Revised Curriculum Structure
(to be effective from 2018-19 admission batch)

Department: Mechanical Engineering

Curriculum for B.Tech

Under Autonomy (**GR A:** ECE, EE, EIE, BM E ; **GR B:** CSE, IT, M E, CE,FT)

1st Semester								
Sl No	**Course Type**	**Course Code**	**Theory**	**Contact Hours /Week**				**Credit Points**
				L	**T**	**P**	**Total**	
A. THEORY								
1	BS	M 101	Mathematics -I	3	1	0	4	4
2	BS	CH 101/ PH 101	Chemistry (Gr. A) / Physics- I (Gr. B)	3	0	0	3	3
3	ES	EE 101/ EC 101	Basic Electrical Engineering (Gr. A) / Basic Electronics Engineering (Gr. B)	3	0	0	3	3
4	HS	HU 101	English	2	0	0	2	2
Total of Theory							**12**	**12**
B. PRACTICAL								
5	BS	CH 191/ PH191	Chemistry Lab (Gr. A) / Physics- I Lab (Gr. B)	0	0	3	3	1.5
6	ES	EE 191/ EC 191	Basic Electrical Engineering Lab (Gr. A) / Basic Electronics Engineering Lab (Gr. B)	0	0	3	3	1.5
7	ES	ME 191/ ME 192	Engineering Graphics & Design (Gr A) / Workshop/Manufacturing Practices (Gr-B)	0	0	3	3	1.5
8	PROJ	PR 191	PROJECT-IA	0	0	1	1	0.5
9	PROJ	PR 192	PROJECT-IB	0	0	1	1	0.5
C. MANDATORY ACTIVITIES / COURSES								
10	MC	MC 181	Induction Program	0	0	0	0	
Total of Theory, Practical & Mandatory Activities/Courses							**22**	**17.5**

2nd Semester								
Sl No	**Course Type**	**Course Code**	**Theory**	**Credit Hours /Week**				**Credit Points**
				L	**T**	**P**	**Total**	
A. THEORY								
1	BS	M 201	Mathematics -II	3	1	0	4	4
2	BS	CH 201/ PH 201	Chemistry - (Gr. B) / Physics – I (Gr. A)	3	0	0	3	3
3	ES	EE 201/ EC 201	Basic Electrical Engineering (Gr. B) / Basic Electronics Engineering (Gr. A)	3	0	0	3	3
4	ES	CS 201	Programming for Problem Solving	3	0	0	3	3
5	ES	ME 201	Engineering Mechanics	3	0	0	3	3
Total of Theory							**16**	**16**
B. PRACTICAL								
6	ES	CS291	Programming for Problem Solving Lab	0	0	3	3	1.5
7	BS	CH 291/ PH 291	Chemistry Lab (Gr. B) / Physics - I Lab (Gr. A)	0	0	3	3	1.5
8	ES	EE 291/ EC 291	Basic Electrical Engineering Lab (Gr. B) / Basic Electronics Engineering Lab (Gr. A)	0	0	3	3	1.5
9	ES	ME 291/ ME 292	Engineering Graphics & Design (Gr B) / Workshop/Manufacturing Practice (Gr-A)	0	0	3	3	1.5
10	HS	HU 291	Language Lab	0	0	2	2	1
11	PROJ	PR 291	Project-II	0	0	1	1	0.5
12	PROJ*	PR 292	Innovative activities-I	0	0	0	0	0.5
C. MANDATORY ACTIVITIES / COURSES								
13	MC	MC 281	NSS/ Physical Activities/Meditation & Yoga/Photography/ Nature Club	0	0	0	3	
Total of Theory, Practical & Mandatory Activities/Courses							**34**	**24**

***** Inter/ Intra Institutional Activities viz; Training with higher Institutions; Soft skill training organized by Training and Placement Cell of the respective institutions; contribution at incubation/ innovation
/entrepreneurship cell of the institute; participation in conferences/workshops/competitions etc.; Learning at Departmental Lab/ Tinkering Lab/ Institutional workshop; Working in all the activities of Institute's Innovation Council for eg: IPR workshop/Leadership Talks/ Idea/ Design/ Innovation/ Business Completion/ Technical Expos etc. (evaluation by Programme Head through certification)

Innovative activities to be evaluated by the Programme Head/ Event coordinator based on the viva voce and submission of necessary certificates as evidence of activities.

3rd Semester								
SL No	Course Type	Course Code	Theory	Contact Hours/Week				Credit Points
				L	T	P	Total	
A. THEORY								
1	PC	ME 301	Engineering Thermodynamics	3	0	0	3	3
2	PC	ME 302	Strength of Material	3	0	0	3	3
3	PC	ME 303	Fluid Mechanics	3	0	0	3	3
4	PC	ME 304	Materials Engineering	3	0	0	3	3
5	BS	M 301	Mathematics -III	3	1	0	4	4
6	BS	PH(ME)301	Physics - II	3	0	0	3	3
Total of Theory							**19**	**19**
B. PRACTICAL								
7	PC	ME 391	Material Testing Lab	0	0	3	3	1.5
8	PC	ME 392	Machine Drawing	0	0	3	3	1.5
9	BS	PH(ME)391	Physics – II Lab	0	0	2	2	1
10	PROJ	PR 391	Project-III	0	0	2	2	1
11	PROJ*	PR 392	Innovative activities-II	0	0	0	1	0.5
C. MANDATORY ACTIVITIES / COURSES								
12	MC	MC 301	Environmental Science	3	0	0	3	
Total of Theory, Practical & Mandatory Activities/Courses							**32**	**24.5**

*****Students may choose either to work on participation in all the activities of Institute's Innovation Council for eg: IPR workshop/Leadership Talks/ Idea/Design/Innovation/Business Completion/ Technical Expos etc.

