitigation.

UNIT II TYPES OF DISASTERS 6 hours

Types of Disaster; natural disasters (earthquakes, volcanoes, forest fires and explosions, heat and cold waves, floods, draught, cyclones, tsunami, landslides, soil erosion); manmade disasters (industrial pollution, artificial flooding in urban areas, nuclear radiation, chemical spills, transportation accidents, terrorist strikes, etc.), hazard and vulnerability profile of India, mountain and coastal areas, ecological fragility.

UNIT III DISASTER IMPACTS 6 hours

Disaster Impacts (environmental, physical, social, ecological, economic, political, etc.); health, psycho-social issues; demographic aspects (gender, age, special needs); hazard locations; global and national disaster trends; climate change and urban disasters.

UNIT IV DISASTER RISK MITIGATION MEASURES 6 hours

Disaster Risk Reduction (DRR) - Disaster management- four phase approach; prevention, mitigation, preparedness, relief and recovery; structural and non-structural measures; risk analysis, vulnerability and capacity assessment; early warning systems, Post disaster environmental response (water, sanitation, food safety, waste management, disease control, security, communications), DRR programmers in India and the activities of National Disaster Management Authority. Roles and responsibilities of government, community, local institutions, NGOs and other stakeholders; Policies and legislation for disaster risk reduction.

UNIT V IMPACT OF DEVELOPMENTAL ACTIVITIES 6 hours

Disasters, Environment and Development - Factors affecting vulnerability such as impact of developmental projects and environmental modifications (including of dams, landuse changes, urbanization etc.), sustainable and environmental friendly recovery; reconstruction and development methods.

Course Outcomes:

The students after completing the course will be able to:

1. Explain various disaster concepts
2. Differentiate between categories of disasters
3. Analyze impact of various types of disasters
4. Select disaster risk mitigation measures
5. Identify the impact of development activities

Text Books:

1. Ghosh G.K., 2006, Disaster Management, APH Publishing Corporation

Data Books:

1. C P Kothandaraman & S Subramanyan, Heat and Mass Transfer data book, New Age International Publishers, Eight Edition.

Reference Books:

1. http://ndma.gov.in/ (Home page of National Disaster Management Authority)
2. http://www.ndmindia.nic.in/ (National Disaster management in India, Ministry of Home affairs).
3. Pradeep Sahni, 2004, Disaster Risk Reduction in South Asia, Prentice Hall.
4. Singh B.K., 2008, Handbook of Disaster Management: Techniques & Guidelines, Rajat Publication.
5. Disaster Medical Systems Guidelines. Emergency Medical Services Authority, State of California, EMSA no.214, June 2003
6. Inter Agency Standing Committee (IASC) (Feb. 2007). IASC Guidelines on Mental Health and Psychosocial Support in Emergency Settings. Geneva: IASC

Mode of Evaluation: Assignments, Mid Term Tests

III Year II Semester

B. Tech. Mechanical Engineering

III Year II Semester

20ME112 CAD/CAM

L	T	P	C
3	0	0	3

Pre-requisite: None

Course description:

This course provides an understanding, importance, and relevance to the fundamentals of design software usage and manufacturing processes for producing various products.

Course objectives:

1. Understand the significance of CAD & CAM in industries and acquire knowledge for generating high quality images.
2. To learn the concepts of geometry, surface and solid modelling surface modeling and surface visualization.
3. To learn basic understanding of Computer Numerical Controlled (CNC) machines.
4. To learn machining processes - milling and turning and write part programming using a combination of G Codes and M codes.
5. To learn the basic principles of finite element methods.

UNIT I INTRODUCTION TO CAD/ CAM & COMPUTER GRAPHICS 8 hours

Introduction-Computer in industries- CAD/CAM hardware, computer graphics- CRT, Raster Scan, Random Scan Techniques. transformation of geometry, 3D transformations, Introduction to CAD Data Exchange Formats-IGES, ACIS, DXF and STL, Geometric Dimensions and Tolerances (GD&T), CNC machining tolerances, The Datum Reference Frame (DRF), Interpreting GD&T Symbols, Applying Geometric Symbols to Engineering Drawings.

UNIT II GEOMETRY, SURFACE AND SOLID MODELLING 10 hours

Geometry modelling, Introduction- Representation of Curves – non parametric and parametric. Synthetic Curves – Hermite Cubic spline –Bezier Curves – B-Spline Curves. Surface Modeling: Introduction-Classification of surface entities, –Plane Surface –Ruled Surface – Surface of Revolution – Tabulated Cylinder. Synthetic Surfaces – Hermite Bi-cubic Surface – Bezier Surface – B – Spline Surface.Solid Modeling: Introduction, Fundamentals – Geometry and topology, Boundary representation techniques – CSG techniques.

UNIT III INTRODUCTION TO CAM 9 hours

Introduction, Concepts of NC Systems, CNC Systems, DNC Systems, Components, Advantages, Disadvantages and Limitations, CNC- Turning and Milling Centers: Types, Features, Axes Nomenclature, Feedback devices (Transducers, Encoders), Tool magazine, Automatic Tool Changers (ATC), Automatic Pallet Changer (APC), Tool- Pre-setting – Concept and Importance,

Qualified Tools- Definition, Need and Advantages. Tool holders and Work Holding Devices - Types and Applications.

UNIT IV CNC PROGRAMMING 10 hours

Manual Part Programming, Computer Aided Part Programming - Definition and importance of various positions like machine zero home position, work piece zero, and program zero, coordinate system- ISO- G Codes and M-codes for turning and milling machining. Simple and Complex part programming for turning and milling using ISO format having straight turning, taper turning (linear interpolation) and concave/ convex turning (circular interpolation), ISO format milling. Importance, types and applications and format for 1. Canned Cycles, 2. Macro, 3. Do Loops, 4. Subroutine. Need and Importance of various compensations: Tool length compensation, Tool radius compensation, Pitch error compensation, Tool offset.

UNIT V INTRODUCTION TO FMS & INDUSTRY 4.0 8 hours

Flexible Manufacturing Systems: Systems-characteristics-economics and technological justification-planning, installation, operation and evaluation issues-role of group technology and JIT in FMS-typical case studies, future prospects.
Industry 4.0: Introduction to Industry 4.0, Integrations in Industry 4.0, technologies, security, people/workers and society, Globalization, architectures and standardization.

Course outcomes:

The students after completing the course will be able to:

1. Learn to manipulate the objects by using various transformations techniques.
2. Create surface entities and solid models using various CAD techniques
3. To demonstrate a basic and advanced understanding of NC, CNC and DNC strategies.
4. To demonstrate an ability to set-up, write part program using G- Codes and M- Codes to machine parts for CNC milling and turning.
5. State the applications of FEM in various engineering fields

Text books:

1. CAD/CAM Theory and Practice, Ibrahim Zeid and R. Sivasubramanian, Mcgraw Hill Education.
2. CAD/CAM - Principles and applications, P.N. Rao, TMH.
3. Introduction to Finite Elements in Engineering, Chandraputla, A and Belegundu, PHI.
4. Mikell P.Groover-Automation, Production Systems and Computer IntegratedManufacturing, Second edition, Prentice Hall of India, 2002.

References:

1. CAD/CAM Theory and Practice, R. Sivasubramaniam, TMH.
2. Computer Aided Design and Manufacturing, Lalit Narayan, PHI.
3. CAD/CAM: Concepts and Applications, Chennakesava R. Alavala, PHI.
4. Finite Element Methods in Engineering, SS Rao, Pergamon A first course in Finite Element Method, Daryl L Logan, Cengage Learning

Mode of Evaluation: Assignments, Internal Mid Tests and External End Examinations

B. Tech. Mechanical Engineering

III Year II Semester

20ME113 AUTOMATION AND ROBOTICS

L	T	P	C
3	0	0	3

Pre-requisite: None

Course description:

Automation and robotics is mainly related to industry technologies. Automation and robotics with respect to industrial context, automation as a technology that is concerned with the applications of mechanical, electronic, and computer-based systems in the operation and control of production. Examples of this technology include transfer lines, Mechanized assembly machines, feedback control systems, numerically controlled machine tools, and robots. Accordingly, robotics is a form of industrial automation.

Course objectives:

1. The student should understand some fundamental aspects of an overview of robotics& automation, including Components of the Industrial Robotics, arms, architecture, end effectors, actuators& feedback components.
2. Emphasis is placed on understanding motion analysis described mathematically.
3. The Manipulator Kinematics, D-H notation joint coordinates and world coordinates, forward and inverse kinematics are also considered in some detail.
4. The Differential transformation and Trajectory planning, different motions should be able to apply to the analysis of robotics.
5. The student should able to apply the knowledge to solve more complicated problems and study the effect of problem parameters and able to describe the construction and working of different types of robots.
6. The student should be prepared to continue the study and analyze the robotics to solve the complicated practical problems

UNIT I INTRODUCTION TO AUTOMATION 9 hours

Need, Types, Basic elements of an automated system, levels of automation, hardware components for automation and process control, mechanical feeders, hoppers, orienters, high speed automatic insertion devices.

UNIT II AUTOMATED FLOW LINES & ASSEMBLY LINE BALANCING 9 hours

Part transfer methods and mechanisms, types of Flow lines, flow line with/without buffer storage, qualitative analysis. Assembly process and systems assembly line, line balancing methods, ways of improving line balance, flexible assembly lines.

UNIT III INTRODUCTION TO SENSORS & ACTUATORS 9 hours

Classification. Robot configurations, Functional line diagram, Degrees of Freedom. Components, common types of arms, joints, grippers. Manipulator Kinematics: Homogeneous transformations as applicable to rotation and translation - DH notation, Forward and inverse

kinematics. Robot actuators and Feedback components: Actuators: Pneumatic, Hydraulic actuators, electric & stepper motors, comparison. Position sensors – potentiometers, resolvers, encoders – Velocity sensors, tactile sensors, Proximity sensors.

UNIT IV MANIPULATOR DYNAMICS, TRAJECTORY PLANNING AND ROBOT PROGRAMMING 9 hours

Differential transformation, Jacobians. Lagrange – Euler and Newton – Euler formations. Trajectory Planning: Trajectory planning and avoidance of obstacles, path planning, Skew motion, joint integrated motion – straight line motion. Robot programming-Types – features of languages and software packages.

UNIT V INTRODUCTION TO INDUSTRIAL ROBOTS 9 hours

Basics about industrial robots, flexible automation, components - manipulator arm, robotic controller, sensors, drive, and end-effector, types of industrial robots – Articulated, Cartesian, SCARA, Delta, Collaborative Robots. Robotic Applications - Arc Welding, Spot Welding, Assembly, Palletizing, Material Handling, Material Removal, Inspection, Dispensing, Painting, Packaging.

Course outcomes:

The students after completing the course will be able to:

1. Demonstrate knowledge of Robotics and learning the design of such systems.
2. Demonstrate Cognitive skills (thinking and analysis).
3. Link the scientific concepts they are learning with real applications by giving live examples where the subject concepts are applied.
4. Understand the practical importance of Robot in industry and is of importance also for other advanced courses.

Text books:

1. Automation, Production systems and CIM,M.P. Groover/Pearson Edu.
2. Industrial Robotics - M.P. Groover, TMH.

References:

1. Robotics, Fu K S, McGraw Hill.
2. An Introduction to Robot Technology, P. Coiffet and M. Chaironze, Kogam Page Ltd. 1983 London.
3. Robotic Engineering , Richard D. Klafter, Prentice Hall
4. Robotics, Fundamental Concepts and analysis – Ashitave Ghosal,Oxford Press
5. Robotics and Control, Mittal R K &Nagrath I J, TMH.
6. Introduction to Robotics – John J. Craig, PearsonEdu

Mode of Evaluation: Assignments, Internal Mid Tests and External End Examinations

B. Tech. Mechanical Engineering

III Year II Semester

20ME114 MACHINE LEARNING FOR MECHANICAL ENGINEERS

L	T	P	C
3	0	0	3

Pre-requisite: 20ME104

Course description:

Machine Learning is the study of how to build computer systems that learn from experience. This course on Machine Learning will explain how to build systems that learn and adapt using real-world applications. The objective of this course is to provide the students of mechanical engineering with the fundamental concepts in machine learning and popular machine learning algorithms. In this course, the standard and most popular supervised andun-supervised learning algorithms including linear regression, logistic regression, k-nearest neighbor, support vector machines are introduced. It is intended that the course is taught in a computer laboratory providing a hand-on approach of learning the course. It is anticipated that the example data sets that would be used to teach the concepts of machine learning would be of engineering applications. The course will be taught using Python.

Course objectives:

1. Students who successfully complete this course will have acquired a sufficient understanding of the basic concepts and methods of machine learning to make use of some elementary machine learning techniques in the design of mechanical systems.
2. Develop an understanding of basic machine learning algorithms, their efficient implementations, and their applicability to different tasks.
3. To make the students implement regression, KNN and support vector methods for classification and prediction.
4. Identify machine learning techniques suitable for a given problem

UNIT I MANAGING AND UNDERSTANDING DATA 9 hours

Introduction to machine learning, Supervised and Unsupervised Learning, Using the Scikit• learn Dataset, Using the Kaggle Dataset, Linearly Distributed Dataset, Clustered Dataset, Exploring the structure of data, Measuring the central tendency using mean, median and mode, Measuring the spread of the data using range, variance, standard deviation and quartiles, Visualizing numeric variables using box-plots and histograms, Understanding numeric data using uniform and normal distribution, Visualizing relationships using scatter plots, Examining relationships using two-way cross tabulations, Cleaning Rows with NaNs, Replacing NaN with the Mean of the Column, Removing Rows, Removing Duplicate Rows, Normalizing Columns, Removing Outliers, Tukey Fences, Z-Score.

UNIT II LINEAR AND LOGISTIC REGRESSION 9 hours

Types of Linear Regression, Using the Linear Regression Class for Fitting the Model, Making Predictions, Plotting the Linear Regression Line, Getting the Gradient and Intercept of the Linear Regression Line, Examining the Performance of the Model by Calculating the Residual Sum of Squares, Evaluating the Model Using a Test Dataset, Data Cleansing, Feature Selection, Multiple Linear Regression, Training the Model, Getting the Intercept and Coefficients, Plotting the 30 Hyperplane, Polynomial Regression, Formula for Polynomial

Regression, Polynomial Regression in Scikit-leam, Understanding Bias and Variance, Plotting the 30 Hyperplane Understanding Odds, Logit Function, Sigmoid Curve, Examining the Relationship Between Features, Plotting the Features in 20, Plotting in 30, Training Using One Feature, Finding the Intercept and Coefficient, Plotting the Sigmoid Curve, Making Predictions, Training the Model Using All Features, Testing the Model, Getting the Confusion Matrix, Computing Accuracy, Recall, Precision, and Other Metrics, Receiver Operating Characteristic (ROC) Curve, Plotting the ROC and Finding the Area Under the Curve (AUC)

UNIT III CLASSIFICATION USING K-NEAREST NEIGHBORS (KNN) 9 hours

Supervised Leaming: Introduction to K-Nearest Neighbors, Implementing KNN in Python, Plotting the Points, Calculating the Distance between the Points, Implementing KNN, Making Predictions, Visualizing Different Values of K, Using Scikit-Leam's K-Neighbors Classifier Class for KNN, Exploring Different Values of K, Cross-Validation, Parameter-Tuning K, Finding the Optimal K.
Unsupervised Leaming: Introduction to Unsupervised Leaming, Unsupervised Leaming Using K-Means, Implementing K-Means in Python, Evaluating Cluster Size Using the Silhouette Coefficient, Importing the Data, Cleaning the Data, Plotting the Scatter Plot, Clustering Using K-Means, Finding the Optimal Size Classes.

UNIT IV SUPPORT VECTOR MACHINES 9 hours

Introduction to Support Vector Machine, Maximum Separability, Support Vectors, Formula for the Hyperplane, Using Scikit-leam for SVM, Plotting the Hyperplane and the Margins, Making Predictions, Kernel Trick, adding a Third Dimension, Plotting the 30 Hyperplane, Types of Kernels, C, Radial Basis Function (RBF) Kernel, Gamma, Polynomial Kernel.

UNIT V DEPLOYING MACHINE LEARNING MODELS 9 hours

Deploying ML, Case Study, Loading the Data, Cleaning the Data, Examining the Correlation between the Features, Plotting the Correlation Between Features, Evaluating the Algorithms, Logistic Regression, K-Nearest Neighbors, Support Vector Machines, Selecting the Best Performing Algorithm, Training and Saving the Model, Deploying the Model, Testing the Model. Public Datasets for Machine Learning and Data Science. Machine learning in the cloud.

Course outcomes:

The students after completing the course will be able to:

1. Import various available datasets and determine the statistical parameters of the data.
2. The students will also be able to clean and normalize the data and present the data using various visual techniques.
3. Apply linear regression to quantify the relationship between one or more predictor variable(s) and one outcome variable. The students will also be able to apply Logistic regression to predict the class of data based on one or multiple predictor variables.
4. Apply the KNN techniques for classification and classify new cases based on a similarity measure.
5. Apply support vector machine algorithm for classification and regression problems.

B. Tech. Mechanical Engineering

Text books:

1. Sebastian Raschka, "Python Machine Leaming", Packt Publishing Ltd, 2015

References:

1. Prateek Joshi, "Python Machine Leaming Cookbook", Packt Publishing Ltd, 2016

2. Yuxi (Hayden) Liu, "Python Machine Leaming By Example", Packt Publishing Ltd, 2017

Mode of Evaluation: Assignments, Internal Mid Tests and External End Examinations

B. Tech. Mechanical Engineering

III Year II Semester

20ME210 CAD/CAM LABORATORY

L	T	P	C
0	0	3	1.5

Pre-requisite: 20ME204

Course description:

This course can demonstrate the significance of finite element software like FEASTSMT/Ansys/ABAQUS, which enables us to confidently predict the material behaviour under different types of mechanical loads and ambient conditions.

Course objectives:

1. Understand and Analyse Basic Structural Problems
2. Understand and Analyse Buckling & Stress Problems.
3. Understand and Analyse Modal Problems.
4. Understand and Analyse Heat Transfer Problems.
5. Simulation & Hands on training on CNC Operations.

LIST OF EXPERIMENTS **45 hours**

1. Cantilever beam with point load at free end
2. Distributed loading of a 1D simply supported beam
3. Buckling failure analysis
4. Stress analysis of Axi-symmetry structure
5. Analysis of 2D Truss
6. Modal analysis of a cantilever beam & plate
7. 1D heat conduction thermal analysis
8. Radiation exchange between surfaces
9. Simulation of CNC step turning and facing
10. Simulation of CNC taper turning and chamfering
11. Simple turning, milling, chamfering and fillet operation using CNC

Course outcomes:

The students after completing the course will be able to:

1. Basic Structural Problems.
2. Buckling & Stress Problems.
3. Modal Problems.
4. Heat Transfer Problems.
5. CNC Operations.

Text books:

Laboratory manual provided by the department

Mode of Evaluation: Continuous Internal Evaluation and End Semester Examination

B. Tech. Mechanical Engineering

III Year II Semester

20ME211 ROBOTICS LABORATORY

L	T	P	C
0	0	3	1.5

Pre-requisite: Basic programming Skills

Course description:

The objective of this course is to provide an experiential based learning platform to practically teach the concepts of IoT from basics to advance by building projects and develop the skills needed for an exciting career in IoT. By successfully completing the experiments in this laboratory, the students would earn basic skills in making a robot move and control it using an embedded program

Course objectives:

1. To familiar with weather monitoring using IoT.
2. To learn the basics of soil moisture measurement.
3. To learn about DTMF Decoder.
4. To learn the basics about of IR sensors in Obstacle Detection Robots.
5. To learn about accelerometers and its interfacing with programming logic for gesture robot.

LIST OF EXPERIMENTS **45 hours**

1. Introduction to microcontrollers & IDE for programming.
2. Connecting, testing and evaluation of robotics sensors – IR sensors
3. Connecting, testing and evaluation of robotics sensors – Ultrasonic sensors
4. Connecting, testing and evaluation of robotics sensors – DHT sensors
5. Connecting, testing and evaluation of robotics sensors – DTMF sensors
6. Connecting, testing and evaluation of robotics sensors – Moisture sensors
7. Connecting, testing and evaluation of robotics DC motors
8. Developing a line follower robot
9. Developing obstacle avoiding robot
9. Developing obstacle following robot
10. Developing mobile controlled robot using Bluetooth
11. Developing mobile controlled robot using DTMF

Course outcomes:

The students after completing the course will be able to:

1. The student will be able to weather monitoring using IoT programming logic. Students will be able to set up Thing Speak App.
2. Students will learn the concepts and working of soil moisture sensor. They will be able to interface soil moisture sensor and reading data from soil moisture sensor.
3. Students will learn DTMF Decoder and its working and also detect DTMF tones using mobile app programming logic for DTMF decoder

4. The student will be able to learn the placement and connection of IR sensors in Obstacle Detection Robots and develop an obstacle avoider robot
5. Students will learn accelerometers and their working. They will also learn to interface accelerometer with programming logic for gesture robot.

Text books:

1. Lab manual provided by the department

References:

1. Richard Grimmett, “Arduino Robotic Projects”, PACKT Publishing Ltd.

2. Adeel Javed “Building Arduino Projects for the Internet of Things”, Apress 2016

Mode of Evaluation: Continuous Internal Evaluation and End Semester Examination.

B. Tech. Mechanical Engineering

III Year II Semester

20ME212 ENGINEERING METROLOGY AND MEASUREMENTS LABORATORY

L	T	P	C
0	0	3	1.5

Pre-requisite: None

Course description:

This course provides the necessary skills for calibration and testing of different gauges and instruments. It focuses the necessary skills to collect data, perform analysis and interpret results to draw valid conclusions through standard test procedures using various metrology instruments.

Course objectives:

1. To familiar with different measurement equipments and use of this industry for quality inspection.
2. To enable the students in measuring various measurements by using metrology instruments.
3. To familiar with precise control and measuring instruments.

LIST OF EXPERIMENTS **45 hours**

1. Measurement of lengths, heights, diameters by vernier callipers, micrometer etc.
2. Measurement of bores by internal micrometer and dial bore indicator.
3. Chordal addendum, chordal height of spur gear by gear teeth Vernier callipers.
4. LVDT transducer for displacement measurement.
5. Strain gauge for Strain measurement.
6. Toolmakers Microscope for pitch angle measurements
7. Angle and Taper Measurements by sine bar, slip gauges, Angle measuring instruments etc.
8. Thread measurement by two/three wire method.
9. Surface roughness measurement by Talysurf instrument.
10. Straightness, circularity, eccentricity measurement of axis symmetrical specimens using dial indicators.

Course outcomes:

The students after completing the course will be able to:

1. Measure the gear tooth dimensions, angle using sine bar, straightness and flatness, thread parameters, force, displacement, etc.
2. Calibrate the Vernier, micrometre and slip gauges and setting up the comparator for the inspection.
3. Apply knowledge of metrology and machine tools for practical applications.
4. Understand and build their abilities for running of metrology and machine tools lab.

Text books:

Lab manual provided by the department

Mode of Evaluation: Continuous Internal Evaluation and End Semester Examination

B. Tech. Mechanical Engineering

Mandatory Course

III Year II Semester

20HUM902 ** **/20HUM102**# **UNIVERSAL HUMAN VALUES**

L	T	P	C
2**/3#	0	0	0**/3#

Pre-requisite: None

Course description:

This course discusses students' role in their family and briefly touches issues related to their role in the society and the nature,

Course objectives:

At the end of the course, Students will

1. Understand Happiness and Prosperity correctly and basic Human Aspirations
2. Able to self-verify the Harmony in the Human Being
3. Visualize a universal harmonious order in society which leads to Undivided Society at Universal Order- from family to world family.
4. Understanding Harmony in the Nature and Existence - Whole existence as Coexistence
5. Implicate the UHV in professional ethics.

UNIT I THE PROCESS FOR VALUE EDUCATION - BASIC HUMAN ASPIRATIONS **8 hours**

L1: Purpose and motivation for the course, recapitulation from Universal Human Values-I
L2: Self – Exploration – what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration
L3: Continuous Happiness and Prosperity- A look at basic Human Aspirations
L4: Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority
L5: Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario
L6: Method to fulfil the above human aspirations: understanding and living in harmony at various levels.
T1 & T2: Discussion on natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking.

B. Tech. Mechanical Engineering

UNIT II UNDERSTANDING HARMONY IN THE HUMAN BEING - HARMONY IN MYSELF! 8 hours

L7: Understanding human being as a co-existence of the sentient 'I' and the material 'Body'
L8: Understanding the needs of Self ('I') and 'Body' - happiness and physical facility
L9: Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer)
L10: Understanding the characteristics and activities of 'I' and harmony in 'I'
L11: Understanding the harmony of I with the Body: Self-regulation and Health; correct appraisal of Physical needs, meaning of Prosperity in detail.
L12: Programs to ensure Self-regulation and Health.
T3 & T4: Discussion on the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease

UNIT III UNDERSTANDING HARMONY IN THE FAMILY AND SOCIETY 7 hours

L13: Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship
L14: Understanding the meaning of Trust; Difference between intention and competence
L15: Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship
L16: Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals
L17: Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.
T5 & T6: Reflection on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives

UNIT IV UNDERSTANDING HARMONY IN THE NATURE AND EXISTENCE 6 hours

L18: Understanding the harmony in the Nature
L19: Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self- regulation in nature
L20: Understanding Existence as Co-existence of mutually interacting units in all-pervasive space
L21: Holistic perception of harmony at all levels of existence.
T7 & T8: Discussion on human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

UNIT V IMPLICATIONS OF HOLISTIC UNDERSTANDING OF HARMONY ON PROFESSIONAL ETHICS **11 hours**

L22: Natural acceptance of human values
L23: Definitiveness of Ethical Human Conduct
L24: Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order
L25; Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people-friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems.
L26: Case studies of typical holistic technologies, management models and production systems
L27: Strategy for transition from the present state to Universal Human Order: a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers b. At the level of society: as mutually enriching institutions and organizations
L28: Sum up.
T9-T14: Exercises and Case Studies For e.g. Individual discussion on the conduct as an engineer or scientist etc.

Course Outcomes:

By the end of the course, students are expected to become

1. Understood the natural acceptance in human being as the innate acceptance,
2. More aware of themselves,
3. Maintain harmony with family and society by recognizing Harmony in Human-Human Relationship,
4. Try to get Harmony in the Nature and Existence by realizing existence as Coexistence
5. More responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind with better critical ability.

Text books:

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010

References:

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi

Mode of Evaluation: Assignments and Internal Mid Tests

OPEN ELECTIVE - II

B. Tech. Mechanical Engineering

Open Elective - II

20MAT302 ENGINEERING OPTIMIZATION

L	T	P	C
3	0	0	3

Pre-requisite: 20MAT101, 20MAT106, 20MAT104, 20MAT108, 20MAT109, 20MAT110.

Course Description:
Unconstrained and constrained optimization, Linear programming problem, transportation and assignment problems, dynamic programming problem, project management and queuing models.

Course Objectives:
1. Understand the optimization techniques for solving engineering problems.
2. Formulate and solve linear programming problem.
3. Obtain the optimal solution for transportation and assignment problems.
4. Avail knowledge to solve dynamic programming problem using recursive relations.
5. Analyze the techniques of project management and queuing models.

UNIT I CLASSICAL OPTIMIZATION **9 hours**

Introduction to optimization, unconstrained optimization with single variable and multi variable. Constrained multivariable optimization with equality constraints- Lagrange multipliers method, constrained multivariable optimization with inequality constraints - Kuhn-Tucker conditions.

UNIT II LINEAR PROGRAMMING PROBLEM **9 hours**

Linear Programming Problem (LPP), Mathematical formulation, graphical solution, simplex method. Artificial variable technique - Big M-method and two phase simplex method. Duality, dual Simplex method.

UNIT III TRANSPORTATION PROBLEM AND ASSIGNMENT PROBLEM **9 hours**

Transportation problem: definition and algorithm, transshipment problem. Assignment problem, travelling salesman problem.

UNIT IV DYNAMIC PROGRAMMING **9 hours**

Introduction, developing optimal decision policy, Dynamic Programming Problem (DPP) under certainty, DPP approach for solving LPP.

UNIT V PROJECT MANAGEMENT AND QUEUING MODELS **9 hours**

Network analysis: Network representation, Critical Path Method (CPM) and Project Evolutionary and Review Technique (PERT). Introduction to queuing system, single server queuing models (M/M/1) :(∞/FCFS), (M/M/1): (N/FCFS).

Course Outcomes:
At the end of the course, students will be able to:
1. Understood the importance of unconstrained and constrained optimization to solve engineering problems.
2. Get an idea about the linear programming techniques.
3. Solve transportation and assignment problems in engineering situations.

4. Apply the Bellman principle of optimality to solve dynamic programming problem.
5. Analyze the problems of network analysis for project management and Queuing systems engineering & industry.

Text Books:

1. J K Sharma, Operations Research: Theory and Practice, Macmillan Publishers India Ltd, 5th edition,2013.
2. B.S. Grewal, Higher Engineering Mathematics, 43rd edition (2014), Khanna publishers.

Reference Books

1. Hamdy A Taha, Operations Research: An Introduction, Pearson Education, 9/E, 2011.
2. FS Hillier and GJ Lieberman, Introduction to Operations Research, TMH, 8/E, 2006.
3. JC Pant, Introduction to Optimization: Operations Research, Jain Brothers, New, 6/E, 2004.
4. A Ravindran, DT Philips and JJ Solberg, Operations Research: Principles and Practice, John Wiley& Sons, Singapore, 2nd edition.

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination

B. Tech. Mechanical Engineering

Open Elective - II

20PHY301 OPTICAL PHYSICS AND ITS APPLICATIONS

L	T	P	C
3	0	0	3

Pre-requisite: None

Course Description:
The course will cover Geometrical optics, Aberrations, Physical Optics, Diffraction and Optical fibers.

Course Objectives:
Students will

1. Knowledge of basic principles and concepts in optics and the techniques used to deal with them.
2. Explain the limitations associated with spherical and chromatic aberration
3. Describe optical systems such as microscopes and telescopes with reference to parameters such as angular magnification and depth of field
4. Provide students with a working knowledge of optical physics, including interference, diffraction and physical optics.
5. Introduce construction and concepts of basic fiber optic communication system and to make the students learn about its important applications for societal needs.

UNIT I INTRODUCTION 9 hours

Corpuscular and wave theory, Fermat's principle, Matrices for translation, refraction and reflection, Unit and nodal planes, Eigenvalues and Eigenvectors.

UNIT II ABERRATIONS AND OPTICAL INSTRUMENTS 9 hours

Types of aberrations, Chromatic and monochromatic aberrations. Different types of monochromatic aberrations. Simple and Compound microscopes, Astronomical and Terrestrial telescopes. Ramsden's and Huygens' eye pieces.

UNIT III WAVE OPTICS & INTERFERENCE 9 hours

Huygens's principle, Superposition of waves, Fourier transforms, representation of slits and apertures, Two beam interference by Division of wave front. Applications of Interference, Nonlinear interaction of light with matter (self-study).

UNIT IV DIFFRACTION & POLARISATION 9 hours

Fraunhoffer diffraction, Diffraction from single slit, double slit & multiple slits, Fresnel half-period zones, Zone plate, Applications of diffraction, Polarization, Malus' law, double refraction. Applications of polarization.

UNIT V FIBER OPTICS 9 hours

Construction and working principle of optical fibers, Numerical aperture and acceptance angle, Types of optical fibers. Attenuation and losses in optical fibers, Analog and Digital optical fiber communication system. Applications of optical fibers in communications, sensors and medicine.

B. Tech. Mechanical Engineering

Course Outcomes:

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

1. Recollect the fundamental characteristics of light and their mathematical principles.
2. Learn the principles of superposition, Interference and Diffraction
3. Understand nonlinear optics and photonics phenomena.
4. Be exposed to the application of optical techniques in cutting edge research areas.
5. Describe the basic laser physics, working of lasers and principle of propagation of light in optical fibers.

Text Books:

1. Optics by Ghatak, 4th Edition, Tata McGraw Hill (2011).

Reference Books

1. Optics by Lipson, Lipson & Lipson, 4th Edition, Cambridge Univ Press (2010).
2. Optics by Hecht, 4th Edition, Addison-Wesley (2002).

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination

B. Tech. Mechanical Engineering

Open Elective – II

20PHY302 LASER PHYSICS AND ADVANCED LASER TECHNOLOGY

L	T	P	C
3	0	0	3

Pre-requisite: Basic knowledge of atomic structure at intermediate (10+2) level is sufficient

Course Description:

Laser usage is rampant in various technological applications. Several fields gaining attention in the usage of lasers. This course covers the introduction to the theory and mechanism of laser action, various types of lasers and their applications and future use.

Course Objectives:

1. Make the student to understand the detailed principles of various lasers.
2. Profound understanding of different variety of lasers will provide them to think of superior selection and usage of lasers in practical technological applications.
3. Students are aware of latest developments in certain areas of Laser technology which have important applications for societal needs.
4. Explain how material processing is accomplished with lasers. Estimate laser operation parameters for material processing.
5. Exposure about Lasers applications in engineering, communications, spectroscopy and material process etc.

UNIT I INTRODUCTION TO LASER TECHNOLOGY 9 hours

Laser characteristics, The Einstein Coefficients, Absorption and Emission Cross Sections, Spontaneous and Stimulated emission of radiation, Population inversion, Methods of Population Inversion, Laser Rate Equations, stable two minor optical resonators, Mode selection, Gain in the regenerative laser cavity.

UNIT II GASES AND LIQUIDS LASING MEDIUM 9 hours

Energy levels & Radiative properties of Atoms and molecules; Atomic lasers: He-Ne laser, Argon Ion laser; Molecular Lasers: Carbon dioxide laser, Liquid energy levels and their radiative properties, Organic Dye laser.

UNIT III SOLID STATE LASERS 9 hours

Energy Levels in solids-dielectric medium, Solid-state lasing materials, Narrow line width laser materials, broad band line width laser materials, solid state lasers: Nd:YAG, Nd:YLF; Ti:Sapphire (introduction only)

Energy Levels in solids-semiconductor medium, direct and indirect band gap semiconductors, Semiconductor diode laser, Quantum dot lasers (Introduction only);

UNIT IV PULSED OPERATION OF LASERS 9 hours

Nanosecond: Q-Switching, Techniques of Q-Switching: electro-optic, Acousto - Optic - Femtosecond: Relationship between pulse duration and Spectral Width, Passive mode-locking, Active mode locking, Kerr lens mode locking, Amplification of femtosecond pulses.

UNIT V LASER APPLICATIONS 9 hours

Laser processing of materials: laser cutting, laser drilling, welding; Lasers in metrology- Accurate measurement of length, light wave communications; Laser spectroscopy: Laser fluorescence and Raman scattering.

Course Outcomes:

Upon completion of this course the students shall be able to:

1. Understand the principle of phenomenon of laser and identify the operating principle involved in various type of lasers.
2. Estimate stability requirements in producing laser light by different types of sources
3. Differentiate or list the various types of lasers and their means of excitation.
4. Assess (Identify) which laser would best meet the need for a particular industrial or research task.
5. Student can knowledge of latest technological developments in laser technology. Femtosecond laser etc.

Text Books:

1. Laser Fundamentals: William T Silfvast. Cambridge Publication.
2. Laser Theory and Applications: A.K. Ghatak and K. Thyagarajan, Springer
3. Femtosecond Laser Pulses Principles and Experiments: Claude Rulli`ere, Springer
4. Principles of Laser: O. Svelto
5. Laser Physics: Peter W Miloni, Joseph H Eberly.

Reference Books

1. Solid State Laser Engineering: Walter Koechner. Springer series in optical sciences.
2. Ultrafast Optics, Andrew M. Weiner
3. Laser spectroscopy: Demtroder
4. Laser Applications: Monte Ross

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination

B. Tech. Mechanical Engineering

Open Elective - II

20CHE301 INTRODUCTION TO PETROLEUM INDUSTRY

L	T	P	C
3	0	0	3

Pre-requisite: Basic Chemistry at Intermediate or equivalent level.

Course Description:
It deals with basic principles of petroleum engineering and the processes involved in petroleum industry.

Course Objectives:
Students will

1. To understand the basic concepts of crude oil, distillation process, internals, petroleum products and their properties, Instruments used for fuel testing.
2. To understand the type of chemicals and their application in petroleum industry.
3. To introduce the basic principles of hydroprocessing and fluid catalytic cracking and familiarize the processes involved there.
4. To familiarize the basic concepts of catalysis, bioprocesses in the refinery.
5. Health, environment, process safety and management in petroleum companies.

UNIT I BASIC PROCESSES IN PETROLEUM REFINING AND FUEL TESTING **9 hours**

Source of Crude oils and types, Overview of refinery process, Atmospheric Distillation, Vacuum distillation, Desalter, Desulphurization, Cracking, catalysis, Effluent treatment plant. Density, viscosity, pour point, flashpoint, octane number, cetane number, Fire point, Chromatography, Ductility, Water content, Sulphur analysis, MCRT, SARA, HFRR, calorofic value etc.

UNIT II CHEMICALS AND THEIR IMPORTANCE IN PETROLEUM INDUSTRY **9 hours**

Types of products in the refinery and their structural properties, Netralizing amines, Corrosion inhibitors, Multifunctional additives, viscosity improvers, drag reducing agents, antioxidants, Lubricity improvers, Antifoam additives, Oil spill absorbers, Dispersants and their applications, Types of Catalysts used in the refinery, Chemicals for ETP plant.

UNIT III ROLE OF HYDROPROCESSING AND FLUID CATALYTIC CRACKING IN PETROLEUM INDUSTRY **9 hours**

Objectives, Hydrocracking Reactions, Hydrocracking feedstocks, Modes of Hydrocracking, Effects of process variables, Hydro treating process and catalysts Resid hydro processing, FCC Cracking, Catalyst coking and regeneration, Design concepts, New Designs for Fluidized-Bed Catalytic Cracking Units

UNIT IV ROLE OF CATALYSTS, BIOPROCESSES IN PETROLEUM INDUSTRY **9 hours**

Types of catalyst and their importance, Design of catalyst, selection of catalyst, Catalytic processes. Introduction to biotechnology, oil recovery from reservoirs, refining of petroleum using biodesulphurisation, Bioremediation, commercial processes for bioethanol, propanol.

UNIT V HEALTH, ENVIRONMENT, PROCESS SAFETY AND MANAGEMENT IN PETROLEUM INDUSTRY **9 hours**

Safety policy, Personal protective equipment, Different type of extinguishers, Types of gloves and their application, Hydrants and their role, Safety indicators, Safety contact, Environmental pollution, precaution and first aid, precautions safety, Occupational safety and management, different elements and their role.

Course Outcomes:

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

1. Be able to understand the overview of petroleum industry
2. Be able to understand the concepts of crude oil, types of crude oils, properties of fuels such as octane number, cetane number, viscosity, density etc. Instruments.
3. Be familiarized with importance and their use of chemicals involved in the petroleum industry.
4. Be familiarized with the processes involved in hydroprocessing and fluid catalytic cracking.
5. Be familiarized the types of catalysts and bioprocesses in the petroleum industry.
6. Understanding the PPE, different types of extinguishers, First aid, process safety and management in the petroleum industry.

Text Books:

1. Mohamed A. Fahim, Taher A. Al-Sahhaf, Amal Elkilani, Fundamentals of Petroleum Refining, Elsevier,2009
2. David T Day, Handbook of the Petroleum Industry, Volume 1, ISBN: 137595962X, CHIZINE PUBN, 2017
3. S. P. Srivastava Jenő Hancsók, *Fuels and fuel additives*, Wiley VCH Verlag Gmbh & Co, Weinheim, 2004.
4. Robert O. Anderson, *Fundamentals of the Petroleum Industry*–University of Oklahoma Pres, 1987.
5. James G.Speight, *Handbook of Petroleum Product Analysis,* John Wiley & Sons, Inc, 2015
6. Physical Chemistry by G.W. Castellan (Addison Wesley Publishing Company)

Reference Books

1. Sankara Papavinasam, Corrosion Control in the Oil and Gas Industry, Elsevier, 2013
2. Petroleum Engineering Handbook (Vol. 1 through VIII). Editor in Chief: Larry W. Lake, Society of Petroleum Engineers.
3. Srinivasan Chandrasekaran. Health, safety and Environmental Management for offshore and Petroleum Engineers, John Wiley and Sons, U.K., ISBN: 978-11-192-2184-5, 2016.