Innovative activities to be evaluated by the Programme Head/ Event coordinator based on the viva voce and submission of necessary certificates as evidence of activities.

4th Semester								
Sl No	**Course Type**	**Course Code**	**Theory**	**Contact Hours /Week**				**Credit Points**
				L	**T**	**P**	**Total**	
A. THEORY								
1	PC	ME401	Fluid Machinery	3	0	0	3	3
2	PC	ME402	Manufacturing Process	3	0	0	3	3
3	PC	ME403	Kinematics &Dynamics of Machines	3	0	0	3	3
4	PC	ME404	Applied Thermodynamics	3	0	0	3	3
5	ES	ME405	Data Structure and algorithm	2	0	0	2	2
6	ES	M(ME)401	Numerical Methods	2	0	0	2	2
Total of Theory							**16**	**16**
B. PRACTICAL								
7	PC	ME491	Fluid Mechanics & Fluid Machines Lab	0	0	3	3	1.5
8	PC	ME492	Manufacturing Process Lab	0	0	3	3	1.5
9	PC	ME493	Dynamics of Machine Lab	0	0	3	3	1.5
10	PROJ	PR 491	Project-IV	0	0	2	2	1
11	PROJ*	PR 492	Innovative activities-III	0	0	0	0	0.5
C. MANDATORY ACTIVITIES / COURSES								
12	MC	MC401	Constitution of India	3	0	0	3	
Total of Theory, Practical & Mandatory Activities/Courses							**30**	**22**

*Students may choose either to work on participation in all the activities of Institute's Innovation Council for eg: IPR workshop/ Leadership Talks/ Idea/ Design/ Innovation/ Business Completion/ Technical Expos etc.

Innovative activities to be evaluated by the Programme Head/ Event coordinator based on the viva voce and submission of necessary certificates as evidence of activities.

5th Semester								
Sl No	**Course Type**	**Course Code**	**Theory**	**Contact Hours /Week**				**Credit Points**
				L	**T**	**P**	**Total**	
A. THEORY								
1	PC	ME 501	Heat Transfer	3	0	0	3	3
2	PC	ME 502	Manufacturing Technology	3	0	0	3	3
3	PC	ME 503	Design of Machine Elements	3	0	0	3	3
4	PC	ME 504	Refrigeration and Air Conditioning	3	0	0	3	3
5	PE	ME 505	A. Composite Materials B. Solid Mechanics C. Computer Aided Design	3	0	0	3	3
Total of Theory							**15**	**15**
B. PRACTICAL								
6	PC	ME591	Heat Transfer and Refrigeration Lab	0	0	3	3	1.5
7	PC	ME592	Manufacturing Technology Lab	0	0	3	3	1.5
8	PROJ	PR 591	Project-V	0	0	2	2	1
9	PROJ*	PR 592	Innovative activities-IV	0	0	0	0	0.5
C. MANDATORY ACTIVITIES / COURSES								
10	MC	MC 581	Technical Seminar Presentation	0	0	3	3	
Total of Theory, Practical & Mandatory Activities/Courses							**26**	**19.5**

***** Students may choose either to work on participation in Hackathons etc. Development of new product/ Business Plan/ registration of start-up.

Students may choose to undergo Internship/Innovation/Entrepreneurship related activities. Students may choose either to work on innovation or entrepreneurial activities resulting in start-up or undergo internship with industry/NGO's/Government organizations/Micro/Small/ Medium enterprises to make themselves ready for the industry/ Long Term goals under rural Internship. (Duration 4-6 weeks)

Innovative activities to be evaluated by the Programme Head/Event coordinator based on the viva voce and submission of necessary certificates as evidence of activities.

6th Semester								
Sl No	**Course Type**	**Course Code**	**Theory**	**Contact Hours /Week**				**Credit Points**
				L	**T**	**P**	**Total**	
A. THEORY								
1	PC	ME601	Internal Combustion Engine and Gas Turbine	3	0	0	3	3
2	PE	ME602	A. Power Plant Engineering B. Finite Element Analysis C. Total Quality Management	3	0	0	3	3
3	OE	ME 603	A. Electrical Machines B. DataBase Management System C. Internet Of Things	3	0	0	3	3
4	OE	ME 604	A. Mechatronics Systems B. Computational Fluid Dynamics C. Fluid Power control	3	0	0	3	3
5	HS	HU601	Values & Ethics in Profession	2	0	0	2	2
Total of Theory							**14**	**14**
B. PRACTICAL								
6	PC	ME 691	Internal Combustion Engine Lab	0	0	3	3	1.5
7	OE	ME692	A. Mechatronics Systems Lab B. Computational Fluid Dynamics Lab C. Fluid Power Control Lab	0	0	3	3	1
7	PROJ	PR 691	Project-VI**	0	0	2	2	1
8	PROJ*	PR 692	Innovative activities-V	0	0	0	0	0.5
C. MANDATORY ACTIVITIES / COURSES								
10	MC	MC 681	Group Discussion	0	0	3	3	
Total of Theory, Practical & Mandatory Activities/Courses							**22**	**18**

*Students may choose either to work on participation in all the activities of Institute's Innovation Council for eg: IPR workshop/ Leadership Talks/ Idea/ Design/ Innovation/ Business Completion/ Technical Expos etc.

** Design and Modelling of 3D Machine Elements using AUTOCAD/SOLIDWORKS/CATIA/CREO

Innovative activities to be evaluated by the Programme Head/ Event coordinator based on the viva voce and submission of necessary certificates as evidence of activities.

7th Semester								
Sl No	**Course Type**	**Course Code**	**Theory**	**Contact Hours/Week**				**Credit Points**
				L	**T**	**P**	**Total**	
A. THEORY								
1	HS	HU 704	Principle of Management	2	0	0	2	2
2	PC	ME 701	Advanced Manufacturing Technology	3	0	0	3	3
3	PE	ME 702	A. Materials Handling B. Design Of Transmission System C. Nuclear Power Generation & Supply	3	0	0	3	3
4	PE	ME 703	A. Renewable Energy System B. Tribology C. Reliability & Maintenance	3	0	0	3	3
5	OE	ME 704	A. Operation Research B. Robotics C. Biomechanics & Biomaterials	3	0	0	3	3
Total of Theory							**14**	**14**
B. PRACTICAL								
6	PC	ME 791	Advanced Manufacturing Lab	0	0	3	3	1.5
7	PROJ	PR 791	Project-VII (Part 1)	0	0	6	6	3
8	PROJ	PR 792	Minor Project**	0	0	3	3	1.5
9	PROJ*	PR 793	Innovative activities-VI	0	0	0	0	0.5
C. MANDATORY ACTIVITIES / COURSES								
10	MC	MC 781	Behavioural and Interpersonal Skills	0	0	3	3	
Total of Theory, Practical & Mandatory Activities/Courses							**29**	**20.5**

*Students may choose either to work on participation in Hackathons etc. Development of new product/ Business Plan/ registration of start-up.

Students may choose to undergo Internship / Innovation / Entrepreneurship related activities. Students may choose either to work on innovation or entrepreneurial activities resulting in start-up or undergo internship with industry/ NGO's/ Government organizations/ Micro/ Small/ Medium enterprises to make themselves ready for the industry/ Long Term goals under rural Internship. (Duration 4-6 weeks)

Innovative activities to be evaluated by the Programme Head / Event Coordinator based on the viva voce and submission of necessary certificates as evidence of activities.

** PR792 - Part Modelling, Assembly, Simulation of Mechanical Systems based on Structural and Thermal Hydraulic analysis using ANSYS/SOLIDWORKS/CATIA/NASTRAN/SOLIDEDGE or similar software

8th Semester								
Sl No	**Course Type**	**Course Code**	**Theory**	**Contact Hours /Week**				**Credit Points**
				L	**T**	**P**	**Total**	
A. THEORY								
1	HS	HU 803	Industrial & Financial Management	2	0	0	2	2
2	PE	ME 801	A. Automobile Engineering B. Turbomachinery C. Gas Dynamics & Jet Propulsion	3	0	0	3	3
3	OE	ME802	A. 3D Printing and Design B. Nanotechnology C. Industrial Instrumentation D. Energy Conservation & Management	3	0	0	3	3
4	OE	ME803	A. Artificial Intelligence B. Safety & Occupational Health C. Microprocessor in Automation D. Introduction to Electric Vehicles	3	0	0	3	3
			Total of Theory				**11**	**11**
B. PRACTICAL								
5	PROJ	PR 891	Project-VIII (Part II)	0	0	0	6	3
C. MANDATORY ACTIVITIES / COURSES								
6	MC	MC 801	Essence of Indian Knowledge Tradition	3	0	0	3	
Total of Theory, Practical & Mandatory Activities/Courses							**20**	**14**

Mandatory Credit Point=160

Total Credit = (17.5+24+24.5+22+19.5+18+20.5+14) = 160

For Honors additional 20 Credit Point is to be earned (1st Sem to 8th Sem) through MOOCs courses. All the Certificates received by the students across all semester for MOOCs Courses from approved organization (Appendix A) is to be submitted to COE office prior to 8th Semester Examination.

Category	Credit Allocation As per Autonomy	Credit Allocation As per AICTE
Humanities, Social Sciences & Management Courses	9	12*
Basic Sciences Courses	25	25*
Engineering Sciences Courses including Workshop, Drawing, Basics of Electrical/Mechanical/Computer etc	23.5	24*
Professional Core Courses	55	48*
Professional Elective Courses relevant to chosen specialization/Branch	15	18*
Open Elective Courses-Electives from other technical and / or emerging subjects	16.5	18*
Project work, seminar and internship in industry or elsewhere	16	15*
Mandatory Courses [Environmental Science, Induction Training, Indian Constitution, Essence of Indian Knowledge Tradition and other Co & extracurricular activities		Non-credited
Total	160	160

Credit Distribution Ratio:

* Minor Variation is allowed as per need of the respective disciplines.

Subject Distribution in Different Category:

A. Humanities, Social Sciences & Management Courses (HS)							
Sl No	**Paper Code**	**Theory**	**Contact Hours /Week**				**Credit Points**
			L	**T**	**P**	**Total**	
1	HU 101	English	2	0	0	2	2
2	HU 291	Language Lab	0	0	2	2	1
3	HU 601	Values & Ethics in Profession	2	0	0	2	2
4	HU 704	Principle Of Management	2	0	0	2	2
5	HU 803	Industrial & Financial Management	2	0	0	2	2
		Total Credit:					**9**
B. Basic Sciences Courses (BS)							
1	M 101	Mathematics -I	3	1	0	4	4
2	CH	Chemistry	3	0	0	3	3
3	CH	Chemistry Lab	0	0	3	3	1.5
4	M 201	Mathematics -II	3	1	0	4	4
5	PH	Physics – I	3	0	0	3	3
6	PH	Physics I Lab	0	0	3	3	1.5
7	M 301	Mathematics-III	3	1	0	4	4
8	PH(ME) 301	Physics II	3	0	0	3	3
9	PH(ME) 391	Physics II Lab	0	0	2	2	1
		Total Credit:					**25**