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination

B. Tech. Mechanical Engineering

Open Elective – II

20CHE302 GREEN CHEMISTRY AND CATALYSIS FOR SUSTAINABLE ENVIRONMENT

L	T	P	C
3	0	0	3

Pre-requisite: Basic Chemistry at Intermediate or equivalent level.

Course Description:
This course aims to introduce the interdisciplinary concept for engineering's to enhance their knowledge that they need to contribute with relevance and confidence in developing green technologies. This course covers feedstocks, green metrics and the design of safer, more efficient processes, as well as the role catalysts and solvents and green processes for Nanoscience.

Course Objectives:
Students will

1. Learn an interdisciplinary approach to the scientific and societal issues arising from industrial chemical production, including the facets of chemistry and environmental health sciences that can be integrated to promote green chemistry
2. Sensitize the students in redesigning of chemicals, industrial processes and products by means of catalysis.
3. Understand the use of alternatives assessments in using environmentally benign solvents.
4. Emphasize current emerging greener technologies and the need of alternative energies.
5. Learn to adopt green chemistry principles in practicing Nanoscience.

UNIT I PRINCIPLES AND CONCEPTS OF GREEN CHEMISTRY 9 hours

Introduction, Green chemistry Principles, sustainable development and green chemistry, atom economy, atom economic: Rearrangement and addition reactions and un-economic reactions: Substitution, elimination and Wittig reactions, Reducing Toxicity. Waste - problems and Prevention: Design for degradation.

UNIT II CATALYSIS AND GREEN CHEMISTRY 9 hours

Introduction to catalysis, Heterogeneous catalysts: Basics of Heterogeneous Catalysis, Zeolites: Catalytic cracking, ZSM-5 catalyst and high silica zeolites, TS1 Oxidation catalyst, Catalytic Converters, Homogeneous catalysis: Hydrogenation of alkenes using wilkinson's catalyst, Phase transfer catalysis: Hazard Reduction, C–C Bond Formation, Oxidation Using Hydrogen Peroxide.

UNIT III ORGANIC SOLVENTS: ENVIRONMENTALLY BENIGN SOLUTIONS 9 hours

Organic solvents and volatile organic compounds, solvent free systems, supercritical fluids: Super critical carbondioxide, super critical water and water as a reaction solvent: water based coatings, Ionic liquids as catalyst and solvent.

UNIT IV EMERGING GREENER TECHNOLOGIES AND ALTERNATIVE ENERGY SOURCES 9 hours

Biomass as renewable resource, Energy: Fossil Fuels, Energy from Biomass, Solar Power, Fuel Cells(Hydrogen—oxygen fuel cell), Photochemical Reactions: Advantages of and Challenges Faced by Photochemical Processes, Examples of Photochemical Reactions(caprolactum), Chemistry Using Microwaves: Microwave Heating, Microwave-assisted Reactions, Sonochemistry.

UNIT V GREEN PROCESSES FOR GREEN NANOSCIENCE 9 hours

Introduction and traditional methods in the nanomaterials synthesis, Translating green chemistry principles for practicing Green Nanoscience. Green Synthesis of Nanophase Inorganic Materials and Metal Oxide Nanoparticles: Hydrothermal Synthesis, Reflux Synthesis, Microwave-Assisted Synthesis, Other methods for Green synthesis of metal and metal oxide nanoparticles, Green chemistry applications of Inorganic nanomaterials

Course Outcomes:

Upon completion of this course the students should:

1. Recognize green chemistry concepts and apply these ideas to develop respect for the interconnectedness of our world and an ethic of environmental care and sustainability.
2. Understand and apply catalysis for developing eco-friendly processes.
3. Be in a position to use environmental benign solvents where ever possible.
4. Have knowledge of current trends in alternative energy sources.
5. Apply green chemistry principles in practicing green Nanoscience.

Text Books:

1. M. Lancaster, Green Chemistry an introductory text, Royal Society of Chemistry, 2002.

2. Paul T. Anastas and John C. Warner, Green Chemistry Theory and Practice, 4th Edition, Oxford University Press, USA

Reference Books

1. Edited by Alvise Perosa and Maurizio Selva , Hand Book of Green chemistry Volume 8: Green Nanoscience, wiley-VCH

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination

B. Tech. Mechanical Engineering

Open Elective – II

20CE301 GROUND IMPROVEMENT TECHNIQUES

L	T	P	C
3	0	0	3

Pre-requisite: None

Course Description:
Identification of problematic soils; ground improvement techniques; densification in granular soils; densification in cohesive soils; soil stabilization; confinement; reinforced earth; geo-synthetics; improvement of expansive soils.

Course Objectives:
Students will

1. To introduce engineering properties of soft, weak and compressible deposits, principles of treatment for granular and cohesive soils and various stabilization techniques.
2. To bring out concepts of reinforced earth.
3. Applications of geotextiles in various civil engineering projects.

UNIT I DEWATERING & GROUTINHG 9 hours

Introduction- Need for engineered ground improvement, classification of ground modification techniques; suitability, feasibility and desirability of ground improvement technique.
Methods of de-watering- sumps and interceptor ditches- wells- drains- Electro- osmosis. Objectives of grouting- grouts and their properties-grouting methods.

UNIT II DENSIFICATION 9 hours

In - situ densification methods in cohesionless Soils: - Vibration at the ground surface, Impact at the Ground Surface, Vibration at depth, Impact at depth. In - situ densification methods in cohesive soils: - preloading or dewatering, Vertical drains - Sand Drains- Sand wick geo-drains
- Stone and lime columns - thermal methods.

UNIT III STABILIZATION 9 hours

Methods of stabilization-mechanical-cement- lime-bituminous-chemical stabilization with calcium chloride- sodium silicate and gypsum.

UNIT IV REINFORCED EARTH & GEOSYNTHETICS 9 hours

Principles - Components of reinforced earth - factors governing design of reinforced earth walls design principles of reinforced earth walls. Geotextiles- Types, Functions and applications - geo- grids and geo-membranes - functions and applications.

UNIT V EXPANSIVE SOILS 9 hours

Problems of expansive soils - tests for identification - methods of determination of swell pressure. Improvement of expansive soils - Foundation techniques in expansive soils - under reamedpiles.

B. Tech. Mechanical Engineering

Course Outcomes:

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

1. Evaluate basic deficiencies of various soil deposits and able to decide various dewatering methods to improve the soil.
2. Implement different techniques of soil densification.
3. Choose the best method for stabilizing the soil for a given soil condition.
4. Choose-the best geosynthetic materials in different engineering applications.
5. Assessing various types of foundation techniques and methods to control swelling of soil

Text Books:

1. Dr. Purushotham Raj, P., Ground Improvement Techniques, Laxmi Publications, New Delhi.

2. Dr. Sivakumar Babu, GL, An Introduction to Soil Reinforcement & Geosynthetics, Universities Press

Reference Books

1. Hausmann M.R., Engineering Principles of Ground Modification, McGraw-Hill International Edition, 1990.

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination

B. Tech. Mechanical Engineering

Open Elective – II

20CE302 ENVIRONMENTAL IMPACT ASSESSMENT

L	T	P	C
3	0	0	3

Pre-requisite: None

Course Description:
The course will focus on Basic concept of Environmental Impact Assessment (EIA), EIA Methodologies, Impact of Developmental Activities and Land use in soil, water, and vegetation, Environmental Audit, Post Audit activities, The Environmental pollution Acts.

Course Objectives:
Students will
1. To impart knowledge on Environmental management and Environmental Impact Assessment.
2. To give the student the brief knowledge about various legislations and audit protocols.
3. To give student knowledge about the framing of environmental audit through case studies.

UNIT I CONCEPTS AND METHODOLOGIES IN EIA **9 hours**

Introduction - Elements of EIA - Factor affecting EIA -Impact evaluation and analysis - Preparation of Environmental Base map - Classification of environmental parameters. Criteria for the selection of EIA Methodology - EIA methods: Ad-hoc methods - matrix methods - Network method - Environmental Media Quality Index Method -overlay methods - cost/benefit Analysis.

UNIT II IMPACT OF DEVELOPMENTAL ACTIVITIES **9 hours**

Introduction and Methodology for the assessment of soil and ground water - Delineation of study area - Identification of actives. Procurement of relevant soil quality - Impact prediction - Assessment of Impact significance -Identification and Incorporation of mitigation measures. EIA in surface water - Air and Biological environment.

UNIT III IMPACT ON VEGETATION AND WILD LIFE **9 hours**

Assessment of Impact of development Activities on Vegetation and wildlife - environmental Impact of Deforestation - Causes and effects of deforestation.

UNIT IV ENVIRONMENTAL AUDIT **9 hours**

Environmental Audit & Environmental legislation objectives of Environmental Audit - Types of environmental Audit - Audit protocol - stages of Environmental Audit - onsite activities - evaluation of audit data and preparation of audit report - Post Audit activities.

UNIT V ENVIRONMENTAL POLLUTION ACTS **9 hours**

The water Act-1974 - The Air Act-1981 (Prevention & Control of pollution Act.) - Wild life Act- 1972 - Indian Forest Conservation Act-1980 -National Green Tribunal Act –2010 - Biological Diversity Act-2002.

B. Tech. Mechanical Engineering

Course Outcomes:

The students after completing the course will be able to:

1. Apply the various methods used in predicting environmental impacts.
2. Apply site information to interpret impacts on land and groundwater.
3. Evaluate environmental impacts of various development activities on existing ecosystem.
4. Apply the procedures and various protocols involved in preparation of environmental audit report.
5. Apply the implications of environmental prevention and protection acts in relation to environmental impact assessment.

Text Books:

1. Anjaneyulu, Y., Environmental Impact Assessment Methodologies, B.S. Publication, Sultan Bazar, Kakinada.

Reference Books

1. Glynn, J. and Gary W. Hein Ke., Environmental Science and Engineering, Prentice Hall Publishers
2. Suresh K. Dhaneja Environmental Science and Engineering, S.K., Katania& Sons Publication, New Delhi.
3. Dr. Bhatia, H.S., Environmental Pollution and Control, Galgotia Publication (P) Ltd, Delhi.

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination

B. Tech. Mechanical Engineering

Open Elective – II

20CE303 WATERSHED MANAGEMENT

L	T	P	C
3	0	0	3

Pre-requisite: None

Course Description:
Topic covers basic concepts of watershed, sustainable watershed management approached and practices, integrated watershed management and modelling, social aspect in watershed management, quantification of water quality and quantity at the catchment outlet using modern techniques, drought, flood and storm management at catchment scale.

Course Objectives:
1. To discuss various aspects of water resources development and management on watershed basis.
2. To proliferate the sustainable use and development of natural resources.
3. To enrich the students for change in the hydrological fluxes due altered physiographic condition (land use or elevation) on a watershed scale.
4. To improve the quantitative problem solving skills of the students for natural resources management.

UNIT I CONCEPT OF WATERSHED 9 hours

Concept of watershed - classification of watershed - introduction to watershed management - objective of watershed development - Hydrological cycle - water balance equation - different stakeholders and their relative importance - watershed management policies and decision making. Factor Affecting Watershed Development**:** Morphological characteristics: linear - Arial and Relief aspect - land use - vegetation - soil and geological characteristics - Hydrology and geology and socio-economic characteristics.

UNIT II WATERSHED MODELING 9 hours

Watershed delineation - modelling of rainfall - runoff process - Concept of integrated watershed management conjunctive use of water resources - Integrated water resources management. PRA - Private sector participation - Institutional issues - Socio- economy issues - Integrated development - Water legislation and implementations - Tools and emerging technologies for watershed management and planning.

UNIT III EROSION AND SEDIMENTATION 9 hours

Types of erosion - factor affecting erosion - effect of erosion on land fertility and capacity - estimation of soil loss due to erosion: universal soil loss equation - Prevention And Control To Erosion: contour techniques - ploughing - furrowing- trenching - bunding - terracing - gully control - rockfill dams - check dams - brushwood dam - Gabion structure.

UNIT IV WATER HARVESTING 9 hours

Rain water harvesting - catchment harvesting - harvesting structures - soil moisture conservation - check dams - artificial recharge from pond - percolation tanks - Flood And Drought Management: Definition of flood - Flood frequency analysis: Weibul - Gumbel - and log Pearson methods - Definition and classification of drought - drought analysis techniques - drought mitigation planning - Management Of Water Quality: Water quality and pollution - types and Sources of pollution - water quality modelling- environmental guidelines for water quality.

UNIT V COVER MANAGEMENT **9 hours**

Land use land cover change estimation through satellite imageries - land capability classification - management of forest - agricultural - grassland and wild land - Reclamation of saline and alkaline soil. Classification of columns based on slenderness ratio - reinforcement & loading - Design of rectangular and circular columns subjected to axial load - (axial load + uni-axial bending) and (axial load + bi-axial bending). Different Types of Footings - Design of isolated - square - rectangular and circular footings. Integrated Cropping System For Watersheds: Intercropping - mix cropping strip and terrace cropping - sustainable agriculture - cover cropping (biomass conservation) - horticulture - dryland agriculture and afforestation.

Course Outcomes:

The students after completing the course will be able to:

1. Classify watershed and Identify factors to consider for watershed Development.
2. Apply the concepts of watershed development and planning
3. Evaluate the erosion rate and total amount of soil loss from a watershed
4. Select the flood and drought mitigation measures
5. Quantify the change in land use land/cover and its impact on hydrological processes.

Text Books:

1. Kenneth N. Brooks Peter F. Ffolliott Joseph A. Magner. Hydrology and the Management of Watersheds. A John Wiley & Sons, Inc., Publication (4th Edition)
2. VVN, Murthy. Land and Water Management- Kalyani Pblication

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination

B. Tech. Mechanical Engineering

Open Elective – II

220EEE301 INDUSTRIAL ELECTRICAL SYSTEMS

L	T	P	C
3	0	0	3

Pre-requisite: 20EEE101

Course Description:
This course deals with basics of electrical wiring systems for residential, commercial and industrial consumers, and its representation with standard symbols and drawings, various components of industrial electrical systems and its sizing and control aspects of industrial electrical system using PLC and SCADA.

Course Objectives:
1. To understand the electrical wiring systems for residential, commercial and industrial consumers.
2. To learn the representation of systems with standard symbols and drawings.
3. To understand the various components of industrial electrical systems.
4. To analyze and select the proper size of several electrical system components.
5. To study the control aspects of industrial electrical system using PLC and SCADA

UNIT I ELECTRICAL SYSTEM COMPONENTS 9 hours

LT system wiring components, selection of cables, wires, switches, distribution box, metering system, Tariff structure, protection components- Fuse, MCB, MCCB, ELCB, inverse current characteristics, symbols, single line diagram (SLD) of a wiring system, Contactor, Isolator, Relays, MPCB, Electric shock and Electrical safety practices.

UNIT II RESIDENTIAL AND COMMERCIAL ELECTRICAL SYSTEMS 9 hours

Types of residential and commercial wiring systems, general rules and guidelines for installation, load calculation and sizing of wire, rating of main switch, distribution board and protection devices, earthing system calculations, requirements of commercial installation, deciding lighting scheme and number of lamps, earthing of commercial installation, selection and sizing of components.

UNIT III ILLUMINATION SYSTEMS 9 hours

Understanding various terms regarding light, lumen, intensity, candle power, lamp efficiency, specific consumption, glare, space to height ratio, waste light factor, depreciation factor, various illumination schemes, Incandescent lamps and modern luminaries like CFL, LED and their operation, energy saving in illumination systems, design of a lighting scheme for a residential and commercial premises, flood lighting.

UNIT IV INDUSTRIAL SUBSTATION SYSTEMS 9 hours

HT connection, industrial substation, Transformer selection, Industrial loads, motors, starting of motors, SLD, Cable and Switchgear selection, Lightning Protection, Earthing design, Power factor correction – kVAR calculations, type of compensation, Introduction to PCC, MCC panels. Specifications of LT Breakers, MCB and other LT panel components.

UNIT V INDUSTRIAL SYSTEM AUTOMATION 9 hours

DG Systems, UPS System, Electrical Systems for the elevators, Battery banks, Sizing the DG, UPS and Battery Banks, Selection of UPS and Battery Banks.

Study of basic PLC, Role of in automation, advantages of process automation, PLC based control system design, Panel Metering and Introduction to SCADA system for distribution automation.

Course Outcomes:

Upon successful completion of the course, students will be able to

1. Discuss the various component representation involved in the design of electrical wiring for Low Tension.
2. Understand the guidelines for wiring of household and commercial buildings.
3. Understand the various components of illumination in industrial electrical systems.
4. Select the proper size of various electrical system components required for designing different electrical wiring systems.
5. Understand the control aspects of industrial electrical system using PLC and SCADA.

Text Books:

1. S. L. Uppal and G. C. Garg, "Electrical Wiring, Estimating & Costing", Khanna publishers, 2008
2. K. B. Raina, "Electrical Design, Estimating & Costing", New age International, 2007.

Reference Books

1. S. Singh and R. D. Singh, "Electrical estimating and costing", Dhanpat Rai and Co., 1997.
2. H. Joshi, "Residential Commercial and Industrial Systems", McGraw Hill Education, 2008.
3. https://www.bis.gov.in/

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination

B. Tech. Mechanical Engineering

Open Elective – II

20EEE302 INTRODUCTION TO MEMS

L	T	P	C
3	0	0	3

Pre-requisite: 20EEE101

Course Description:
This course describes about manufacturing, modeling and applications of MEMS.

Course Objectives:

1. To know the fundamentals of MEMS materials, their physical properties and Principles of operation of MEMS devices.
2. To know various MEMS microfabrication technologies.
3. To provide various MEMS technology for mechanical, optical, and chemical sensors and actuator

UNIT I INTRODUCTION 9 hours

Overview – History and industry perspectives – Working principles – Mechanics and dynamics — Scaling law

UNIT II MICRO SENSORS & ACTUATORS 9 hours

Micro sensors: Pressure sensors, accelerometers, gyroscopes-Micro actuators: comb drive actuators – Micro-electromechanical systems.

UNIT III MICRO MANUFACTURING 9 hours

Materials for MEMS and Microsystems- Micro fabrication processes: Photolithography, Ion Implantation, Diffusion, Oxidation, Chemical Vapour Deposition- Physical Vapour Deposition, Micro manufacturing: Bulk micromachining, surface micromachining, LIGA Process- Packaging.

UNIT IV MODELING IN MEMS 9 hours

Micro system design: Finite Element Methods-– Modeling of simulation – piezoelectric, Gyroscope

UNIT V MEMS APPLICATIONS 9 hours

Micro fluids-sensors for turbulence measurement and control, micro-actuators for flow control, RFMEMS- filters, Oscillators and phase shifters, Optical MEMS, micro robotics – Case studies

Course Outcomes:

Upon successful completion of the course, students will be able to

1. Explain the fundamentals of MEMS materials, their physical properties and Principles of operation of MEMS devices.
2. Analyze the Micro sensors and actuators and its fabrication.
3. Explain the materials for MEMS and Microsystems.
4. Design MEMS using microfabrication techniques.
5. Explain the advantages of MEMS technology for mechanical, optical, and chemical sensors and actuator

Text Books:

1. Chang Liu, 'Foundations of MEMS', Pearson Education Inc., 2006

2. G.K. Ananthsuresh et al ,'Micro and Smart Systems', Wiley, India, 2010

Reference Books

1. NadimMaluf, "An introduction to Micro electro mechanical system design", ArtechHouse, 2000.
2. Mohamed Gad-el-Hak, editor, "The MEMS Handbook", CRC press Baco Raton, 2000.
3. James J.Allen, micro electro mechanical system design, CRC Press published in 2005
4. Stephen D. Senturia, Microsystem Design, Kluwer Academic Publishers, 2001

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination

B. Tech. Mechanical Engineering

Open Elective – II

20ECE301 BIO-MEDICAL ELECTRONICS

L	T	P	C
3	0	0	3

Pre-requisite: None

Course Description:
This course provides the fundamental knowledge on applications of electronics in bio-medical signal measurements and processing, bio-medical instrumentation and imaging techniques.

Course Objectives:
This course enables students to

1. Acquire the basic knowledge on human physiology and biological transducers.
2. Learn about bio-electrodes and bio-amplifiers used in bio-signal acquisition.
3. Understand the working principle of bio-medical measuring instruments.
4. Study various types of imaging techniques used in medicine.
5. Learn the applications of medical instrumentation in designing artificial medical aids

UNIT I HUMAN PHYSIOLOGY AND BIOMEDICAL TRANSDUCERS 9 hours

Introduction to human physiology - Biomedical transducers for measuring displacement, velocity, force, acceleration, potential, dissolved ions and gases.

UNIT II BIO-ELECTRODES AND AMPLIFIERS 9 hours

Introduction to bio-potential, Bio-electrodes, Typical waveforms and characteristics of ECG, EMG and EEG, Bio-potential amplifiers for ECG, EMG and EEG – Lead systems and recording methods.

UNIT III BIOMEDICAL MEASURING INSTRUMENTS 9 hours

Measurement of blood pressure and temperature, Blood flow meter, Cardiac output measurement, Respiratory measurement, Blood cell counter, Impedance plethysmography.

UNIT IV MEDICAL IMAGING 9 hours

X-ray, Computed Tomography (CT), Magnetic Resonance Imaging (MRI), Nuclear imaging, Ultrasonic Imaging.

UNIT V PROSTHESES AND AIDS 9 hours

Pacemakers, Defibrillators, Heart-lung machine, Artificial kidney, Aids for the handicapped, Safety aspects

Course Outcomes:
Upon successful completion of the course, students will be able to

1. Understand the applications of biological transducers in medical field.
2. Analyze the design of bio-electrodes and bio-amplifiers.
3. Apply suitable measuring instruments to measure various medical parameters.
4. Understand and test various imaging techniques used in bio-medical diagnosis.
5. Analyze the applications of artificial medical aids.

Text Books:

1. W.F. Ganong, Review of Medical Physiology, 26th Edition, Tata McGraw-Hill, New Delhi, 2019.

2. J.G. Websster, ed., Medical Instrumentation, 3rd Edition, Wiley India Pvt. Ltd. 2009

Reference Books

1. A.M. Cook and J.G. Webster, eds., Medical Devices and Human Engineering, Taylor & Francis, 2014

2. R.S.Khandpur,"Handbook of Biomedical Instrumentation", 2nd edition, Tata McGraw - Hill, New Delhi, 2005

3. LeslieCromwell,"BiomedicalInstrumentationandMeasurement",Prentice-Hall, New Delhi, 2011.

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination

B. Tech. Mechanical Engineering

Open Elective – II

20ECE302 VLSI DESIGN

L	T	P	C
3	0	0	3

Pre-requisite: None

Course Description:
This course describes about various VLSI design methodologies, fundamentals of CMOS technology. It incorporates basics of MOSFET models, CMOS design rules, Design of VLSI Systems, combinational logic design, sequential logic design, logic families and VLSI Design flow.

Course Objectives:
This course enables students to

1. Study the fundamentals of CMOS circuits and its characteristics
2. Learn the design and realization of combinational digital circuits.
3. Learn the design and realization of sequential digital circuits.
4. Architectural choices and performance tradeoffs involved in designing and realizing the circuits in CMOS technology are discussed
5. Learn the different FPGA architectures and testability of VLSI circuits.

UNIT I INTRODUCTION TO MOS TRANSISTOR 9 hours

MOS Transistor, CMOS logic, Inverter, Pass Transistor, Transmission gate, Layout Design Rules, Gate Layouts, Stick Diagrams, Long-Channel I-V Charters tics, C-V Charters tics, Non ideal I-V Effects, DC Transfer characteristics, RC Delay Model, Elmore Delay, Linear Delay Model, Logical effort, Parasitic Delay, Delay in Logic Gate, Scaling.

UNIT II COMBINATIONAL MOS LOGIC CIRCUITS 9 hours

Circuit Families: Static CMOS, Ratioed Circuits, Cascode Voltage Switch Logic, Dynamic Circuits, Pass Transistor Logic, Transmission Gates, Domino, Dual Rail Domino, CPL, DCVSPG, DPL, Circuit Pitfalls.

Power: Dynamic Power, Static Power, Low Power Architecture.

UNIT III SEQUENTIAL CIRCUIT DESIGN 9 hours

Static latches and Registers, Dynamic latches and Registers, Pulse Registers, Sense Amplifier Based Register, Pipelining, Schmitt Trigger, Monostable Sequential Circuits, Astable Sequential Circuits.

Timing Issues: Timing Classification Of Digital System, Synchronous Design.

UNIT IV DESIGN OF ARITHMETIC BUILDING BLOCKS AND SUBSYSTEM 9 hours

Arithmetic Building Blocks: Data Paths, Adders, Multipliers, Shifters, ALUs, power and speed tradeoffs, Case Study: Design as a tradeoff.

Designing Memory and Array structures: Memory Architectures and Building Blocks, Memory Core, Memory Peripheral Circuitry.

UNIT V IMPLEMENTATION STRATEGIES AND TESTING 9 hours

FPGA Building Block Architectures, FPGA Interconnect Routing Procedures. Design for Testability: Ad Hoc Testing, Scan Design, BIST, IDDQ Testing, Design for Manufacturability, Boundary Scan

B. Tech. Mechanical Engineering

Course Outcomes:

Upon successful completion of the course, students will be able to

1. Realize the concepts of digital building blocks using MOS transistor.
2. Design combinational MOS circuits and power strategies
3. Design and construct Sequential Circuits and Timing systems.
4. Design arithmetic building blocks and memory subsystems.
5. Apply and implement FPGA design flow and testing.

Text Books:

1. Neil H.E. Weste, David Money Harris "CMOS VLSI Design: A Circuits and Systems Perspective", 4th Edition, Pearson , 2017.

2. Jan M. Rabaey ,Anantha Chandrakasan, Borivoje. Nikolic, "Digital Integrated Circuits:A Design perspective", Second Edition , Pearson , 2016.

Reference Books

1. Operating Systems - Internals and Design Principles. Stallings, 6th Edition2009. Pearson education.

2. William Stallings, "Operating Systems – Internals and Design Principles", 7th Edition, Prentice Hall, 2011.

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination

B. Tech. Mechanical Engineering

Open Elective – II

20CST301 OPERATING SYSTEMS

L	T	P	C
3	0	0	3

Pre-requisite: 20CSE101, 20CSE102

Course Description:
Student will understand Modern Operating System and their principles. The course will cover theory as well as practice aspects of a subject through scheduled lectures and labs, course will cover details of processes, CPU scheduling, memory management, file system, storage subsystem, and input/output management.

Course Objectives:

1. To understand the basic concepts and functions of operating systems
2. To understand Processes and Threads
3. To analyze Scheduling algorithms
4. To understand the concept of Deadlocks
5. To analyze various memory management schemes
6. To understand I/O management and File systems

UNIT I OPERATING SYSTEMS OVERVIEW 9 hours

Operating system overview: Objectives – functions - Computer System Organization-Operating System Structure - Operating System Operations- System Calls, System Programs.

UNIT II PROCESS MANAGEMENT 9 hours

Processes: Process Concept - Process Scheduling - Operations on Processes – Inter process Communication. Process Synchronization: The Critical-Section Problem - Semaphores - Classic Problems of Synchronization – Monitors. Case Study: Windows 10 operating system

UNIT III SCHEDULING AND DEADLOCK MANAGEMENT 9 hours

CPU Scheduling: Scheduling Criteria - Scheduling Algorithms. Deadlocks: Deadlock Characterization - Methods for Handling Deadlocks - Deadlock Prevention - Deadlock Avoidance - Deadlock Detection - Recovery from Deadlock. Case Study: MAC operating system

UNIT IV STORAGE MANAGEMENT 9 hours

Main Memory: Swapping - Contiguous Memory Allocation, Segmentation, Paging. Virtual Memory: Demand Paging - Page Replacement - Allocation of Frames - Thrashing. Case Study: Android operating system

UNIT V MASS STORAGE MANAGEMENT 9 hours

Mass Storage Structure: Disk Structure - Disk Scheduling - Disk Management. File-System Interface: File Concepts, Directory Structure - File Sharing – Protection. File System. Case Study: Linux operating system

B. Tech. Mechanical Engineering

Course Outcomes:

Upon successful completion of the course, students will be able to

1. Understand operating system program, structures and operations with system calls.
2. Apply the process management concept for real time problems
3. Illustrate CPU scheduling algorithms and to handle the deadlock for the given situation.
4. Explain the concepts of various memory management techniques
5. Summarize the storage concepts of disk and file.

Text Books:

1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, "Operating System Concepts", 10th Edition, John Wiley and Sons Inc., 2020.
2. Richard Petersen, "Linux: The Complete Reference", 6th Edition, Tata McGraw-Hill, 2008

Reference Books

1. Operating Systems - Internals and Design Principles. Stallings, 6th Edition2009. Pearson education.
2. William Stallings, "Operating Systems – Internals and Design Principles", 7th Edition, Prentice Hall, 2011.

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination

B. Tech. Mechanical Engineering

Open Elective – II

20CSE301 JAVA PROGRAMMING

L	T	P	C
3	0	0	3

Pre-requisite: None

Course Description:
Basics of Object-Oriented Programming - objects, classes, polymorphism, inheritance, static and dynamic binding. Object Oriented Programming using Java-classes, interfaces, inheritance, polymorphism, method dispatch, features for encapsulation and modularity.

Course Objectives:
1. Understand object-oriented programming concepts, and apply them in solving problems.
2. Learn the principles of inheritance and polymorphism; and demonstrate how they relate to the design of abstract classes.
3. To Introduce the implementation of packages and interfaces.
4. Learn the concepts of exception handling and multithreading.
5. Learn the design of Graphical User Interface using applets and swing controls.

UNIT I INTRODUCTION TO OOPS CONCEPTS AND CLASSES 9 hours

Introduction to Object Oriented Programming, Java buzzwords, Java Programming Basics, Sample programs, Data types and operators, Control statements.
Classes: Classes, Objects, Methods, Constructors, this and static keywords, Method and Constructor Overloading, Access modifiers, Polymorphism
Arrays: One Dimensional and multi-dimensional arrays.

UNIT II STRINGS, INHERITANCE, INTERFACES, AND PACKAGES 9 hours

Strings: Strings, String Handling - Inheritance: Basics, Usage of Super, Multi-level hierarchy, Method overriding, Abstract class, Final keyword. - Interfaces: Creating, Implementing, Using, Extending, and Nesting of interfaces - Packages: Defining, Finding and Importing packages, Member Access.

UNIT III EXCEPTION HANDLING &MULTI-THREADING 9 hours

Exception Handling: Fundamentals, Types, Multiple catch clauses, Nested try blocks, Thrown Class, Using Finally and Throws, Built-in exceptions, User-defined exceptions.
Multi-threading: Thread Class, Runnable interface, creating multiple threads, life cycle of thread, thread properties, synchronization, thread communication, suspending, resuming and stopping threads.

UNIT IV I/O STREAMS AND COLLECTION FRAME WORK CLASSES 9 hours

I/O Streams: Byte Stream Classes and Character Stream Classes.
Collection Frame work : Hierarchy of collection framework, Array-List, Linked-List, Vector, Stack, Queue, Priority Queue, Hash Set, Linked Hash Set, Tree Set.

UNIT V GUI PROGRAMMING AND EVENT HANDLING 9 hours

Swing – Introduction, limitations of AWT, MVC architecture, components, containers, Event Handling-Handling mouse and keyboard events, Exploring Swing- JApplet, JFrame and JComponent, Icons and Labels, text fields, buttons – The JButton class, Check boxes, Radio buttons, Combo boxes, Tabbed Panes, Scroll Panes, Trees, and Tables. JDBC: Connecting to Database, querying a database and processing the results, updating data with JDBC.

B. Tech. Mechanical Engineering

Course Outcomes:

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

1. Choose object-oriented programming concepts for problem solving.
2. Create and use packages and interfaces.
3. Develop multithreaded applications with synchronization.
4. Provide computed based solutions by using java collection framework and I/O classes.
5. Design GUI based applications.

Text Books:

1. Java The Complete Reference, Herbert Schildt, MC GRAW HILL Education, 9th Edition, 2016.

Reference Books

1. Core Java Volume I – Fundamentals, by Cay S. Horstmann, Gary Cornell Pearson Education Ninth Edition
2. "Java Fundamentals - A Comprehensive Introduction", Herbert Schildt and Dale Skrien, **Special Indian Edition, McGrawHill, 2013.**
3. "Java – How to Program", Paul Deitel, Harvey Deitel, PHI.
4. "Thinking in Java", Bruce Eckel, Pearson Education.
5. Java and Object Orientation, an introduction, John Hunt, second edition, Springer.

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination

B. Tech. Mechanical Engineering

Open Elective – II

20CSE302 MULTIMEDIA TECHNOLOGIES

L	T	P	C
3	0	0	3

Pre-requisite: None

Course Description:
This course aims to introduce the students to Multimedia technologies and their usage in real world applications. This course covers introduction to multimedia, different image, video and audio formats, image coding and compression techniques, I/O technologies, Multimedia network and Multimedia Security and Forensics.

Course Objectives:
1. To provide the foundation knowledge of multimedia technologies.
2. To provide the knowledge about media characteristics, compression standards, multimedia representation, data formats, multimedia technology development.
3. To understand Multimedia security and forensics.
4. To understand multimedia components efficiently
5. To develop integrated, collaborative multimedia systems

UNIT I INTRODUCTION **9 hours**

Introduction to Multimedia: Multimedia Elements – Multimedia applications – Evolving technologies for Multimedia – Defining objects for Multimedia systems – Multimedia Data interface standards – Multimedia Databases, Multimedia Architecture – Multimedia Documents

UNIT II COMPRESSION, ANIMATION , FILE FORMATS **9 hours**
Compression, Decompression, Binary Image Compression Schemes, Types of Compression, Image Compression, Video Compression, Audio Compression. Principles of animation, 2D, 3D animation.
File formats: Rich Text Format – TIFF File Format – Resource Interface File Format – MIDI File Format - JPEG DIB File Format.

UNIT III MULTIMEDIA TECHNOLOGIES **9 hours**
Multimedia I/O Technologies: Image Scanners – Digital Voice and Audio – Digital Camera – Video Images – Full Motion Video -Video Motion Analysis.

UNIT IV MULTIMEDIA PROTOCOLS **9 hours**
Protocol - QOS Issues - RTP, RTCP, RTSP, SIP - Media on demand –ITV - STB Broadcast Schemes for VoD Buffer Management- Multimedia over wireless networks.

UNIT V SECURITY ATTACKS **9 hours**
Multimedia encryption - Digital Watermarking. Security Attacks- Digital Forensics taxonomy, goals/requirements - Forensic Data Acquisition -Forensics Analysis and Validation.

B. Tech. Mechanical Engineering

Course Outcomes:

Upon completion of this course, students should be able to

1. Understand the characteristics of different media and the representations of different multimedia data formats.
2. Understand the characteristics of Image, Audio and Video systems and takes into considerations in multimedia techniques design and implementation.
3. Describe different coding and compression principles and compare different compression techniques.
4. Design multimedia components efficiently
5. Develop integrated, collaborative multimedia system

Text Books:

1. Li, Ze-Nian and Mark S. Drew, "Fundamentals of Multimedia", Prentice Hall of India, 2004.

2. Steinmetz Ralf and K. Nahrstedt "Multimedia: Computing, Communications & Applications",Pearson Education, 1995.

Reference Books

1. Ralf Steinmetz and Klara, "Multimedia Computing, Communications and Applications", Pearson Education, 2009
2. Chun-Shien Lu, "Multimedia Security : Steganography and Digital Watermarking techniques for Protection of Intellectual Property", Springer Inc 2007

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination

Open Elective – IV

B. Tech. Mechanical Engineering

Open Elective - IV

20PHY303 THIN FILM TECHNOLOGY AND ITS APPLICATIONS

L	T	P	C
3	0	0	3

Pre-requisite: None

Course Description:

Nucleation, crystallization, surface energy, various thin film coating processes including both physical vapour deposition such as evaporation, sputtering, pulsed laser deposition and chemical vapour deposition, spray coating, and other methods such as spin-coating, plasma polymerization, Langmuir Blodgett, transport phenomena in thin films, various properties of thin films, techniques and method to characterize thin films, current application of thin film, introduction to fabrication of thin film devices

Course Objectives:

1. To provide students with a comprehensive overview on the fundamentals of thin film preparation and characterization.
2. To enable the students to develop a thorough understanding of how core physics can be used to understand thin film deposition processes.
3. To establish the correlation between processing variables and materials characteristics and performance within the framework of key modern technologies.
4. To realize thin film applications to science and technology

UNIT I PHYSICS OF THIN FILMS 8 hours

Introduction - Role of thin films in devices - Thin film definition - Crystalline and amorphous films - Crystal defects - Nucleation and growth - film formation.

UNIT II THIN FILM DEPOSITION TECHNIQUES 10 hours

Physical methods of films deposition-evaporation, e-beam, sputter deposition, pulsed laser, molecular beam epitaxy. Chemical methods of film deposition -Deposition of Inorganic films from Solutions-Chemical vapour deposition - Electrolysis, Anodization, Spray pyrolysis, Other techniques: Langmuir Blodgett and Spin Coating.

UNIT III PROPERTIES OF THIN FILMS 8 hours

Structural-Optical-Electrical-Magnetic-Mechanical and Thermal properties of thin films.

UNIT IV CHARACTERIZATION OF THIN FILMS 10 hours

Imaging Techniques (SEM, AFM, TEM) - Structural Techniques (XRD, Raman)-Optical Techniques (UV-Vis-NIR, PL)-Electrical Techniques (Hall Effect, IV, CV)-Magnetic Techniques (EPR, H-V curve)-Mechanical Techniques (Hardness testing)-Thickness measurement (profilometer, ellipsometry).

UNIT V APPLICATIONS OF THIN FILMS 9 hours

Transparent conducting coating - Optical coating – Solar cells – Photocatalytic – Sensors - Superconductivity- Superhard coatings – Thin film transistors.

B. Tech. Mechanical Engineering

Course Outcomes:

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

1. Discuss the differences and similarities between different vacuum based deposition techniques, evaluate and use models for nucleating and growth of thin films.
2. Asses the relation between deposition technique, film structure, and film properties.
3. Know the typical thin film applications.
4. Motivate selection of deposition techniques for various applications.

Text Books:

1. Thin Film Deposition: Principles and Practice, Donald L. Smith, McGraw Hill, Singapore, 2001.
2. Maissel, L.I and Glang. R, "Handbook of thin film technology", McGraw Hill, 1970.

Reference Books:

1. Thin film phenomena / Kasturi L. Chopra, New York: McGraw-Hill, c1969.
2. G. Cao, "Nanostructures & Nanomaterials: Synthesis, Properties & Applications" Imperial College Press, 2004.
3. G. Cao, "Nanostructures & Nanomaterials: Synthesis, Properties & Applications" Imperial College Press, 2004.
4. Thin film processes, John L Vossen, Werner Kehn editors, Academic Press, New York, 1978.
5. Thin film physics / O.S. Heavens, London: Methuen, c1970.

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination

B. Tech. Mechanical Engineering

Open Elective - IV

20CHE303 INTRODUCTION TO NANO SCIENCE AND TECHNOLOGY

L	T	P	C
3	0	0	3

Pre-requisite: None

Course Description:
This is primarily a lecture course which brings together relevant knowledge from the disciplines of physics and chemistry to give students a fundamental understanding of the integrated multidisciplinary nature of Nanotechnology.

Course Objectives:

1. To understand the emergence of nanoscience and technology through history.
2. The various process techniques available for nanostructured materials.
3. The role of nanotechnology in electronics how basic nano-systems work
4. To use physical reasoning to develop simple nanoscale models to interpret the behaviour of such physical systems

UNIT I MOLECULE TO MATERIALS: BASICS OF NANOTECHNOLOGY **8 hours**

History & emergence (Feynman to present) of Nanoscience and Nanotechnology, Challenges in Nanotechnology. Atomic Structures: Rutherford and Bohr's model of atom. Bohr's model to Quantum: Wave function, Uncertainty principle, Orbital quantum numbers, Shape of the orbitals. Types of simple crystal structures, defects in crystals.