C. Engineering Sciences Courses including Workshop, Drawing, Basics of Electrical/Mechanical/Computer etc (ES)							
1	EC 101	Basic Electronics Engineering	3	0	0	3	3
2	EC 191	Basic Electronics Engineering Lab	0	0	3	3	1.5
3	ME 192	Workshop or Manufacturing Practice	0	0	3	3	1.5
4	EE 201	Basic Electrical Engineering	3	0	0	3	3
5	CS 201	Programming for Problem Solving	3	0	0	3	3
6	ME 201	Engineering Mechanics	3	0	0	3	3
7	CS 291	Programming for Problem Solving Lab	0	0	3	3	1.5
8	EE 291	Basic Electrical Engineering Lab	0	0	3	3	1.5
9	ME 291	Engineering Graphics & Design	0	0	3	3	1.5
10	ME 405	Data Structure and C++	3	0	0	3	2
11	M(ME)401	Numerical Methods	0	0	2	2	2
		Total Credit:					**23.5**
D. Professional Core Courses (PC)							
1	ME 301	Engineering Thermodynamics	3	0	0	3	3
2	ME 302	Strength of Material	3	0	0	3	3
3	ME 303	Fluid Mechanics	3	0	0	3	3
4	ME 304	Materials Engineering	3	0	0	3	3
5	ME 391	Material Testing Lab	0	0	3	3	1.5
6	ME 392	Machine Drawing	0	0	3	3	1.5
7	ME 401	Fluid Mechinery	3	0	0	3	3
8	ME 402	Manufacturing Processes	3	0	0	3	3
9	ME 403	Kinematics & Dynamics Of Machines	3	0	0	3	3
10	ME 404	Applied Thermodynamics	3	0	0	3	3
11	ME 491	Fluid Mechanics & Fluid Machines Lab	0	0	3	3	1.5
12	ME 492	Manufacturing Process Lab	0	0	3	3	1.5
13	ME 493	Dynamics Of Machines Lab	0	0	3	3	1.5
14	ME 501	Heat Transfer	3	0	0	3	3
15	ME 502	Design Of Machine Elements	3	0	0	3	3
16	ME503	Manufacturing Technology	3	0	0	3	3
17	ME 504	Refrigeration and Air Conditioning	3	0	0	3	3
18	ME 591	Heat Transfer and Refrigeration Lab	0	0	3	3	1.5
19	ME 592	Manufacturing Technology Lab	0	0	3	3	1.5
20	ME 601	Internal Combustion Engine and Gas Turbine	3	0	0	3	3
21	ME 691	Internal Combustion Engine Lab	0	0	3	3	1.5
22	ME 701	Advanced Manufacturing Technology	3	0	0	3	3
23	ME 791	CNC Machine & Robotics Lab	0	0	3	3	1
		Total Credit:					**55**
E. Professional Elective Courses relevant to chosen specialization/Branch (PE)							
1	ME 505	A. Composite Materials B. Solid Mechanics C. Computer Aided Design	3	0	0	3	3
2	ME 602	A. Power Plant Engineering	3	0	0	3	3

		B. Finite Element Analysis					
		C. Total Quality Management					

3	ME 702	A. Materials Handling	3	0	0	3	3
		B. Design Of Transmission System					
		C. Nuclear Power Generation & Supply					
4	ME 703	A. Renewable Energy System	3	0	0	3	3
		B. Tribology					
		C. Reliability & Maintenance					
5	ME 801	A. Automobile Engineering	3	0	0	3	3
		B. Turbomachinery					
		C. Gas Dynamics & Jet Propulsion					
		Total Credit:					**15**
F. Open Elective Courses-Electives from other technical and / or emerging subjects (OE):							
1	ME 603	A. Electrical Machines	3	0	0	3	3
		B. Data Base Management System					
		C. Internet Of Things					
2	ME604	A. Mechatronics Systems	3	0	0	3	3
		B. Computational Fluid Dynamics					
		C. Fluid Power control					
3	ME692	A. Mechatronics Systems Lab	0	0	3	3	1.5
		B. Computational Fluid Dynamics Lab					
		C. Fluid Power control Lab					
4	ME 704	A. Operation Research	3	0	0	3	3
		B. Robotics					
		C. Biomechanics & Biomaterials					
5	ME 802	A. Robotics: Mechanics and Control	3	0	0	3	3
		B. 3D Printing and Design					
		C. Turbulent Combustion: Theory & Modeling					
6	ME803	A. Microprocessor in Automation	3	0	0	3	3
		B. Safety & Occupational Health					
		C. Fundamentals of Artificial Intelligence					
		Total Credit:					**16.5**
G. Project work, seminar and internship in industry or elsewhere (PW)							

1	PR 191	Project-IA	0	0	1	1	0.5
2	PR 192	Project-IB	0	0	1	1	0.5
3	PR 291	Project-II	0	0	1	1	0.5
4	PR 292	Innovative activities-I	0	0	0	0	0.5
5	PR 391	Project-III	0	0	2	2	1
6	PR 392	Innovative activities-II	0	0	0	1	0.5
7	PR 491	Project-IV	0	0	2	2	1
8	PR 492	Innovative activities-III	0	0	0	0	0.5
9	PR 591	Project-V	0	0	2	2	1
10	PR 592	Innovative activities-IV	0	0	0	0	0.5
11	PR 691	Project-VI	0	0	2	2	1
12	PR 692	Innovative activities-V	0	0	0	0	0.5
13	PR 791	Project-VIIA	0	0	0	3	1.5
14	PR 792	Project-VIIB	0	0	0	6	3
15	PR 793	Innovative activities-VI	0	0	0	0	0.5
16	PR 891	Project-VIII	0	0	0	6	3
		Total Credit:					**16**
H. Mandatory Courses [Environmental Science, Induction Training, Indian Constitution, Essence of Indian Knowledge Tradition and other Co & extracurricular activities (MC)							
1	MC181	Induction Program	0	0	6	6	
2	MC 281	NSS/ Physical Activities/Meditation & Yoga/Photography/ Nature Club	0	0	3	3	
3	MC 301	Environmental Science	3	0	0	3	
4	MC 401	Constitution of India	3	0	0	3	
5	MC 581	Technical Seminar Presentation	0	0	3	3	
6	MC 681	Group Discussion	0	0	3	3	
7	MC 781	Behavioural & Interpersonal skills	0	0	3	3	
8	MC 801	Essence of Indian Knowledge Tradition	3	0	0	3	