UNIT II TYPES AND SYNTHESIS OF NANOSTRUCTURES **10 hours**

Definition of a Nano system - Zero Dimensional (OD), One Dimensional (1D) - Two Dimensional (2D) - Three Dimensional (3D) nanostructured materials. Nanoscale building blocks, Top-down and Bottom-up approaches. Synthesis of Nanomaterials – Physical & Chemical methods: Chemical Vapour Deposition (CVD), Atomic Layer Deposition (ALD), Chemical Reduction, Co-precipitation, Emulsion Polymerization (Polymer and Organic NPs), Sol-Gel, Green synthesis of Nanoparticle (NP).

UNIT III PROPERTIES OF NANOMATERIAL **8 hours**

Thermal, Mechanical, Optical, Electrical and Magnetic properties of nanomaterials (Metal oxides, Ceramics, Nanocomposites, Semiconductors). Carbon age materials: CNTs, and other Carbon-based materials). Effect of size and shape on the properties of nanomaterials.

UNIT IV CHARACTERIZATION OF NANOMATERIALS **10 hours**

Structure: Powder XRD (SAXS); Composition: XPS; Thermal: TG-DTA; Optical & Electron microscopes: Atomic force microscopes (AFM), Scanning electron microscope (SEM), Transmission electron microscope (TEM); Magnetic characterization (SQUID).

UNIT V APPLICATIONS OF NANOMATERIALS **9 hours**

Molecular electronics and nano-electronics – LED applications, Quantum electronic devices - CNT based transistor and Field Emission Display – Biological (anti-bacterial, anti-fungal, anti-microbial) applications - Biochemical sensor - Membrane based water purification, Target based drug delivery system.

B. Tech. Mechanical Engineering

Course Outcomes:

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

1. Understand the correlation between atomic, molecular structures and nanomaterials
2. Classify the types and synthesis the nanomaterials based on the needs of the society and environment.
3. Infer and interpret the properties of nanomaterials
4. Apply the knowledge of characterization tools towards making the sustainable engineering products.
5. Illustrate the application of various nanomaterials in daily life, industry towards the sustainable development.

Text Books:

1. M. Wilson, K. Kannangara, G. Smith, M. Simmons, and B. Raguse, Nanotechnology: Basic science and Emerging technologies, Overseas Press India Pvt Ltd, New Delhi, First Edition, 2005.
2. C. N. R. Rao, A. Muller, and A. K. Cheetham (Eds), The chemistry of nanomaterials: Synthesis, properties and applications, Wiley VCH Verlag Gmbh & Co, Weinheim, 2004.
3. Kenneth J. Klabunde (Eds), Nanoscale Materials Science, John Wiley & Sons, InC, 2001.
4. C. S. S. R. Kumar, J. Hormes, and C. Leuschner, Nanofabrication towards biomedical applications, Wiley - VCH Verlag GmbH & Co, Weinheim, 2004.
5. T. Pradeep, Nano: The Essentials, Understanding Nanoscience and Nanotechnology, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2007.

Reference Books

1. W. Rainer, Nano Electronics and information Technology, Wiley, 2003.
2. K. E. Drexler, Nano systems, Wiley, 1992.
3. G. Cao, Nanostructures and Nanomaterials: Synthesis, properties and applications, Imperical College Press, 2004.
4. P. Yang, Chemistry of Nanostructured Materials, World Scientific Publishers, 2005.

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination

B. Tech. Mechanical Engineering

Open Elective - IV

20CHE304 COMPUTATIONAL METHODS IN MATERIALS SCIENCE AND ENGINEERING

L	T	P	C
3	0	0	3

Pre-requisite: Exposure to Introductory engineering mathematics, introductory materials science and introductory programming courses is preferred.

Course Description:

This course deals with various computational approach and mathematical methods to understanding and apply different concepts in materials science and engineering.

Course Objectives:

1. To get exposed to the basic concepts in Materials Science and Engineering.
2. To understand the basic concepts of Programming and Graphical plotting.
3. To introduce the basic concepts of Data types and handling of various data.
4. To familiarize the basic concepts of modelling and simulation.
5. To acquire and apply the current knowledge and trends in the field of Computational Materials Science.

UNIT I INTRODUCTION TO COMPUTATIONAL MATERIALS SCIENCE AND ENGINEERING **9 hours**

Concepts in materials science and engineering; use of computers and freely available open source software to: data handling; understand concepts and solve problems of engineering interest.

UNIT II PROGRAMMING AND PLOTTING **9 hours**

Introductions to the advanced concept C programming language; open source software for numerical computations and visualization (gnuplot, GNU Octave, Scilab); introduction to the LaTeX software for report preparation along with other miscellaneous software and programs.

UNIT III DATA TYPES AND HANDLING TECHNIQUES **9 hours**

Classification, and understanding of data properties, data handling - plotting, fitting, functional forms, interpolation, and integration.

UNIT IV COMPUTATIONAL MODELING AND SIMULATIONS **9 hours**

Understanding the materials properties; atomistic and electronic modelling of materials; concepts in molecular dynamics and its application using Quantum ESPRESSO.

UNIT V CURRENT TRENDS IN COMPUTATIONAL MATERIALS SCIENCE **9 hours**

Applied materials for various engineering field; research literature exploration; real-time application of computational methods in materials science and engineering, mini-project.

B. Tech. Mechanical Engineering

Course Outcomes:

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

1. Understand the importance and applications of computational methods in Materials Science and Engineering.
2. Be familiarized with the tools of the trade, namely programming and graphical plotting.
3. Be able to understand and access the various types of data sets and appropriately handle it to productively work with it.
4. Get the knowledge about handling various open source computational tools and their effective usage to do computational modeling and simulations.
5. Be familiarized with up to date trends in computational materials science by taking up real time research problems and provide solutions.

Text Books:

1. Computational Materials Science: An Introduction, Second Edition 2nd Edition, by June Gunn Lee, 2014
2. Materials science and engineering: an introduction, William D Callister, Sixth edition, John Wiley & Sons, 2013.
3. The C programming language, Brian W Kernighan and Dennis M Ritchie, Second edition, PHI Learning Private Limited, 2010.
4. Materials science and engineering: a first course, V Raghavan, Fifth edition, PHI Private Limited, 2008.
5. Physical metallurgy principles, Robert E. Reed-Hill, Second edition, Affiliated East-West Press Pvt. Limited, 2008.
6. An introduction to materials science and engineering, Kenneth M Ralls, Thomas H Courtney, and John Wulff, Wiley India Pvt. Ltd., 2011.

Reference Books

1. Materials Science and Engineering,V Raghavan,Prentice-Hall India, 2004
2. Advanced Engineering Mathematics, E Kreyzig, Wiley-India,1999.
3. A Review of Computational Methods in Materials Science, International Journal of Molecular Sciences 10(12):5135-216

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination

B. Tech. Mechanical Engineering

Open Elective - IV

20CE304 GREEN BUILDINGS AND ENERGY CONSERVATION

L	T	P	C
3	0	0	3

Pre-requisite: None

Course Description:
The course covers various aspects of bioclimatic architecture like climate sensitive design, passive solar architecture, Water management, green building materials and construction techniques.

Course Objectives:

1. The course introduces concepts of sustainability and bioclimatic design in planning, construction and life of buildings.
2. This course intends to equip students with technical knowledge of energy-efficient green buildings
3. This course guide students, through projects, to apply concepts and ideas for the design of a green building by introducing them to green initiatives and ratings.
4. This course also initiates students in basics of functional design and drawing of the various buildings using the above concepts.

UNIT I GREEN BUILDING CONCEPTS 9 hours

Introduction to bioclimatic architecture - Sustainability in building science and Functional planning - Orientation - Elements of building design and drawing - Building regulations and bylaws - Traditional and VernacularArchitecture - Climate zones - Design Charts - sun path diagram - Solar angles - Indices of thermal comfort - Vernacular buildings in different climate zones.

UNIT II CLIMATE RESPONSIVE SCIENTIFIC PROCESS OF DESIGN 9 hours

Introduction - various steps in Site planning - Plan form Building envelope Land form -Topography - vegetation - water bodies; Orientation - S/V ratio - P/A ratio - Walls, Fenestration - Roof and floors - Active and passive solar strategies - Passive solar architecture.

UNIT III THERMAL FLOW IN BUILDINGS 9 hours

Calculation of thermal conductance - Heat flow through different building elements - Ventilation and day lighting- Design and placement of openings- Water management in buildings- Techniques to recycle, reuse and harvest water.

UNIT IV GREEN BUILDING MATERIALS AND CONSTRUCTION 9 hours

Material properties - Energy efficiency using various materials - emerging new materials Construction techniques- Techniques for roof, wall and foundations.

UNIT V ECONOMY OF GREEN BUILDING 9 hours

Cost of building - operation and maintenance - Green building rating system - Evaluation criteria of LEED - TERI GRIHA case studies - Case studies in different climate zones.

B. Tech. Mechanical Engineering

Course Outcomes:

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

1. Use various regulations and by laws for green building construction0.
2. Do site planning for Green Building.
3. Compute thermal flow through different building elements
4. Identify energy efficient building materials
5. Compute cost of building/operation and maintenance

Text Books:

1. Krishnan, A., Baker, N., Yannas, S., & Szokolay, S. (Eds.). (2001). Climate responsive architecture, a design handbook for energy efficient buildings. New Delhi: Tata McGraw- Hill Publishing Company.
2. TERI & ICAEN (InstitutCatalad'Energia). (2004). Sustainable building design manual (Vol. II). New Delhi: The Energy and Resources Institute(TERI) Press.

Reference Books

1. Bureau of Indian Standards. (1995). SP:41, Handbook on functional requirements of buildings (other than industrial buildings) (First reprint ed.). New Delhi: Bureau of Indian Standards.
2. Indian Green Building Council, LEED-India. (2011). LEED 2011 for India- Green building rating system, abridged reference guide for new construction and major renovations (LEED India NC). Hyderabad: Indian Green Building Council.
3. Koenigsberger, O., ingersoll, T. G., Mayhew, A., & Skozolay, S. V. (2011). Manual of Tropical Housing and Building. Hyderabad: Universities Press.
4. Prabhu, Balagopal T S, K Vincent Paul, and C Vijayan. Building Design and Drawing. Calicut: Spades Publishers, 2008.
5. Szokolay, S. V. (2008). Introduction to Architectural Science - The Basis of sustainable Design (Second ed.). Architectural Press/Elsevier.
6. The Energy and Resources Institute (TERI). (2011). Green Rating for Integrated Habitat Assessment (GRIHA) manual. New Delhi: TERI press.
7. Journals: Energy and Buildings, Building and Environment, Other relevant publications.
8. National Building Code, Bureau of Indian Standards: New Delhi. 2005; Building Bye laws and building rules of selected Indian urban and rural areas
9. Swamy, N. K., & Rao, A. K. (2013). Building planning and Drawing,New Delhi, CharotharPublishing House

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination

B. Tech. Mechanical Engineering

Open Elective - IV

20CE305 ENVIRONMENTAL ENGINEERING

L	T	P	C
3	0	0	3

Pre-requisite: None

Course Description:
The course covers demand, quality and treatment of water along with characterization, water and wastewater treatment plant units and design , low cost treatment of wastewater and household drainage. Similarly, air pollution, noise pollution and solid waste management are also included. Further the course also covers basic laboratory

Course Objectives:

1. To explain different sources of water, water quality standards, water demands, distribution of water, population forecast, characteristics of water.
2. To analyze various water treatment plant units and their design considerations, advanced water treatment systems.
3. To explain the generation and collection of wastewater; wastewater treatment plant design, various wastewater treatment units and sludge treatment.
4. To explain various impacts of air and noise pollution and various methods to control them air and noise pollution
5. To describe about solid waste generation, characterization, impacts and various management techniques

UNIT I WATER SUPPLY ENGINEERING 9 hours

Water- Sources of Water, Water quality standards, Quantity of water: water demands, percapita demand, design period, population forecast, fluctuation in demand. General requirement for water supply: Sources, Types of intakes, Pumping and distribution of water; Quality of water: Physical, chemical, and biological characteristics of water and significance, necessity of treatment, water quality standards for various water uses.

UNIT II WATER TREATMENT 9 hours

Engineering system for water purification: Aeration, Screening, Coagulation and Flocculation, Sedimentation, Softening, Filtration, Disinfection; Methods of treatment: Removal of color, tastes and odor control, removal of iron and manganese, fluoridation and defluorination. Advanced water treatment: Ion exchange, electro-dialysis, RO (principles only.

UNIT III WASTEWATER TREATMENT 9 hours

Generation and collection of wastewaters- sanitary, storm and combined sewerage systems, quantities of sanitary wastes and storm water, design of sewerage system. Engineered system for wastewater treatment: Primary treatment, Screening, Grit removal, Sedimentation, Sedimentation aided with coagulation. Secondary treatment: Basis of microbiology, Growth and food utilization, Suspended growth systems, Attached growth systems, Secondary clarification, Disinfections of effluents; Sludge treatment and disposal: Sludge characteristics, thickening, disposal.

UNIT IV AIR AND NOISE POLLUTION 9 hours

Air - Composition and properties of air, urban air pollution, Air quality standards, Measures and major equipment for air pollution control, Noise - Basic concept, measurement, and various noise control methods.

UNIT V SOLID WASTE MANAGEMENT 9 hours

Solid waste management-Municipal solid waste, Composition, and various chemical and physical parameters of MSW, MSW management: Collection, transport, treatment, and disposal of MSW. Effects of solid waste on environment: effects on air, soil, water surface and ground, health hazards. Disposal of solid waste-segregation, reduction at source, recovery and recycle, Disposal methods.

Course Outcomes:

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

1. Estimate water demand and population forecasting and characteristics of water
2. Estimate water generation and perform basic design of the unit operations that are used in water treatment plants.
3. Explain various wastewater generation sources and different units of wastewater treatment and sludge treatment techniques
4. Describe the impacts of air and noise pollution and review various air and noise pollution control methods
5. Discuss about the impacts of solid waste and various solid waste management techniques

Text Books:

1. Environmenatal Engineering (Volume I & II) by S. K. Garg-Khanna Publishers.
2. Rao M and Rao H. V. N. Air Pollution, McGraw Hill Education, 2017.
3. Jagbir Singh and Ramanathan A. L., Solid Waste Management: Present and Future Challenges, I K International Publishing House Pvt. Ltd., 2009
4. Environmental Engineering by H. S. Peavy, D.R. Rowe and G. Tchobanoglous, MGH.

Reference Books

1. Birdie, G.S, Birdie, J.S., Water supply and sanitary Engineering, Including Environmental Engineering, Water and Air Pollution Laws and Ecology, Dhanpat Rai Publications, 1996.
2. Punmia, B.C, Ashok Kr Jain, Arun Kr Jain., Waste Water Engineering, Laxmi Publications, 1998.
3. Integrated Solid Waste Management, Tchobanoglous, Theissen & Vigil. McGraw Hill Publication
4. Metcalf & Eddy, Wastewater Engineering Treatment and Dispose, McGraw Hill Publication

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination

B. Tech. Mechanical Engineering

Open Elective – IV

20EEE304 ELECTRICAL SAFETY

L	T	P	C
3	0	0	3

Pre-requisite Nil 20EEE101

Course Description:
To provide a comprehensive exposure to electrical hazards, various grounding techniques, safety procedures and various electrical maintenance techniques.

Course Objectives:
This course enables students to

1. To impart knowledge on electrical hazards and safety equipment.
2. To analyze and apply various grounding and bonding techniques.
3. To select appropriate safety method for low, medium and high voltage equipment.
4. To understand how to participate in a safety team.
5. To carry out proper maintenance of electrical equipment by understanding various standards.

UNIT I ELECTRICAL HAZARDS 9 hours

Primary and secondary hazards- arc, blast, shocks-causes and effects-safety equipment- flash and thermal protection, head and eye protection-rubber insulating equipment, hot sticks, insulated tools, barriers and signs, safety tags, Classification of insulating materials, locking devices- voltage measuring instruments- proximity and contact testers-safety electrical one-line diagram-electrician's safety kit.

UNIT II GROUNDING AND BONDING 9 hours

General requirements for grounding and bonding- definitions- grounding of electrical equipment-bonding of electrically conducting materials and other equipment- connection of grounding and bonding equipment- system grounding- purpose of system grounding- grounding electrode system-grounding conductor connection to electrodes-use of grounded circuit conductor for grounding equipment- grounding of low voltage and high voltage systems Ground resistance measurement using megger.

UNIT III SAFETY METHODS 9 hours

The six step safety methods- pre job briefings- hot -work decision tree-safe switching of power system- lockout-tag out- flash hazard calculation and approach distances- calculating the required level of arc protection-safety equipment, procedure for low, medium and high voltage systems- the one minute safety audit.

UNIT IV SAFETY TEAM 9 hours

Electrical safety programme structure, development- company safety team- safety policy-programme implementation- employee electrical safety teams- safety meetings- safety audit-accident prevention-first aid- rescue techniques-accident investigation.

UNIT V MAINTENANCE OF ELECTRICAL EQUIPMENT 9 hours

Safety related case for electrical maintenance- reliability centred maintenance (RCM) - eight-step maintenance programme- frequency of maintenance- maintenance requirement for specific equipment and location- regulatory bodies- national electrical safety code- Indian standard for electrical safety in work place- occupational safety and health administration standards.

Course Outcomes:

After completing this Unit, students will be able to

1. Understand various types of dielectric materials, their properties in various conditions.
2. Analyze and apply various grounding and bonding techniques.
3. Select appropriate safety method for low, medium and high voltage equipment.
4. Participate in a safety team.
5. Carry out proper maintenance of electrical equipment by understanding various standards**.**

Text Book(s)

1. Dennis Neitzel, Al Winfield, 'Electrical Safety Handbook', McGraw-Hill Education, 4th Edition,2012.

Reference Books

1. John Cadick, 'Electrical Safety Handbook', McGraw-Hill School Education Group, 1994.

2. The Institution of Electric Engineers, 1994.

3. Ray A. Jones, Jane G. Jones, 'Electrical safety in the workplace', Jones & Bartlett Learning, 2000.

4. Tareev, 'Electrical Engineering Materials', Verlag Technik, Berlin

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination.

B. Tech. Mechanical Engineering

Open Elective – IV

20ECE303 EMBEDDED SYSTEMS

L	T	P	C
3	0	0	3

Pre-requisite None

Course Description:
The course will provide strong foundation on embedded system design. The course covers theory and logic to develop programming expertise. Student will understand application of embedded microcontrollers ARM.

Course Objectives:
This course enables students to

1. To provide knowledge on the basics, building blocks of Embedded System.
2. To provide basic of operating system and Real time programming languages
3. To teach automation using scheduling algorithms and Real time operating system.
4. To understand firmware design and Architectural Support for Operating Systems for various applications
5. To discuss on different Phases & Modeling of a new embedded product.

UNIT I THE CONCEPT OF EMBEDDED SYSTEMS 9 hours

Embedded System Design, Introduction to Embedded Hardware Elements, Sensors and Actuators, Embedded Processors, Memory Architectures. Embedded System vs. General Purpose computing systems, Examples of embedded systems, Embedded memories, Embedded microcontroller cores

UNIT II SOFTWARE ASPECTS OF EMBEDDED SYSTEMS – I 9 hours

Operating System Basics, types of Operating Systems, Task and Task States, Semaphores and shared Data, RTOS services and design using RTOS, Tasks, Process and Threads, Multiprocessing and Multitasking, Real time programming languages.

UNIT III SOFTWARE ASPECTS OF EMBEDDED SYSTEMS- II 9 hours

Task Communication: Shared Memory, Message Passing, Remote Procedure Call and Sockets, Task Synchronization: Task Communication Synchronization Issues, Task Synchronization Techniques, Device Drivers, how to Choose an RTOS, Integrated Development Environment (IDE).

UNIT IV FIRMWARE AND ARCHITECTURAL SUPPORT FOR OPERATING SYSTEMS 9 hours

Firmware and Bootloader, an introduction to operating systems, The ARM system control coprocessor Embedded ARM Applications, CP15 protection unit registers, CP15 MMU registers, ARM MMU architecture, Synchronization, Context switching, Input/Output, Example and exercises, The ARM7500 and ARM7500FE.

UNIT V MODELLING WITH HARDWARE/SOFTWARE DESIGN APPROACHES 9 hours

Modelling embedded systems- embedded software development approach -Overview of UML modelling with UML, UML Diagrams-Hardware/Software Partitioning, Co-Design Approaches for System Specification and modelling- Co-Synthesis- features comparing Single-processor Architectures & Multi-Processor Architectures-design approach on parallelism in uniprocessors & Multiprocessors.

B. Tech. Mechanical Engineering

Course Outcomes:

Upon successful completion of the course, students will be able to

1. To understand the functionalities of processor internal blocks, with their requirement
2. Understand the basics of operating systems and then to learn the programming language used for real time operating system.
3. systems and related terms.
4. Understand the role and features of RT operating system, that makes multitask execution possible by processors.
5. Understand that using multiple CPU based on either hard-core or softcore helps data overhead management with processing.

Text Book(s)

1. M.A. Mazdi & J.G. Mazdi, The 8051 Microcontroller and Embedded System, Pearson Education India , 2013
2. Andrew N. Sloss & Dominic Symes, ARM System Developer's Guide Designing and Optimizing System Software, Morgan Kaufmann Publisher, 2004.

Reference Books

1. Steve Furber, Arm System-On-Chip Architecture, 2000.
2. J.K. Peckol, Embedded Systems A contemporary Design Tool, Wiley Student Edition , 2008
3. K J Ayala, The 8051 Microcontroller Architecture, Programming and Application, Penram International Publishing (India)
4. S. Heath, Embedded Systems Design, Elsevier, 2009

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination.

B. Tech. Mechanical Engineering

Open Elective – IV

20ECE304 DSP ARCHITECTURE

L	T	P	C
3	0	0	3

Pre-requisite 20ECE110

Course Description:

The course will provide an insight into the architectures of DSP processors for handling the bottlenecks in executing DSP algorithms. On the application side the students can develop FPGA based DSP Systems and can understand the concept of multicore DSP as HPC infrastructure

Course Objectives:

This course enables students to

1. Understand the programmable digital signal processing hardware.
2. study the architecture of TMS320CX processor and block diagram
3. Know syntax and write the assembly language programming for digital signal processors.
4. Study the architecture of FPGA based DSP for various applications.
5. Study about High-Performance Computing using P-DSP.

UNIT I PROGRAMMABLE DSP HARDWARE 9 hours

Introduction: Digital signal-processing system, discrete Fourier Transform (DFT) and fast Fourier transform (FFT), differences between DSP and other microprocessor architectures. Processing Architectures (von Neumann, Harvard), DSP core algorithms (FIR, IIR, Convolution, Correlation, FFT), IEEE standard for Fixed and Floating-Point Computations, Special Architectures, Modules used in Digital Signal Processors (like MAC unit, Barrel shifters), On-Chip peripherals, DSP benchmarking.

UNIT II STRUCTURAL AND ARCHITECTURAL CONSIDERATIONS 9 hours

Parallelism in DSP processing, Commercial digital Signal-processing Devices, Basics of TMS320C54x and C55x Families in respect of Architecture improvements and new applications fields, Data Addressing Modes of TMS32OC54xx., TMS320C5416 DSP Architecture, Memory Map, Interrupt System, Peripheral Devices, Illustrative Examples for assembly coding.

UNIT III VLIW ARCHITECTURE 9 hours

Current DSP Architectures, GPUs as an alternative to DSP Processors, TMS320C6X Family, Addressing Modes, Optimizations, Heuristics. Replacement of MAC unit by ILP, Detailed study of ISA, Assembly Language Programming, Code Composer Studio, Mixed C and Assembly Language programming, On-chip peripherals, Simple application developments as an embedded environment.

UNIT IV FPGA BASED DSP SYSTEMS 9 hours

Limitations of P-DSPs, FPGA based signal processing design-case study of a complete design of DSP processor.

UNIT V HIGH PERFORMANCE COMPUTING USING P-DSP 9 hours

Modified bus structures and memory access in PDSPs, special addressing modes in PDSPs, Preliminaries of HPC, MPI, OpenMP, multicore DSP as HPC infrastructure.

B. Tech. Mechanical Engineering

Course Outcomes:

After completing this Unit, students will be able to
1. Identify and formalize architectural level characterization of DSP hardware.
2. Design and test various digital signal processors.
3. Write assembly language programming for various digital signal processors.
4. Utilize FPGA based DSP hardware for Control, Audio and Video Signal processing applications.
5. Understand the High-Performance Computing using P-DSP.

Text Book(s)

1. B. Venkataramani, M. Bhaskar, "Digital Signal Processors: Architecture, Programming and Applications", Tata McGraw-Hill Education Private Limited, 2011.

2. Phil Lapsley; Jeff Bier; Amit Shoham; Edward A. Lee, "DSP Processor Fundamentals: Architectures and Features", Wiley-IEEE Press, 1997.

Reference Books

1. Emmanuel C. Ifeachor, Barrie W. Jervis, "Digital Signal Processing: A practical approach", Pearson-Education, PHI, 2002.

2. Sen M. Kuo, Woon-Seng S. Gan, "Digital Signal Processors: Architectures, Implementations, And Applications", Pearson/Prentice Hall, 2005.

3. Peter Pirsch, "Architectures for Digital Signal Processing", John Wiley & Sons, 2009

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination.

B. Tech. Mechanical Engineering

Open Elective – IV

20ECE305 COMMUNITY RADIO TECHNOLOGY

L	T	P	C
3	0	0	3

Pre-requisite

Course Description:

This course offers a comprehensive exploration of Community Radio, from foundational concepts to practical implementation. It begins with an introduction to the principles of Community Radio and guides students through the process of establishing a Community Radio Station (CRS). Key topics include Studio Technology, Operations and Management along with detailed instruction in Audio Pre-Production and Post-production techniques. Students will also gain essential knowledge of Radio Transmission technology, including the setup of an FM transmitter. By the end of the course, students will have a thorough understanding of Community Radio principles and the Practical skills required to effectively operate a Community Radio station.

Course Objectives:

This course enables students to

1. Associate the concept of fundamentals in Community Radio in Local Communication and development.
2. Gain knowledge of Studio technology and operations including Soundboards, Microphones, Recording, scheduling, content creation, and team coordination.
3. Develop skills in Audio Pre-production and post-production such as recording, editing, and mixing audio content.
4. Categorize the Radio Transmission Technology comprising signal requirements aligning with factors affecting Coverage and Shadow Areas.
5. Explore Radio Transmission technology essentials and understand the technical aspects of setting up and maintaining an FM transmitter.

UNIT I COMMUNITY RADIO FUNDAMENTALS AND SETUP 9 hours

Introduction to Radio Broadcasting in India - Community Radio: Evolution - Community Radio Policy – Technical principles; Components of a CR Station - Radio Waves and Spectrum - Basics of Electricity - Power Backup and Voltage Stabilization

UNIT II STUDIO TECHNOLOGY & OPERATIONAL PRACTICES 9 hours

Basics of Sound - Analog and Digital Audio - Components of the Audio Chain - Studio Acoustics; Good Engineering Practices for Studio Setup - Studio Equipment: Preventive & Corrective Maintenance - Content Distribution: Alternative Mechanisms

UNIT III AUDIO PRE & POST PRODUCTION 9 hours

Audio Hardware and Field Recording – Microphones - Audio Cables and Connectors - Free and Open-Source Software - Telephony for Radio - Landline Systems - GSM/CDMA - Voice Over Internet Protocol (VoIP); Sound Recording and Editing - Mixing and Mastering - File Formats and Compression Transmission - Storing and Retrieval

UNIT IV RADIO TRANSMISSION TECHNOLOGY 9 hours

Transmission Chain Overview – Live and Pre-recorded Transmission - Principles of FM Transmission – FM Transmitter console- Antenna System - Types of Mast/Towers - Layers of Atmosphere and Radio Wave Propagation - Factors Affecting Coverage and Shadow Areas - Signal Requirements and Coverage Planning Parameters

UNIT V FM TRANSMITTER SETUP 9 hours

Connecting Audio Feed to the Transmitter - Back Panel Connectors - Mounting and Connecting the Transmitter - Probable Causes of Failure of Transmitters - Fault Diagnostics and Corrective Maintenance - Transmitter Operation and Upkeep Issues

Course Outcomes:

Upon the completion of the course, Student will be able to

1. Interpret the evolution with a framework of Community Radio with Technical Principles and essential Radio Spectrums.
2. Apply Studio Technology and Operational practices with the components of the Audio Chain including Acoustics and Equipment maintenance.
3. Conduct Comprehensive Audio Pre & Post-production to operate field Recordings with Hardware and Open-source software to manage sound recording, editing, mixing, mastering, and file compression.
4. Infer the principles of FM transmission, Antenna systems, Radio wave propagation and factors affecting coverage.
5. Demonstrate knowledge of the connecting audio feeds for Transmitter setup by resolving operational Issues with corrective maintenance.

Text Book(s)

1. Pooja Murada R. Sreedher, “Community Radio in India”, Aakar Books, 2019.
2. Prof. Raj Misra , “Community Radio By the people, For the People”, Orange Books Publication, 2022
   Fraser, Colin, and Sonia Restrepo Estrada, “Community radio handbook”. Paris: Unesco, 2001.

Reference Books

1. Juliet Fox, “Community Radio’s Amplification of Communication for Social Change”, 7th Edition, Palgrave Macmillan (Springer International Publishing.), 2019.
2. Kanchan K. Malik, Vinod Pavarala, “Community Radio in South Asia: Reclaiming the Airwaves”, Routledge India, 2020.
3. Vinod Pavarala and Kanchan K. Malik, “Other voices: the struggle for community radio in India”,Sage Publications India Pvt Ltd, 2007.
4. Michael C. Keith, “The Radio Station: Broadcast, Satellite & Internet”, 7th Edition, Focal Press (Elsevier Inc.), 2007.
5. “Certificate in Community Radio Technology (CCRT)”
   https://www.cemca.org/resources/certificate-community-radio-technology-ccrt-0

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination.

B. Tech. Mechanical Engineering

Open Elective - IV

20CSE303 MOBILE APPLICATION DEVELOPMENT

L	T	P	C
3	0	0	3

Pre-requisite NIL

Course Description:

This course is concerned with the development of applications on Android platform. Android is used as a basis for the development of mobile applications. This course starts with the basic concepts of Java, history of android and architecture. It introduces the major building blocks that are used to develop an android application with examples. It also covers the development of applications using widgets, events, networking. It provides ideas on sensors, their types and writing programs based on sensor classes for application development.

Course Objectives:

This course enables students to

1. Understand Android history and its fundamentals and know the building blocks of android
2. Get idea on the creation of android user interface and its testing mechanisms
3. Identify the usage of threads, broadcast receivers, indents, services and their working methodology
4. Know about the storage mechanism in android using SQLite and the usage of content providers
5. Recognize the usage of android widgets and sensors in android based applications

UNIT I INTRODUCTION AND INSTALLATION OF ANDROID TOOLS **9 hours**

Android Overview – History – Android Versions - Android Flavors. Android Stack: Linux, Native Layer and Hardware Abstraction Layer (HAL) – ART - Application Framework: Native C++ Library – Applications: System and User Applications - Installation and Use of Android Tools: Installing the Android SDK - Anatomy of an Android Project - Drawable Resources – XML Introduction - Creating user interface using XML – Overview of Android Building Blocks – Logging Messages in Android

UNIT II USER INTERACTION **9 hours**

Example. Input Components – Text View – Image View – List View and Alert Dialogues – Menus: Popup, Options and Context Menus – Screen Navigation through App Bar – Recycler View – Material Design – Testing the User Interface: Expresso – Screen Navigation using Intents: Definition – Usage of Intends – Creation of Indents with example program – Lists and Adapters – Types of Adapters – Examples using Adapters

UNIT III THREADS, LOADERS AND ASYNCTASK LOADER, BROADCAST RECEIVERS, SERVICES **9 hours**

Threading in Android – AsyncTask – Loaders – AsyncTask Loader – Connecting to Internet: JSON - HTTP API, Apache HTTP Client, HTTP URL Connection - Broadcast Receivers: Custom Broadcasts – Broadcasting Intends and their related API - Boot Receiver - Alarms and system

services – Examples on alarms and services – Services: Services Life Cycle – Intent Service – Implementing Intent Service – Notifications: Managing Notifications

UNIT IV SAVING, RETRIEVING AND LOADING DATA 9 hours

Android File systems and Files - Action Bar: Preferences and Action Bar - Shared Preferences – App Settings - Databases on Android - SQLite - Status Contract Class, Update Refresh Service – Cursors – Backups - Content Providers: Overview – Role of Content Providers - - Content Provider Example Program – Content Resolver

UNIT V APPLICATIONS WIDGETS, INTERACTION AND SENSORS 9 hours

App Widgets: Creation of Application Widgets - Interaction and Animation: Live Wallpaper and Handlers - Sensors: Sensor API in Android - Motion Sensor, Position Sensor, Environmental Sensor, Sensor Values, Sensor Manager Class, Sensor Class, Sensor Event class, Sensor Event Listener interface, Compass Accelerometer and orientation Sensors, Sensor Examples.

Course Outcomes:

Upon successful completion of the course, students will be able to

1. Work on android basic components and Install android
2. Create User Interfaces with various Layouts and views using android building blocks
3. Work with Broadcast Receivers and Services
4. Create Database in Android, Store and Retrieve data using SQLite and Content Providers
5. Develop widgets, Wall papers for an android application and write programs based on Sensors

Text Book(s)

1. Android Programming-The Big Nerd Ranch Guide, Bill Philips, Christ Stewart, Kristin Mariscano, Big Nerd Ranch publishers, 3rd Edition
2. Android Programming for Beginners, John Horton, PACKT publishers
3. Learning Android , By Marko Gargenta & Masumi Nakamura, O'Reilly, II Edition
4. Android Application Development All in One for Dummies, Barry Burd, Wiley, 2nd Edition

Reference Books

1. Android application Development-Black Book, Pradeep Kothari, dreamtech
2. Android Programming - Unleashed, B.M.Harwani, Pearson Education, 2013
3. Head First Android Development: A Brain-Friendly Guide, Dawn Griffiths and David Griffiths, O'Reilly, 2nd Edition
4. Android System Programming, Roger Ye, PACKT publishers
5. Programming Android, By Zigurd Mednieks, Laird Dornin, G.Blake Meike & Masumi Nakamura, O'Reilly

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination.

B. Tech. Mechanical Engineering

Open Elective - IV

20CSE304 SOFTWARE PROJECT MANAGEMENT

L	T	P	C
3	0	0	3

Pre-requisite 20CSE115

Course Description:

Software Project Management is generally seen as a key component of successful software projects. Together with software techniques it can produce software of high quality. This course deals with the decisions and actions related to planning, organizing, leading, and controlling programs and projects. Students are expected to gain a comprehensive understanding of Strategy, organization and leadership in managing projects and understanding of Processes, methods and systems used to plan, schedule and monitor projects.

Course Objectives:

This course enables students to

1. To understand the basic concepts and issues of software project management.
2. To understand successful software projects that support organization's strategic goals.
3. Develop the skills for tracking and controlling software deliverables.
4. Understand and assess the cost of risk involved in a project management
5. Understand the various software management tools.

UNIT I SPM CONCEPTS 9 hours

Definition – components of SPM – challenges and opportunities – tools and techniques – managing human resource and technical resource – costing and pricing of projects – training and development – project management techniques.

Agile Methodology: Theories for Agile Management-Agile Software Development-Traditional Model Vs Agile Model-Classification of Agile Methods-Lean Production-SCRUM.

UNIT II SOFTWARE MEASUREMENTS 9 hours

Monitoring & measurement of Software development – cost, size and time metrics – methods and tools for metrics – issues of metrics in multiple projects.

UNIT III SOFTWARE QUALITY 9 hours

Quality in Software development – quality assurance – quality standards and certifications – the process and issues in obtaining certifications – the benefits and implications for the organization and its customers – change management.

UNIT IV RISK ISSUES 9 hours

The risk issues in Software development and implementation – identification of risks – resolving and avoiding risks – tools and methods for identifying risk management.

UNIT V SPM TOOLS 9 hours

Software project management using Primavera & Redmine - Case study on SPM tools.

B. Tech. Mechanical Engineering

Course Outcomes:

Upon successful completion of the course, students will be able to

1. Maintain software projects and monitor software project process

2. Design and develop project modules and assign resources

3. Understand software quality and project management techniques

4. Comprehend, assess, and calculates the cost of risk involved in a project management

5. Use Primavera & Redmine software management tools.

Text Book(s)

1. Richard H. Thayer, "Software Engineering Project Management", John Wiley & Sons, 2nd Edition-2001
2. Royce, Walker, "Software Project Management", Pearson Education, 2002 4. Kelker, S. A., "Software Project Management", Prentice Hall, 2003

Reference Books

1. Software Project Management, Bob huges, Mike cotterell, Tata McGraw Hill, New Delhi,2002.
2. Software Project Management: A Concise Study, S. A. Kelkar, PHI.
3. Software Project Management, Joel Henry, Pearson Education.
4. Software Project Management in practice, Pankaj Jalote, Pearson Education.
5. David J. Anderson and Eli Schragenheim, ―Agile Management for Software Engineering: Applying the Theory of Constraints for Business Results, Prentice Hall, 2003.

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination.

B. Tech. Mechanical Engineering

Open Elective - IV

20CST302 CLOUD COMPUTING

L	T	P	C
3	0	0	3

Pre-requisite -

Course Description:
This course will cover a top-down view of cloud computing, from applications and administration to programming and infrastructure. The aim is to provide skills and knowledge about operations and management in cloud technologies and design cloud infrastructure to meet the business needs.

Course Objectives:

1. To learn the design and development process involved in creating a cloud-based application.
2. To implement and use parallel programming using various tools.
3. To learn Various service models such as IaaS and PaaS and deployment models such as private, public, hybrid, and community.
4. To provide skills to design suitable cloud infrastructure that meets the business services and customer needs.
5. To identify various security and privacy issues in cloud.

UNIT I INTRODUCTION TO CLOUD COMPUTING 9 hours

Inception and need for cloud computing: Motivations from distributed computing predecessors - Evolution - Characteristics - Business Benefits – Challenges in cloud computing - Exploring the Cloud Computing Stack - Fundamental Cloud Architectures – Advanced Cloud Architectures - Specialized Cloud Architectures

UNIT II SERVICE DELIVERY AND DEPLOYMENT MODELS 9 hours

Service Models (XaaS): Infrastructure as a Service (IaaS) - Platform as a Service (PaaS) – Software as a Service(SaaS) - Deployment Models: Types of cloud - Public cloud - Private cloud – Hybrid cloud – Service level agreements - Types of SLA – Lifecycle of SLA- SLA Management.

UNIT III VIRTUALIZATION 9 hours

Virtualization as Foundation of Cloud – Understanding Hypervisors – Understanding Machine Image and Instances - Managing Instances – Virtual Machine Provisioning and Service Migrations

UNIT IV CLOUD COMPUTING: APPLICATIONS AND PARADIGMS 9 hours

Existing Cloud Applications and Opportunities for New Applications - Architectural Styles for Cloud Applications - Workflows: Coordination of Multiple Activities - Coordination Based on a State Machine Model: The ZooKeeper - The Map Reduce Programming Model - A Case Study: The GrepTheWeb Application

UNIT V CLOUD PLATFORMS AND SECURITY 9 hours

Comparing Amazon web services, Google AppEngine, Microsoft Azure from the perspective of architecture (Compute, Storage Communication) services and cost models. Cloud application development using third party APIs, Working with EC2. Security Clouds

Course Outcomes:

Upon successful completion of the course, students will be able to

1. Understand the evolution, principles, and benefits of Cloud Computing in order to assess existing cloud infrastructures to choose an appropriate architecture that meets business needs.
2. Decide a suitable model to capture the business needs by interpreting different service delivery and deployment models.
3. Understand virtualization foundations to cater the needs of elasticity, portability and resilience by cloud service providers.
4. Infer architectural style, workflow of real-world applications and to implement the cloud applications using map reduce programming models.
5. Design a cloud framework with appropriate resource management policies and mechanism

Text Books:

1. Rajkumar Buyya, James Broberg, Andrzej, M. Goscinski, Cloud Computing: Principles and Paradigms, Wiley, 1st Edition, 2013.
2. Dongarra, Jack, Fox, Geoffrey, Hwang, Kai,"Distributed and Cloud Computing",.1st Edition, Morgan Kaufmann, 2013.
3. Marinescu, Dan C. Cloud Computing: Theory and Practice. Morgan Kaufmann, 2017.

Reference Books:

1. Buyya, Rajkumar, Christian Vecchiola, and S. Thamarai Selvi. Mastering Cloud Computing: Foundations and Applications Programming, Tata Mcgraw Hill, 1st Edition, 2017.
2. Toby Velte, Anthony Velte, Robert Elsenpeter, Cloud Computing: A Practical Approach, Mc Graw Hill Education, 1st Edition, 2017.

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination.

Open Elective – V

B. Tech. Mechanical Engineering

Open Elective - V

20HUM301 PRINCIPLES OF MANAGEMENT

L	T	P	C
3	0	0	3

Pre-requisite NIL

Course Description:

The course provides students with a practical and concrete explanation of management concepts and techniques they will need to manage today's and tomorrow's organizations. The course will follow the "planning, organizing, leading, controlling" format of managerial functions while putting together many small pictures presented by individual modules into one bigger meaningful picture in which managerial knowledge would apply. At the end of the course students are expected to understand role of components of bigger picture and interactions between and among components.

Course Objectives:

The course is intended to:

1. Describe the concepts of Management theories, approaches and their application with organizations around us;

2. Know the concepts of planning and management;

3. Explain the basic concepts of organization, types and structure of organization;

4. Make the students know leading, good communication, theories of motivation; and

5. Explain controlling, operations management, value chain management and management audit.

UNIT I INTRODUCTION 9 hours

Introduction to Management and Organizations- Management definition, skills, roles, goals and functions of a manager, organization, value of studying management - Managing in a Global Environment- Global Perspective, Understanding global environment, - Social Responsibility and Managerial Ethics.

UNIT II PLANNING 9 hours

Decision-making process, Types of decisions and decision making conditions, styles, biases and errors, Planning: Meaning of planning, establishing goals and developing plans, contemporary issues in planning - Strategic Management-Importance of strategic management, strategic management process, types of organizational strategies, current issues in strategic management.

UNIT III ORGANIZING 9 hours

Organizational structures - HRM process, Contemporary issues in HRM – Departmentation – decentralization – delegation of Authority - Managing Change and Innovations.

UNIT IV COMMUNICATION, MOTIVATION AND LEADING 9 hours

Functions of communication, Inter-personal communication, Barriers of Communication – Understanding Information Technology- Motivation**:** Theories of motivation and current issues in motivation. Leading: Leaders and Leadership, Leadership theories - Leadership issues in twenty first century

UNIT V CONTROLLING 9 hours

Process of Control – Problems of Control Process-Types of Control – Techniques of Control-Essential conditions for effective control- Contemporary issues in control – Strategic role of Operations Management - Value Chain Management.

Management Audit: Objectives-Importance-Activities of Management Auditor.

Course Outcomes:

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

1. Understand the various concepts, approaches and theories of management in the real situation,

2. Analyze the concept of planning and apply on the decisions in strategic management,

3. Compare organization structure designs and chart diligently with theoretical learning concepts,

4. Apply communication and theories of motivation in an organization, and

5. Understand various tools for controlling organizational performance, management audit and apply to achieve the corporate objectives.

Text Book(s)

1. Stephen P. Robbins, Mary Coulter "Management", Pearson Education, 2010, 10th edition.

2. P. Subba Rao "Management and Organizational Behavior", Himalaya Publishing House.

Reference Books

1. Gary Dessler, "Management", Prentice Hall, Inc., 1998, 1st edition.

2 Daft Richard L. 'Management' Thomson South Western, 5th edition.

3 Koontz H. and Weihrich H., "Essentials of Management", McGraw Hill Int. ed., 2004, 6th edition.

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination.

B. Tech. Mechanical Engineering

Open Elective - V

20HUM302 HUMAN RESOURCE DEVELOPMENT

L	T	P	C
3	0	0	3

Pre-requisite NIL

Course Description:
The course content includes: Introduction to HRM, strategic human resource challenges, work flows, job analysis, managing diversity, concepts, goals, mechanism and system of HRD, recruitment and selection, downsizing and outplacement, appraising and managing employee performance, training, career development, managing compensation, rewarding performance, designing benefit plans, employee relation and employee discipline, and workplace safety and health.

Course Objectives:
The course is intended to:
1. Explain the nature and scope of HRM, its functions, policies and strategies;
2. Describe the human resource planning, work analysis and importance in designing jobs;
3. Know the recruitment, selection and the process of performance appraisal;
4. Make the student to learn about training and development, compensation management and
5. Explain the trade unions, industrial relations and grievance.

UNIT I INTRODUCTION 9 hours

Understanding the nature and scope of Human Resource Management- Definition, Evolution of HRD, Functions - objectives, organization of department. Human Resource Management v/s Personnel Management, Role and responsibility of HRM.

UNIT II HUMAN RESOURCE PLANNING 9 hours

Human Resource Planning- Factors affecting HRP, the planning process, managerial succession planning. Job Analysis, Methods of collecting job data, Competency based Job Analysis, Job design approach, contemporary issues in Job Description.

UNIT III RECRUITMENT, SELECTION AND PERFORMANCE APPRAISAL 9 hours

Recruiting and selecting employees-, Selection process, Barriers, selection in India. Performance Management, Process of Performance Appraisal, Methods of Performance Appraisal - Errors in Performance Appraisal.

UNIT IV TRAINING AND DEVELOPMENT 9 hours

Meaning – importance and benefits of Training and Development, Training v/s Development – Training Methods - challenges in training - Career development: Definition-objectives—importance of career development – Reward Management – Compensation Management: Nature-Objectives-Components of Compensation- Theories of Compensation-Factors influencing employee compensation.

UNIT V INDUSTRIAL RELATIONS, TRADE UNIONS 9 hours

Trade Unions: Importance-Objectives- Functions and Structure of the Trade Unions- Trade Union movement in India- Industrial Relations: Nature--Importance- Approaches-essential conditions for sound IR. Industrial Disputes: Meaning – Types- Causes-Industrial disputes settlement machinery. Grievance: Sources and Process of Redressal,

Course Outcomes:

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

1. Understand the concept of HRM, its nature, scope, functions, policies and strategies;
2. Analyse human resource planning and apply in designing jobs;
3. Evaluate the recruitment, selection and the process of performance appraisal;
4. Understand the importance of training and development activities, compensation management and
5. Examine the trade unions, industrial relations and grievance.

Text Book(s)

1. Aswathappa K., Human Resource Management- Text and Cases, Tata McGraw Hill, 6th Edition, 2010
2. Gomez-Mejia, L.R., Balkin, D.B., & Cardy, R.L. Managing Human Resource Management 6th edition, Pearson Edu. 2007.
3 VSP Rao, Human Resource Management-Text & Cases, Excel Books.

Reference Books

1. Garry Dessler, BijuVarkkey , Human Resource Management ,11th Edition, Pearson Education, 2009.
2 R. Wayne Mondy, Human Resource Management, 10th Edition, 2010
Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination.

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination.

B. Tech. Mechanical Engineering

Open Elective - V

20HUM303 SOFT SKILLS

L	T	P	C
3	0	0	3

Pre-requisite 20ENG201

Course Description:

Soft skills are the personal attributes that make a student a valuable employee and a wholesome personality. They include aspects like communication, teamwork, problem-solving, and time management. Employers are increasingly looking for employees with strong soft skills, as they are essential for success in the workplace. This course will help students analyze themselves and build soft skills needed for their personal and career success.

Course Objectives:

The course is intended to:

1. Analyze their strengths and skills, and build confidence in presenting themselves
2. Work seamlessly as a team and negotiate for solutions
3. Think laterally and critically to evaluate a situation and present it with clarity
4. Write business emails effectively
5. Prepare holistically for a job interview

UNIT I SELF ANALYSIS AND DEVELOPMENT 10 hours

Personal ethics (politeness, empathy, and honesty); self-motivation / building confidence and assertiveness; identifying one's unique selling points (USPs) through skills introspection and recognizing strengths and weaknesses; nurturing strengths and fixing weaknesses; self-introduction.

UNIT II TEAM WORKING AND DYNAMICS 12 hours

Brainstorming techniques, team building, collaboration, and negotiation skills; team role plays (involving negotiation and decision making); group discussion etiquette (greetings and body language), idea generation, and common GD phrases; group discussion practice

UNIT III THINKING AND REASONING SKILLS 6 hours

Lateral thinking, critical thinking and logical reasoning through texts, images, and videos; Speaking activities (e.g. JAM) involving lateral thinking and reasoning through thought-provoking pictures, videos, cartoons, comic strips or articles.

UNIT IV PRESENTATION SKILLS 7 hours

Presentation etiquette; slides design; and presentation practice.

UNIT V INTERVIEW SKILLS 10 hours

Preparing resume and cover letter for job interviews; interview etiquette: dress code, body language, tone, and greeting; HR interviews: answering common interview questions, practice for HR interviews.

B. Tech. Mechanical Engineering

Course Outcomes:

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

1. Understand and express themselves with confidence
2. Work as an active team member
3. Think and express their views logically and speak on varied topics without hesitations.
4. Prepare business presentations and emails effectively
5. Attend job interviews with confidence

Text Book(s)

1. Sabina Pillai and Agna Fernandez; Soft Skills and Employability Skills; Cambridge University Press, 2018.

2. Archana Ram, PlaceMentor, 2018, Oxford University Press

Reference Books

1. Karen Kindrachuk, Introspection, 2010, 1st Edition

2 Karen Hough, The Improvisation Edge: Secrets to Building Trust and Radical Collaboration at work, 2011, Berrett-Koehler Publishers

3. Colin Swatridge, Oxford Guide to Effective Argument and Critical Thinking 1st Edition, Oxford University Press

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination.

B. Tech. Mechanical Engineering

Open Elective - V

20HUM304 NATIONAL CADET CORPS

L	T	P	C
3	0	0	3

Pre-requisite: NCC B-Certificate

Course Description:
The main aim of this course is to mould the youth into responsible citizens of the nation. It helps to improve character and leadership qualities towards nation building. This course also motivates the youth to offer Selfless service to the society and nation. The course comprises Common subjects, Service subjects of NCC, societal aspects and basic organization of Indian Armed Forces.

Course Objectives:
This course enables the student to –

1. Get aware of NCC organization and general structure of Defence Forces.
2. Learn leadership and national integration.
3. Motivate towards to maintain Health and hygiene, personality development.
4. Learn elementary characteristics of disaster management, Field craft and Battle craft.
5. Acknowledge the Social activities, Communication and Military History.

UNIT I **10 hours**

INTRODUCTION TO NCC
Introduction, History of NCC , NCC Motto, NCC Flag, Aims of NCC, Cardinal points of NCC, Organization of defence forces in general, Organizational structure of Indian Army(Armed forces), Organizational structure of NCC, NCC Song, Incentives of NCC, Ranks in Army, Navy and Air Force, current representatives – Certificate Examination in NCC– Honours and Awards.

FOOT DRILL BASICS
Aims of Drill, Word of Commands, Attention, Stand at Ease, Turning Left, Right and Inclining at the Halt. Sizing, Forming up in three Ranks and Numbering, Open and Close March Order, Dressing the Squad, Saluting at the Halt, Getting on Parade, Falling Out and Dismissing, Marching, Guard of Honour.

UNIT II **10 hours**

LEADERSHIP
Meaning, Leadership Traits, Types of Leadership, Discipline & Duty of an Indian Citizen, Motivation, Code of Ethics, Perception, Communication, Customs of Services, Importance of Team Work, leaders(swami Vivekananda).

NATIONAL INTEGRATION
Meaning and Importance, Unity in Diversity, Indian History and Culture, Religion and Customs of India, India and its Neighbours, Contribution of Youth in Nation Building, Contribution of leaders in nation unification .

UNIT III **12 hours**

HEALTH AND HYGIENE
Structure and Function of Human Body, Hygiene and Sanitation, Preventable Diseases, First Aid, Yoga: Introduction and Exercises, Physical and Mental Health, Fractures: Types and Treatment.

PERSONALITY DEVELOPMENT

Introduction to personality development, Physical and social factors influencing / shaping personality, psychological and philosophical factors influencing / shaping personality, Self-awareness, SWOT analysis, mind set, interpersonal relationship and communication, effective communication, barriers of communication.

ENVIRONMENT AND ECOLOGY

Environment: Meaning, Global Warming, Acid Rain, Depletion of Ozone Layer, Conservation of Environment. Ecology: Introduction, Component of Ecological System, Forest Ecology, Wild Life, Pollution Control.

UNIT IV **10 hours**

DEFENCE AND DISASTER MANAGEMENT

Civil Defence: Meaning, Organization and its Duties, Civil Defence Services, Fire Fighting : Meaning, Mode of Fire, Fire Fighting Parties, Fire Fighting Equipment. Introduction, Classification of Disaster: Natural Disaster & Man Made Disaster, Disaster Management During Flood, Cyclone and Earth Quake, Assistance in Removal of Debris, Collection and Distribution of Aid Material, Message Services.

SOCIAL SERVICE ACTIVITIES (Social Service And Community Development)

Basics of Social Service, Weaker Sections in the Society and its Identification, Contribution of Youth towards Social Welfare, NGOs and their Role and Contribution , Social Evils, Drug Abuse, Family Planning, Corruption, Counter Terrorism, Eradication of Illiteracy – Aids Awareness programme – Cancer Awareness Programme.

UNIT V **10 hours**

COMMUNICATION

Types of communication, characteristics of wireless technology, Walkie/talkie, Basic RT procedure, Latest trends and development(Multimedia, video conferencing, IT)

MILITARY HISTORY

Biography of Indian Historical Leaders: Chatrapati Shivaji, Maharana Pratap, Akbar Famous Battles / Wars of India: Indo – Pak War 1971(all wars), Kargil War.(Categorise: before/ After independence)
Biography of Successful Leaders: General Patton, General Mac. Arthur, Field Marshal Sam Maneksha.

Course Outcomes:

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

6. Analyse the NCC structure and different ranks in Indian Armed Forces along with foot drill.
7. Notify the leadership traits and the need of national integrity towards nation building.
8. Instill respect and responsibility towards personal health and hygiene, develop dynamic personality with adequate qualities.
9. Identify different disasters and judging measurements on the ground.
10. Recognise various communication devices, analyse the Military Organization.

Text Books:

1. HAND BOOK OF NCC – “SANJAY KUMAR MISHRA, MAJOR RC MISHRA”, published by Kanti prakashan-2020.
2. NCC HAND BOOK - “SHASHI RANJAN & ASHISH KUMAR”, published by Goodwin Publications-2021.

Reference Books:

1. NCC Hand book – "R.Gupta's", Ramesh Publishing House-2021.
2 NCC (ARMY WING)- "R.Guptas's",RPH Editorial Board-2021
3 Hand Book Of N.C.C. – "Ashok Pandey", Kanti Publications-2017

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination

Professional Elective - I

B. Tech. Mechanical Engineering

Professional Elective - 1

20ME401 PRODUCTION PLANNING AND CONTROL

L	T	P	C
3	0	0	3

Pre-requisite: None

Course description:

The production planning and control course provides an understanding, importance and relevance to the various components and functions of production planning and control such as work study, product planning, process planning, production scheduling, Inventory Control and also the recent trends like manufacturing requirement Planning (MRP II) and Enterprise Resource Planning (ERP).

Course objectives:

1. Describes the production facilities in the best possible manner along with the proper systematic planning of production activities.
2. Discuss the adequate arrangement of men, money, materials, machines tools, implements and equipment relating to production.
3. Articulates all the arrangements to remove possible obstacles in the way of smooth production.
4. Discuss about the production targets to be achieved by keeping in view the sales forecast.

UNIT I INTRODUCTION 9 hours

Objectives and benefits of planning and control-Functions of production control-Types of production- job- batch and continuous-Product development and design-Marketing aspect - Functional aspects- Operational aspect-Durability and dependability aspect aesthetic aspect. Profit consideration- Standardization, Simplification & specialization- Break even analysis-Economics of a new design.

UNIT II WORK STUDY 9 hours

Method study, basic procedure-Selection-Recording of process - Critical analysis, Development - Implementation - Micro motion and memo motion study – work measurement - Techniques of work measurement - Time study - Production study - Work sampling - Synthesis from standard data - Predetermined motion time standards.

UNIT III PRODUCT PLANNING AND PROCESS PLANNING 9 hours

Product planning - Extending the original product information-Value analysis-Problems in lack of product planning-Process planning and routing-Pre requisite information needed for process planning- Steps in process planning-Quantity determination in batch production-Machine capacity, balancing- Analysis of process capabilities in a multi product system. Material handling, Capacity planning, and Resource planning.

UNIT IV FORECASTING AND PRODUCTION SCHEDULING **9 hours**

Forecasting – Importance of forecasting – Types of forecasting, their uses – General principles of forecasting – Forecasting techniques – qualitative methods and quantitative methods, Production Control Systems-Loading and scheduling-Master Scheduling-Scheduling rules-Basic scheduling problems - Line of balance – Flow production scheduling-Batch production scheduling-Product sequencing Dispatching-Progress reporting and expediting- Manufacturing lead time-Techniques for aligning completion times and due dates.

UNIT V INVENTORY CONTROL AND RECENT TRENDS IN PPC **9 hours**

Inventory control-Purpose of holding stock-Effect of demand on inventories-Ordering procedures, Two bin system -Ordering cycle system-Determination of Economic order quantity and economic lot size- ABC analysis-Recorder procedure-Introduction to computer integrated production planning systems- elements of JIT Systems-Fundamentals of SAP, MRP II And ERP.

Course outcomes:

The students after completing the course will be able to:

1. Interpret the role and importance of manufacturing planning & control system processes.
2. Demonstrate manufacturing planning & control system processes in industry.
3. Compare good manufacturing planning & control system processes in industry.
4. Examine manufacturing planning & control system practices in industry
5. Understand the inventory control and its applications in manufacturing systems.

Text books:

1. R. Panneerselvam, “Operations Research”, Second Edition, PHI Learning Pvt. Ltd., 2006.
2. Martand Telsang, “Industrial Engineering and Production Management”, First edition, S. Chand and Company, 2000.
3. James.B.Dilworth,”Operations management – Design, Planning and Control for manufacturing and services” Mcgraw Hill International edition 1992.

References:

1. Samson Eilon, “Elements of Production Planning and Control”, Universal Book Corpn.1984
2. Elwood S.Buffa, and Rakesh K.Sarin, “Modern Production / Operations Management”, 8th Edition, John Wiley and Sons, 2000.
3. KanishkaBedi, “Production and Operations management”, 2nd Edition, Oxford university press, 2007.
4. Melynk, Denzler, “Operations management – A value driven approach” Irwin Mcgraw hill.
5. Norman Gaither, G. Frazier, “Operations Management”, 9th edition, Thomson learning IE,2007

6. Jain. K.C & L.N. Aggarwal, "Production Planning Control and Industrial Management", KhannaPublishers, 1990.

7. Chary. S.N. "Theory and Problems in Production & Operations Management", Tata McGrawHill, 1995.

8. Upendra Kachru, "Production and Operations Management – Text and cases", 1st Edition, Excel books 2007.

Mode of Evaluation: Assignments, Internal Mid Tests and External End Examinations

B. Tech. Mechanical Engineering

Professional Electives – 1

20ME402 COMPUTATIONAL FLUID DYNAMICS

L	T	P	C
3	0	0	3

Pre-requisite: 20MAT102,20MAT103,20ME103,20ME105

Course description:

Computational fluid dynamics (CFD) has become an essential tool in analysis and design of thermal and fluid flow systems in wide range of industries. Few prominent areas of applications of CFD include meteorology, transport systems (aerospace, automobile, high-speed trains), energy systems, environment, electronics, bio-medical (design of life-support and drug delivery systems), etc. The correct use of CFD as a design analysis or diagnostic tool requires a thorough understanding of underlying physics, mathematical modelling and numerical techniques. The user must be fully aware of the properties and limitations of the numerical techniques incorporated in CFD software. This course aims to provide precisely these insights of CFD.

Course objectives:

1. To understand mathematical characteristics of partial differential equations.
2. To understand basic properties of computational methods – accuracy, stability, consistency.
3. To learn computational solution techniques for time integration of ordinary differential equations.
4. To learn computational solution techniques for various types of partial differential equations. To learn how to computationally solve Euler and Navier-Stokes equations.
5. To acquire basic programming and graphic skills and to conduct the flow field calculations and data analysis.

UNIT I INTRODUCTION TO CFD 11 hours

Introduction and Philosophy of Computational Fluid Dynamics, Need for problem solving with CFD, Applications of CFD, Models of fluid flow, Finite Control Volume, Infinitesimal Fluid Element, concept of substantial derivative, The Divergence of the Velocity: Its Physical Meaning, Governing equations of fluid flow: Continuity, Momentum & Energy equations, Conservation and Non-conservation forms of governing equations.

UNIT II MATHEMATICAL BEHAVIOR OF PARTIAL DIFFERENTIAL EQUATIONS: THE IMPACT ON CFD 10 hours

Classification of Quasi-Linear Partial Differential Equations, A General Method of Determining the Classification of Partial Differential Equations: The Eigen value Method, General Behaviour of the Different Classes of Partial Differential Equations: Impact on Physical and Computational Fluid Dynamics, Hyperbolic Equations, Parabolic Equations, Elliptic Equations, Some Comments: The Supersonic Blunt Body Problem Revisited, Well-Posed Problems

UNIT III BASIC ASPECTS OF DISCRETIZATION 7 hours

Discretization, Need to discretize the domain, Classification: FDM, FVM, FEM, Introduction to Finite Differences, Difference Equations, Explicit and Implicit Approaches: Definitions and Contrasts

UNIT IV GRID GENERATION 9 hours

Introduction, Types of grid, Factors affecting the grid, Grid transformations, General Transformation of the Equations, Grid independence study, Metrics and Jacobians, Form of the Governing Equations Particularly Suited for CFD Revisited: The Transformed Version, Stretched (Compressed) Grids, Boundary-Fitted Coordinate Systems; Elliptic Grid Generation.

UNIT V SOME SIMPLE CFD TECHNIQUES: A BEGINNING 8 hours

Introduction, Physical boundary conditions for inviscid fluid, viscid fluid, compressible flows and unsteady flows, SIMPLE algorithms, Mac-Cormack technique, Lax-Wendroff technique, ADI Scheme, Relaxation technique. Validation techniques, Turbulence modelling.

Course outcomes:

The students after completing the course will be able to:

1. Derive the governing equations and boundary conditions for Fluid dynamics
2. Analyze Finite difference and Finite volume method for Diffusion
3. Analyze Finite volume method for Convective diffusion
4. Analyze Flow field problems and Grid Generation
5. Explain the Turbulence models and Validation Techniques.

Text books:

1. Anderson, J. D., Computational Fluid Dynamics: The Basics with Applications, McGrawHill (1995).

References:

1. Tannehill, J. C., Anderson, D. A., and Pletcher, R. H., Computational Fluid Mechanics andHeat Transfer, 2nd ed., Taylor & Francis (1997).
2. Hoffmann, K. A. and Chiang, S. T., Computational Fluid Dynamics for Engineers, 4th ed.,Engineering Education Systems (2000).
3. Hirsch, C., Numerical Computation of Internal and External Flows: The Fundamentals ofComputational Fluid Dynamics, Vol. I, 2nd ed., Butterworth-Heinemann (2007).
4. Patankar, S. V., Numerical Heat Transfer and Fluid Flow, Hemisphere (1980).
5. Ferziger, J. H. and Peric, M., Computational Methods for Fluid Dynamics, 3rd ed., Springer (2002).

Mode of Evaluation: Assignments, Internal Mid Tests and External End Examinations

B. Tech. Mechanical Engineering

Professional Elective – 1

20ME403 ENGINEERING ANALYSIS AND COMPUTATION

L	T	P	C
3	0	0	3

Pre-requisite: 20MAT101, 20CSE101, 20MAT102, 20MAT103

Course description:

This course introduces the students to theory and practice of numerical analysis as it is applied to solving engineering problems. The computational techniques used for problems like finding roots of transcendental equations, solving systems of linear equations, determining Eigen values, interpolation, curve fitting, integration, differentiation and solving differential equations are covered both through lectures as well as hands on practical sessions.

Course objectives:

1. To introduce the basics of numerical analysis like Taylor Series, round off errors and truncation errors.
2. To familiarize students with various numerical methods used in engineering problem solving and their respective merits and demerits.
3. To train the students in writing computer codes using modern tools like Python or MATLAB for applying numerical techniques to engineering problems.
4. To instruct the students on selecting appropriate numerical technique to for a given engineering problem and apply it effectively.

UNIT I BASICS AND NON-LINEAR EQUATIONS 9 hours

Introduction to problem solving using numerical methods, Types of errors in numerical solutions, Taylor Series.
Finding roots of non-linear equations using: Fixed point iteration, Bi-section, Newton-Raphson, and Secant methods, Convergence of these methods. Newton's Method for system of non-linear equations. Iterations and equations solving using Python programming.

UNIT II APPLIED LINEAR ALGEBRA 8 hours

Solution of linear system of equations using Gauss elimination method, Pivoting, Gauss Jordan method, Iterative methods of Gauss Jacobi and Gauss Seidel.
Eigenvalues of a matrix by Power method and Jacobi's iterative method for symmetric matrices. Matrix calculations using Python programming.

UNIT III INTERPOLATION AND APPROXIMATION 9 hours

Polynomial Interpolation-Lagrange's interpolation–Newton's divided difference.
Piecewise interpolation–Linear Splines.
Curve Fitting – Least square regression for linear and non-linear curve fitting.
Fourier Transform –Discreate Fourier Transform. Solving Fourier transform using Python programming

UNIT IV NUMERICAL DIFFERENTIATION AND INTEGRATION 9 hours

Approximation of derivatives using finite differences, Richardson extrapolation and derivatives by interpolation.
Numerical integration using Trapezoidal, Simpson's 1/3 rule, Romberg's Method, Two point and three-point Gaussian quadrature formulae.
Evaluation of double integrals by Trapezoidal and Simpson's 1/3 rules. Simple integration problem solving using Python programming.

UNIT V SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS 10 hours

Euler's method, Modified Euler's method, Runge-Kutta methods (second order and fourth order). Shooting method and finite difference method for boundary value problems. Introduction to solving Partial Differential Equations. Solving partial differential equations using Python programming.

Course outcomes:

The students after completing the course will be able to:

1. Solve non-linear equations using appropriate numerical methods like bisection method, Newton-Raphson method etc.
2. Solve a system of linear and non-linear equations using iterative or direct techniques.
3. Select and apply suitable methods for approximation of functions using techniques like interpolation, curve fitting etc.
4. Evaluate numerical integration and differentiation using numerical methods.
5. Solve initial and boundary value problems in ODEs using appropriate methods.

Text books:

1. Steven Chapra, Applied Numerical Methods with MATLAB for Engineers and Scientists,

McGraw Hill Education, 3rd edition.

2. Jaan Kiusalaas, Numerical Methods in Engineering with Python, Cambridge University

Press, 3rd edition.

References:

1.Numerical Methods for Engineers; Steven C. Chapra and Raymond P. Canale, 7th edition,

McGraw Hill, 2014.

2. Introduction to Numerical Analysis, S.S. Sastry; Prentice Hall of India, 2012.

Mode of Evaluation: Assignments, Internal Mid Tests and External End Examinations

B. Tech. Mechanical Engineering

Professional Elective – 1

20ME404 FLUID POWER SYSTEMS

L	T	P	C
3	0	0	3

Pre-requisite: 20ME105

Course description:

Fundamental concepts of fluid power systems; study about pumps and actuators; detailed study and understanding of hydraulic and pneumatic power systems.

Course objectives:

1. To elucidate the fundamentals of fluid power systems
2. To teach the classifications, construction, working and applications of different pumps.
3. To teach the classifications, construction, working and applications of different actuators.
4. To explicate the rudimentary aspects in hydraulic power systems.
5. To explicate the rudimentary aspects in pneumatic power systems.

UNIT I INTRODUCTION TO FLUID POWER SYSTEMS 9 hours

Fluid power system: components, advantages, and applications. Transmission of power at static and dynamic states. Pascal's law and its applications. Fluids for hydraulic system: types, properties, and selection. Additives, effect of temperature and pressure on hydraulic fluid. Seals, sealing materials, compatibility of seal with fluids. Types of pipes, hoses, and quick acting couplings. Pressure drop in hoses/pipes.

UNIT II PUMPS 8 hours

Classification of pumps, pumping theory of positive displacement pumps, construction and working of Gear pumps, Vane pumps, Piston pumps, fixed and variable displacement pumps, Pump performance characteristics, pump selection factors, problems on pumps. Accumulators: Types, selection/ design procedure, applications of accumulators. Types of Intensifiers, Pressure switches /sensor, Temperature switches/sensor, Level sensor.

UNIT III ACTUATORS 8 hours

Classification cylinder and hydraulic motors, Hydraulic cylinders, single and double acting cylinder, mounting arrangements, cushioning, special types of cylinders, problems on cylinders. Construction and working of rotary actuators such as gear, vane, piston motors, and Hydraulic Motor. Theoretical torque, power, flowrate, and hydraulic motor performance; numerical problems. Symbolic representation of hydraulic actuators (cylinders and motors).

UNIT IV HYDRAULIC POWER SYSTEMS 10 hours

Classification of control valves, Directional Control Valves-symbolic representation, constructional features of poppet, sliding spool, rotary type valves solenoid and pilot operated DCV, shuttle valve, and check valves. Pressure control valves – types, direct operated types and pilot operated types. Flow Control Valves -compensated and non-compensated FCV, needle valve, temperature compensated, pressure compensated, pressure

and temperature compensated FCV, symbolic representation. Simple exercise on hydraulic circuit design.

UNIT V PNEUMATIC POWER SYSTEMS 10 hours

Pneumatic power system, advantages, limitations, applications, Choice of working medium. Characteristics of compressed air and air compressors. Structure of pneumatic control System, fluid conditioners-dryers and FRL unit. Pneumatic Actuators: Linear cylinder –types of cylinders, working, end position cushioning, seals, mounting arrangements, and applications. Rotary cylinders- types, construction and application, symbols. Simple exercise on pneumatic circuit design.

Course outcomes:

The students after completing the course will be able to:

1. Identify and analyse the functional requirements of a fluid power transmission system for a given application.
2. Visualize how a hydraulic/pneumatic circuit will work to accomplish the function.
3. Design an appropriate hydraulic or pneumatic circuit or combination circuit like electro-hydraulics, electro-pneumatics for a given application.
4. Select and size the different components of the circuit.
5. Develop a comprehensive circuit diagramby integrating the components selected for the given application.

Text books:

1. Anthony Esposito, “Fluid Power with applications”, Pearson edition,2000 .

2. Majumdar S.R., “Oil Hydraulics”,TalaMcGRawHllL, 2002 .

3. Majumdar S.R., “Pneumatic systems - Principles and Maintenance”,Tata McGraw-Hill, New Delhi, 2005

References:

1. John Pippenger, Tyler Hicks, “Industrial Hydraulics”, McGraw Hill International Edition, 1980.

2. Andrew Par, Hydraulics and pneumatics, Jaico Publishing House, 2005.

3. FESTO, Fundamentals of Pneumatics,VolI,IIandIII.

4. Herbert E. Merritt, “Hydraulic Control Systems”, John Wiley and Sons, Inc.

5. Thomson, Introduction to Fluid power, PrentcieHaIl, 2004

6. John Watton, “Fundamentals of fluid power control”, Cambridge University press, 2012.

Mode of Evaluation: Assignments, Internal Mid Tests and External End Examinations

B. Tech. Mechanical Engineering

Professional Elective – 1

20ME405 FINITE ELEMENT METHODS

L	T	P	C
3	0	0	3

Pre-requisite: 20ME106

Course description:

To understand the basic concepts of finite element methods and to analyse and solve structural, dynamic analysis, and heat conduction problems by applying finite element methods

Course objectives:

1. To make students familiar with the basics of finite element methods, its applications and advantages.
2. To teach students how to perform 1-D structural analysis using finite element methods.
3. To teach students how to perform 2-D structural analysis using finite element methods.
4. To teach students how to perform 1-D heat conduction and convection analysis using finite element methods.
5. To teach students how to perform 1-D dynamic analysis using finite element methods.

UNIT I INTRODUCTION TO FEM 9 hours

Basic concepts, general description, application of FEM, advantages of FEM, Types of basic elements & shapes, interpolation functions, principle of minimum potential energy, Galerkin method, basic equations of elasticity, strain displacement relations, solution of system of equations using Gauss elimination.

UNIT II 1-D STRUCTURAL PROBLEMS 10 hours

Axial bar element- solution for displacement, stress, strain in 1D straight bars, stepped bars and tapered bars, stiffness matrix, load vector, temperature effects, quadratic shape functions, Analysis of plane trusses.

UNIT III BEAMS & SHAFTS 8 hours

Boundary conditions, Analysis of beams -Hermite shape functions, stiffness matrix, load vector Analysis of shafts employing FAE

UNIT IV 2-D PROBLEMS & 1-D HEAT TRANSFER ANALYSIS 9 hours

Introduction to CST, iso- parametric element, shape functions, stiffness matrix and load vector, and boundary conditions, Derivation of the basic differential equation, finite element solution for combined conduction and convection conditions

UNIT V FEM FOR MODAL ANALYSIS 9 hours

Lagrange’s equations, consistent and lumped mass matrices for bar and 2D truss Characteristic polynomial approach - Eigenvalues, Eigenvectors, natural frequencies, mode shapes for bars and 2D trusses.

B. Tech. Mechanical Engineering

Course outcomes:

The students after completing the course will be able to:

1. State the applications of FEM in various engineering fields.
2. Calculate stresses and strains for one-dimensional problems using finite element methods.
3. Analyse 2-D problems using FEM.
4. Analyse and solve 1-D heat transfer problems.
5. Analyse the frequency response and find the mode shapes of bars and 2D trusses.

Text books:

1.Introduction to Finite Elements in Engineering, Chandraputla, A and Belegundu, PHI
2.A first course in the Finite Element Method Logan, D. L Cengage Learning 6th Edition 2016
3.Finite Element Method in Engineering Rao, S. S Pergaman Int. Library of Science 5th Edition 2010

References:

1.Finite Element Method J.N.Reddy McGraw -Hill International Edition
2.Finite Elements Procedures Bathe K. J PHI
3.Concepts and Application of Finite Elements Analysis Cook R. D., et al. Wiley & Sons 4th Edition 2003

Mode of Evaluation: Assignments, Internal Mid Tests and External End Examinations

B. Tech. Mechanical Engineering

Professional Elective – 1

20ME406 FUNDAMENTALS OF AUTOMOTIVE ENGINEERING

L	T	P	C
3	0	0	3

Pre-requisite: 20ME103, 20ME105

Course description:

The detailed concept, construction and principle of operation of engine and various engine components, combustion, cooling and lubrication systems will be taught to the students. At the end of the course the students will have command over automotive engines and the recent development in the area of engines.

Course objectives:

1. Understand the Engine components, Types and operation.
2. Understand about fuel systems and Governor.
3. Understand about the combustion chamber and Catalytic converter.
4. Understand the concept of Supercharging, Turbocharging and testing methodologies
5. Understand the Cooling system and Lubrication system.

UNIT I VEHICLE STRUCTURE AND ENGINES 9 hours

Types of automobiles vehicle construction and different layouts, chassis, frame and body, Vehicle aerodynamics (various resistances and moments involved), IC engines – components-functions and materials, variable valve timing (VVT).

UNIT II ENGINE AUXILIARY SYSTEMS 9 hours

Electronically controlled gasoline injection system for SI engines, electronically controlled diesel injection system (Unit injector system, Rotary distributor type and common rail direct injection system), Electronic ignition system (Transistorized coil ignition system, capacitive discharge ignition system), Turbo chargers (WGT, VGT), Engine emission control by three way catalytic converter system, Emission norms (Euro and BS).

UNIT III TRANSMISSION SYSTEMS 9 hours

Clutch-types and construction, gear boxes- manual and automatic, gear shift mechanisms, Over drive, transfer box, fluid flywheel, torque converter, propeller shaft, slip joints, universal joints, Differential and rear axle, Hotchkiss Drive and Torque Tube Drive.

UNIT IV STEERING, BRAKES AND SUSPENSION SYSTEMS 9 hours

Steering geometry and types of steering gear box-Power Steering, Types of Front Axle, Types of Suspension Systems, Pneumatic and Hydraulic Braking Systems, Antilock Braking System (ABS), electronic brake force distribution (EBD) and Traction Control.

UNIT V ALTERNATIVE ENERGY SOURCES 9 hours

Use of Natural Gas, Liquefied Petroleum Gas, Bio-diesel, Bio-ethanol, Gasohol and Hydrogen in Automobiles- Engine modifications required –Performance, Combustion and Emission Characteristics of SI and CI engines with these alternate fuels - Electric and Hybrid

Vehicles, Fuel Cell Note: Practical Training in dismantling and assembling of Engine parts and Transmission Systems should be given to the students.

Course outcomes:

The students after completing the course will be able to:

1. Recognize the various parts of the automobile and their functions and materials
2. Discuss the engine auxiliary systems and engine emission control.
3. Distinguish the working of different types of transmission systems.
4. Explain the Steering, Brakes and Suspension Systems.
5. Predict possible alternate sources of energy for IC Engines.

Text books:

1. Ganesan V., "Internal Combustion Engines", Tata McGraw Hill, 2007
2. Ramalingam K.K., “Internal Combustion Engines”, Sci-Tech Publications, 2005.
3. Devaradjane. Dr. G., Dr. M. Kumaresan, "Automobile Engineering", AMK Publishers, 2013.

References:

1. Heisler, "Advanced Engine Technology" SAE Publication, 1995
2. Edward F. Obert "Internal Combustion Engines" 3 Edition, 1970
3. Gupta. H.N. "Fundamentals of Internal Combustion" Engines, reprint, PHI Learning Pvt. Ltd. 2006
4. Mathur and Sharma "Fundamental Combustion Engines" Dhanpat Rai and Sons, 2002
5. John B. Heywood, “Fundamentals of Internal Combustion Engines”, 1988

Mode of Evaluation: Assignments, Internal Mid Tests and External End Examinations

Professional Elective - III

B. Tech. Mechanical Engineering

Professional Elective – III

20ME407 ENTREPRENEURSHIP AND PROJECT MANAGEMENT

L	T	P	C
3	0	0	3

Pre-requisite: None

Course description:

This course is designed to ignite the entrepreneurship idea into the young minds of engineers. This course gives the complete details to setup an enterprise which includes the generating business ideas, writing business plan and executing the plan successfully.

Course objectives:

1. Understand the requirements of entrepreneurship as a profession.
2. Understand and develop the business plan.
3. Identify the various financial terms and conditions of new business venture.
4. Selection of plant location and choosing layout.
5. Analyse the market research for new ventures and small businesses.

UNIT I INTRODUCTION 9 hours

Introduction to Entrepreneurship, history of entrepreneurship development, social Entrepreneurship, Intrapreneurship, Definition of Entrepreneur, Entrepreneurial Traits, Entrepreneur vs. Manager, Entrepreneur vs Intrapreneur. The Entrepreneurial decision processes. Role of Entrepreneurship in Economic Development, Ethics and Social responsibility of Entrepreneurs. Opportunities for Entrepreneurs in India and abroad. Woman as Entrepreneur. Realities & Case studies about successful Entrepreneur.

UNIT II CREATING AND STARTING THE VENTURE 9 hours

Sources of new Ideas, Methods of generating ideas. The Business Plan Nature and scope of Business plan, Writing Business Plan, Evaluating Business plans, implementation of business plans. Case studies of successful business plan, Marketing plan, financial plan, and organizational plan, Launching formalities. Developing business plan and evaluation with team.

UNIT III FINANCING AND MANAGING THE NEW VENTURE 9 hours

Sources of capital, venture capital, angel investment, Record keeping, recruitment, motivating and leading teams, financial controls. Marketing and sales controls. Ecommerce and Entrepreneurship, Internet advertising. New venture Expansion Strategies and Issues, Features and evaluation of joint ventures, acquisitions, merges, franchising. Case studies about entrepreneur who success or failure in their business based on the financial control.