R18 B

College Name:

STR

Paper Code

Format for Project Work Evaluation

	University Roll No.		
	Name of the Student		
	Title of the Project		
Semester Examination	Project Report (10)		
	Development of Prototype/ Model (20)		
	Power point presentation (15)		
	Viva-Voce (15)		
	Usage of Modern Tool / Technology (10)		
	Innovative-ness (10)		
	Individual contribution (10)		
	Group activity (10)		
	Total (100)		

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Appendix A

MOOCs Courses
For B.Tech Students for AY 2018-19
(1st Semester to 8th Semester)

Total Credit for MOOCs Subjects will be 20.

List of websites which offers online certification Courses

List of Websites which offers online certification courses:

1. Swayam- https://swayam.gov.in/
2. NPTEL- https://onlinecourses.nptel.ac.in/
3. Mooc- http://mooc.org/
4. Edx - https://www.edx.org/
5. Coursera- https://www.coursera.org/
6. Udacity - https://in.udacity.com/
7. Udemy - https://www.udemy.com/
8. Khan academy - https://www.khanacademy.org/
9. Skill sahre - https://www.skillshare.com/
10. Harvard University - https://online-learning.harvard.edu/
11. Ted - https://ed.ted.com/
12. Alison - https://alison.com/
13. Future learn - https://www.futurelearn.com/
14. Web Development - https://digitaldefynd.com/best-free-web-development-courses- tutorials- certification/
15. Digital Marketing - https://digitaldefynd.com/best-free-digital-marketing-certifications/
16. ios app development - https://digitaldefynd.com/best-ios-app- - development-course- tutorial/
17. Open Learn - http://www.open.edu/openlearn/
18. Future Learn - https://www.futurelearn.com/
19. Tuts Plus - https://tutsplus.com/
20. Open Culture - http://www.openculture.com/

For Honors additional 20 Credit Point is to be earned (1st Sem to 8th Sem) through MOOCs courses. All the Certificates received by the students across all semester for MOOCs Courses from approved organization, should be submitted to CoE office prior to 8th Semester Examination.

The distribution of the credit with respect to weeks are as follows: 4 to 7 weeks: 2 Credit
8 to 11 weeks: 3 Credits
12 to 15 weeks: 4 Credits
16 or more than that: 6 Credits

Sl No	MOOC Courses	Applicable Students (Semester wise)
1	Environmental Science & Studies	I/II
2	Engineering Dra wing	I/II
3	Computer Fundamentals	I/II
4	C Programming	I/II
5	Engineering Mechanics	I/II
6	Concepts of Thermodynamics	III/IV

7	La ws of thermodynamics	III/IV
8	Introduction to Fluid Mechanics	III/IV
9	Solid Mechanics	III/IV
10	Material Science and Engineering	III/IV
11	Heat Treatment and Surface Hardening - I	III/IV
12	Theor y Of Mechanism	III/IV
13	Applied Thermodynamics For Engineers	III/IV
14	Kinematics of Mechanisms and Machines	III/IV/V/VI
15	Fluid Dynamics and Turbomachines	V/VI
16	Theor y of Production Processes	IV/V
17	Engineering Metrology	III/IV
18	Rapid Manufacturing	III/IV
19	Principles of Mechanical Measurement	IV/V/VI
20	IC Engines and Gas Turbines	III/IV
21	Advanced Composites	VII/VIII
22	Refrigeration and air-conditioning	V/VI
23	Heat and Mass Transfer	VI/VII
24	Design Practice - II	V/VI
25	Mechanics of Machining	V/VI
26	Introduction to Composites	VII/VIII
27	Steam Power Engineering	V/VI
28	Energy conservation and waste heat recover y	VII/VIII
29	Manufacturing of Composites	VII/VIII
30	Steel Qualit y : Role of Secondary Refining & Continuous Casting	VII/VIII
31	Advanced Fluid Mechanics	V/VI
32	Introduction to Mechanical Vibration	V/VI
33	Programming with MATLAB	III/IV/V/VI
34	Renewable Energy Sources & Its Applications	IV/V/VI/VII
35	Computer numerical control (CNC) of machine tools and processes	VI/VII
36	Fundamentals of Gas Dynamics	V/VI
37	Introduction to Nuclear Engineering	III/IV/V
38	Advanced Manufacturing Processes	VII/VIII
39	Computational Fluid Dynamics	VII/VIII
40	Cr yogenic Engineering	VI/VII
41	Computer Aided Engineering Design	VII/VIII
42	Principles of Vibration Control	VI/VII
43	Rocket Propulsion	VII/VIII
44	Engine Combustion	VI/VII
45	Engineering Fracture Mechanics	VII/VIII
46	Robotics: Advanced Concepts and Analysis	VI/VII/VIII
47	Industrial Engineering	VI/VII/VIII
48	Manufacturing Processes I	VI/VII/VIII
49	Strength of Materials	VI/VII/VIII
50	Fundamentals of Operations Research	VI/VII/VIII

20 credit for Honors, should be earned by the students from the MOOC Basket and any other subjects related to the specific program of the respective departments.