UNIT IV PLANT LAYOUT 9 hours

Definition of plant layout and its types, Issues related to Selection of layout. Production and Marketing Management, Selection of production Techniques, plant utilization and maintenance. Case study about selection of site and plant layout for new business venture.

UNIT V MARKET ANALYSIS AND PROJECT MANAGEMENT 9 hours

Inventory control, material handling and quality control. Marketing functions, market segmentation, market research and channels of distribution, Sales promotion and product pricing. Case studies on market analysis on entrepreneur perspective. Project Organization-Project Planning, Monitoring, Control and Learning. Detailed life cycle and post-mortem analysis, Resource allocation, Risk and uncertainty, Budget constraints, Project feasibility.

Course outcomes:

The students after completing the course will be able to:

1. Describe the sources of new business ideas, methods to develop new ideas and use the problem-solving techniques.
2. Write a business plan which includes financial plan, organizational plan and marketing plan.
3. Identify the financial sources for new business ventures.
4. Select a plant layout and draw a plant layout.
5. Design a workplace and analyse the market research for new business.

Text books:

1.Entrepreneurship, Robert Hisrich, & Michael Peters, 5/e TMH.
2. Entrepreneurship, Dollinger, Pearson, 4/e, 2004.

References:

1. Dynamics of Entrepreneurial Development and Management, Vasant Desai, Himalaya Publ. House, 2004.
2. Harvard Business Review on Entrepreneurship. HBR Paper Back, 1999.
3. Entrepreneurial Management, Robert J.Calvin, TMH, 2004.

Mode of Evaluation: Assignments, Internal Mid Tests and External End Examinations

B. Tech. Mechanical Engineering

Professional Elective – III

20ME408 REFRIGERATION AND AIR CONDITIONING

L	T	P	C
3	0	0	3

Pre-requisite: 20ME103

Course description:
Fundamental concepts of Refrigeration and Air Conditioning; Nomenclature of Refrigerants; Different Types of Refrigeration Systems; Psychrometric properties and processes; Different Types of Air Conditioning Systems; and Air Conditioning Equipment.

Course objectives:

1. To elucidate the fundamental concepts of Refrigeration and Vapour compression refrigeration system.
2. To explain the working of components in VCR system and to impart basics of refrigerants.
3. To explain the working of Vapour absorption refrigeration system and other refrigeration systems.
4. To elucidate the fundamental concepts of Air Conditioning and Air Conditioning Systems.
5. To explain the working of equipment in Air conditioning system and to introduce Comfort conditions and Heat pumps.

UNIT I INTRODUCTION TO REFRIGERATION AND VCR SYSTEM — 9 hours

Introduction to Refrigeration, Necessity and Applications, Unit of Refrigeration, COP, EER, Methods of refrigeration.

Vapour compression refrigeration system – Working principle, effect of sub cooling and super heating, ideal and actual cycle, multi-stage, cascading VCR systems, numerical problems.

UNIT II COMPONENTS OF VCR SYSTEM AND REFRIGERANTS — 9 hours

Vapour Compression Refrigeration System Components: General classification of compressors, condensers, evaporators and expansion devices and working principles.

Refrigerants: Desirable properties, Classification of refrigerants, Nomenclature, Environmental impact.

UNIT III VAR SYSTEM AND OTHER REFRIGERATION SYSTEMS — 9 hours

Vapour Absorption Refrigeration system: Introduction to Vapour absorption refrigeration system, Lithium-Bromide absorption refrigeration system, three fluid absorption refrigeration system and comparison of compression and absorption refrigeration systems.

Other Refrigeration systems: Working principles of Steam jet refrigeration system, Thermoelectric refrigeration system, Vortex & Pulse tube refrigeration system.

UNIT IV INTRODUCTION TO AIR CONDITIONING AND SYSTEMS — 9 hours

Psychrometric Properties & Processes, Characterization of Sensible and Latent Heat Loads, Need for Ventilation, Consideration of Infiltrated Air, Heat Load Concepts.

Air Conditioning Systems: Air Cooler (Evaporative Cooling), Window, Split, Summer, Winter, Year-Round, Central Air Conditioning Systems.

UNIT V AIR CONDITIONING EQUIPMENT 9 hours

Air Conditioning Equipment: Humidifiers, Dehumidifiers, Air Filters, Fans and Blowers. **Human Comfort:** Requirements of Temperature, Humidity and Concept of Effective Temperature, Comfort Chart. Heat Pump, Heat Sources, Different Heat Pump Circuits.

Course outcomes:

The students after completing the course will be able to:

1. Understand different methods of refrigeration and the applications.
2. Classify different types of refrigerants and their impact on the environment.
3. Understand the Vapour absorption refrigeration and other refrigeration systems.
4. Solve load calculations for air conditioning systems.
5. Understand the knowledge of different equipment used in Air conditioning systems.

Text books:

1. C. P. Arora, Refrigeration and Air Conditioning, TMH Publishers, New Delhi.
2. Domkundwar, Arora, Domkundwar A course in Refrigeration and Air Conditioning, Dhanpati Rai publications, New Delhi.

Data Book:

1. C P Kothandaraman, Refrigerant Tables and Charts, New Age International Publishers, Sixth Edition.
2. C P Kothandaraman, Steam Tables, New Age International Publishers, Fifth Edition.

References:

1. R.S. Khurmi, J.K. Gupta, Refrigeration and Air Conditioning, S. Chand publications.
2. Dossat, Principles of Refrigeration, Pearson Education, New Delhi.
3. Manohar Prasad, Refrigeration and Air Conditioning, NAI Publishers, New Delhi.
4. R.K. Rajput, Refrigeration and Air Conditioning, Kataria & Sons, New Delhi.

Mode of Evaluation: Assignments, Internal Mid Tests and External End Examinations

B. Tech. Mechanical Engineering

Professional Elective – III

20ME409 INTERNET OF MANUFACTURING THINGS

L	T	P	C
3	0	0	3

Pre-requisite: Basic knowledge on computers.

Course description:

The industrial sector is a key source of sustained income for contemporary society. To satisfy the needs of today's complex products, traditional manufacturing processes and related management strategies require ongoing evaluation and improvement. Internet of Things has Possibility to gather, process, analyze, and share real-time data while improving overall productivity within a predetermined time limit with greater flexibility and transparency. The goal of this course is to give students the skills they need to connect manufacturing and IoT systems.

Course objectives:

1. To impart fundamental understanding and the significance of IoT, as well as its logic and applications in the manufacturing sector.
2. To impart fundamental information about cloud computing and real-time information sensing in industrial systems.
3. Acquiring knowledge of the ideas behind IoT-enabled smart trolleys and assembly systems.
4. To give a fundamental grasp of scheduling software and methodologies for real-time production performance analysis.
5. To give a fundamental understanding of a system for information-driven, real-time production scheduling.

UNIT I INTRODUCTION 9 hours

Concept of IoT, Existing manufacturing paradigms and their limitations, Applications of IoT in Manufacturing System (MS), The Concept of IoT-MS and its limitations. Overview of IoT-Enabled Manufacturing System: Overall architecture of IoT-MS, Integration framework of real-time manufacturing information.

UNIT II REAL-TIME (RT) MULTISOURCE MANUFACTURING INFORMATION SENSING SYSTEM 9 hours

Introduction, Overall Architecture of RT and multisource RMMISS, Deployment of multi-sensors, Multiple sensors manager, Multiple source manufacturing Information Capturing and Sharing, Case studies. Cloud Computing-Based Manufacturing – Introduction, Overall architecture, Cloud Machine Model, MS-UDDI, Task driven manufacturing service method

UNIT III IOT-ENABLED SMART ASSEMBLY STATION 9 hours

Introduction, RFID based applications and assistant services in assembly line, Overall architecture, Real-time: Status Monitoring, Production Guiding, Data Sharing, Production Requeuing. IoT Enabled Smart Trolley– Material handling and real time strategy, RT-data capturing in manufacturing field, overall architecture, Real-time: Information capturing, Encapsulation, Workflow based guidance. Two stage combination optimization method.

UNIT IV REAL-TIME (RT) PRODUCTION PERFORMANCES ANALYSIS METHOD **9 hours**

Real-time: Production monitoring technique, KPI analysis, Anomaly analysis. Overall architecture, even hierarchy of critical event, HTCPN analysis. Real time production anomaly diagnosis.

UNIT V REAL-TIME INFORMATION DRIVEN PRODUCTION SCHEDULING SYSTEM **9 hours**

Introduction, RT production scheduling, Agent technology, Manufacturing information monitor technology, Overall architecture, Equipment agent, Capability evaluation agent model, RT- scheduling agent model, Production execution monitor agent model.

Course outcomes:

The focus of this course is to study the inculcation of IoT in manufacturing systems. By the end of the course student should:

1. Be able to understand the fundamentals of IoT and its application in manufacturing Systems.
2. Have a clear overall picture of multisource manufacturing information sensing system and cloud manufacturing.
3. Outline various methods of IoT enabled smart assembly systems and summarize the usage of smart trolleys
4. Make use of various RT- production performance analysis methods for test its applicability to real life problems.
5. Make use of various RT- information driven production scheduling system for test its applicability to real life problems.

Text books:

1. Fei Tao, Y. Zhang, “Optimization of Manufacturing Systems Using the Internet of Things”, 1st Edition, 2017, Academic Press, Elsevier.

References:

1. A. Gilchrist, “Industry 4.0: The Industry Internet of Things”, 1st Edition, 2016, Apress.
2. M. Dastbaz, P. Cochrane, “Industry 4.0 and Engineering for a Sustainable Future”, 1st Edition, 2019, Springer.

Mode of Evaluation: Assignments, Internal Mid Tests and External End Examinations

B. Tech. Mechanical Engineering

Professional Elective – III

20ME410 RENEWABLE ENERGY SYSTEMS

L	T	P	C
3	0	0	3

Pre-requisite: NIL

Course description:

The course delivers knowledge on fundamental concepts of Solar Energy, Biomass Energy, Wind Energy and Other Alternate Energy Sources.

Course objectives:

1.To facilitate the students to achieve a clear conceptual understanding of technical and commercial aspects of Wind, Solar, Biomass and Alternative Sources of Energy.

2.To enable the students to develop managerial skills to assess feasibility of alternative approaches and drive strategies regarding Wind, Solar, Biomass and Alternative Sources of Energy.

UNIT I INTRODUCTION 9 hours

Global and national energy scenarios, concept of energy services, patterns of energy supply, energy resource availability, cultural, economic, and national security aspects of energy consumption, forms and characteristics of renewable energy sources, energy classification, source and utilization, thermodynamic power cycles and binary cycles.

UNIT II SOLAR ENERGY & BIOMASS ENERGY 9 hours

Solar radiation, flat plate collectors, solar concentration, thermal applications of solar energy, photovoltaic technology and applications, energy storage.

Energy from biomass, thermo-chemical, biochemical conversion to fuels, biogas, and its applications.

UNIT III WIND ENERGY 9 hours

Wind characteristics, resource assessment, horizontal and vertical axis wind turbines, electricity generation and water pumping, Micro/Mini hydropower system, water pumping and conversion to electricity, hydraulic pump.

UNIT IV HYDROGEN & FUEL CELLS 9 hours

Introduction to Fuel cell Technology, Various types of fuel cell systems, Low & high temperature fuel cells, Fuel cell thermodynamics, Fuel cell efficiency.

Introduction to hydrogen economy, production, storage, and transportation systems, hydrogen from fossil fuels, transmission and infrastructure requirements, safety and environmental impacts, economics of transition to hydrogen systems.

UNIT V OTHER RENEWABLE SOURCES 9 hours

Ocean thermal energy conversion, Geothermal, Tidal, Wave energy, MHD, environmental issues of energy sources.

Course outcomes:

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

1. Understand the fundamentals, availability, economics, and characteristics of the basic renewable energy sources.
2. Understand the fundamentals of solar energy and biomass energy.
3. Understand the fundamentals of wind energy.
4. Understand the fundamentals of hydrogen and fuel cells.
5. Understand the fundamentals of various renewable energy sources like geothermal, tidal, wave, etc.,

Text books

1.Rai, G.D., Non-Conventional Energy Sources, Khanna Publishers (2005).

2.Rao, S. and Parulekar, B.B., Energy Technology: Non-Conventional, Renewable and Conventional, Khanna Publishers (2005).

References:

1.Wadhwa, C.L., Generation, Distribution and Utilization of Electric Energy, New Age International (P) Limited, Publishers (2007).

2.Simon, Christopher A., Alternate Source of Energy, Rowman and Little Field Publishers Inc. (2007).

3.Venikov, V.A. and Putyain, E.V., Introduction to Energy Technology, Mir Publishers (1990

Mode of Evaluation: Assignments, Internal Mid Tests and External End Examinations

B. Tech. Mechanical Engineering

Professional Elective – III

20ME411 CARBON FOOTPRINT ESTIMATION AND REDUCTION TECHNIQUES

L	T	P	C
3	0	0	3

Pre-requisite: NIL

Course description:

The carbon footprint represents the total volume of greenhouse gases (GG) resulting from everyday economic and human activity. Knowing the carbon footprint of an activity, which is measured in tons of CO2 emissions, is important when it comes to taking measures and launching initiatives to reduce it to the lowest possible level. This course provides overview and insights in reducing carbon footprint along with few case studies.

Course objectives:

1. To introduce climate change and carbon footprint
2. To study the principle of product life cycle and Green House Gas emissions accounting
3. To study the Methodology for Carbon Footprint Calculation
4. To learn emission mitigation and carbon sink
5. To study the case study of carbon footprint.

UNIT I CLIMATE CHANGE AND CARBON FOOTPRINT 9 hours

Green House Effect and Climate Change - Causes and Impacts of Climate Change – Economic implications of Climate Change -IPCC Reports and Projected Climate Change Scenarios – Green House Gas (GHG) Emission – Carbon footprint of Activities, Processes, Products and Services of Organizations – GHG Emission factors and Calculations.

UNIT II PRODUCT LIFE CYCLE AND GHG EMISSIONS 9 hours

Life-cycle GHG Accounting - Principles of Product Life Cycle GHG Accounting and Reporting - Fundamentals of Product Life Cycle GHG Accounting - Establishing the Scope of a Product Inventory- GHG Emission Inventories and Accounting - Collecting Data and Assessing Data Quality Allocation and Assessing Uncertainty.

UNIT III METHODOLOGICAL ASPECTS OF CARBON FOOTPRINT 9 hours

Methodology for Carbon Footprint Calculation in Crop and Livestock Production, End of Life Scenarios and Carbon Footprint of Wood Cladding, Carbon Footprints and Greenhouse Gas Emission Savings of Alternative Synthetic Biofuels, Making Food Production GHG Efficient, Carbon Footprint of Wood-Based Products and Buildings, Challenges and Merits of Choosing Alternative Functional Units, modeling aspects of carbon footprint, Quantifying Spatial–Temporal Variability of Carbon Stocks and Fluxes

UNIT IV EMISSION MITIGATION AND CARBON SINK 9 hours

Setting GHG Reduction Targets and Tracking Inventory Changes – Non-Fossil Fuel based Energy Systems - Carbon Dioxide capture and Storage Technologies –Mitigation potentials of different Sectors and systems – Innovation, Technology Development and Transfer, - Social aspects of mitigation –Polices, Institutions and international corporations – Carbon Pricing and Finance –GHG Offsetting and Green marketing.

UNIT V CASE STUDIES 9 hours

Carbon Footprint Estimation from Building Sector - Urban Carbon Footprint Evaluation – Applications of carbon footprint in urban planning – Mechanical Equipment and Electronic

Product Carbon Footprint - Carbon Footprint of Aqua and Agriculture products- GHG Emissions from Municipal Wastewater Treatment and Solid waste management

Course outcomes:
The students after completing the course will be able to:
1. Explain the climate change and carbon footprint
2. Discuss the principle of product life cycle and Green House Gas emissions accounting
3. Explain the Methodology for Carbon Footprint Calculation
4. Discuss emission mitigation and carbon sink
5. Explain the case study of carbon footprint.

Text books:

1. Assessment of Carbon Footprint in Different Industrial Sectors, Volume 1, by Subramanian Senthilkannan Muthu, Springer; Softcover reprint of the original 1st ed. 2014 edition (23 August 2016), ISBN-10 : 9811011737
2. Assessment of Carbon Footprint in Different Industrial Sectors, Volume 2, by Subramanian Senthilkannan Muthu, Springer Nature; 2014th edition (30 April 2014), ISBN-10 : 9814585742

References:
1. Subramanian, Senthil Kannan, Muthu (2016), Carbon Foot Print Handbook, CRC Press
2. Subramanian, Senthil Kannan, Muthu (2016), Environmental Carbon Foot Print Industrial case Studies, Butterworth Heinemann Publishers
3. World Resources Institute, Green House Gas Protocol - Product Life Cycle Accounting and Reporting Standard
4. ISO 14067 -2018, Green House gases and carbon footprint, Requirements and Guidelines for Quantification, International Organisation for Standardisation.
5. IPCC (2022) –Sixth Assessment Reports – Intergovernmental Panel on Climate Change, United Framework convention on Climate Change.

Mode of Evaluation: Assignments, Internal Mid Tests and External End Examinations

Professional Elective - IV

B. Tech. Mechanical Engineering

Professional Elective - IV

20ME412 ELECTRIC VEHICLE TECHNOLOGY

L	T	P	C
3	0	0	3

Pre-requisite: NIL

Course description:

This course introduces the fundamental concepts, principles and analysis of Electric Vehicles and its accessories.

Course objectives:

1. To study the various aspects of EV technology.
2. To study and understand motors used for EV.
3. To understand the basic functionality of hybrid electric vehicle.
4. To study the various design of EV controllers.
5. To understand the storage, charging and safety in EV.

UNIT I INTRODUCTION TO ELECTRIC VEHICLE 9 hours

A Brief History of EVs, Past, Present & Feature of EV, Current Major Issues, Recent Development Trends, EV Concept, Key EV Technology, State-of-the Art EVs & HEVs, Comparison of EV Vs IC Engine. EV Configuration: Fixed & variable gearing, single & multiple motor drive, In-wheel drives, EV Parameters: Weight, size, force, energy & performance parameters.

UNIT II INTRODUCTION TO TRACTION MOTORS: 9 hours

Propulsion Machine Overview - DC Machines, AC Machines, Induction motor, Switched reluctance motor, Permanent Magnetic BLDC Motor Drives: Comparison of Traction Machines, A case study; Machine Specification - Four-Quadrant Operation, Rated Parameters, Rated Torque, Rated and Base Speeds, Rated Power, Peak Operation, Starting Torque; Characteristic Curves of a Machine - Constant-Torque Mode, Constant-Power Mode, Maximum-Speed Mode, Efficiency Maps.

UNIT III HYBRID ELECTRIC VEHICLE 9 hours

Configuration of HEV (Series, Parallel, Series-parallel &Complex), Power Flow control, Examples. Power flow control in all HEV configurations, Examples of HEV system performance.

UNIT IV FUNDAMENTALS OF EV CONTROLLERS 9 hours

Introduction to Control, Feedback Controller Design Approach, Modelling the Electromechanical System, The Mechanical System, The PM DC Machine, The DC-DC Power Converter, The PI Controller, Acceleration of Battery Electric Vehicle (BEV) using PM DC Machine, Acceleration of BEV using WF DC Machine.

UNIT V STORAGE, CHARGING & SAFETY 9 hours

Different Batteries and Ultra capacitors; Battery characteristics (Discharging &Charging) Battery Chargers: Conductive (Basic charger circuits, Microprocessor based charger circuit. Arrangement of an off-board conductive charger, Standard power levels of conductive chargers, Inductive (Principle of inductive charging, Soft-switching power converter for inductive charging), Battery indication methods, Charging Infrastructure: Domestic Charging Infrastructure, Public Charging Infrastructure, Normal Charging Station,

Occasional Charging Station, Fast Charging Station, Battery Swapping Station, Move-and-charge zone. Safety and Environment Aspects of EV Technology.

Course outcomes:
At the end of this course, students will be able to

1. Understand the various parameters involved in EV technology.
2. Classify and understand the motors used in EV.
3. Understand the application of Hybrid Electric Vehicle.
4. Interpret the design of EV controllers.
5. Execute the installation, storage, charging and safety in EV.

Text books:
1. John G. Hayes and A. Goodarzi, "Electric Powertrain - Energy Systems, Power electronics and drives for Hybrid, electric and fuel cell vehicles", Wiley Publication, 2018.
2. C.C Chan, K.T Chau: Modern Electric Vehicle Technology, Oxford University Press Inc., New York 2001

Data Book: NIL

References:
1. K Wang Hee Nam: AC Motor Control & Electrical Vehicle Application, CR Press, Taylor & Francis Group, 2019
2. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003.
3. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003

Mode of Evaluation: Assignments, Internal Mid Tests and External End Examinations

B. Tech. Mechanical Engineering

Professional Elective –IV

20ME413 ADDITIVE MANUFACTURING

L	T	P	C
3	0	0	3

Pre-requisite: 20ME104, 20ME108

Course description:

This course introduces the fundamental concepts, principles and analysis of Battery Management System in Electric Vehicles Course.

Course objectives:

The main objective of this course is t:

1. Acquaint students with the concept of AM
2. Teach various AM technologies, post-processing
3. Teach Selection of AM parts, hybrid processes
4. Teach applications of AM in various fields.

UNIT I INTRODUCTION TO ADDITIVE MANUFACTURING 9 hours

The Generic AM Process, Need for Additive Manufacturing, Benefits of AM, Distinction between AM and CNC machining and other related technologies, Development of Additive Manufacturing Technology, Classification of AM Process, Generalized Additive Manufacturing Process Chain, Advantages and Limitations of AM.

UNIT II EXTRUSION AND POWDER BED FUSION AM PROCESSES 9 hours

Models and specifications, Process parameters, working principle, Applications, Advantages and Disadvantages of Vat Photopolymerization Processes, Stereolithography Apparatus (SLA), Solid ground curing (SGC). Laminated Object Manufacturing (LOM), Fused Deposition Modeling (FDM), Selective laser Sintering (SLS), Electron Beam melting (EBM).

UNIT III DIRECTED ENERGY DEPOSITION AM PROCESSES 9 hours

Process Description, Material Delivery, Process parameters of Laser Engineered Net Shaping (LENS), Direct Metal Deposition (DMD), Electron Beam Based Metal Deposition, Processing-structure-properties, relationships, Benefits and drawbacks, Applications of Directed Energy Deposition Processes. Functional effects and defects in AM.

UNIT IV POST PROCESSING OF AM PARTS AND PROCESS SELECTION 9 hours

Post Processing of AM Parts: Support Material Removal, Surface Texture Improvement, Accuracy Improvement, Aesthetic Improvement, Preparation for use as a Pattern, Property Enhancements using Non-thermal and Thermal Techniques. Guidelines for Process Selection, Selection Methods for a Part, Challenges of Selection.

UNIT V TRENDS AND APPLICATIONS OF AM 9 hours

Hybrid AM: Ultrasonic AM (UAM), Cold Spraying AM (CSAM), Friction stir AM (FSAM), Comparison between UAM, CSAM and FSAM.

AM Applications: Application of AM parts as Visualization Tools, Aerospace applications, Automotive applications, Medical Applications, Construction Industry and Retail applications.

Course outcomes:

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

1. Understand the concept and importance of AM
2. Understand the working principle and process parameters of AM processes
3. Select the directed energy deposition AM process for the given application.
4. Perform and select suitable post-processing operations based on product repair requirement
5. Explore the trends and applications of AM processes in various fields

Text books:

1. Ian Gibson, David W Rosen, Brent Stucker., "Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing", 2nd Edition, Springer, 2015.
2. Chua Chee Kai, Leong Kah Fai, "3D Printing and Additive Manufacturing: Principles & Applications", 4th Edition, World Scientific, 2015.
3. Manu Srivastava, Sandeep Rathee, Sachin Maheshwari and T. K. Kundra, "Additive Manufacturing Fundamentals and Advancements", 1st edition, CRC Press, 2019.

Data Book: NIL

References:

1. Andreas Gebhardt, Understanding additive manufacturing: rapid prototyping, rapid tooling, rapid manufacturing, Hanser Publishers, 2011.
2. J.D. Majumdar and I. Manna, Laser-assisted fabrication of materials, Springer Series in Material Science, 2013.
3. L. Lu, J. Fuh and Y. S. Wong, Laser-induced materials and processes for rapid prototyping, Kluwer Academic Press, 2001.
4. Zhiqiang Fan and Frank Liou, Numerical modeling of the additive manufacturing (AM) processes of titanium alloy, lnTech, 2012.

Mode of Evaluation: Assignments, Internal Mid Tests and External End Examinations

B. Tech. Mechanical Engineering

Professional Elective – IV

20ME414 FUNDAMENTALS OF AERODYNAMICS

L	T	P	C
3	0	0	3

Pre-requisite: 20ME105

Course description:

An introduction to aerodynamics including wing and airfoil theory, automobile aerodynamics and wind tunnel testing.

Course objectives:

1. To understand the basics of fluid mechanics as a prerequisite to Aerodynamics
2. Acquire knowledge on typical airfoil characteristics and two-dimensional flows over airfoil and study the incompressible over finite wings.
3. Assimilate the understanding of application of aerodynamics on automobiles and wind tunnel testings.

UNIT I REVIEW OF BASIC FLUID MECHANICS 9 hours

Continuity, momentum and energy equation, Control volume approach to Continuity, momentum and energy equation, Types of flow, path lines, streamlines, and streak lines, units and dimensions, inviscid and viscous flows, compressibility, Mach number regimes. Vorticity, Angular velocity, Stream function, velocity potential function, Circulation, Mach cone and Mach angle, Speed of sound.

UNIT II AIRFOIL CHARACTERISTICS 9 hours

Fundamental aerodynamic variables, Airfoil nomenclature, airfoil characteristics. wing planform geometry, aerodynamic forces and moments, centre of pressure, pressure coefficient, aerodynamic center, calculation of airfoil lift and drag from measured surface pressure distributions, typical airfoil aerodynamic characteristics at low speeds. Types of drag-Definitions.

UNIT III TWO DIMENSIONAL FLOW OVER AIRFOIL 9 hours

Two Dimensional Flows & Incompressible Flow Over Airfoil Uniform flow, Source flow, Sink flow, Combination of a uniform flow with source and sink. Doublet flow. Non-lifting flow over a circular cylinder. Vortex flow. Lifting flow over a circular cylinder.

UNIT IV INTRODUCTION TO AUTOMOBILE AERODYNAMICS 9 hours

Scope, historical developments, fundamental of fluid mechanics, flow phenomenon related to vehicles, external and Internal flow problem, resistance to vehicle motion, performance, fuel consumption and performance potential of vehicle aerodynamics, engine cooling requirement, air flow to passenger compartment, duct for air conditioning, cooling of transverse engine and rear engine.

UNIT V Wind Tunnels for Automotive Aerodynamics 9 hours

Introduction – Principles of wind tunnel technology – Limitation of simulation – Stress with scale models – Full scale wind tunnels – Measurement techniques – Equipment and transducers – Road testing methods.

Course outcomes:

The students after completing the course will be able to:

1. Understand the basic of fluid dynamics and its connectivity with aerodynamics.
2. Evaluate typical airfoil characteristics.
3. Evaluate two-dimensional flows over airfoil.
4. Understand the fundamentals of automobile aerodynamics.
5. Apply aerodynamics concepts in wind tunnel testing.

Textbooks:

1. Fundamental of Aerodynamics Anderson J.D McGraw-Hill International Edition, New York 5th edition,2011
2. Aerodynamics for Engineering Students E. L. Houghton, P.W. Carpenter Elsevier, New York 5th edition,2010
3. Hucho,W.H., "Aerodynamics of Road vehicles", Butterworths Co. Ltd., 1987.
4. Pope, A., "Wind Tunnel Testing", John Wiley & Sons, 2nd Edt, New York, 1974.

References:

1. Clancy L. J. "Aerodynamics", Sterling book house, New Delhi, 2006, ISBN: 9780582988804.
2. Louis M. Milne-Thomson, "Theoretical Aerodynamics", Dover Publications-USA, Imported Edition,2011, ISBN 9780486619804.
3. Automotive Aerodynamics: Update SP-706, SAE, 1987.
4. Vehicle Aerodynamics, SP-1445, SAE, 1996

Mode of Evaluation: Assignments, Internal Mid Tests and External End Examinations

B. Tech. Mechanical Engineering

Professional Elective – IV

20ME415 NON DESTRUCTIVE TESTING

L	T	P	C
3	0	0	3

Pre-requisite: Knowledge on welding process, casting of products, X ray techniques

Course description:

This course provides students a synopsis of non-destructive and destructive evaluation methodsthat are used in evaluation of welds. This includes understanding the basic principles of various NDT methods, fundamentals, and discontinuities in different product forms, importance of NDT, applications, limitations of NDT methods and techniques and codes, standards and specifications related to non-destructive testing technology. Students also will be introduced torelevant quality assurance and quality control requirements in accordance with ASME, ASTM,AWS, BS, IBR standards

Course objectives:

1. To understand principle behind various NDT techniques.
2. To study about NDT equipment and accessories.
3. To learn working procedures of various NDT techniques.
4. To learn international inspection standards and specifications related to NDTtechniques

UNIT I SURFACE NON DESTRUCTIVE EVALUATION TECHNIQUES **9 hours**

Overview of the Non-Destructive Testing Methods for the detection of manufacturing defects.Liquid Penetrant Testing – Principles, types and properties of liquid penetrants, developers, advantages and limitations of various methods, Testing Procedure, Interpretation of results. Magnetic Particle Testing- Theory of magnetism, inspection materials, Magnetization methods, Interpretation and evaluation of test indications, Principles and methods of demagnetization, Residual magnetism.

UNIT II CONVECTION HEAT TRANSFER **9 hours**

Thermography- Principles, Contact and non-contact inspection methods, Techniques for applying liquid crystals, Advantages and limitation – infrared radiation and infrared detectors,Instrumentations and methods, applications. Eddy Current Testing-Generation of eddy currents, Properties of eddy currents, Eddy current sensing elements, Probes, Instrumentation, Types of arrangement, Applications, advantages, Limitations, Interpretation/Evaluation..

UNIT III ULTRASONIC TESTING **9 hours**

Fundamentals of ultrasonic waves, Generation of ultrasonic waves-piezo electric effect, Ultrasonic inspection methods-pulse echo method, through transmission method, resonance method, Study of A, B and C scan presentations, Interpretation for welds, castings etc, applications, various case studies, Inspection standards and specifications (ASME, ASTM, AWS, BS, IBR etc.).

UNIT IV RADIOGRAPHIC TESTING AND SAFETY **9 hours**

Basic principles of radiography- X rays and their properties, X ray generation, X ray absorption and scattering, Radiographic image-image formation and quality, image interpretation, radiography of weldments, Radiation safety- radiation detectors, radiation shielding. Interpretation for welds, castings etc, applications, various case studies, Inspection standards and specifications (ASME, ASTM, AWS, BS, IBR etc.)

UNIT V ADVANCED NDE TECHNIQUES 9 hours

Acoustic emission testing: Basic principle, parameters, Kaiser-Felicity theory Phased array techniques- Principles of phased array inspection, Theory and principles of time of flight diffraction (TOFD), Synthetic Aperture Focusing Technique (SAFT), Electro Magnetic Acoustic Transducer (EMAT), Laser ultrasonics-Laser Shearographics, Structural health monitoring, Digital Radiography, Computed Tomography (CT).

Course outcomes:

The students after completing the course will be able to:

1. Know the different surface NDE techniques which enables to carry out various inspection
2. Perform inspection of samples and identify the defects using Theromgraphy and Eddycurrent testing
3. Understand basic knowledge of ultrasonic testing which enables them to perform inspectionof samples
4. Differentiate various defect types and characterize them using radiography
5. Understand the recent developments in NDE and their application in various industries

Text books:

1. Peter J. Shull "Non Destructive Evaluation: Theory, Techniques and Application" Marcel Dekker, Inc., New York, 2002.
2. Baldev raj, T Jeyakumar, M. Thavasimuthu "Practical Non-Destructive Tesitng" Narosa Publishing house, New Delhi, 2002.

References:

1. Baldev Raj and B.Venkataraman, "Practical Radiology", Narosa Publishing House, 2004.
2. Krautkramer.J, "Ultra Sonic Testing of Materials", 1st Edition, Springer – VerlagPublication, New York, 1996.

Mode of Evaluation: Assignments, Internal Mid Tests and External End Examinations

B. Tech. Mechanical Engineering

Professional Elective – IV

20ME416 TOTAL QUALITY MANAGEMENT

L	T	P	C
3	0	0	3

Pre-requisite: None

Course description:

Total quality management (TQM) is a philosophy, methodology and system of tools aimed to create and maintain mechanism of organization's continuous improvement. It involves all departments and employees for the improvement of processes and products. TQM encompasses various principles, techniques, and tools for identifying and solving problems, fostering a culture of quality, promoting teamwork, and striving for excellence in all areas of the organization. The goal of TQM is to achieve sustainable and long-term success by consistently delivering high-quality products and services that meet or exceed customer expectations while improving overall organizational performance.

Course objectives:

1. Study comprehensive knowledge about the principles, practices, tools and techniques of total quality management.
2. Gain knowledge on leadership, customer satisfaction, addressing customer complaints, team work, employee involvement, related to customer and supplier partnership.
3. Gather information on various tools and techniques, concept on Six Sigma, bench marking and Failure Mode Effective Analysis (FMEA).
4. Know the importance of Quality circle, Quality Function Deployment, Taguchi design and case studies related to TQM.
5. Facilitate the understanding of standards of quality.

UNIT I INTRODUCTION 9 hours

Introduction - Evolution of Quality - Historical Perspective, Basic Concepts of Quality – Quality control, Quality management and Quality Assurance - Definition of TQM – Basic concepts of TQM - TQM Framework - Contributions by Deming, Juran, Crosby and Feigenbaum – Dimensions of product and service quality

UNIT II TQM PRINCIPLES 9 hours

TQM principles - Strategic quality planning, Quality statements – Customer focus – Customer orientation, Customer satisfaction, Customer complaints, Customer retention – Role of Leadership and Commitment in Quality Deployment, Team Building, Motivation and Rewards, Total Employee Empowerment, Performance appraisal - Continuous process improvement – Supplier partnership – Partnering, Supplier selection,

UNIT III TOOLS OF TQM 9 hours

The seven traditional tools of quality – New management tools – Six-sigma: Concepts, methodology, applications to manufacturing, service sector including IT – Bench marking – Reason to bench mark, Bench marking process – KAIZEN, 5S, JIT, Documentation – Failure mode and Effect Analysis (FMEA)

UNIT IV TQM TECHNIQUES 9 hours

Quality circles – Quality Function Deployment (QFD) – House of Quality – Design of Experiments – Taguchi quality engineering – Orthogonal Arrays – Signal to Noise Ratio – TPM – Concepts, improvement needs – Cost of Quality – Performance measures

UNIT V IMPELMENTATION OF TQM 9 hours

Introduction – Benefits of ISO Registration – ISO 9000 Series of Standards –Implementation – Environmental Management System: Introduction – ISO 14000 Series Standards – Concepts of ISO 14001 – Requirements of ISO 14001, Case studies on TQM principles followed by Indian Industries.

Course outcomes:

The students after completing the course will be able to:

1. Understand the various principles and practices of TQM to achieve quality.
2. Identify the various statistical approaches for Total Quality Control.
3. Demonstrate the TQM tools for continuous process improvement.
4. Adopt the importance of ISO and Quality systems.
5. Make use of the concepts of TQM to solve case studies

Text books:

Dale H. Besterfield, et al., Total Quality Management, Pearson Education Asia, Third Edition, Indian Reprint (2003).

References:

1. James R. Evans and William M. Lindsay, The Management and Control of Quality, (6th Edition), South-Western (Thomson Learning), 2005.
2. Oakland, J.S. TQM – Text with Cases", Butterworth – Heinemann Ltd., Oxford, Third Edition (2003).
3. Suganthi,L and Anand Samuel, Total Quality Management, Prentice Hall (India) Pvt. Ltd. (2006) Model.

Mode of Evaluation: Assignments, Internal Mid Tests and External End Examinations

B. Tech. Mechanical Engineering

Professional Elective – V

20ME417 MECHANICAL VIBRATIONS

L	T	P	C
3	0	0	3

Pre-requisite: NIL

Course description:

An introduction to vibrations, damped vibrations, forced vibrations and instruments.

Course objectives:

4. To understand the force-motion relationship in components subjected to external forces and analysis of standard mechanisms.
5. To understand the effect of Dynamics of undesirable vibrations.
6. The student will be able to understand the sources of vibration in automobiles and make design modifications to reduce the vibration and improve the life of the components

UNIT I INTRODUCTION 9 hours

Types of vibrations, Definitions, Simple Harmonic Motion (S.H.M.), Work done by harmonic force, Principle of super position applied to SHM, Beats, Fourier theorem and problems.

Undamped (Single Degree of Freedom) Free Vibrations 9

Derivations for spring mass systems, Methods of Analysis, Natural frequencies of simple systems, Springs in series and parallel, Torsional and transverse vibrations, Effect of mass of spring and Problems.

UNIT II DAMPED FREE VIBRATIONS (1DOF) 9 hours

Types of damping, Analysis with viscous damping - Derivations for over, critical and under damped systems, Logarithmic decrement and Problems.

UNIT III MULTI DEGREE FREEDOM SYSTEMS 9 hours

Principle modes of vibrations, Normal mode and natural frequencies of systems (without damping) – Simple spring mass systems, masses on tightly stretched strings, double pendulum, torsional systems, combined rectilinear and angular systems, geared systems and Problems. Undamped dynamic vibration absorber and Problems.

UNIT IV FORCED VIBRATIONS (1DOF) 9 hours

Introduction, Analysis of forced vibration with constant harmonic excitation - magnification factor, rotating and reciprocating unbalances, excitation of support (relative and absolute amplitudes), force and motion transmissibility, Energy dissipated due to damping and Problems.

UNIT V VIBRATION MEASURING INSTRUMENTS 9 hours

Vibration Measuring Instruments and Whirling of shafts: Seismic Instruments, Vibrometers, Accelerometer, Frequency measuring instruments and Problems. Whirling of shafts with and without damping, discussion of speeds above and below critical speeds and Problems.

Course outcomes:

The students after completing the course will be able to:

1. Summarize the Basics of Vibration.
2. Summarize the Natural frequency of simple systems.
3. Explain the types of damping.
4. Discuss the forced vibration
5. Describe the various frequency measuring instruments.

Textbooks:

1. Singiresu S.Rao, “Mechanical Vibrations”, 6th Edition, Pearson Education, 2016.
2. Theory of Vibrations with Applications 5th Edition, by William T. Thomson, Marie Dillon Dahlen, Chandramouli Padmanabhan (Author) , Perason.

References:

1. Balakumar Balachandran and Edward B. Magrab, “Fundamentals of Vibrations”, 1st Editon, Cengage Learning, 2009
2. Benson H. Tongue, “Principles of Vibrations”, 2nd Edition, Oxford University, 2007
3. Grover. G.T., “Mechanical Vibrations”, Nem Chand and Bros., 2009

Mode of Evaluation: Assignments, Internal Mid Tests and External End Examinations

B. Tech. Mechanical Engineering

Professional Elective – V

20ME418 GAS DYNAMICS AND JET PROPULSION

L	T	P	C
3	0	0	3

Pre-requisite: 20ME103

Course description:

The goal of this course is to lay out the fundamental concepts and results for the compressible flow of gases. Topics to be covered include appropriate conservation laws; propagation of disturbances; isentropic flows; compressible flows in ducts with area changes, friction, or heat addition; heat transfer to high-speed flows; Principle of Jet propulsion and working of various propulsion devices.

Course objectives:

1. To derive the general expression for the velocity of an infinitesimal pressure disturbance in an arbitrary medium using the governing equations of fluid dynamics.
2. Starting with basic principles of continuity, energy, and momentum, derive expressions for property ratios in terms of Mach number and specific heat ratio for fanno flow with a perfect gas.
3. Sketch a normal shock process on a T-s diagram, indicating as many pertinent features as possible, such as static and total pressures, static and total temperatures, and velocities. Indicate each of the properties before and after the shock.
4. Analyze an oblique shock in a perfect gas and develop the relation among shock angle, deflection angle and entering Mach number.
5. To demonstrate principle of operation of Jet propulsion and working of various propulsion devices.

UNIT I FUNDAMENTALS OF COMPRESSIBLE FLOW 9 hours

Introduction to compressible flow, second law of thermodynamics and entropy equation, acoustic velocity, Mach number and its significance, various flow regimes, Mach cone, Mach angle, Von Karman's rule of supersonic flow, concept of stagnation condition, relation between static an stagnation properties, entropy change in terms of stagnation properties, adiabatic energy equation, Prandtl velocity ellipse, critical speed of sound, stagnation speed of sound, maximum isentropic speed, reference Mach number, Crocco number, Stream thrust and the impulse function, dynamic pressure, flow compressibility factor, pressure coefficient of airfoil, steady one dimensional compressible flow of perfect gas.

UNIT II ONE-DIMENSIONAL ISENTROPIC FLOW 9 hours

Isentropic process on Mollier diagram, flow expansion and compression, performance curves, effect of area variation, property ratios in terms of Mach number, area ratio in terms of Mach number, impulse function ratio, mass flux in terms of Mach number, mass flux in terms of pressure ratio, flow factor, Mach number and area ratio in terms of pressure ratio, use of gas tables and charts.

UNIT III FANNO FLOW 9 hours

Governing equations for Fanno flow, Fanno line in Mollier diagram, effect of friction in subsonic and supersonic flows, limiting Mach number, effect of increase in flow resistance, effect of back pressure, Fanno relations for a perfect gas, temperature ratio, pressure ratio, density ratio, velocity ratio, stagnation pressure ratio, impulse function ratio, Change in entropy due to friction, friction coefficient, pressure drop due to friction, effect of friction on flow parameters, tables and charts for Fanno flow, Isothermal flow in Mollier diagram, flow parameter relations in isothermal flow, change in entropy, maximum length of duct, effect of friction in isothermal flow.

UNIT IV RAYLEIGH FLOW 9 hours

Governing equations for Rayleigh flow, Rayleigh line in Mollier diagram, simple heating process, simple cooling process, Chocking in Rayleigh flow, state of maximum enthalpy, Mach number at maximum entropy and enthalpy, region between maximum enthalpy and entropy, Rayleigh relations for a pefect gas, pressure ratio, stagnation pressure ratio, temperature ratio, stagnation temperature ratio, density ratio, velocity ratio, change in entropy due to heat transfer, working tables and charts, choking due to heat transfer, maximum possible heat addition.

UNIT V JET PROPULSION 9 hours

Principle of Operation – Classification of Jet Propulsive Engines – Working Principles with Schematic Diagrams and Representation on T-S Diagram - Thrust, Thrust Power and Propulsion Efficiency – Turbo Jet, Turbo Prop, Pulse Jet Engines – Schematic Diagram, Thermodynamic Cycle. Introduction to Rocket Propulsion.

Course outcomes:

The students after completing the course will be able to:

1. State the basic concepts of gas dynamics.
2. Write equations for the stagnation property in terms of static property, Mach number and ratio of specific heats.
3. Simplify the general equations of continuity, energy and momentum to obtain basic relations valid for any fluid in Fanno flow.
4. Sketch a Raleigh line in the p-v plane together with lines of constant entropy and constant temperature. Sketch a Rayleigh line in the h-s plane.
5. State the principle of operation of Jet propulsion and working of various propulsion devices.

Text books:

1. Pr. S.L. Somasundaram, “Gas Dynamics and Jet Propulsions”, New Age International Publishers.
2. S.Senthil, “Gas Dynamics and Jet Propulsion”, A.R.S. Publicatons.

Databook:

1. Gas Tables for Compressible Flow, S M Yahya, New Age International Publishers.

References:

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

Mode of Evaluation: Assignments, Internal Mid Tests and External End Examinations

B. Tech. Mechanical Engineering

Professional Elective – V

20ME419 MANUFACTURING OF COMPOSITE MATERIALS

L	T	P	C
3	0	0	3

Pre-requisite: 20ME104

Course description:

Composite material consists of both fiber and matrix. This course is designed to understand the composite materials applications, types of composite materials, phases, and various reinforcement and matrix. The various manufacturing techniques used of preparation of PMC, MMC & CMC are covered and gaining popularity over monolithic materials.

Course objectives:

1. To grasp the basic theory of composite materials and their importance.
2. To learn the different types of fibres used as reinforcements in composite material.
3. To impart knowledge on polymer composites and processing methods.
4. To understand the various matrix materials used as matrix in composite material.
5. To study the different type of manufacturing process for fabrication of ceramic composite materials.

UNIT I INTRODUCTION 9 hours

Introduction to Composites; Reinforcement and matrices; Types of reinforcements; Types of matrices; types of composites; Function of the Matrix and Reinforcement in Composites Matrices: Thermosets and Thermoplastic; Fibre Reinforcement; properties of composites in comparison with standard materials; applications of composites (metal, ceramics, and polymer matrix composites).

UNIT II MATRIX MATERIAL 9 hours

Matrix Materials – Polymers, glass transition temperature, thermoplastics and thermosets plastics, stress – strain behaviour, epoxy, polyester, Polyether ether ketone (PEEK), polypropylene (PP), matrix materials – metals: structure, strengthening methods, properties of metals (aluminium, titanium, magnesium), matrix materials – ceramics: bonding and structure, fracture toughness, properties of ceramics (glass, alumina, silicon carbide), fibre – matrix interface: wettability, surface roughness, mechanical bonding, chemical bonding,

UNIT III PROCESSING OF POLYMER MATRIX COMPOSITES (PMC) 9 hours

Thermoset matrix composites: hand layup, spray, filament winding, Pultrusion, resin transfer moulding, autoclave moulding - bag moulding, compression moulding – thermoplastic matrix composites – film stacking, diaphragm forming, thermoplastic tape laying, injection moulding – interfaces in PMCs – structure, properties and application of PMCs.

UNIT IV PROCESSING OF METAL MATRIX COMPOSITES (MMC) 9 hours

Metallic matrices: aluminium, titanium, magnesium, copper – processing of MMCs: liquid state, solid state, in – situ fabrication techniques – diffusion bonding – powder metallurgy techniques – Interfaces in MMCs – mechanical properties – machining of MMCs – Applications.

UNIT V PROCESSING OF CERAMIC MATRIX COMPOSITES (CMC) & Testing of Composites **9 hours**

Processing of CMCs: cold pressing, sintering, reaction bonding, liquid infiltration, lanxide process – in situ chemical reaction techniques, chemical vapour deposition, chemical vapour impregnation, sol-gel – interfaces in CMCs – mechanical properties and applications of CMCs – applications.

Testing of Composites: Mechanical testing of composites, tensile testing, Compressive testing, Intra-laminar shear testing, Inter-laminar shear testing, Fracture testing etc.

Course outcomes:

The students after completing the course will be able to:

1. Classify the various matrix material and reinforcements for polymer matrix composites, MMC and ceramic matrix composites.
2. Developing the knowledge on processing, interfacial properties, and application of composites.
3. To get the thorough knowledge on manufacturing of polymer matrix composites.
4. Understanding the fabrication process of metal matrix composites.
5. Summarizing the various fabrication process of ceramic matrix composites.

Text books:

1. Krishan K. Chawla, "Composite Materials: Science and Engineering", Second edition. Springer-Verlag, Newyork, 2010.

References:

1. Mallick P.K., Fiber Reinforced Composites: Materials, Manufacturing and Design, CRC press, New Delhi, 2010.
2. Sanjay K. Majumdar, "Composites manufacturing- materials, product, and process engineering" CRC Press, 2001.
3. B.D. Agrawal L.J. Broutman and K. Chandrashekhara "Analysis and Performance of Fiber Composites", John Wiley & Sons, 2006.
4. ASM Hand Book, " Composites", Vol.21, ASM International, 2001.

Mode of Evaluation: Assignments, Internal Mid Tests and External End Examinations

B. Tech. Mechanical Engineering

Professional Elective – V

20ME420 POWER PLANT ENGINEERING

L	T	P	C
3	0	0	3

Course Description:

Introduction of power plants and their selection, steam power plant generators and accessories, their design and Environmental Aspects, Gas Turbine Power Plant, Solar and Wind based Power Generation, Economics of Power Generation

Course objectives:

1. To study coal based thermal power plants.
2. To study diesel, gas turbine and combined cycle power plants.
3. To learn the basics of nuclear engineering and power plants.
4. To learn the power from renewable energy
5. To study energy, economic and environmental issues of power plants

UNIT I COAL BASED THERMAL POWER PLANTS 9 hours

Rankine cycle - improvisations, Layout of modern coal power plant, Super Critical Boilers, FBC Boilers, Turbines, Condensers, Steam & Heat rate, Subsystems of thermal power plants – Fuel and ash handling, Draught system, Feed water treatment. Binary Cycles and Cogeneration systems.

UNIT II DIESEL, GAS TURBINE AND COMBINED CYCLE POWER PLANTS 9 hours

Otto, Diesel, Dual & Brayton Cycle - Analysis & Optimisation. Components of Diesel and Gas Turbine power, plants. Combined Cycle Power Plants. Integrated Gasifier based Combined Cycle systems.

UNIT III NUCLEAR POWER PLANTS 9 hours

Basics of Nuclear Engineering, Layout and subsystems of Nuclear Power Plants, Working of Nuclear Reactors: Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANada Deuterium- Uranium reactor (CANDU), Breeder, Gas Cooled and Liquid Metal Cooled Reactors. Safety measures for Nuclear Power plants.

UNIT IV POWER FROM RENEWABLE ENERGY 9 hours

Hydro Electric Power Plants – Classification, Typical Layout and associated components including Turbines. Principle, Construction and working of Wind, Tidal, Solar Photo Voltaic (SPV), Solar Thermal, Geo Thermal, Biogas and Fuel Cell power systems.

UNIT V ENERGY, ECONOMIC AND ENVIRONMENTAL ISSUES OF POWER PLANTS 9 hours

Power tariff types, Load distribution parameters, load curve, Comparison of site selection criteria, relative merits & demerits, Capital & Operating Cost of different power plants. Pollution control technologies including Waste Disposal Options for Coal and Nuclear Power Plants.

Course outcomes (co):

At the end of the course the students would be able to:

1. Explain the layout, construction and working of the components inside a thermal power plant.
2. Explain the layout, construction and working of the components inside a Diesel, Gas and Combined cycle power plants.
3. Explain the layout, construction and working of the components inside nuclear power plants.
4. Explain the layout, construction and working of the components inside Renewable energy power plants
5. Explain the applications of power plants while extend their knowledge to power plant economics

Text books:

1. Nag. P.K., "Power Plant Engineering", Third Edition, Tata McGraw – Hill Publishing Company Ltd., 2008.
2. A Textbook of Power Plant Engineeringby R.K. Rajput | 1 January 2016

References:

1. El-Wakil. M.M., "Power Plant Technology", Tata McGraw – Hill Publishing Company Ltd., 2010.
2. Godfrey Boyle, "Renewable energy", Open University, Oxford University Press in association with the Open University, 2004.
3. Thomas C. Elliott, Kao Chen and Robert C. Swanekamp, "Power Plant Engineering", Second Edition, Standard Handbook of McGraw – Hill, 1998.
4. Power Plant Engineeringby B. Vijaya Ramnath C. Elanchezhian, L. Saravanakumar | 1 November 2019.
5. Power Plant Engineering, As per AICTE: Theory and Practice by Dipak Kumar Mandal, Somnath Chakrabarti, et al. | 1 January 2019

Mode of Evaluation: Assignments, Internal Mid Tests and External End Examinations

B. Tech. Mechanical Engineering

Professional Elective – V

20ME421 OPERATIONS RESEARCH

L	T	P	C
3	0	0	3

Course Description:

Operational Research (OR) is the application of similar ideas to larger, more complex decisions that concern the operations of systems, such as businesses and networks of machines. Making these decisions using OR entails employing mathematical methods in order to solve a numerical version of the problem at hand.

Course objectives:

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

1. To learn Selecting the constraints on the availability of resources and developing a model and rendering an optimal solution for the given circumstances.
2. To study Appraising the challenges in the transportation and production problems and furnishing a rational solution to maximize the benefits.
3. To learn Planning the purchase/ manufacturing policies, managing the spares/ stocks and meeting the customer demands.
4. To Analysing the queue discipline and exploring the avenues for better customer service.
5. To Investigating the nature of the project and offering methodical assistance towards decision making in maintenance.

UNIT I INTRODUCTION 9 hours

Introduction: Evolution of OR, Definitions of OR, Scope of OR, Applications of OR, Phases in OR study. Characteristics and limitations of OR, models used in OR, Linear Programming Problem (LPP), Generalized LPP- Formulation of problems as L.P.P. Solutions to LPP by graphical method (Two Variables).

UNIT II LINEAR PROGRAMMING PROBLEMS 9 hours

Simplex method, Canonical and Standard form of LP problem, slack, surplus and artificial variables, Solutions to LPP by Simplex method, Big-M Method and Two Phase Simplex Method, Degeneracy in LPP. Concept of Duality, writing Dual of given LPP. Solutions to L.P.P by Dual Simplex Method.

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UNIT III TRANSPORTATION PROBLEM 9 hours

Formulation of transportation problem, types, initial basic feasible solution using North-West Corner rule, Vogel's Approximation method. Optimality in Transportation problem by Modified Distribution (MODI) method. Unbalanced T.P. Maximization T.P. Degeneracy in transportation problems, application of transportation problem. Assignment Problem-Formulation, Solutions to assignment problems by Hungarian method, Special cases in assignment problems, unbalanced, Maximization assignment problems. Travelling Salesman Problem (TSP). Difference between assignment and T.S.P, Finding best route by Little's method. Numerical Problems.

UNIT IV NETWORK ANALYSIS 9 hours

Introduction, Construction of networks, Fulkerson's rule for numbering the nodes, AON and AOA diagrams; Critical path method to find the expected completion time of a project, determination of floats in networks, PERT networks, determining the probability of completing a project, predicting the completion time of project; Cost analysis in networks. Crashing of networks- Problems. Queuing Theory: Queuing systems and their

characteristics, Pure-birth and Pure-death models (only equations), Kendall & Lee's notation of Queuing, empirical queuing models – Numerical on M/M/1 and M/M/C Queuing models.

UNIT V GAME THEORY & SEQUENCING 9 hours

Game Theory: Definition, Pure Strategy problems, Saddle point, Max-Min and Min-Max criteria, Principle of Dominance, Solution of games with Saddle point. Mixed Strategy problems. Solution of 2X2 games by Arithmetic method, Solution of 2Xn m and mX2 games by graphical method. Formulation of games. Sequencing: Basic assumptions, Johnson's algorithm, sequencing 'n' jobs on single machine using priority rules, sequencing using Johnson's rule-'n' jobs on 2 machines, 'n' jobs on 3 machines, 'n' jobs on 'm' machines. Sequencing of 2 jobs on 'm' machines using graphical method. Case studies of various automobile industries & their operation methodologies.

Course outcomes:

At the end of the course the students would be able to:

1. Understand the importance of unconstrained and constrained optimization to solve engineering problems.
2. Get an idea about the linear programming techniques.
3. Solve transportation and assignment problems in engineering situations.
4. Analyze the problems of network analysis for project management and Queuing systems engineering & industry.
5. Get an idea about the game theory & sequencing.

Text books:

1. Operations Research, P K Gupta and D S Hira, S. Chand and Company LTD. Publications, New Delhi – 2007
2. Operations Research, An Introduction, Seventh Edition, Hamdy A. Taha, PHI Private Limited, 2006.J K Sharma,
3. Operations Research: Theory and Practice, Macmillan Publishers India Ltd, 5th edition,2013. B.S. Grewal, Higher Engineering Mathematics, 43rd edition (2014), Khanna publishers. Reference Books 1. Hamdy A Taha,
4. Operations Research: An Introduction, Pearson Education, 9/E, 2011. 2. FS Hillier and GJ Lieberman, Introduction to Operations Research, TMH, 8/E, 2006. 3. JC Pant,
5. Introduction to Optimization: Operations Research, Jain Brothers, New, 6/E, 2004. 4. A Ravindran, DT Philips and JJ Solberg,

References:

1. Operations Research, Theory and Applications, Sixth Edition, J K Sharma, Trinity Press, Laxmi Publications Pvt. Ltd. 2016.
2. Operations Research, Paneerselvan, PHI
3. Operations Research, A M Natarajan, P Balasubramani, Pearson Education, 2005
4. Introduction to Operations Research, Hillier and Lieberman, 8th Ed., McGraw Hill

Mode of Evaluation: Assignments, Internal Mid Tests and External End Examinations

Skill Oriented Courses

B. Tech. Mechanical Engineering

Skill Oriented Course – I

20ME601 DESIGN THINKING AND PRODUCT INNOVATION

L	T	P	C
1	0	2	2

Course Prerequisite: Basic Engineering Mathematics and Physics

Course Description:

This course is an introductory course on Innovation and Design Thinking. It focuses on providing you with the knowledge and fundamental understanding of Creativity, Innovation, and some contemporary approaches to innovation including design thinking. The course will cover seminal models, key principles, and methods and techniques in innovation and design thinking, including their applications.

Course Objectives:

1. To Define Creativity and Innovation
2. Recognize the significance of innovation
3. Discuss both individual and contextual factors that are linked to creativity
4. Discuss key concepts and principles that guide innovative practices
5. Examine approaches to innovation practiced by various organizations

UNIT I: HISTORY OF MODERN DESIGN 6 hours

An insight into design, History of Modern design: Early innovations industrialization, new materials, nature of design, work design for survival and survival through design

- Design a mind map of design thinking
- Thirty circle Exercise ---ideation

UNIT II: DESIGN THINKING APPROACHES 6 hours

Design thinking: Design thinking as a systematic approach to innovation, brain storming, visual thinking, design challenges, product development

- Prepared a toothpick bridge (mock-up model)
- Build a wind power car (mock up model)
- Prepared a marble maze (mock up model)

UNIT III: DECISION MAKING 6 hours

Innovation, art of innovation, strategies for creativity, teams for innovation, design alternatives, decision making for new design

- Develop customer journey map for a given case
- Construct empathy maps for a given case study-1
- Construct empathy maps for a given case study-2

UNIT IV: DESIGN THINKING APPLICATIONS 6 hours

Design thinking for strategic innovation, application of design, thinking in business and strategy, linking design thinking solution to business challenges, enterprise creativity, competitive logic of business strategy, design thinking for start-ups

- Make a hydraulic elevator (mock up models)
- Make a paper prototype for user testing (mock-up model)

UNIT V: DESIGN THINKING TECHNIQUES **6 hours**

Creative thinking techniques: Linear thinking, constraints in design, design thinking to meet corporate needs, designing today for tomorrow

- Design and development of cell phone wallet (mock-up model)
- Design thinking using sprint base software

Course Outcomes:

The students after completing the course will be able to:

1. Grasp the fundamental capabilities in the methods used for practicing Design Thinking
2. Understand challenges and benefits of Design Thinking
3. Communicate clearly about Design Thinking
4. Innovate in multidisciplinary teams
5. Have a process and mindset suited to innovation and creative problem-solving

Text Books:

1. Tim Brown, "Change by Design" Harper Bollins (2009)
2. Idris Mootee, "Design Thinking for Strategic Innovation", John Willey & Sons (2013)

References:

1. Tom Kelley and Jonathan Littman, "The Art of Innovation", Harper Collins Business (2001)
2. Jimmy Jain, "Thinking for Startups", Notion Press (2018)
3. David Raizman, "History of Modern Design", Laurence King Publishing Ltd. Edition 2 (2010)
4. Tom Kelley and Jonathan Littman, " The Art of Innovation", Harper Collins Business (2001)
5. Michael Michalko, "Thinker Toys", Ten Speed Press (2006)

Mode of Evaluation: Assignments, Internal Mid Tests and External End Examinations

B. Tech. Mechanical Engineering

Skill Oriented Course – II

20ENG601 CORPORATE COMMUNICATION

L	T	P	C
1	0	2	2

Pre-requisite: **18ENG201**

Course Description:
English is practical and it is a must for any institution to provide students with opportunities to indulge in actively applying their language skills. Thus the Communication Skills Lab facilitates students with adequate opportunities to put their communication skills in use. It also accommodates peer learning by engaging students in various interactive sessions. This lab will be accompanied by a practical lab component.

Course Objectives:

This course enables the students to –

1. Focus on their interactive skills
2. Develop their communicative competency
3. Fortify their employability skills
4. Empower their confidence and overcome their shyness
5. Become effective in their overall performance in the industry

UNIT I LISTENING SKILLS **8 hours**

Listening/watching interviews, conversations, documentaries, etc.; Listening to lectures, discussions from TV/Radio/Podcast.

UNIT II SPEAKING **10 hours**

Articulation of sounds; Intonation.; Conversational skills (Formal and Informal); Group Discussion; Making effective Oral presentations**:** Role play.

UNIT III READING SKILLS **8 hours**

Reading for main ideas; Applying background knowledge to predict content; Skimming; Scanning; Making inferences; Reading different genres of texts ranging from newspapers to creative writing; Reading Comprehension.

UNIT IV WRITING SKILLS **9 hours**

Writing an introduction; Essay structure; Descriptive paragraphs; Writing a conclusion.
Writing job applications and resume; Emails; Letters; Memorandum; Reports; Writing abstracts and summaries; Interpreting visual texts.

UNIT V INTERVIEW SKILLS **10 hours**

Different types of interviews: Answering questions and offering information; Mock interviews; Body Language.

Course Outcomes:

At the end of the course, learners will be able to—

1. Read articles from magazines and newspapers
2. Participate effectively in informal conversations
3. Introduce themselves and their friends and express opinions in English
4. Comprehend conversations and short talks delivered in English
5. Write short essays of a general kind, draft Reports and personal letters and emails in English.

Text Books:

1. Sanjay Kumar and Pushp Lata; Communication Skills; Oxford University Press, 2012.
2. Sabina Pillai and Agna Fernandez; Soft Skills and Employability Skills; Cambridge University Press, 2018.
3. S.P. Dhanavel; English and Communication Skills for Students of Science and Engineering; Orient Blackswan, 2009.
4. M. Ashraf Rizvi; Effective Technical Communication; Tata Mc Graw Hill Co. ltd, 2005.

Reference:

1. Dr. M.Adithan; Study Skills for Professional Students in Higher Education; S.Chand & Co. Pvt., 2014.
2. Guy Brook Hart & Vanessa Jakeman; Complete IELTS: Cambridge University Press, 2014.
3. Vanessa Jakeman & Clare Mcdowell; Action Plan for IELTS: Cambridge University Press, 2006.
4. Guy Brook Hart; Instant IELTS; Cambridge University Press, 2004.
5. S.P.Bakshi & Richa Sharma; Descriptive General English; Arihant Publications, 2012.
6. Charles Browne, Brent Culligan 7 Joseph Phillips; In Focus (level 2); Cambridge University Press.
7. Steven Gershon; Present Yourself 2 (second edition); Cambridge University Press.
8. Leo Jones; Let's Talk 3 (second edition); Cambridge University Press.
9. Nutall J. C.; Reading Comprehension; Orient Blackswan.
10 www.cambridgeenglish.org/in/
11. https://learnenglish.britishcouncil.org/en/english-grammar
12. https://www.rong-chang.com/

Mode of Evaluation: Assignments, Internal Mid Tests and External End Examinations

B. Tech. Mechanical Engineering

Skill Oriented Course – III

20ME602 COMPUTER MODELING FOR MECHANICAL ENGINEERING-I

L	T	P	C
1	0	2	2

Pre-requisite: Solid Edge

Course description:
The objective of this course is to introduce the students to 3D modelling, assembly and simulation of different machines/mechanisms.

Course objectives:
1. To introduce commercial CAD software used in industries.
2. Conversion of basic 2D drawings to 3D mechanism CAD models.
3. To apply basic kinematic constraints like turning pair, prismatic pair etc.
4. Parametric modelling of gears.
5. Simulation of relative motion of links of a mechanism.

UNIT I RIGID LINK MECHANISMS 6 hours

Kinematic Links and Kinematic Pairs, Classification of Link and Pairs, Constrained Motion and Classification, Mechanism and Machines, Inversion of Mechanism, Inversions of Quadric Cycle, Inversion of Single Slider Crank Chains, Inversion of Double Slider Crank Chains.

- Draw a four-bar mechanism using Solid Edge.

UNIT II CAM AND FOLLOWER MECHANISMS 6 hours

Cams Terminology, Uniform velocity Simple harmonic motion, Uniform acceleration, Maximum velocity during outward and return strokes, Maximum acceleration during outward and return strokes.

- Draw a Cam and follower mechanism using Solid Edge

UNIT III SLIDING MECHANISMS 6 hours

Motion of link in machine, Velocity and acceleration diagrams, Graphical method, Relative velocity method four bar chain.

- Draw a Slider crank mechanism using Solid Edge

UNIT IV GEAR TRAIN MECHANISMS 6 hours

Toothed gears types, Condition for constant velocity ratio, Velocity of sliding phenomena, Condition for minimum number of teeth, Expressions for arc of contact and path of contact Gear Trains, Simple and reverted wheel train, Epicycle gear Train, Differential gear for an automobile.

- Draw a Simple and planetary gear train mechanism using Solid Edge
- Draw a Rack and pinion mechanism using Solid Edge

UNIT V ROBOTIC ARMS 6 hours

Robot kinematics - Geometric approach for 2R, 3R manipulators, homogenous transformation using D-H representation, kinematics of WMR, Lagrangian formulation for 2R robot dynamics.

- Draw a Robotic arm mechanism using Solid Edge.

Course outcomes:
The students after completing the course will be able to:
1. Draw basic 3D rigid bodies (Links) in CAD software.
2. Create simple mechanisms by applying kinematic pair constraints to the links.
3. Model gear tooth profiles.
4. Create simulations (animations) of motion of mechanisms.
5. To understand kinematics and dynamics of machines through simulation.

Text books:
Lab manual provided by the department

References:
1. Solid Edge 2022 for Designers, 19th Edition, Prof. Sham Tickoo Purdue Univ. and CADCIM Technologies.
2. Solid Edge 2020 Documentation by Siemens, https://docs.plm.automation.siemens.com/tdoc/se/2020/se_help

Mode of Evaluation: Continuous Internal Evaluation and End Semester Examination.

B. Tech. Mechanical Engineering

Skill Oriented Course – IV

20ME603 Computer Modeling for Mechanical Engineering-II

L	T	P	C
1	0	2	2

Pre-requisite: Basic CAD Modeling

Course description:
The objective of this course is to introduce the students to FEM (Finite Element Method) simulation of machine elements and structures under static and transient loading conditions.

Course objectives:
1. The basic concepts of finite element analysis.
2. FEM modelling: Pre-processing, meshing & post processing of machine elements & structures.
3. Simulate the stresses developed due to tensile, compressive, bending loads.
4. Simulate the stresses developed in machine elements and structures due to cyclic loads.
5. Simulate the stresses developed in pressure vessels.
6. Perform vibrational analysis of structures and machine elements.

UNIT I FEM BASICS 6 hours

General steps of the finite element method. Engineering applications of finite element method. Advantages of the Finite Element Method.

- Introduction to FEM simulation: Preprocessing, meshing and post processing.

UNIT II FEM MODELING 6 hours

Introduction, Derivation of stiffness matrix, Derivation of stiffness matrix for a spring element, Assembly the total stiffness matrix by superposition. One-Dimensional Elements-Analysis of Bars and Trusses, Linear interpolation polynomials in terms of local coordinate's for1D, 2Delements.

- Analysis of a cantilever beam with point and uniformly distributed loads (UDL).
- Analysis of a simple supported beam with point and uniformly distributed loads (UDL).

UNIT III PRIMARY STRESS 6 hours

Boundary conditions, Load vector, Hermite shape functions, Beam stiffness matrix based on Euler-Bernoulli beam theory, Examples on cantilever beams.

- Buckling analysis of columns.
- Analysis of a C-frame hook.

UNIT IV INDUCED STRESS 6 hours

Finite element formulation of shafts, determination of stress and twists in circular shafts.

- Analysis of a connecting rod of an engine.
- Fatigue analysis of machine elements.

UNIT V VIBRATIONS 6 hours

Types of vibrations, Definitions, Simple Harmonic Motion (S.H.M.), Work done by harmonic force, Principle of super position applied to SHM, Beats, Fourier theorem.

- Structural analysis of pressure vessels.
- Vibrational analysis of structures and machine elements.

Course outcomes:

The students after completing the course will be able to:

1. Carry out FEM analysis of machine elements and structures.
2. Calculate stresses and strains due to tensile, compressive and bending loads.
3. Simulate stresses under fatigue and transient loading conditions.
4. Calculate frequency response and mode shape of machine elements and structures subjected to vibration.
5. Design new products considering load and boundary constraints, selection of proper material and theories of failure.

Text books:

1.Introduction to Finite Elements in Engineering, Chandraputla, A and Belegundu, PHI
2.A first course in the Finite Element Method Logan, D. L Cengage Learning 6th Edition 2016
3.Finite Element Method in Engineering Rao, S. S Pergaman Int. Library of Science 5th Edition 2010

References:

1.Finite Element Method J.N.Reddy McGraw -Hill International Edition
2.Finite Elements Procedures Bathe K. J PHI
3.Concepts and Application of Finite Elements Analysis Cook R. D., et al. Wiley & Sons 4th Edition 2003

Mode of Evaluation: Continuous Internal Evaluation and End Semester Examination.

B. Tech. Mechanical Engineering

Skill Oriented Course – V

20ME604 ADVANCED MANUFACTURING TECHNOLOGIES

L	T	P	C
1	0	2	2

Pre-requisite: 20ME108, 20ME205, 20ME208, 20ME212

Course description:

This course gives hands on experience on various advanced manufacturing techniques and characterization equipment using CNC lathe machine, CNC milling machine, CNC lathe machine, Electrical Discharge Machining machine, Pin on disc tribometer, 3D Printing, optical microscope and surface roughness tester.

Course objectives:

1. To gain the knowledge and hands on experience for writing and operating of programs for CNC machines.
2. To gain knowledge and hands-on experience in EDM machine and Tribometer.
3. To learn knowledge and hands on experience on coding and operation of 3D printer.
4. To have hands on experience on various characterization equipment namely optical microscope and surface roughness tester.

UNIT I CNC lathe Machine: Introduction of CNC lathe (Use G and M codes)

a) Programming for plain turning – facing, center drilling
b) Programming of step turning
c) Programming for step, taper and undercut process.
d) Programming for threading turning process.

UNIT II CNC Milling machine: Introduction to CNC Milling Machine (Use G code and M code)

a) Programming for up and down milling.
b) Programming taper milling.
c) Programming for end milling.
d) Programming for profile milling

UNIT III Electrical Discharge Machining & Pin on Disc Tribometer

a) Electric discharge performance study on Material Removal Rate (MRR)
b) Study on effect of powder mixed Electrical Discharge Machining process and surface properties.
c) Study of Pin on Disc Tribometer for Wear Measurement.
d) Identification of wear rate for various Loading Condition.
e) Analysis of velocity and its influence on velocity.
f) Wear rate variation under various environmental conditions.

UNIT IV 3D Printing

a) Introduction to 3D printing, its historical development, advantages.
b) Classification of 3D printing process.
c) Process chain, 3D modelling, Data Conversion, and transmission.
d) Part orientation and printing.
e) Support structure generation.
f) Types of fills while printing.
g) Post processing of printed components.

UNIT V Optical microscope and surface roughness tester.

a) Surface roughness measurement and surface defect analysis of turned and milled products using optical microscope using surface roughness tester.
b) Measurement of tool wear and identification of tool wear mechanisms using optical microscope.

Course outcomes:

At the end of the course, students can:

1. Execute part programs for lathe and milling operations.
2. Operate CNC machines and manufacture products.
3. Operate EDM machine and manufacture products.
4. Perform wear analysis using Pin on Disc Tribometer.
5. Operate 3D printing machine and manufacture products.
6. Measure tool wear and surface roughness using Optical microscope and surface roughness tester respectively.

Text books:

1. Lab manual provided by the Department.
2. Computer Control of Manufacturing Systems, Yoram Koren.
3. Electrical Discharge Machining (EDM): Types, Technologies & Applications, Dr. Jahan MP.
4. Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing, Ian Gibson, David Rosen, Brent Stucker.

References:

1. Serope Kalpakjian, Steven R. Schmid (2018) Manufacturing Engineering and Technology (7th Edition) By Pearson.

Mode of Evaluation: Assignments, Internal Mid Tests and External End Examinations

MINOR in
MECHANICAL ENGINEERING –
Stream Name: Digital Manufacturing

(Offered to all the Engineering Disciplines except Mechanical Engineering)

B. Tech. Mechanical Engineering

Minor

20MDME101 COMPUTER AIDED MANUFACTURING PROCESS

L	T	P	C
3	0	0	3

Pre-requisite: None

Course description:

This course is the first course of Mechanical minor degree in digital manufacturing technology. It provides an insight of materials, manufacturing and its requirements of emerging practices. Topics include selection of materials, manufacturing processes and machining processes and various relevant activity. Computer aided manufacturing processes involves various functions involved in the pre and post processes.

Course objectives:

1. Study the Mechanical properties of materials and their functionality.
2. Selection of materials based on the applications and usability.
3. Study and understand the manufacturing processes and its requirements with modern computer aided environment.
4. Learn various types of activities in manufacturing systems, principles and working processes.
5. Understand and apply the knowledge to select the suitable material, manufacturing and CNC machines.

UNIT I MATERIALS PROPERTIES 8 hours

Mechanical properties – fatigue strength – fracture Toughness – Thermal Properties – Magnetic Properties – Fabrication Properties -electrical, optical properties – Environmental Properties, Corrosion properties -shape and size – Material Cost and Availability- failure analysis

UNIT II SELECTION OF MATERIALS 9 hours

Selection of Materials for Biomedical Applications – Medical Products – Materials in Electronic Packaging – Advanced Materials in Sports Equipment – Materials Selection for Wear Resistance -Advanced Materials in Telecommunications – Using Composites – Manufacture and Assembly with Plastics, fibre and Diamond Films.

UNIT III MANUFACTURING PROCESSES 9 hours

Interaction of Materials Selection, Design, and Manufacturing Processes – Production Processes and Equipment for Metals – Metal Forming, Shaping, and Casting – Plastic Parts Processing -Composites Fabrication Processes – Advanced Ceramics Processing – surface treatment -Resource -The Price and Availability of Materials.

UNIT IV COMPUTER AIDED MANUFACTURING 9 hours

CAM Concepts, Objectives & scope, Nature & Type of manufacturing system, Evolution, Benefits of CAM, Role of management in CAM, Concepts of Computer Integrated Manufacturing, Impact of CIM on personnel, Role of manufacturing engineers, CIM Wheel to understand basic functions. Types of manufacturing systems, transfer lines, flexible manufacturing system (FMS), The manufacturing cell, tool management and workpiece handling system, benefits of CIM.

UNIT V NC/CNC MACHINE TOOLS: NC AND CNC TECHNOLOGY 9 hours

Types, Classification, Specification and components, Construction Details, Controllers, Sensors and Actuators, CNC hardware: Re-circulating ball screw, anti-friction slides, step/servo motors. Axis designation, NC/CNC tooling. Fundamentals of part programming, Types of formats, Part Programming for drilling, lathe and milling machine operations, subroutines, do loops, canned Cycles, parametric sub routines.

Course outcomes:

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

1. Understand the materials properties and their characteristics.
2. Select the suitable material for the specific application.
3. Select and apply the suitable manufacturing process to make a product.
4. Explain the role and functions of Computers in manufacturing processes.
5. Explain the NC/CNC machine tools construction and applications.

Text books:

1. Ashby, M. F. Materials selection in mechanical design, 4th edition, Elsevier, 2011.
2. Radhakrishna Subramanyan & Raju CAD/CAM/CIM, 4th edition, New Age International (P) Ltd., Publishers, 2008.

References:

1. Mikell.P.Groover “Automation, Production Systems and Computer Integrated Manufacturing”, Prentice Hall of India, 2008.
2. Chris McMahon and Jimmie Browne “CAD/CAM Principles", "Practice and Manufacturing management “ Second Edition, Pearson Education, 1999.

Mode of Evaluation: Assignments, Internal Mid Tests and External End Examinations

B. Tech. Mechanical Engineering

Minor

20MDME102 PRODUCT DESIGN AND DEVELOPMENT

L	T	P	C
3	0	0	3

Pre-requisite: None

Course description:

Product design and development is an important process of all manufacturing industries. This course provides a comprehensive view of idea to product realization. In this course, the students are introduced to various design for manufacture the product based on the development cycle. Industrial design is introduced to the students to simulating the manufacturing process in digital and virtual forms.

Course objectives:

1. Describe the product development process and account for its conditions and terms and use the most common methods of managing terms and concept development, use basic sketching techniques to communicate ideas, plan, implement and present a design project.
2. Use a CAD-software to design products with moving parts and with the help of topdown methodology,
3. Create advanced solid and surface models, produce realistic images and simple animations of a product,
4. Apply the PDM/PLM-processes to design products.
5. Apply the prototyping model concepts on new product development.

UNIT I INTRODUCTION 9 hours

Need for product design & development-Strategic importance of Product development - integration of customer, designer, material supplier and process planner, Competitor and customer - behaviour analysis. Understanding customer-promoting customer understanding involve customer in development and managing requirements - Organization process management and improvement.

UNIT II CONCEPT GENERATION, SELECTION AND TESTING 9 hours

Plan and establish product specifications. Task - Structured approaches - clarification – search externally and internally-Explore systematically - reflect on the solutions and processes - concept selection - methodology - benefits. Implications - Product change - variety - component standardization - product performance - manufacturability – Concept Testing Methodologies.

UNIT III PRODUCT ARCHITECTURE 9 hours

Product development management - establishing the architecture - creation - clustering - geometric layout development - Fundamental and incidental interactions - related system level

design issues - secondary systems -architecture of the chunks - creating detailed interface specifications-Portfolio Architecture.

UNIT IV INDUSTRIAL DESIGN 9 hours

Integrate process design - Managing costs - Robust design - Integrating CAE, CAD, CAM tools – Simulating product performance and manufacturing processes electronically - Need for industrial design-impact – design process - investigation of customer needs - conceptualization - refinement - management of the industrial design process - technology driven products - user driven products - assessing the quality of industrial design.

UNIT V DESIGN FOR MANUFACTURING AND PRODUCT DEVELOPMENT 9 hours

Definition - Estimation of Manufacturing cost-reducing the component costs and assembly costs – Minimize system complexity - Prototype basics - Principles of prototyping - Planning for prototypes - Economic Analysis - Understanding and representing tasks-baseline project planning - accelerating the project-project execution.

Course outcomes:`

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

1. Summarize the concept of Product and Process for organization management.
2. Apply the structured approaches for concept generation, selection and testing of products.
3. Solve system level design issues and creating interface specifications.
4. Explain the importance of CAD/CAM integration in industrial design process.
5. Explain the concept of design for manufacturing and product development.

Text books:

1. Karl T. Ulrich and Steven D. Eppinger, Product Design and Development, McGraw – Hill International Edns.1999
2. Kevin Otto, Kristin Wood, “Product Design”, Indian Reprint 2004, Pearson Education

References:

1. Peter scalon, “Process planning, Design/Manufacture Interface”, Elsevier science technology Books, Dec 2002.
2. Chitale A.V. and Gupta R.C., “Product Design and Manufacturing”, 2nd Edition, PHI, 2002.
3. Mikell P. Groover, “Automation, Production, Systems and Computer Integrated Manufacturing”, Pearson Education 2001.

Mode of Evaluation: Assignments, Internal Mid Tests and External End Examinations

B. Tech. Mechanical Engineering

Minor

20MDME103 DIGITAL MANUFACTURING PLANNING AND CONTROL

L	T	P	C
3	0	0	3

Pre-requisite: None

Course description:

This course is essential for working in any capacity of operations in the supply chain because students will gain a thorough understanding of Manufacturing Planning and Control key elements. MPC, is responsible for the planning and control of the flow of materials through the manufacturing process. For efficient, effective and economical operation in a manufacturing unit of an organization, it is essential to integrate the manufacturing planning and control system.