MOOC BASKET FOR MECHANICAL ENGINEERING

51	Project and Production Management	VI/VII/VIII
52	Robotics	VI/VII/VIII
53	Failure Anal ysis and Prevention	VI/VII/VIII
54	Smart Materials and Intelligent System Design	V/VI
55	Introduction to Abrasive Machining and Finishing Processes	VII/VIII
56	Heat Exchangers: Fundamentals and Design Anal ysis	VI/VII
57	Gear and Gear Unit Design : Theor y and Practice	VI/VII
58	Applied Ergonomics	VI/VII
59	Sustainabilit y through Green Manufacturing Systems: An Applied Approach	VI/VII
60	Processing of Pol ymers and Pol ymer Composites	VII/VIII
61	Random vibrations & Failure Anal ysis	VII/VIII
62	Conduction and Convection Heat Transfer	VII/VIII
63	Solar Energy Technology	VII/VIII
64	Finite Element Method	VI/VII
65	Mechanical Measurements and Metrology	V/VI
66	Biomaterials for bone tissue engineering applications	VII/VIII
67	Advances in Corrosion Engineering	VII/VIII

* For Mandatory Additional Requirement (MAR), Student may opt any subject but other than the above listed subjects

MAR:

Appendix B

List of Activity Heads and Sub-Activity Heads along with their capping of the Activity Points that can be earned by the students during the entire B.Tech duration.

Sl. No.	Name of the Activity	Points	Maximu m Points Allowed
1.	MOOCS (SWAYAM/NPTEL/Spoken Tutorial) (per course)	20	40
2.	Tech Fest/Teachers Day/Freshers Welcome		
	Organizer	5	10
	Participants	3	6
5.	Rural Reporting	5	10
6.	Tree Plantation (per tree)	1	10
7.	Participation in Relief Camps	20	40
8.	Participation in Debate/Group Discussion/ Tech quiz	10	20
9.	Publication of Wall magazine in institutional level (magazine/article/internet)	10	20
10.	Publication in News Paper, Magazine & Blogs	10	20
11.	Research Publication (per publication)	15	30
12.	Innovative Projects (other than course curriculum)	30	60
13.	Blood donation	8	16
	Blood donation camp Organization	10	20
15.	Participation in Sports/Games		
	College level	5	10
	University Level	10	20
	District Level	12	24
	State Level	15	30
	National/International Level	20	20
21.	Cultural Programme (Dance, Drama, Elocution, Music etc.)	10	20
22.	Member of Professional Society	10	20
23.	Student Chapter	10	20
24.	Relevant Industry Visit & Report	10	20
25.	Photography activities in different Club (Photography club, Cine Club, Gitisansad)	5	10
26.	Participation in Yoga Camp (Certificate to be submitted)	5	10
27.	Self-Entrepreneurship Programme	20	20
28.	Adventure Sports with Certification	10	20
29.	Training to under privileged/Physically challenged	15	30
30.	Community Service & Allied Activities	10	20

Department: Mechanical Engineering
LIST OF MOOCS COURSES FOR MAR

MOOCs Equivalent (Theory)	**Minimum Duration**	**Suggested MAR Point**
Ethics in Engineering Practice	8weeks	16
Environmental Studies: A Global Perspective	6weeks	12
Introduction To Biology: The Secret of Life	12weeks	20
Engineering Econometrics	12weeks	20
Management in Engineering	8weeks	16
Human Resource Development	12 weeks	20
Organizational Behavior	7 weeks	16
Project Management for Managers	12weeks	20
International Cyber Conflicts	5weeks	10
Fundamentals of Digital Marketing, Social Media, and E- Commerce	6weeks	12
Developing Soft Skills and Personality	8 weeks	16
History of English Language and Literature	12 weeks	20
Interpersonal Skills	8 weeks	16
Soft skills	12 weeks	20
Technical English for engineers	8 weeks	16
Better Spoken English	12 weeks	20
Business English Communication	4 weeks	8
Calculus of One Real Variable	8 weeks	16

Educational leadership	8 weeks	16
Economics of IPR	4 weeks	8
Enhancing Soft Skills and Personality	8 weeks	16
Human Resource Development	12 weeks	20
Indian Philosophy	12 weeks	20
Intellectual Property	12 weeks	20
Introduction on Intellectual Propertyto Engineers and Technologists	8 weeks	16
Literature, Culture and Media	12 weeks	20
Science, Technology and Society	12 weeks	20
Soft Skill Development	8 weeks	16
Speaking Effectively	8 weeks	16
Strategic Performance Management	8 weeks	16
Water, Society and Sustainability	4 weeks	8
Calculus of Several Real Variables	8 weeks	16
Higher Engineering Mathematics	12 weeks	20
Introduction to Abstract and Linear Algebra	8 weeks	16

Note: This is a basic guideline for MAR point. More courses can be taken in consultation with the Department.

Record of Activities for Mandatory Additional Requirement

College Name (College Code):							Department:					
Student Name:		University Roll No:					Registration No:					
Sl No	Activity	Points	Max. Points Allowed	Points Earned								
				Sem1	Sem2	Sem3	Sem4	Sem5	Sem6	Sem7	Sem8	Total
1	*MOOCS (SWAYAM/NPTEL/Spoken Tutorial) per course*											
	For 12 weeks duration	**20**	**40**									
	For 8 weeks duration	**16**										
2	*Tech Fest/Teachers Day/Freshers Welcome*											
	Organizer	**5**	**10**									
	Participants	**3**	**6**									
3	Rural Reporting	**5**	**10**									
4	Tree Plantation and up keeping (per tree)	**1**	**10**									
5	Participation in Relief Camps	**20**	**40**									
6	Participation in Debate/Group Discussion/ Tech quiz	**10**	**20**									
7	*Publication of Wall magazine in institutional level (magazine/article /internet)*											
	Editor	**10**	**20**									
	Writer	**6**	**12**									
8	Publication in News Paper, Magazine & Blogs	**10**	**20**									
9	Research Publication (per publication)	**15**	**30**									
10	Innovative Projects (other than course curriculum)	**30**	**60**									
11	Blood donation	**8**	**16**									
	Blood donation camp Organization	**10**	**20**									

Record of Activities for Mandatory Additional Requirement (Contd.)

Sl No	Activity	Points	Max. Points Allowed	Points Earned								
				Sem1	Sem2	Sem3	Sem4	Sem5	Sem6	Sem7	Sem8	Total
12	*Participation in Sports/Games*											
	College level	**5**	**10**									
	University Level	**10**	**20**									
	District Level	**12**	**24**									
	State Level	**15**	**30**									
	National/International Level	**20**	**20**									
13	Cultural Programme (Dance, Drama, Elocution, Music etc.)	**10**	**20**									
14	Member of Professional Society	**10**	**20**									
15	Student Chapter	**10**	**20**									
16	Relevant Industry Visit & Report	**10**	**20**									
17	Photography activities in different Club(Photography club, Cine Club, Gitisansad)	**5**	**10**									
18	Participation in Yoga Camp (Certificate to be submitted)	**5**	**10**									
19	Self-Entrepreneurship Programme	**20**	**20**									
20	Adventure Sports with Certification	**10**	**20**									
21	Training to under privileged / Differently abled	**15**	**30**									
22	Community Service & Allied Activities	**10**	**20**									
Total Points												
Signature of Mentor												
Signature of HoD												

Department: Mechanical Engineering

Detailed Curriculum & Syllabus
(Effective from 2018-19 admission batch)

Under Autonomy (**GR A:** ECE, EE, EIE, BME; **GR B:** CSE, IT, ME, CE, FT)

1st Semester								
Sl No	**Course Type**	**Course Code**	**Theory**	**Contact Hours /Week**				**Credit Points**
				L	**T**	**P**	**Total**	
A. THEORY								
1	BS	M 101	Mathematics -I	3	1	0	4	4
2	BS	CH 101/ PH 101	Chemistry (Gr. A) / Physics- I (Gr. B)	3	0	0	3	3
3	ES	EE 101/ EC 101	Basic Electrical Engineering (Gr. A) / Basic Electronics Engineering (Gr. B)	3	0	0	3	3
4	HS	HU 101	English	2	0	0	2	2
Total of Theory							**12**	**12**
B. PRACTICAL								
5	BS	CH 191/ PH191	Chemistry Lab (Gr. A) / Physics- I Lab (Gr. B)	0	0	3	3	1.5
6	ES	EE 191/ EC 191	Basic Electrical Engineering Lab (Gr. A) / Basic Electronics Engineering Lab (Gr. B)	0	0	3	3	1.5
7	ES	ME 191/ ME 192	Engineering Graphics & Design (Gr A) / Workshop/Manufacturing Practices (Gr-B)	0	0	3	3	1.5
8	PROJ	PR 191	PROJECT-IA	0	0	1	1	0.5
9	PROJ	PR 192	PROJECT-IB	0	0	1	1	0.5
C. MANDATORY ACTIVITIES / COURSES								
10	MC	MC 181	Induction Program	0	0	0	0	
Total of Theory, Practical & Mandatory Activities/Courses							**22**	**17.5**

Detailed Syllabus- 1st Semester

Course Name: Mathematics-I
Course Code: M 101
Contact: 3:1:0
Total Contact Hours: 48
Credits: 4

Prerequisites:

The students to whom this course will be offered must have the concept of (10+2) standard matrix algebra and calculus.

Course Objectives:

The objective of this course is to disseminate the prospective engineers with techniques in matrix algebra and calculus. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.

Course Outcomes:

CO1	Understand and recall the properties and formulas related to matrix algebra, differential calculus, integral calculus and vector algebra. multivariable calculus, vector calculus and infinite series
CO2	Determine the solutions of the problems related to matrix algebra, differential calculus, multivariable calculus, vector calculus and infinite series.
CO3	Apply the appropriate mathematical tools of matrix algebra, differential calculus, Integral Calculus, multivariable calculus, vector calculus and infinite series for the solutions of the related problems.
CO4	Analyze different engineering problems linked with matrix algebra, differential calculus, Integral Calculus, multivariable calculus, vector calculus,
CO5	Apply different engineering problems linked with matrix algebra, differential calculus, Integral Calculus, multivariable calculus, vector calculus.

Course Content:

Module I: Matrix Algebra (11)

Echelon form and Normal (Canonical) form of a matrix; Inverse and rank of a matrix; Consistency and inconsistency of system of linear equations, Solution of system of linear equations; Eigenvalues and eigenvectors; Diagonalization of matrices; Cayley-Hamilton theorem.

Module II: Differential Calculus and Infinite Series (10)

Rolle's Theorem, Mean value theorems, Taylor's and Maclaurin theorems with remainders; Concept of sequence and series, Tests for convergence of infinite series: Comparison test, D'Alembert's ratio test, Raabe's test, Cauchy's root test, Power series; Taylor's series, Series for exponential, trigonometric and logarithm functions.

Module III: Multivariable Calculus (Differentiation) - I (9)

Function of several variables, Concept of limit, continuity and differentiability; Partial derivatives, Total derivative and its application; Chain rules, Derivatives of implicit functions Euler's theorem on homogeneous function, Jacobian.

Module IV: Multivariable Calculus (Differentiation) - II (7)

Maxima and minima of functions of two variables, Method of Lagrange multipliers; Directional derivatives, Gradient, Divergence, Curl.

Module V: Integral Calculus (11)

Evolutes and involutes; Evaluation of definite integrals and its applications to evaluate surface areas and volumes of revolutions; Improper integrals; Beta and Gamma functions and their properties.