Course objectives:

The general objectives of the course are to enable the students to

1. Able to develop, manage and control all aspects of an effective and efficient manufacturing planning and control system- a key to the success of any product manufacturing company.
2. Gain knowledge to develop a demand management system, including activities such as forecasting, determining, and estimating customer demand, converting specific customer orders into promised delivery dates, and balancing demand with supply
3. Understand the Planning and forecasting-how to link strategic goals to production by developing an overall business plan which integrates the various functional planning efforts
4. Construct and manage an effective operations planning and control for making good use of manufacturing resources
5. Understand the Materials Requirement Planning-using e- tool for simulation and performing the detailed analysis.

UNIT I INTRODUCTION 7 hours

Overview of manufacturing systems and various issues of interest: Assembly Line, Repetitive batch manufacturing, Cellular manufacturing, FMS, JIT, CIM.

UNIT II MANUFACTURING PLANNING 9 hours

Preplanning: Forecasting, Economic analysis, Aggregate planning, Capacity planning, Inventory planning. Decision making in design of manufacturing systems : Group Technology, Line balancing, Plant layout. Using computer programmes solve forecasting and line balancing problem.

UNIT III OPERATIONAL PLANNING 9 hours

Operations planning: MRP, MRP II, Hierarchical planning systems, JIT systems, FMS Operation and control: Lot sizing decisions, production scheduling, line of balance, quality planning and control, cost planning and control, productivity planning and control and applications of theory of constraints.

UNIT IV WORLD CLASS MANUFACTURING SYSTEMS 9 hours

Road map to World Class Manufacturing Systems: Ideal Manufacturing, Intelligent Manufacturing and Agile Manufacturing Systems. Simulation: Simulation analysis of manufacturing systems.

UNIT V IMPLEMENTATION OF DIGITAL MANUFACTURING 11 hours

Applications of recent developments in IT including ERP, e-Business, Enterprise Applications Integration (EAI) and Virtual Manufacturing: Concepts, Justification and Status of development and implementation.

Course outcomes:`

1. Understand the aspects of an effective and efficient manufacturing planning and control system- a key to the success of any product manufacturing company.
2. Apply the knowledge to plan the management activities such as forecasting, determining, and estimating customer demand, converting specific customer orders into promised delivery dates, and balancing demand.
3. Apply control strategies to production by developing an overall business plan which integrates the various functional planning efforts
4. Explain the various functionalities of world class manufacturing system.
5. Explain the digital manufacturing process and issues on the implementation process.

Text books:

1. R. B. Chase, N. J. Aanilano and F. R. Jacobs (2011), Production and Operations Management- Manufacturing and Services, Tata McGraw Hill, APICS/CPIM Certification Edition.
2. H. Noori and R. Radford (1995), Production and Operations Management, McGraw Hill Inc.

References:

1. Danny Samson, “Manufacturing & Operations Strategy”, Prentice Hall, 1991
2. K.C. Jain & L.N. Aggarwal, “Production Planning Control and Industrial Management”, Khanna Publishers 1990.

Mode of Evaluation: Assignments, Internal Mid Tests and External End Examinations

B. Tech. Mechanical Engineering

Minor

20MDME104 BIG DATA ANALYTICS FOR MANUFACTURING

L	T	P	C
3	0	0	3

Pre-requisite: None

Course description:

This course deals with real world applications of big data especially in manufacturing engineering. Begin with big data collection in the manufacturing sources and how effectively utilized for further analysis in manufacturing activities. Various practical applications and their case studies illustrates the potential possibility of improvement in the process towards world class manufacturing.

Course objectives:

Specific objectives may be summarized as:

1. Optimize business decisions and create competitive advantage with Big Data analytics
2. Explore the fundamental concepts of big data analytics.
3. Learn to analyze the data acquisition in data collection systems.
4. Understand and apply big data analytics in the various manufacturing applications.
5. Understand the issues and challenges of big data in design and manufacturing.

UNIT I BIG DATA 7 hours

Big Data and its Importance – Four V's of Big Data – Drivers for Big Data – Introduction to Big Data Analytics – Big Data Analytics applications.

UNIT II BIG DATA PROCESSING 7 hours

Integrating disparate data stores - Mapping data to the programming framework - Connecting and extracting data from storage - Transforming data for processing.

UNIT III DATA ACQUISITION 7 hours

Data Acquisition, considerations, frameworks, big data collection systems, Messaging queues, custom connectors. Batch analysis-case studies

UNIT IV APPLICATIONS IN MANUFACTURING 12 hours

Benefits and Impacts of Big Data in Design and Manufacturing Engineering, Applying Big Data Concepts to Improve Flat Steel Production Processes, Big Data in General Electric, General Motors and the Automotive Industry, Big Data in Semiconductor Manufacturing and Integrated Circuits, Big Data at Work for a Missile Plan, Big Data in Cloud-based Design and Manufacturing.

UNIT V CHALLENGES AND ISSUES 12 hours

Applications of recent developments in IT including ERP, e-Business, Enterprise Applications Integration (EAI) and Virtual Manufacturing: Concepts, Justification and Status of development and implementation.

Course outcomes:`

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

1. Understand the business decisions and create competitive advantage with Big Data analytics
2. Apply the fundamental concepts on the big data analytics.
3. Analyze the data acquisition in data collection and processing.
4. Understand and apply big data analytics in the various manufacturing applications.
5. Study and resolve the issues and challenges of big data in design and manufacturing.

Text books:

1. Arshdeep Bahga & Vijay Madisetti, “Big Data Analytics: A Hands-On Approach, Bahga, 2016.
2. Chris Eaton, Dirk DeRoos, Tom Deutsch, George Lapis, Paul Zikopoulos, “Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data”, McGrawHill Publishing, 2012.
3. Michael Berthold, David J. Hand, “Intelligent Data Analysis”, Springer, 2007.

References:

1. Bill Franks, “Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics”, John Wiley& sons, 2012.
2. Big data in manufacturing: a systematic mapping study, O’Donovan et al. Journal of Big Data (2015) 2:20, DOI 10.1186/s40537-015-0028-x.

Mode of Evaluation: Assignments, Internal Mid Tests and External End Examinations

B. Tech. Mechanical Engineering

Minor

20MDME201 COMUPTER AIDED DESIGN AND MANUFACTURING LABORATORY

L	T	P	C
0	0	4	2

Pre-requisite: None

Course objectives:

1. To gain practical experience in handling 2D drafting and 3D modelling software systems.
2. To study the features of CNC Machine Tool.
3. To expose students to modern control systems (Fanuc, Siemens etc.,)
4. To know the application of various CNC machines like CNC lathe, CNC Vertical Machining centre and CNC EDM.
5. To study the rapid prototyping and build model using 3D printing.

LIST OF EXPERIMENTS **7 hours**

1. Creation of 3D assembly model of following machine elements using 3D Modelling software, Flange Coupling, Plummer Block, Screw Jack, Lathe Tailstock, Universal Joint, Machine Vice, Safety Valves, Non-return valves, Connecting rod and Piston.

2. Part Programming: CNC Machining Centre

a) Linear Cutting.

b) Circular cutting.

c) Cutter Radius Compensation.

d) Canned Cycle Operations.

3. Part Programming: CNC Turning Centre

a) Straight, Taper and Radius Turning

b) Thread Cutting

c) Rough and Finish Turning Cycle

d) Drilling and Tapping Cycle.

4. Computer Aided Part Programming:

a) CL Data and Post process generation using CAM packages.

b) Application of CAPP in Machining and Turning Centre. 3D printing practice

B. Tech. Mechanical Engineering

Course outcomes:`

The students after completing the course will be able to:

1. Draw 3D and Assembly drawing using CAD software.
2. Demonstrate manual part programming with G and M codes using CAM
3. CNC programming with machining practice with CNC Lathe and Milling
4. Develop the prototype using 3 D printer.

Text books:

Lab manual provided by the department

Mode of Evaluation: Assignments, Internal Mid Tests and External End Examinations

B. Tech. Mechanical Engineering

Minor

20MDME105 SMART SENSORS AND INDUSTRY 4.0

L	T	P	C
3	0	0	3

Course Description:
Introduction of application of hardware, communication protocol, IOT platform, machine learning etc. to implement IoT for smart manufacturing for the need of Industry 4.0.

Course objectives:

1. Impart knowledge of smart manufacturing for industry 4.0 for making student innovative.

UNIT I INTRODUCTION TO INDUSTRY 4.0 9 hours

Industry 4.0 Concept, Globalization and emerging issues, The Fourth Revolution, LEAN manufacturing, Smart and connected business perspectives, Smart factories, case studies.

UNIT II AUTOMATION 9 hours

Programable Logic Controller (PLC) and its Programming software, Communication of different devices with PLC, Sensor, Smart Sensor, HMI design, Cyber Physical System – key components, ISA-95 architecture, CPS-5C architecture, Concept of Digit Twin

UNIT III COMMUNICATION 9 hours

Protocols – MQTT, OPC UA, EtherNet/IP, Profinet, EtherCAT, etc; MQTT – History, MQTT broker, Message types, Quality of Service (QoS), Application; OPC UA – History, Specification, Client, Server, Programming with – Free and open-source software, Propriety software; Augmented Reality

UNIT IV IoT PLATFORM 9 hours

Data Modelling, IoT platforms – Thing, basic functionalities, Abstract definition of Thing, Networks, etc; IoT Gateway, Machine interfaces – Cloud-based Mosquitto brokers, Programming with – Free and open-source software, Propriety software

UNIT V MACHINE LEARNING FOUNDATION 9 hours

Learning algorithms – Supervised, Unsupervised, Self-learning, Feature learning, etc. Models – Artificial Neural Networks, Decision trees, Regression analysis, Genetic algorithms, etc.; Programming with – Free and open-source software, Propriety software

Course outcomes:
At the end of the course the students would be able to:

1. Introduce concept of Industry 4.0 for Smart Manufacturing.
2. Understand use various hardware used in Smart Manufacturing.
3. Understand need of various communication protocols. hardware and software, IoT Layers and their relative importance.
4. Understand could-computing IoT platform for Smart Manufacturing.
5. Understand machine learning to make smart factories

Text books:

1. Christoph Jan Bartodziej, "The Concept Industry 4.0 – An Empirical Analysis of Technologies and Application in Production Logistics", Spinger Gabler, 2015
2. Alasdair Gilchrist, "Industry 4.0 – The Industrial Internet of Thigs", Springer Link, 2016

References:

1. Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", ISBN: 978-1-118-47347-4, Willy Publications.
2. Michahelles, "Architecting the Internet of Things", ISBN 978-3- 642-19156-5 e-ISBN 978- 3-642-19157-2, Springer.
3. Hakima Chaouchi, "The Internet of Things Connecting Objects to the Web" ISBN : 978-1-84821-140-7, Willy Publications.
4. Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things: Key Applications and Protocols", ISBN: 978-1-119-99435-0, 2nd Edition, Willy Publications
5. W. Botton, "Programmable Logic Controllers", Fourth Edition, Elsevier, 2006
6. P. Juahs, K. Molnar, "Key Components of the Architecture of Cyber-physical manufacturing systems", International Scientific Journal "Industry 4.0", 2017, issue 205-207
7. Jen-Ruey Jiang, "An improved cyber-physical systems architecture for Industry 4.0 smart factories", Advances in Mechanical Engineering, 2018, Vol. 10(6) 1-15
5. Power Plant Engineering, As per AICTE: Theory and Practice by Dipak Kumar Mandal, Somnath Chakrabarti, et al. | 1 January 2019

Mode of Evaluation: Assignments, Internal Mid Tests and External End Examinations

B. Tech. Mechanical Engineering

Minor

20MDME106 LEAN MANUFACTURING

L	T	P	C
3	0	0	3

Course Description:

Lean manufacturing is a methodology that focuses on minimizing waste within manufacturing systems while simultaneously maximizing productivity. Waste is seen as anything that customers do not believe adds value and are not willing to pay for. Some of the benefits of lean manufacturing can include reduced lead times, reduced operating costs and improved product quality. Lean manufacturing, also known as lean production, or lean, is a practice that organizations from numerous fields can enable.

Course objectives:

1. To introduce the basics of 6 SIGMA
2. To learning about the lean manufacturing tools.
3. To study about the deeper understanding methodologies of Lean manufacturing.
4. To study the lean concepts and its elements.
5. To learn implementation and challenges of lean manufacturing.

UNIT I BASICS OF 6 SIGMA 9 hours

Introduction to 6 Sigma, basic tools of six sigma like problem solving approach, standard deviation, normal distribution, various sigma levels with some examples, value for the enterprise, Variation, and sources of variation, Mean and moving the mean, Various quality costs, cost of poor quality.

UNIT II INTRODUCTION TO LEAN MANUFACTURING TOOLS 9 hours

Process Capability Indices, Cause and Effect diagram, Control Charts, Introduction to FMEA, APQP, PPAP. 3 foundational 6 Sigma methodologies: DMAIC, DMEDI, and Process Management DMEDI for process creation, DMAIC for process improvement and PDCA for sustaining improvements.

UNIT III DEEPER UNDERSTADING METHODOLOGIES 9 hours

What is a process, Why Process management, Keys to process management, Difference between process management and 6 Sigma, Introduction to Deming cycle, PDCA, DMAIC and continuous improvement, DMEDI for creation process, DMAIC Vs DMEDI with examples, Introduction to Toyota Production System, Six Sigma and Production System integration.

UNIT IV LEAN ELEMENTS 9 hours

Introduction to Lean Concepts like In-Built Quality, Concept of Right Part at the Right Time, Lead Time reduction, Optimum utilization of Capital, Optimum utilization of People. Understanding the Zero-defect concept and Metrics, Focus on Human Resources, Quality, Delivery, Cost. Building Zero defect capabilities, Cultural and Organizational aspects.

UNIT V IMPLEMENTATION AND CHALLENGES 9 hours

Implementing Checks and Balances in the process, Robust Information Systems, Dashboard, follow up and robust corrective and preventive mechanism. Concept of Audits, and continuous improvement from gap analysis, risk assessments etc.

B. Tech. Mechanical Engineering

Course Outcomes:

At the end of the course the students would be able to

1. Discuss the basics of 6 SIGMA
2. Elaborate the lean manufacturing tools.
3. Illustrate about the deeper understanding methodologies of Lean manufacturing.
4. Discuss lean concepts and its elements.
5. Describe the implementation and challenges of lean manufacturing.

Textbooks:

1. Quality Planning and Analysis- JM Juran& FM Gryna. Tata Mc Graw Hill
2. Lean Manufacturing: Principles to Practice by Akhilesh N. Singh, Bibliophile SouthAsia
3. The Toyota Way: 14 Management Principles
4. Gemba Kaizen: A Commonsense Approach to a Continuous Improvement Strategy,Masaki Imai

References:

1. Quality Council of India https://qcin.org/ & its library. https://qcin.org/nbqp/knowledge_bank/
2. International Society of Six Sigma Professionals: https://isssp.org/about-us/
3. NPTEL / SWAYAM: https://nptel.ac.in/courses/110105123 : Six Sigma, Prof. Jitesh J Thakkar, IIT Kharagpur, Certification course. (Self- Learning).
4. Older / Previous editions of AIAG manuals on APQP, FMEA and PPAP. These are great sources of information on Quality Planning and has basics of Project Management and required skills.
5. Quality Management for Organizations Using Lean Six Sigma Techniques- Erick C Jones

Mode of Evaluation: Assignments, Internal Mid Tests and External End Examinations

MINOR in
MECHANICAL ENGINEERING
Stream Name: Energy Engineering

(Offered to all the Engineering Disciplines except Mechanical Engineering)

B. Tech. Mechanical Engineering

Minor

20MDME107 FLUID MECHANICS AND HYDRAULIC MACHINERY

L	T	P	C
2	1	0	3

Pre-requisite: Partial Differential Equations

Course description:

Modelling and predicting the behaviour of fluid flow is an important part of many scientific and technological problems. Flow of fluid is an important aspect of atmospheric and oceanic circulation, combustion in engines, biological processes such as the flow of blood. From the days of Isaac Newton to the present day world, considerable progress has been made in the mathematical modelling of fluid flow. With the advent of enhanced computational ability, computational fluid dynamics has played a major role in solving complex fluid flow problems. In this course, the students are introduced to various fluid properties and to model fluids at rest. Flow of fluids is introduced to the students in two forms, namely, the Lagrangian and the Eulerian form. Eventually, both the integral and differential form of the governing equations of fluid dynamics are derived. Flow of fluids in closed conduits and over various geometries is also introduced. Basic design of hydraulic turbines and pumps are introduced to the students.

Course objectives:

1. To provide a basic understanding of the properties and behavior of matter (fluids) by means of analytical equations.
2. To develop an understanding about hydrostatic law, principle of buoyancy and stability of a floating body and application of mass, momentum and energy equation in fluid flow.
3. To determine the losses in a flow system, flow through pipes, boundary layer flow and flow past immersed bodies.
4. Determine the force applied by a jet on stationary and moving vanes.
5. To understand the working principle of hydraulic machinery like turbines and pumps.

UNIT I FLUID PROPERTIES AND KINEMATICS OF FLUID FLOW 9 hours

The Concept of a Fluid, Classification of fluid flows, System & Control volume, Density, Specific gravity, Thermodynamic Properties of a Fluid, Viscosity, Surface Tension, Capillarity, Vapor pressure and Cavitation. Lagrangian and Eulerian descriptions, material derivative, velocity and acceleration field, streamlines, path lines and streak lines. Fluid statics: Barometer and atmospheric pressure, Manometry, Buoyancy and stability.

UNIT II GOVERNING EQUATIONS OF FLUID FLOW 9 hours

Reynold's transport theorem, Integral form of the conservation of mass for moving or deforming control volumes and steady flow processes, Integral form of Energy equation,

Integral form of linear momentum equation, Integral form of angular momentum equation. Derivation of the Bernoulli equation

UNIT III INTERNAL AND EXTERNAL FLOW 8 hours

Laminar and Turbulent flows, Entrance region, Laminar flow in pipes, Turbulent flow in pipes, Minor and Major losses. Orifice meter and Venturimeter. Flow over flat plate, Boundary layer equations, Displacement, Momentum and Energy thicknesses, Momentum integral technique for boundary layers, Boundary layers with pressure gradients.

UNIT IV IMPACT OF JET VANES & HYDRAULIC TURBINES 11 hours

Hydrodynamic force of jet striking stationary and moving vanes, flat and curved vanes, jet impinging centrally and tangentially. Classification of hydraulic turbines- Impulse and reaction turbines; Basic equation of energy transfer in rotodynamic machines, specific speed; Components of Pelton turbine, Velocity triangles and power for Pelton turbine, Maximum efficiency of Pelton turbine; Types of reaction turbines, Components of Francis turbine, Velocity triangles, power and efficiency of Francis turbine. Kaplan turbine

UNIT V HYDRAULIC PUMPS 8 hours

Working principle and main parts of a centrifugal pump; Classification of centrifugal pumps; Static and Manometric head of a centrifugal pump; Efficiencies of centrifugal pump. Main parts and working of reciprocating pump; Discharge, work done and power required to drive a reciprocating pump; Slip of a reciprocating pump

Course outcomes:

The students after completing the course will be able to:

1. Interpret the properties of fluids and their applications, determine differential pressure using manometric principles, calculate the buoyant forces and estimate the stability of floating and immersed bodies.
2. Distinguish between a system and control volume approach and will be able to use the governing equations based on integral approach for solving fluid flow problems.
3. Have a clear understanding of internal flow physics and capable of estimating the major and minor losses observed in pipe flows. Similarly, they will be able to assess various flow parameters in external flows with and without pressure gradients.
4. Assess the forces acting on vanes with varied geometries and point of jet impact. Further, they can differentiate different turbines and estimate the performance parameters of various turbine used in hydraulic power plants.
5. Differentiate different pumps and calculate their performance characteristics.

Text books:

1. Cengel, Y.A, Cimbala, John, M., “Fluid Mechanics, Fundamentals and Applications”, McGraw Hill Education; Third edition (1 July 2017)
2. B.K. Venkanna, “ Fundamentals of Turbomachinery”, PHI Learning Private Limited,2018

References:

1. R. K. Bansal, "A Textbook of Fluid Mechanics and Hydraulic Machines", Laxmi Publications, Ltd., 2005
2. Robert W. Fox and Alan T. Mc Donald, "Introduction to Fluid Mechanics", John Wiley & Sons Private Ltd., 2009, 7th Edition.
3. James R. Welty, Charles E. Wicks and Robert E. Wilson, "Fundamentals of Momentum, Heat and Mass transfer", John Wiley & Sons (Asia) private limited., 2008, 5th Edition.
4. Frank M White, "Fluid Mechanics", Tata McGraw-Hill, 7th Edition, 2012.
5. Milton Van Dyke, "An Album of Fluid Motion", Parabolic Press, 12th Edition.

Mode of Evaluation: Assignments, Internal Mid Tests and External End Examinations

B. Tech. Mechanical Engineering

Minor

20MDME108 APPLIED THERMODYNAMICS

L	T	P	C
2	1	0	3

Pre-requisite: 20MDME121

Course description:

This course on Applied Thermodynamics focuses on applied aspects of Engineering Thermodynamics which is an essential prerequisite for many courses of mechanical engineering. The principles of thermodynamics are also applicable to a wide range of problems encountered in all branches of engineering. This course is designed to equip the students with a thorough knowledge of basics and applications of thermodynamics and to provide them with necessary skills and techniques to solve problems in thermodynamics through a systematic analysis using fundamental principles. The specific topics to be covered in the course include concepts of system and surroundings, energy, energy transfer by work and heat, properties of substances and property changes, first and second laws of thermodynamics along with applications of these concepts to analysis of steam turbines, nozzles, refrigeration, air conditioning and internal combustion engines.

Course objectives:

1. To introduce the concepts of system, surroundings, energy interactions, thermodynamics properties of substances and to teach different techniques used for estimating the properties like gas laws and property tables
2. To learn the principles of work and energy.
3. To acquire knowledge about the fundamentals of thermodynamic laws, concepts and principles.
4. To perform thermodynamic analysis of engineering systems like steam turbines, nozzles, refrigeration and air conditioning, and internal combustion engines.

UNIT I THERMODYNAMIC BASICS 9 hours

Macroscopic versus Microscopic viewpoint, Thermodynamic system and control volume, Thermodynamic properties, processes and cycles, Homogeneous and heterogeneous systems, Thermodynamic equilibrium, Quasi-static process, Concept of continuum, Zeroth law of thermodynamics, temperature scale, Ideal gas, Work Transfer, Heat transfer, First law of thermodynamics, Specific heat, Enthalpy, Internal Energy, Steady flow energy equation and application, PMM1 and Steady flow energy equation.

UNIT II SECOND LAW OF THERMODYNAMICS 9 hours

Qualitative difference between heat and work, cyclic heat engine, Kelvin-Planck statement of second law, Clausius' statement of second law, Refrigerator and heat pump, Equivalence of Kelvin-Planck and Clausius statement, Reversibility and Irreversibility, Carnot cycle, Reversed heat engine, Carnot's Theorem, Corollary of Carnot's theorem, absolute thermodynamic temperature scale and Efficiency of heat engine, Entropy, Inequality of

Clausius, Temperature-Entropy plot - Pure Substances: Pure substance, Vapor-Liquid-Solid-Phase equilibrium in a pure substance, Independent properties of a pure substance, Phase boundaries, tables of thermodynamic properties, Thermodynamic Surfaces, p-v and p-T diagram for a pure substance, p-v-T surface, T-s and h-s or Mollier diagram for a pure substance, dryness fraction, Steam Tables, Charts of Thermodynamic properties, Measurement of steam quality.

UNIT III STEAM TURBINES & NOZZLES 9 hours

Steam Turbines : Classification of steam turbines, Impulse and Reaction turbines, Staging, Stage and Overall efficiency, Velocity diagram of simple and compound multistage impulse and reaction turbines and related calculations, work done, efficiencies of impulse and reaction turbines, losses in steam turbines, Governing of turbines - Steam and Gas Nozzles: Flow through Convergent and convergent-divergent nozzles, variation of velocity, area and specific volume, choked flow, throat area, Nozzle efficiency, Off design operation of nozzle, Effect of friction on nozzle, Super saturated flow.

UNIT IV REFRIGERATION & AIR-CONDITIONING 9 hours

Refrigerants: Desirable properties, Common refrigerants used, Nomenclature
Refrigeration: Comparison of heat engine, heat pump and refrigerating machine, Unit of refrigeration and C.O.P, Simple vapour compression refrigeration cycle, T-S, P-h and h-s charts, Effect of Subcooling and Superheating, Air refrigeration Cycle.
Air-Conditioning: Properties of moist air, Dry, wet bulb and Dew point temperature, Psychrometric chart, Psychrometric processes in air conditioning equipment.

UNIT V INTERNAL COMBUSTION ENGINES 8 hours

I. C. Engines: Classification of IC engines, two stroke & four stroke, and SI & CI engines – comparison, Otto and Diesel cycles, Valve and port timing diagrams, Performance analysis of I.C Engines, Morse test, Heat balance.
Combustion: Combustion analysis, heating values, air requirement, Air/Fuel ratio, standard heat of reaction and effect of temperature on standard heat of reaction, Combustion efficiency, heat of formation, Adiabatic flame temperature, enthalpy of formation, enthalpy and internal energy of combustion, Combustion in SI and CI Engine, Knocking phenomenon and control.

Course outcomes:

The students after completing the course will be able to:

1. Apply the fundamentals of the zeroth and first laws of thermodynamics and analyze a wide range of systems.
2. Apply the second law of thermodynamics for the design of heat engine, heat pump and refrigerators and to Evaluate entropy changes in a wide range of processes.
3. Calculate important parameters like efficiency, power, and torque for steam turbines and nozzles.
4. Perform simple calculations for refrigeration and air conditioning systems like estimating power requirement, COP etc.

5. Explain the basic nomenclature, working, underlying principles, and combustion processes in IC engines and their performance testing.

Text books:

1. Cengal, Y.A and Boles, M.A, Thermodynamics: An Engineering Approach, 5th ed., McGraw-Hill, 2006.
2. R.K. Rajput, Applied Thermodynamics, 2nd Edition, Laxmi Publications.

References:

1. Sonntag, R.E., Borgnakke, C., and Van Wylen, G.J., Fundamentals of Thermodynamics, 6th ed., John Wiley, 2003.

Mode of Evaluation: Assignments, Internal Mid Tests and External End Examinations

B. Tech. Mechanical Engineering

Minor

20MDME109 HEAT TRANSFER

L	T	P	C
2	1	0	3

Pre-requisite: 20MDME121 & 20MDME122

Course description:

Fundamental concepts of heat transfer; steady-state and unsteady-state heat conduction; analytical and empirical relations for forced and free convection heat transfer; condensation and boiling; heat exchanger analysis and design; and Heat transfer by radiation.

Course objectives:

1. To elucidate the fundamental mechanisms of heat transfer
2. To teach the governing laws of heat transfer by conduction, convection, and radiation
3. To train the students in using the analytical and empirical methods for estimating heat transfer under different conditions.
4. To explicate the rudimentary aspects in heat transfer with phase change.
5. To introduce different approaches for solving sizing and rating problems in Heat Exchanger design

UNIT I INTRODUCTION AND STEADY ONE-DIMENSIONAL CONDUCTION 9 hours

Underlying physics and basic rate equations for conduction, convection and radiation modes of heat transfer; Relationship to Thermodynamics, Thermal properties of materials, Heat conduction equation in Cartesian, cylindrical and spherical coordinates; Boundary conditions and initial conditions. Simplification of conduction equations for one dimensional steady state conduction; Applications to plane wall, cylindrical shell and spherical shells, composite walls; Electrical analogy and overall heat transfer coefficient; conduction with heat generation.

UNIT II EXTENDED SURFACES AND TRANSIENT CONDUCTION 9 hours

Heat transfer from extended surfaces; governing equation and analytical solutions for different boundary conditions, performance and efficiency of fins. The Lumped heat capacitance model, governing equation, Biot number; One dimensional transient heat flow: applications to semiinfinite solid, plane slab, cylinders and spheres; Heisler charts.

UNIT III CONVECTION HEAT TRANSFER 9 hours

Thermal and velocity boundary layers, convection heat transfer coefficient, laminar and turbulent boundary layers, boundary layer momentum and energy equations, non-dimensional parameters and their significance, Correlations for forced convection problems involving flat plates, cylinders; spheres and banks of tubes. Internal flows- mean velocity, mean temperature, entry and fully developed regions, correlations for heat transfer in laminar and

turbulent pipe flows. Natural convection heat transfer on a vertical plate; governing equations, dimensionless numbers, empirical relations for natural convection on plates, cylinders and spheres.

UNIT IV BOILING, CONDENSATION AND HEAT EXCHANGERS 9 hours

Non-dimensional numbers in heat transfer with phase change, Boiling heat transfer modes, pool boiling, forced convection boiling, empirical correlations for boiling heat transfer, Condensation heat transfer mechanism, condensation on a vertical plate and vertical cylinders, film condensation inside horizontal tubes; dropwise condensation. Classification of heat exchangers, overall heat transfer coefficient, fouling factor, LMTD and NTU analyses of heat exchangers.

UNIT V RADIATION HEAT TRANSFER 8 hours

Physical mechanism of Radiation, radiation intensity, black body radiation, Planck's distribution law, Wein's displacement law, Stefan Boltzmann law, Real surfaces, emissivity, absorptivity, reflectivity and transmissivity, Kirchoff's identity, grey surface, view factor between surfaces, reciprocity relation, heat exchange between grey surfaces and black surfaces, electric network analogy, radiation shields. Effect of participating media, Radiation combined with other modes of heat transfer.

Course outcomes:

1. Estimate heat transfer rate due to conduction, convection and radiation under simple conditions using Fourier's Law, Newton's Law, and Stefan-Boltzmann Law.
2. Calculate the temperature distribution and rate of heat transfer in one dimensional heat conduction problems (Cartesian, polar and spherical coordinates) like composite walls, cylinders, and extended surfaces.
3. Calculate temperature evolution in lumped and one-dimensional conduction systems using Newton's law of cooling, analytical methods and chart solutions.
4. Calculate the heat transfer and temperature distribution in external and internal fluid flow problems using the principles of momentum and thermal boundary layer, bulk mean temperature, mean temperature, phase change, Nusselt condensation theory and empirical Nusselt number correlations.
5. Design an appropriate heat exchanger, like condenser, evaporator, radiator etc., for a given heat transfer requirement using LMTD and NTU-ϵ methods.

Text books:

1. F. P. Incropera & D. P. Dewitt, Fundamentals of Heat and Mass Transfer, John Wiley & Sons, 2001, 5th edition.

References:

1. Yunus Cengel, Heat and Mass Transfer: Fundamentals and Application, McGraw Hill
2. J.P. Holman, Heat Transfer, McGraw Hill, 2002, 9th Edition

Mode of Evaluation: Assignments, Internal Mid Tests and External End Examinations

B. Tech. Mechanical Engineering

Minor

20MDME110 COMPUTATIONAL FLUID DYNAMICS

L	T	P	C
2	1	0	3

Pre-requisite: Fluid Mechanics, Thermodynamics and Applied Mathematics.

Course description:

Computational fluid dynamics (CFD) has become an essential tool in analysis and design of thermal and fluid flow systems in wide range of industries. Few prominent areas of applications of CFD include meteorology, transport systems (aerospace, automobile, high-speed trains), energy systems, environment, electronics, bio-medical (design of life-support and drug delivery systems), etc. The correct use of CFD as a design analysis or diagnostic tool requires a thorough understanding of underlying physics, mathematical modelling and numerical techniques. The user must be fully aware of the properties and limitations of the numerical techniques incorporated in CFD software. This course aims to provide precisely these insights of CFD.

Course objectives:

Specific objectives may be summarized as:

1. To give the students necessary exposure to the CFD techniques such that they can solve basic fluid flow problems using CFD
2. To understand mathematical characteristics of partial differential equations.
3. To learn computational solution techniques for various types of partial differential equations.

UNIT I GOVERNING EQUATIONS AND PARTIAL DIFFERENTIAL EQUATIONS — 9 hours

Introduction and Philosophy of Computational Fluid Dynamics, Need for problem solving with CFD, Applications of CFD, Basic structure of a CFD code, Governing equations: Continuity equation, Momentum equation, Energy equation, Mathematical classification of partial differential equations: Parabolic, Elliptic and Hyperbolic equations, Well posed and ill posed problems, Initial and boundary conditions.

UNIT II LINEAR SOLVERS AND FINITE VOLUME METHOD FOR DIFFUSION PROBLEMS — 9 hours

Solution of discretized linear algebraic equations, Iteration method: Jacobi's method, Elimination methods: L-U decomposition technique, Tridiagonal matrix algorithm (Thomas' algorithm), Finite Volume Method for one-dimensional steady state diffusion, two dimensional diffusion and three-dimensional diffusion problems.

UNIT III FINITE VOLUME METHOD FOR CONVECTION-DIFFUSION PROBLEMS **9 hours**

Steady one-dimensional convection and diffusion, Central differencing scheme, Properties of discretization schemes, Assessment of the central differencing scheme for convection-diffusion problems, Upwind differencing scheme, Hybrid differencing scheme, Quick scheme.

UNIT IV SOLUTION ALGORITHMS FOR PRESSURE-VELOCITY COUPLING IN STEADY FLOWS **9 hours**

Introduction, Staggered grid, Momentum equations, The SIMPLE algorithm, Assembly of a complete method, SIMPLER and SIMPLEC methods.

UNIT V TURBULENCE MODELLING AND GRID WITH APPROPRIATE TRANSFORMATION **9 hours**

Effect of turbulence on time-averaged Navier-Stokes equations, Characteristics of simple turbulent flows, Turbulence models: Mixing length model, The k-ε model, Reynolds stress equation model, Grid with Appropriate Transformation: General transformation of the equations, Metrics and Jacobian, Stretched (Compressed) grids, Boundary fitted coordinate systems, Elliptic grid generation.

Course outcomes:

1. Develop the basic governing equations for fluid and heat flow by examining the physical boundary conditions.
2. Construct the discretized equations according to the nature (i.e. elliptic, parabolic and hyperbolic) of the flow problem.
3. Solve the linear algebraic equations by direct and iterative methods.
4. Analyze and evaluate various finite volume based CFD schemes to solve convectiondiffusion problems.
5. Apply the variations of SIMPLE schemes for incompressible flows.

Text books:

1. John D Anderson, “Computational Fluid Dynamics”, Tata-McGraw Hill Publisher, 1st Edition, 1995.
2. K Muralidhar & T Sundararajan, “Computational Fluid Flow and Heat Transfer”, Narosa Book Distributors Pvt Ltd, 2nd Edition, 2009.
3. H K Versteeg& W Malalasekara, “Introduction to Computational Fluid Dynamics: The Finite Volume Method”, Pearson Education (Indian Reprint), 2nd Edition, 2007.

References:

1. S V Patankar, “Numerical Heat Transfer and Fluid Flow”, Taylor & Francis, 1st Edition, 1980.
2. R H Pletcher, J C Tannehill& D A Anderson, “Computational Fluid Mechanics and Heat Transfer”, CRC Press, 3rd Edition, 2012.

Mode of Evaluation: Assignments, Internal Mid Tests and External End Examinations

B. Tech. Mechanical Engineering

Minor

20MDME202 THERMAL ENGINEERING LABORATORY

L	T	P	C
0	0	4	2

Pre-requisite: Thermal Engineering

Course objectives:

1. To enable the students to do experimentation on heat transfer equipment and gain practical knowledge about heat transfer in thermal systems
2. To give practical exposure to students on working and performance evaluation of fluid machinery.
3. To give hands on training to students on

LIST OF EXPERIMENTS

1. Overall heat transfer coefficient of composite slab apparatus
2. Heat transfer coefficient in transient heat conduction
3. Efficiency and effectiveness of a pin-fin
4. Emissivity of gray body
5. Experiment on critical heat flux apparatus
6. Performance test on parallel and counter flow heat exchanger
7. Performance test on Pelton wheel.
8. Performance test on Francis turbine.
9. Performance test on Kaplan turbine.
10. Performance Test on a 4 -Stroke Diesel Engines
11. Performance Test on 2-Stroke Petrol engine
12. Evaluation of Engine friction by conducting Morse test on 4-Stroke Multi cylinder Engine
13. Retardation and motoring test on 4- stroke engine 14. Heat Balance of an I.C. Engine.
14. Performance Test on Reciprocating Air – Compressor Unit

Course outcomes:

The students after completing the course will be able to:

1. Experimentally evaluate important parameters in heat transfer equipment.
2. Conduct performance tests on hydraulic turbines.
3. Conduct different types of performance tests on IC engines.
4. Conduct performance test on compressors.

Text books:

Lab manual provided by the department

Mode of Evaluation: Assignments, Internal Mid Tests and External End Examinations

B. Tech. Mechanical Engineering

Minor

20MDME111 DESIGN OF GAS TURBINE ENGINES

L	T	P	C
2	1	0	3

Course description:

A gas turbine engine is a device that is designed to convert the thermal energy of a fuel into some form of useful power, such as mechanical (or shaft) power or a highspeed thrust of a jet. This subject deals with design fundamentals of such sophisticated gas turbine engines.

Course objectives:

1. To elucidate the fundamental of gas turbine
2. To explain about fluid dynamics and fundamentals of rotating machines
3. To Give proper idea about jet propulsion and cycle arrangements with different types of machines.
4. To explain the Gas Turbine with various operating cycles
5. To Analyze the performance of Gas Turbine.

UNIT I FUNDERMENTALS OF GAS TURBINE 9 hours

Gas Turbine – theory & fundamentals of Gas Turbine, Principle, Classification, Energy equations, Fluid dynamics, Streamtube Area-Velocity Relation, Normal Shock Waves and Equations, Oblique Shock and Expansion Waves, Flow with friction and Heat transfer, Flow in Constant-Area Duct with Friction

UNIT II FUNDERMENTALS OF ROTATING MACHINE 9 hours

General Fluid Dynamics Analysis, Classification of compressor and turbines, Efficiency of Rotating Machines, Elementary Airfoil Theory, Cycle Arrangements- Open cycle & Closed Cycle, Working Medium and its Properties, Ideal Cycle and analysis

UNIT III JET PROPULSION CYCLES AND THEIR ANALYSIS 9 hours

Reciprocating or Propeller Engines, Gas Turbine Engines- Types, The Ramjet Engine, The Pulse Jet Engine, Turboprop Engine, Turbojet engine, Thrust-Thrust Equation, Parameters effecting flight performance

UNIT IV CENTRIFUGAL COMPRESSOR 9 hours

Parts of Centrifugal Compressor- Principle of Operation, Blade Shapes and Velocity of Triangles, Analysis of Flow Through Compressor, Diffuser, Volute Casing, Compressor Characteristics, Surging and Chocking, Axial Flow Compressor- Working Principle- Stage Velocity Triangles, A Single Impulse Stage, A Single Reaction Stage, Multistage machines, Velocity Triangles, Losses and Efficiencies

UNIT V TRANSONIC AND SUPERSONIC COMPRESSOR AND TURBINES 9 hours

The Supersonic Compressor, Supersonic Axial Flow Compressor, Supersonic Radial Compressor, Supersonic Axial Flow Turbines Stages, Inlets, Diffuser, Supersonic and Subsonic Inlets, Exhaust Nozzles, Blades- Materials-Manufacturing Techniques, Blade Fixing-Cooling, Problems on High Temperature Operations

B. Tech. Mechanical Engineering

Course outcomes:

The students after completing the course will be able to:

1. Apply energy equations, various laws used in the design of turbomachines.
2. Able to explain centrifugal and axial flow compressor with Velocity Triangles, Losses and Efficiencies
3. Explain basic phenomenon of jet propulsion cycles and parameters effecting on its performance.
4. Understand working principles of supersonic compressor and turbine stages.
5. Able to estimate the performance of Gas turbine and know different parts of it.

Text books:

1. V. Ganesan, Gas Turbine, Tata McGraw Hill Education Pvt. Lmt., 2012, 8th edition.
2. H. Cohen, Gas Turbine Theory, 4th Edition, Longman, 1998

References:

1. B. Lakshminarayana, Fluid Dynamics & Heat Transfer of Turbomachinery, John Wiley & Sons, 1996.
2. Jack D. Mattingly, Elements of Gas Turbine Propulsion, McGraw-Hill, Inc., 1996.

Mode of Evaluation: Assignments, Internal Mid Tests and External End Examinations

B. Tech. Mechanical Engineering

Minor

20MDME112 FLUID POWER SYSTEM

L	T	P	C
2	1	0	3

Course description:

The goal of this course is to give ideas about the fundamental properties of fluid and fluid power systems. Topics to be covered include Fluids for hydraulic systems, governing laws. Distribution of fluid power, Design, and analysis of typical hydraulic circuits. Know accessories used in fluid power system, Filtration systems and maintenance of system.

Course objectives:

1. To recognize the standard symbols and to understand the functions of basic fluid power generation and actuation elements.
2. To realize the functions of fluid regulation and control elements and its typical uses in pumps and actuators.
3. To familiar and exercise the design procedure of various types of hydraulic fluid power components and its circuits design.
4. To learn about the fundamentals of Pneumatic power systems and Actuators and it's working principles involved in each component in the system.
5. To familiar and exercise pneumatic control systems design and associated applications.

UNIT I INTRODUCTION TO FLUID POWER SYSTEMS 9 hours

Fluid power system: components, advantages and applications. Transmission of power at static and dynamic states. Pascal's law and its applications. Fluids for hydraulic system: types, properties, and selection. Seals, sealing materials, compatibility of seal with fluids. Types of pipes, hoses, and quick acting couplings. Pressure drop in pipes. Fluid conditioning through filters, strainers; sources of contamination and contamination control; heat exchangers.

UNIT II HYDRAULIC PUMPS AND ACTUATORS 9 hours

Classification of pumps, positive displacement pumps, construction and working of Gear pumps, Vane pumps, Piston pumps, fixed and variable displacement pumps, Pump performance characteristics, Hydraulic Actuators: Classification, Hydraulic cylinders, single and double acting cylinder, mounting arrangements, cushioning, special types of cylinders, problems on cylinders. Construction and working of rotary actuators such as gear, vane, piston motors, and Hydraulic Motor. Theoretical torque, power, flow rate, and hydraulic motor performance; numerical problems.

UNIT III HYDRAULIC CIRCUIT COMPONENTS AND ITS DESIGN 9 hours

Classification of control valves, Directional Control Valves-symbolic representation, constructional features of poppet, sliding spool, rotary type valves solenoid and pilot operated DCV, shuttle valve, and check valves. Control of single and Double -acting hydraulic cylinder, regenerative circuit, pump unloading circuit, double pump hydraulic system, counter balance valve application, hydraulic cylinder sequencing circuits, cylinder synchronizing circuit using different methods, hydraulic circuit for force multiplication; speed control of hydraulic cylinder-metering in, metering out and bleed off circuits.

UNIT IV Pneumatic power systems and Actuators 9 hours

Pneumatic power system, advantages, limitations, applications, Structure of pneumatic control System, fluid conditioners-dryers and FRL unit. Pneumatic Actuators: Linear cylinder –types of cylinders, working, end position cushioning, seals, mounting arrangements, and applications. Rotary cylinders- types, construction and application, symbols. Pneumatic Control Valves: DCV such as poppet, spool, suspended seat type slide valve, pressure control valves, flow control valves, types and construction.

UNIT V Pneumatic control circuits 9 hours

Direct and indirect actuation pneumatic cylinders, speed control of cylinders - supply air throttling and exhaust air throttling. Use of OR and AND logic gates in pneumatic applications. Case studies involving the use of logic gates. Coordinated and sequential motion control, motion and control diagrams. Signal elimination methods, Cascading method principle, Practical application examples (up to two cylinders) using cascading method (using reversing valves).

Course outcomes:

The students after completing the course will be able to:

1. Identify and analyse the functional requirements of a fluid power transmission system for a given application.
2. Visualize how a hydraulic/pneumatic circuit will work to accomplish the function.
3. Design an appropriate hydraulic or pneumatic circuit or combination circuit like electro-hydraulics, electro-pneumatics for a given application.
4. Select and size the different components of the circuit.
5. Develop a comprehensive circuit diagram by integrating the components selected for the given application.

Text books:

1. Anthony Esposito, “Fluid Power with applications”, Pearson edition,2000 .
2. Majumdar S.R., “Oil Hydraulics”,TalaMcGRawHllL, 2002 .
3. Majumdar S.R., “Pneumatic systems - Principles and Maintenance”,Tata McGraw-Hill, New Delhi, 2005.

References:

1. John Pippenger, Tyler Hicks, “Industrial Hydraulics”, McGraw Hill International Edition, 1980.

2. Andrew Par, Hydraulics and pneumatics, Jaico Publishing House, 2005.

3. FESTO, Fundamentals of Pneumatics,VolI,IIandIII.

4. Herbert E. Merritt, “Hydraulic Control Systems”, John Wiley and Sons, Inc.

5. Thomson, Introduction to Fluid power, PrentcieHaIl, 2004

6. John Watton, “Fundamentals of fluid power control”, Cambridge University press, 2012

Mode of Evaluation: Assignments, Internal Mid Tests and External End Examinations

HONORS in
MECHANICAL ENGINEERING

B. Tech. Mechanical Engineering

Honors

20HDME101 ADVANCED WELDING TECHNOLOGY

L	T	P	C
3	0	0	3

Pre-requisite: Manufacturing Technology

Course description:

Advanced Welding provides students with opportunities to effectively perform cutting and welding applications of increasing complexity used in the advanced manufacturing industry. Proficient students will build on the knowledge and skills of the Advanced Welding Technology such as Plasma Arc welding, Laser beam welding, Electron beam welding, Ultrasonic welding etc., and weld design, testing/inspection methods. Upon completion of the Advanced Welding Technology course, proficient students will be prepared to complete the American Welding Society (AWS) Entry Welder qualification and certification.

Course objectives:

1. To impart knowledge regarding various advanced welding practices in industries
2. To understand the various parameters and requirements for welding processes
3. To know the comparative merits and demerits of various welding processes
4. To understand the right kind of welding technique suitable for various joints
5. To learn about the joint designs adopted in different types of welding techniques

UNIT I INTRODUCTION 9 hours

Importance and application of welding, classification of welding process. Selection of welding process. Brief review of conventional welding process: Gas welding, Arc welding, MIG, TIG welding, Resistance welding, Electroslag welding, Friction welding etc. Soldering & Brazing, Health & safety measures in welding.

UNIT II ADVANCED WELDING PROCESSES 9 hours

Plasma Arc welding, Laser beam welding, Electron beam welding, Ultrasonic welding, Explosive welding/ Cladding, Underwater welding, Spray-welding / Metallizing, Hard facing. Case studies and applications - industrial, automotive and aerospace.

UNIT III THERMAL AND METALLURGICAL CONSIDERATION 9 hours

Thermal considerations for welding, temperature distribution, heating & cooling curves. Metallurgical consideration of weld, HAZ and Parent metal, micro & macro structure. Solidification behaviour of fusion weld: structural zones, epitaxial growth, weld pool shape and columnar grain structures. Weldability of metals - steels, stainless steels, aluminium, copper, nickel and titanium alloys.

UNIT IV MODELING AND SIMULATION OF WELDING PROCESSES 9 hours

Thermal modelling and simulation of welding processes - governing heat transfer equations and boundary conditions for various types of welding processes. Estimation of cooling rates. Prediction of mechanical properties, micro/macrostructures of weldments and heat-affected zone. Prediction of weld defects such a crack, segregation, lack of fusion. Modelling and simulation of pulsed arc processes. Use of software for simulation.

UNIT V WELD DESIGN AND TESTING 9 hours

Types of welds & joints, joint design, welding symbols, weld defects and distortion and its remedies, inspection and testing of welds, use of imaging techniques for online monitoring, Introduction to Welding Procedure Specification & Procedure Qualification Record.

Course outcomes:

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

1. Understand the fundamental principles of various welding processes
2. Identify suitable advanced welding process for specific application
3. Apply the knowledge of thermal and metallurgical characteristics on weldments
4. Develop the knowledge on modelling and simulation of various welding processes on the required performance criteria.
5. Apply the concept of design, inspection and testing of weldments in an industrial environment.

Text books:

1. AWS, Welding Handbooks (Vol. I & II)
2. Edward R. Bohnart, Welding Principles and Practices, Mc Graw Hill, 4th Edition, 2017
3. Nadkarni S.V, Modern Arc Welding Technology, Oxford IBH Publishers, 2014.
4. Parmar R. S, Welding Engineering and Technology, Khanna Publishers, Delhi – 2013

References:

1. D. L. Olson, T. A. Siewert, S. Liu, G.R. Edwards, ASM Hand Book, Vol 06, Welding, Brazing and Soldering, ASM International, 2008.
2. 2. Richard L Little, Welding & Welding Technology, Mc Graw Hill, 2008
3. 3. Kou S, Welding Metallurgy, John Wiley Publications, New York, 2003, 2nd Edition
4. 4. Grong O. Metallurgical Modelling of Welding, The Institute of Materials, 1997, 2nd Edition

Mode of Evaluation: Assignments, Internal Mid Tests and External End Examinations

B. Tech. Mechanical Engineering

Honors

20HDME102 DESIGN AND ANALYSIS OF WELDED STRUCTURES

L	T	P	C
3	0	0	3

Course description:

This course presents the concepts behind welding and joining technology. The concepts are then applied to the design and fabrication of engineering components, process plant and structures. The importance of selecting the correct welding design, size and parameters for a particular application will be demonstrated. At the end of the course students should have the concepts to assist in the selection of processes and parameters to make appropriately designed, sound joints, fit for service in the operating environment.

Course objectives:

1. To elucidate the fundamental purpose of welded structures
2. To understand the theory of weld structures and design considerations
3. To understand the weld joints design under static and dynamic loading conditions.
4. To train the students in selecting, determining and estimating the weld structure, size and cost respectively.
5. To identify the weld defects and understand the weld quality inspection methods

UNIT I DESIGN FOR PURPOSE OF WELDED STRUCTURES 9 hours

Introduction to design for purpose concepts for welded structures-Post- weld treatment methods for welded structures-Design considerations for manual and automated welding processes

UNIT II DESIGN OF WELDED STRUCTURES 9 hours

Basic theory of structural systems- Loads on structures-Introduction to the design of structures-Analysis methods for structures-Design guidance documents, codes and standards

UNIT III DESIGN OF WELDED JOINTS-I 9 hours

Categories of welded joints-Design of welded joints with predominantly static loading-Design of welded joints with predominantly dynamic/cyclic loading-Design against brittle fracture

UNIT IV DESIGN OF WELDED JOINTS-II 9 hours

Selection of Structural Steel for Welded Construction-Weldability and Welding procedure-Joint Design-Determining weld size-estimating welding cost-welding on existing structures

UNIT V WELDING FABRICATION 9 hours

Control of Shrinkage and Distortion- painting & corrosion of welded structures-weld quality Inspection methods and criteria- Quality assurance in welding fabrication

B. Tech. Mechanical Engineering

Course outcomes:

The students after completing the course will be able to:

1. Demonstrable knowledge of a range of welding structures and the considerations to select an appropriate welding process for a particular application
2. Analytical methods for understanding the design of structures
3. Recognize the importance of impact of static and dynamic loading conditions
4. Apply the concepts of determining and estimating the weld size and cost respectively.
5. Explain the effects of welding defects and inspection methods.

Text books:

1. Design of Welded Structures by Orner W Blodgentt, The James F Linooln arc welding foundation
2. International Welded Structures Designer by Av. Prof. Dr. Cavaco Silva

Data Book:

1. International Welded Structures Designer, Prepared and issued by the IAB-International Authorisation Board Under the authority of the IIW-International Institute of Welding.

References:

1. Welding Metallurgy, IIT Roorkee, Dr. Pradeep K. Jha
2. Welding Engineering, IIT Roorkee.

Mode of Evaluation: Assignments, Internal Mid Tests and External End Examinations

B. Tech. Mechanical Engineering

Honors

20HDME103 COMBUSTION AND EMISSIONS

L	T	P	C
3	0	0	3

Pre-requisite: Engineering Thermodynamics

Course description:

This course builds on the concepts learned in Thermodynamics, fluid mechanics and heat transfer to delve into the underlying concepts in the specialized subject of combustion of fuels and generation of emissions. These learning from this course is essential for students looking to pursue career in energy sector which employs mechanical engineers in significant numbers. The topics covered include thermodynamics and equilibrium consideration of combustion, analysis and mathematical modelling of laminar premixed and diffusion flames, evaporation of liquid flames, turbulence and its influence on combustion, combustion of solid fuels, emissions and their control.

Course objectives:

1. To introduce the basics concepts in the specialized topic of combustion.
2. To explicate the underlying phenomena involved in the combustion of fuels.
3. To shed light on the complex interplay between the fluid flow, mass transfer, heat transfer, phase change and chemical kinetics in a combustion system.
4. To expound on the origins of emission generation in combustion systems and ways to control them.
5. To lay the necessary foundation for the student to take up problems in design of combustion systems.

UNIT I THERMODYNAMIC, MASS TRANSFER AND KINETIC ASPECTS 9 hours

Review of property relations, stoichiometry, reactant and product mixtures, adiabatic flame temperatures, chemical equilibrium, equilibrium products of combustion Rudiments of mass transfer, liquid-vapor interface boundary conditions, droplet evaporation Global versus elementary reactions, elementary reaction rates, oxides of nitrogen formation

UNIT II LAMINAR FLAMES AND THEIR ANALYSIS 9 hours

Constant pressure and constant volume fixed mass reactor, well stirred reactor, plug flow reactor, applications to combustion system modelling. Conservation equations for mass, momentum, energy and any generic scalar.

Premixed flames, simplified analysis, factors influencing flame velocity and thickness, flame speed correlations for selected fuels, quenching, flammability and ignition, flame stabilization. Diffusion flames, laminar jet flames, simplified analysis, flame lengths for circular –port and slot burners, soot formation and destruction.

UNIT III EVAPORATION AND TURBULENCE 9 hours

Simple model of droplet evaporation and droplet burning, one dimensional vaporization – controlled combustion, some applications of droplet evaporation and droplet Burning Introduction to turbulent flows, definition of turbulence, length scales in turbulent flows, analysing turbulent flows, axisymmetric turbulent jet.

UNIT IV TURBULENT FLAMES 9 hours

Turbulent premixed and non-premixed flames, definition of turbulent flame speed, structure of turbulent premixed flames, wrinkled laminar flame regime, distributed reaction regime, flamelets in eddies regime, flame stabilization, jet flames, applications of turbulent premixed flames.

UNIT V SOLID FUELS AND EMISSIONS 9 hours

Burning of solids, coal fired boilers, heterogeneous reactions, burning of carbon, coal combustion. Emission Index, corrected concentrations, control of emissions for premixed and non-premixed flames.

Course outcomes:

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

1. Calculate the basic parameters of combustion like air-fuel ratio, equivalence ratio, adiabatic flame temperature etc.
2. Describe the concepts related to laminar flames like flame speed, flame length.
3. Explain the phenomena of droplet vaporization and turbulence and their significance to the combustion characteristics and control.
4. Explain the concepts related to turbulent flames like flamelets, flame stabilization, and different flame regimes.
5. Describe various aspects of solid fuel combustion and different mechanisms responsible for generation of harmful emissions from combustion.

Text books:

1. Turns, S.R., An Introduction to Combustion -Concepts and Applications, 2nd Edition., McGraw Hill.
2. Jaan Kiusalaas, Numerical Methods in Engineering with Python, Cambridge University Press, 3 edition.

References:

1. Principles of Combustion, Kenneth K. Kuo, John Wiley & Sons .
2. Fundamentals Of Combustion, D P Mishra, PHI Learning.
3. Combustion: Physical and Chemical Fundamentals, Modeling and Simulation, Experiments, Pollutant Formation, Warnatz, J., Maas, Ulrich, Dibble, Robert W., Springer

Mode of Evaluation: Assignments, Internal Mid Tests and External End Examinations

B. Tech. Mechanical Engineering

Honors

20HDME104 ERGONOMICS

L	T	P	C
3	0	0	3

Pre-requisite: None

Course description:

Ergonomics is the process of designing or arranging workplaces, products, and systems so that they fit the people who use them. Ergonomics aims to create safe, comfortable, and productive workspaces by bringing human abilities and limitations into the design of a workspace, including the individual's body size, strength, skill, speed, sensory abilities (vision, hearing), and even attitudes.

Course objectives:

The students will study the following:

1. The human lifestyle of communication, factors affecting human work physiology.
2. The human body function in sitting posture, squatting and cross legging postures.
3. The human behavior in work centres.
4. The human psycho-social behavior aspects and visual performance.
5. The human occupational safety and stress at workplace in view to reduce the potential fatigue, errors, discomforts, and unsafe acts.

UNIT I INTRODUCING ERGONOMICS 9 hours

Introduction to Ergonomics; Design today- Human aid to lifestyle; Journey, Fitting task to man their contractual structure; Domain, Philosophy and Objective; Mutual task comfort: two way dialogue, communication model; Ergonomics/ human Factors fundamentals; Physiology (work physiology) and stress.

UNIT II HUMAN PHYSICAL DIMENSION CONCERN 9 hours

Human body- structure and function; anthropometrics; Anthropometry: body growth and somatotypes; Static and dynamic anthropometry, Stand Posture- erect; Anthropometry landmark: Sitting postures; Anthropometry: squatting and cross-legged postures; Anthropometric measuring techniques; Statistical treatment of data and percentile calculations.

UNIT III POSTURE AND MOVEMENT 8 hours

Human body- structure and function; Posture and job relation; Posture and body supportive devices; Chair characteristics; Vertical work surface; Horizontal work surface; Movement; Work Counter.

UNIT IV BEHAVIOUR AND PERCEPTION, VISUAL ISSUES, ENVIRONMENTS FACTORS **9 hours**

Communication and cognitive issues; Psycho-social behaviour aspects, behaviour and stereotype; Information processing and perception; Cognitive aspects and mental workload; Human error and risk perception; Visual performance; Visual displays; Environmental factors influencing human performance.

UNIT V ERGONOMIC DESIGN PROCESS, PERFORMANCE SUPPORT & DESIGN INTERVENTION **10 hours**

Ergonomics design methodology; Ergonomics criteria while designing; Design process involving ergonomics check; Some checklists for task easiness; Occupational safety and stress at workplace in view to reduce the potential fatigue, errors, discomforts and unsafe acts; Workstation design; Furniture support; Vertical arm reach and design application possibility; Humanising design: Design and human compatibility, comfort and adaptability aspects; Concluding session: Design Ergonomics in India: scope for exploration.

Course outcomes:

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

1. Identify the impact of various personal attributes (anatomical, physiological, anthropometric and psychological) on proper safe working practice.
2. Assess the effect of physical environment factors on comfort and performance
3. Apply principles of good ergonomic design of work areas and equipment to a range of occupational settings.
4. Apply knowledge the ergonomic principles in organisation and culture.
5. Solve ergonomic design process to reduce fatigue discomforts.

Text books:

1. R S Bridger, Introduction to Ergonomics, 2nd Edition, Taylor &Francis, 2003.
2. J Dul and B Weerdmeester, Ergonomics for beginners, a quick reference guide, Taylor & Francis, 1993.

References:

1. S Singh, (Edt), Ergonomics Interventions for Health and Productivity, Himanshu Publications, Udaipur, New Delhi, 2007.
2. Green, W.S. and Jordan,P .W, Human Factors in Product Design, Taylor & Francis, 1999.
3. D. Chakrabarti, Indian Anthropometric Dimensions for ergonomic design practice, National Institute of Design, Ahmedabad, 1997.
4. G. Salvendy (edit), Handbook of Human Factors and ergonomics, John Wiley & Sons, Inc., 1998.

Mode of Evaluation: Assignments, Internal Mid Tests and External End Examinations

B. Tech. Mechanical Engineering

Honors

20HDME105 SOLAR ENERGY FOR PROCESS HEAT AND POWER GENERATION

L	T	P	C
3	0	0	3

Course description:

To study fundamentals and application of solar thermal systems for heating, cooling, power generation and other applications.

Course objectives:

1. The knowledge on solar passive heating and cooling.
2. The fundamentals of design calculations and analysis of solar thermal systems.
3. The functioning and design of solar thermal cooling systems.
4. The basics of solar thermal technology for process heating applications.
5. The fundamentals of design calculations and economics of solar power generation.

UNIT I ENERGY RESOURCES AND SOLAR SPECTRUM 9 hours

World energy resources - Indian energy scenario - Environmental aspects of energy utilization. Renewable energy resources and their importance - Global solar resources. Solar spectrum – Electromagnetic spectrum, basic laws of radiation. Physics of the Sun - Energy balance of the earth, energy flux, solar constant for earth, greenhouse effect.

UNIT II SOLAR THERMAL ENERGY CONVERSION 9 hours

Thermodynamic cycles – Carnot – Organic, reheat, regeneration and supercritical Rankine cycles - Brayton cycle – Stirling cycle – Binary cycles – Combined cycles. Solar thermal power plants - Parabolic trough system, distributed collector, hybrid solar-gas power plants, solar pond based electric-power plant, central tower receiver power plant.

UNIT III APPLICATIONS OF SOLAR COLLECTORS 9 hours

Application of non-concentrating collectors in low temperature solar thermal plants for space heating and cooling, drying, seawater desalination. Use of concentrating collectors for process heat production and power generation.

UNIT IV SOLAR PASSIVE HEATING AND COOLING 9 hours

Thermal comfort - Heat transmission in buildings - Bioclimatic classification. Passive heating concepts - Direct heat gain, indirect heat gain, isolated gain and sunspaces. Passive cooling concepts - Evaporative cooling, radiative cooling, application of wind, water and earth for cooling, roof cooling, earth air-tunnel. Energy efficient landscape design - Concept of solair temperature and its significance, calculation of instantaneous heat gain through building envelope

UNIT V SOLAR THERMAL APPLICATIONS AND POWER PLANTS 9 hours

Solar systems for process heat production - Solar cooking – Performance and testing of solar cookers. Seawater desalination – Methods, solar still and performance calculations. Solar pond - Solar greenhouse. Solar thermal electric power plants based on parabolic trough, solar central receiver, parabolic dish-Stirling engine. Concentrated solar power using Fresnel

lenses. Fundamentals of design calculations and analysis of solar power plants. Economic analysis

Course outcomes:

The students after completing the course will be able to:

1. Apply heat conduction equations to different surface configurations under steady state and transient conditions and solve problems
2. Apply free and forced convective heat transfer correlations to internal and external flows through/over various surface configurations and solve problems
3. Explain the phenomena of boiling and condensation, apply LMTD and NTU methods of thermal analysis to different types of heat exchanger configurations and solve problems
4. Explain basic laws for radiation and apply these principles to radiative heat transfer between different types of surfaces to solve problems
5. Apply diffusive and convective mass transfer equations and correlations to solve problems for different applications

References:

1. Kalogirou .S.A., "Solar Energy Engineering: Processes and Systems", Academic Press, 2009.
2. Vogel. W, Kalb .H, "Large-Scale Solar Thermal Power Technologies", WileyVCH, 2010. 3. Duffie .J. A, Beckman .W. A, "Solar Engineering of Thermal Process", Wiley, 3rd ed. 2006.
3. Khartchenko .N.V, "Green Power: Eco-Friendly Energy Engineering", Tech Books, Delhi, 2004.
4. Goswami .D.Y, Kreith .F, Kreider .J.F, "Principles of Solar Engineering", 2nd ed., Taylor and Francis, 2000, Indian reprint, 2003.
5. Garg .H.P, Prakash .J, "Solar Energy Fundamentals and Applications", Tata McGraw-Hill, 2005.

Mode of Evaluation: Assignments, Internal Mid Tests and External End Examinations

B. Tech. Mechanical Engineering

Honors

20HDME106 FRACTURE MECHANICS

L	T	P	C
3	0	0	3

Pre-requisite: Mechanics of Solids and Engineering Mechanics.

Course description:

The course covers the basic aspects of Engineering Fracture Mechanics. Spectacular failures that triggered the birth of fracture mechanics, Modes of loading, Classification as LEFM and EPFM, Crack growth and fracture mechanisms, Energy release rate, Resistance, Griffith Theory of fracture, Extension of Griffith Theory by Irwin and Orowan, R-Curve, Pop-in phenomena, Crack branching. Necessary and sufficient conditions for fracture, Stress and Displacement fields in the very near and near-tip fields, Various methods for evaluating Stress Intensity Factors, Modeling plastic zone at the crack-tip, fatigue in structural components.

Course objectives:

The students will study the following:

1. To study about the classification of fracture
2. To understand about the importance of crack tip
3. To develop experimental setup while performing a standard test
4. To study about the R curve
5. To understand about the Fatigue crack propagation.

UNIT I INTRODUCTION 9 hours

Introduction: Crack in a structure – Griffith criterion Mechanism of Fracture and Crack Growth: cleavage fracture – ductile fracture fatigue cracking – service failure analysis

UNIT II SOLUTIONS AND ZONES 9 hours

Elastic Crack Tip Stress Field: Solution to crack problems – effect of finite size stress intensity factor – special cases. Crack Tip Plastic Zone: Irwin plastic zone correction – actual shape of the plastic zone.

UNIT III ENERGY AND TOUGHNESS 9 hours

Energy Principle: Energy release rate – criterion for crack growth – J integral Plane Strain. Fracture Toughness: Standard test – size requirement – nonlinearity

UNIT IV STRESS AND FRACTURE 9 hours

Plane Stress and Transitional Behavior: concept of plane stress – R curve concept – thickness effect – plane stress testing Elastic-Plastic Fracture: crack tip opening displacement.

UNIT V CRACK PROPAGATION 9 hours

Fatigue Crack Propagation: Crack growth and stress intensity factor – factors affecting crack propagation – variable amplitude service loading and its numerical retardation model

Course outcomes:

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

1. Analyze the fracture mechanism
2. Gain familiarity with the different modes of failure under the presence of a crack
3. Establish specimen size in accordance with the standard procedures
4. Distinguish between Plane stress fracture toughness and Plane strain fracture toughness
5. Accomplish the relationship between crack propagation and stress intensity factor

Text books:

1. Prashant Kumar., "Elements of fracture mechanics", Mc Graw Hill Education (India) Private Limited, New Delhi - 2014.

References:

1. T.L. Anderson, "Fracture Mechanics - Fundamentals and Applications", 3/e, Taylor and Francis Group, 2005.
2. R.N.L.Smith, "Basic Fracture Mechanics", Butterworth Heinemann Publications, 1991.
3. K. Ramesh," e-Book on Engineering Fracture Mechanics", IIT Madras, 2007. URL: http://apm.iitm.ac.in/smlab/kramesh/book_4.html
4. K. R.Y. Simha, "Fracture Mechanics for Modern Engineering Design", Universities Press (India) Limited, 2001
5. David Broek, "Elementary Engineering Fracture Mechanics, Kluwer Academic Publishers, The Hague – 1984.

Mode of Evaluation: Assignments, Internal Mid Tests and External End Examinations

B. Tech. Mechanical Engineering

Honors

20HDME107 POWDER METALLURGY

L	T	P	C
3	0	0	3

Course Description:
Introduction of sheet metal forming processes involved in the powder forming processes and classification of forming processes.

Course objectives:

1. Describing types of deformations and classification of forming processes.
2. Classifying and explaining bulk forming processes.
3. Describing sheet metal forming processes.
4. Distinguishing differences between conventional forming and special forming processes.
5. Elaborating various stages involved in the powder forming processes.

UNIT I INTRODUCTION 9 hours

Mechanical behavior of materials- Elastic and plastic deformations - Classification of forming processes - Temperature in metal working: Cold, Warm, and hot working - Introduction to the theory of plastic deformation.

UNIT II BULK FORMING 9 hours

Introduction - Plastic deformation in forging, rolling, extrusion, rod/wire, tube drawing and swaging processes and their applications - Effect of friction, calculation of forces, work done, process parameters, equipment's, and defects - Design for manufacturing - Economics of bulk forming.

UNIT III SHEET METAL FORMING 9 hours

Introduction - Sheet metal characteristics - Conventional sheet metal forming processes like shearing, bending and miscellaneous forming processes - High energy rate forming processes - Super plastic forming processes - Deep drawing process - Principles, process parameters, advantages, limitations, and applications of the above - Formability of sheet metals - Equipment's - Defects - Design for manufacturing - Economics of sheet metal forming.

UNIT IV SPECIAL FORMING 9 hours

Orbital forging - Isothermal forging - Hot and cold Isostatic pressing - High speed extrusion - High-speed forming machines - Rubber pad forming - Water hammer forming - Fine blanking - Incremental forming and comparing the above with conventional forming.

UNIT V POWDER FORMING 9 hours

Introduction - Powder production methods - Particle size characterization – Blending – Compacting - Sintering - Secondary and finishing operations - Advantages and applications of powder metallurgy - Design for manufacturing - Powder forging, rolling, extrusion, drawing - Economics of powder forging.

Course outcomes (co):

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

1. Illustrate deformation types and classification of forming processes.
2. Describe bulk forming processes and their applications.
3. Elaborate different sheet metal forming processes and their applications.
4. Compare and distinguish conventional and special forming processes.
5. Discuss powder forming processes and its applications

Text books:

1. Kalpakjian S. and Schmid S.R., "Manufacturing Engineering and Technology", Pearson., New Delhi, India, 2018.
2. Sadhu Singh, "Theory of plasticity and metal forming processes", Khanna Publishers, 2008

References:

1. Heinz Tschätsch, "Metal Forming Practise: Processes - Machines – Tools", Springer-Verlag Berlin Heidelberg., Germany, 2006.
2. Juneja B.L., "Fundamentals of Metal forming Processes", New Age International Publishers Ltd., Chennai, India, 2018.
3. Kumar Surender, "Technology of Metal Forming Processes", PHI learning Pvt. Ltd., New Delhi, India, 2008.
4. Nagpal G.R.,"Metal Forming Processes", Khanna Publishers., New Delhi, India, 2000.
5. Mikell P. Groover, "Fundamental of Modern Manufacturing: Materials, Processes and Systems", John Wiley and Sons Ltd., United States, 2013

Mode of Evaluation: Assignments, Internal Mid Tests and External End Examinations

B. Tech. Mechanical Engineering

Honors

20HDME108 ADVANCED FLUID MECHANICS

L	T	P	C
3	0	0	3

Course description:

The subject deals with the static, kinematics and dynamic aspects of fluids. The study of fluids at rest is called fluid statics. The study of fluid in motion is called fluid kinematics if pressure forces are not considered if pressure force is considered in fluid in motion is called fluid dynamics.

Course objectives:

1. To understand the laws of fluid flow for ideal and viscous fluids.
2. To represent the real solid shapes by suitable flow patterns and to analyze the same for aerodynamics performances.
3. To understand the changes in properties in compressible flow and shock expansion.

UNIT I BASIC EQUATIONS OF FLOW 9 hours

Three dimensional continuity equation - differential and integral forms – equations of motion momentum and energy - Reynolds transport theorem – Navier – Stokes equation – Engineering Applications

UNIT II POTENTIAL FLOW THEORY 9 hours

Rotational and irrorational flows - circulation – vorticity - stream and potential functions for standard flows and combined flows – representation of solid bodies by flow patters. Pressure distribution over stationery and rotating cylinders in a uniform flow - magnus effect - Kutta – Zhukovsky theorem. Complex potential functions. Conformal transformation to analyze the flow over flat plate, cylinder, oval body and airfoils. Thin airfoil theory – generalized airfoil theory for cambered and flapped airfoils.

UNIT III VISCOUS FLOW THEORY 9 hours

Laminar and turbulent flow - laminar flow between parallel plates - Poiseuille's equation for flow through circular pipes. Turbulent flow - Darcy Weisbach equation for flow through circular pipe - friction factor - smooth and rough pipes - Moody diagram – losses during flow through pipes. Pipes in series and parallel – transmission of power through pipes.

UNIT IV BOUNDARY LAYER CONCEPT 9 hours

Boundary Layer - displacement and momentum thickness - laminar and turbulent boundary layers in flat plates - velocity distribution in turbulent flows in smooth and rough boundaries - laminar sub layer.

UNIT V COMPRESSIBLE FLUID FLOW 9 hours

One dimensional compressible fluid flow – flow through variable area passage – nozzles and diffusers – fundamentals of supersonics – normal and oblique shock waves and calculation of flow and fluid properties over solid bodies (like flat plate, wedge, diamond) using gas tables.

B. Tech. Mechanical Engineering

Course outcomes:

The students after completing the course will be able to:

1. familiarized about the ideal and viscous fluid flow
2. familiarized about the boundary layer concepts
3. familiarized about the changes in properties in compressible flow
4. familiarized about the boundary layer concept and shock expansion.
5. familiarized about the compressible fluid flow.

Textbooks:

1. Anderson J.D., Fundamentals of Aerodynamics, McGraw Hill, Boston, 2001.
2. Bansal R.K., Fluid Mechanics, Saurabh and Co., New Delhi, 1985.
3. Houghten E.L. and Carruthers N.B., Aerodynamics for Engineering Students, Arnold Publishers, 1993.

References:

1. Kumar K.L., Engineering Fluid Mechanics, Eurasia Publishing House, New Delhi, 2002.
2. Munson B.R., Young D.F. and Okiisi, T.H., Fundamentals of Fluid Mechanics, John Wiley and Sons Inc., NewYork, 1990.
3. Schlichting H., Boundary layer theory, Mc Graw Hill Book Company, 1979
4. Shames, Mechanics of Fluids, Mc Graw Hill Book Company, 1962.
5. Streeter V.L., Wylie E.B. and Bedford K.W., Fluid Mechanics, WCB McGraw Hill, Boston,1998.

Mode of Evaluation: Assignments, Internal Mid Tests and External End Examinations

B. Tech. Mechanical Engineering

Honors

20HDME109 MODELLING OF SI AND CI ENGINES

L	T	P	C
3	0	0	3

Course description:

Combustion, also known as burning, is the basic chemical process of releasing energy from a fuel and air mixture. In an internal combustion engine (ICE), the ignition and combustion of the fuel occurs within the engine itself. The engine then partially converts the energy from the combustion to work. This course deals about various kinetics and combustion involved in SI and CI engines.

Course objectives:

1. To develop the knowledge about combustion kinetics in SI and CI engines.
2. To understand the combustion reaction kinetics in SI and CI engines.

UNIT I INTRODUCTION 9 hours

Gaseous, liquid and solid fuels, Application of the first and second laws of thermodynamics to combustion, – Low temperature reactions – Cool Flames – as applied to detonation. High temperature reactions – species concentration and products formation.

UNIT II CHEMICAL KINETICS OF COMBUSTION 9 hours

Elementary reactions, Pre-ignition kinetics, Ignition delay, Nitric Oxide Kinetics, Soot Kinetics, Calculations, – Reaction control effect on Engine performance and emissions.

UNIT III MODELLING 9 hours

Calculation of equilibrium composition. Enthalpy and Energy, Coefficients for reactions and adiabatic flame temperature, Modelling of CO, HC NO reactions in SI and CI Engines – Soot Modelling

UNIT IV S.I ENGINE COMBUSTION 9 hours

Combustion in S.I. Engines, Laminar flame theory, Flame structure, Turbulent premixed flames, Homogeneous Combustion reactions between Gasoline and air – Reaction rate Constants – species determination. Burning rate estimation.

UNIT V C.I ENGINE COMBUSTION 9 hours

Combustion in CI Engine, Spray formation, Spray dynamics, Spray models, Introduction to diesel engine combustion, Premixed and diffusion combustion reactions – Lean flame Reactions – Lean flame out reactions - Species determination. Emissions and Combustion, Ignition Delay and Burning rate estimation.

Course outcomes:

The students after completing the course will be able to:

1. understand the concept of combustion kinetics
2. Modelling of the combustion process of different fuels
3. Modelling advanced combustion process
4. Understand and formulate the kinetics for CI engine combustion
5. Understand and formulate the kinetics for SI engine combustion

Textbooks:

1. J.F. Ferguson, Internal Combustion Engines, John Wiley and Sons, 2004.
2. I R.S. Benson & N.D. Whitehouse, Internal Combustion Engines, First edition, Pergamon Press, England 1979.

References:

1. Combustion Engineering, Gary L Bormann, WCB Mc Graw Hill, 1998.
2. John. B. Heywood, "Internal Combustion engine fundamentals" McGraw – Hill, 1988.
3. A.F. Williams, combustion in flames, Oxford Press, Second Edition, 1978.
4. S.P. Sharma, Fuels and Combustion, S.P. Chand and Co., Sixth Edition, 1982.
5. S. W. Benson, The Foundations of Chemical Kinetics, McGraw-Hill, 1960.

Mode of Evaluation: Assignments, Internal Mid Tests and External End Examinations

B. Tech. Mechanical Engineering

Honors

20HDME601 SIMULATION AND ANALYSIS USING ANSYS

L	T	P	C
1	0	2	2

Pre-requisite: 20ME105, 20ME111, 20ME107, 20ME106

Course Description:

This course aims to lay out the fundamental concepts and results covering stress, thermal, and harmonic analysis of mechanical components using different modules of Ansys Software.

Course objectives:

1. Analysing the force and stress in mechanical components.
2. Analysing deflection in mechanical components.
3. Analysing thermal stress of mechanical components
4. Analysing heat transfer in mechanical components.
5. Analysing the vibration of mechanical components

UNIT I INTRODUCTION 9 hours

Study of Basics in ANSYS, Introduction of different modules of the Ansys: design modeler, workbench, APDL, Fluent, CFX. Different approaches of simulation: FDM, FEM, FVM. General processing and details study of Meshing and controlling of meshing

UNIT II SIMULATION AND ANALYSIS OF A FLUID FLOW PROBLEM 9 hours

Basic Navier-stokes equation for laminar and turbulent flow, Geometry, Material Properties, boundary Conditions, turbulence models, Solution Options, Results, and Postprocessing, Case Studies: Any two

UNIT III SIMULATION AND ANALYSIS OF A THERMAL PROBLEM 9 hours

Basics Steady State Heat Transfer, Geometry, Material Properties, Thermal Boundary Conditions, Solution Options, Results, and Postprocessing, Case Studies: Any two

UNIT IV SIMULATION AND STRUCTURAL ANALYSIS 9 hours

Basics of Static Structural Analysis, Geometry, Material Properties, Contact, Analysis Settings, Loads and Supports, Nodal Loads and Supports, Solving Models, Results, and Postprocessing, Case Studies: Any two

UNIT V SIMULATION AND VIBRATION ANALYSIS 9 hours

Basics of Free Vibration, Geometry creations, Contact, Solution Setup, Modal Results, Vibration with Prestress, Case Studies: Any two

B. Tech. Mechanical Engineering

Course outcomes:

The students after completing the course will be able to:

1. Find out the effect of force and impact of stress on the mechanical components.
2. Calculate the deflection occurring on the mechanical components.
3. Get a detailed understanding of the thermal stress creation and its mechanism of spreading in mechanical components.
4. Gain knowledge regarding the mechanism of heat transfer in mechanical components.
5. Find out the vibration effects on mechanical components.

Text books:

1. Matsson, J. E. (2022). *An Introduction to ANSYS Fluent 2022*
2. Anderson, J. D., & Wendt, J. (1995). *Computational fluid dynamics* (Vol. 206, p. 332). New York: McGraw-Hill.
3. Newland, D. E., & Ungar, E. E. (1990). Mechanical vibration analysis and computation.
4. Jaluria, Yogesh. *Computational heat transfer*. Routledge, 2017.
5. Hibbeler, R. C., & Tan, K. H. (2006). *Structural analysis* (pp. 6-4). Upper Saddle River: Pearson Prentice Hall.

References:

1. Andronov, A. A., Vitt, A. A., & Khaikin, S. E. (1981). Theory of vibration. *Moscow Izdatel Nauka*.
2. Holman, J. P. (1986). *Heat transfer*. McGraw Hill.
3. Leet, K., Uang, C. M., & Gilbert, A. M. (2008). *Fundamentals of structural analysis*. New York, NY, USA:: McGraw-Hill Higher Education.

Mode of Evaluation: Assignments, Internal Mid Tests and External End Examinations