Text Books:

1. Kreyszig, E., Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.

2. Ramana, B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.

3. Veerarajan, T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.

4. Grewal, B.S., Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

5. Bali, N.P. and Goyal, M., A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.

Reference Books:

1. Thomas, G.B. and Finney, R.L., Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.

2. Apostol, M., Calculus, Volumes 1 and 2 (2nd Edition), Wiley Eastern, 1980.

3. Kumaresan, S., Linear Algebra - A Geometric approach, Prentice Hall of India, 2000.

4. Poole, D., Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.

5. Bronson, R., Schaum's Outline of Matrix Operations. 1988.

6. Piskunov, N., Differential and Integral Calculus, Vol. I & Vol. II, Mir Publishers, 1969

CO-PO/PSO Mapping:

PO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO 1	3	3	2	-								2	2	2	2
CO 2	3	3	3	3								2	2	2	2
CO 3	3	3	3	3								2	2	2	2
CO 4	3	3	3	3								2	2	2	2
CO 5	3	3	3	3								2	2	2	2

Course Name: Physics –I
Course Code: PH 101
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Pre requisites: Knowledge of Physics up to 12^{th} standard.

Course Objective:
The aim of courses in Physics is to provide an adequate exposure and develop insight about the basic physics principles along with the possible applications. The acquaintance of basic principles of physics would help engineers to understand the tools and techniques used in the industry and provide the necessary foundations for inculcating innovative approaches. It can also create awareness of the vital role played by science and engineering in the development of new technologies. It also gives necessary exposure to the practical aspects, which is an essential component for learning sciences.

Course Outcomes (COs):

After completion of the course students would be able to

PH101.1	Describe different types of mechanical resonance and its electrical equivalence
PH101.2	Explain basic principles of Laser, Optical fiber and Semiconductor Physics.
PH101.3	Apply superposition principle to explain the phenomena of interference and diffraction
PH101.4	Analyze different crystallographic structures according to their co-ordination number and packing factors
PH101.5	Determine and justify the need of a quantum mechanics as remedy to overcome limitations imposed by classical physics

Course Content:

Module 1: Waves & Oscillations (6L)

Simple Harmonic Motion (only preliminary idea), damped harmonic motion-over damped, critically damped and under damped motion, energy decay, logarithmic decrement, force vibration and resonance (amplitude, velocity resonance), sharpness of resonance, quality factor, related numerical problems. 6L

Module 2: Classical Optics (8L) Interference of light: Huygens's principle, superposition of waves, conditions of sustained interference, Newton's ring (qualitative descriptions of working principles and procedures-no deduction required). Engineering applications, Numerical Problems. 3L

Diffraction of light: Fresnel and Fraunhofer class, Fraunhoffer diffraction of a single slit, multiple slits, intensity distributions, missing order, Rayleigh criterion (no deduction) and resolving power of grating and microscope (no deduction), related numerical problems. 5L

Module 3: Quantum Mechanics-I (8L)

Quantum Theory: Inadequacy of classical physics and its modifications by Planck's quantum hypothesis-qualitative (no deductions), particle concept of electromagnetic wave (example: photoelectric and Compton Effect; no derivation required, origin of modified and unmodified lines), wave particle duality; phase velocity and group velocity; de Broglie hypothesis; Davisson and Germer experiment. 4L

Quantum Mechanics 1: Concept of wave function, physical significance of wave function, probability interpretation; normalization of wave functions; uncertainty principle, relevant numerical problems. 4L

Module 4: Solid State Physics-I (7L)

Crystal Structure: Structure of solids, amorphous and crystalline solids (definition and examples), lattice, basis, unit cell, Fundamental types of lattices –Bravais lattice, simple cubic, fcc and bcc lattices, Miller indices and miller planes, co-ordination number and

atomic packing factor, Bragg's equation, applications, numerical problems. 4L

Semiconductor: Physics of semiconductors, electrons and holes, metal, insulator and semiconductor, intrinsic and extrinsic semiconductor, p-n junction. 3L

Module 5 : Modern Optics-I (7L)

Laser: Concepts of various emission and absorption process, Einstein A and B coefficients and equations, working principle of laser, metastable state, population inversion, condition necessary for active laser action, optical resonator, illustrations of Ruby laser, He-Ne laser, Semiconductor laser, applications of laser. 5L

Fibre optics-Principle and propagation of light in optical fibres- Numerical aperture and Acceptance angle, Numerical problems. 2L

Text Books:

Waves & Oscillations:

1. Sound-N. K. Bajaj (TMH)
2. Advanced Acoustics-D. P. Roy Chowdhury (Chayan Publisher)
3. Principles of Acoustics-B.Ghosh (Sridhar Publisher)
4. A text book of sound-M. Ghosh (S. Chand publishers)
5. A text book of Light- K.G. Mazumder & B.Ghoshs, (Book & Allied Publisher)
6. Physics of Oscillations and Waves- R.P. Singh
7. College Physics Vol. II - A.B. Gupta
8. Vibration, Waves and Acoustics- Chattopadhyay and Rakshit

Classical & Modern Optics:

1. A text book of Light- K.G. Mazumder & B.Ghoshs (Book & Allied Publisher)
2. A text book of Light-Brijlal & Subhramanium, (S. Chand publishers)
3. Modern Optics-A. B. Gupta (Book & Allied Publisher)
4. Optics-Ajay Ghatak (TMH)
5. Optics-Hecht
6. Optics-R. Kar, Books Applied Publishers
7. Physical Optics Möler
8. Optics -F.A. Jenkins and H.E White

Quantum Mechanics-I

1. Introduction to Quantum Mechanics-S. N. Ghoshal (Calcutta Book House)
2. Quantum Mechanics-Bagde and Singh (S. Chand Publishers)
3. Perspective of Quantum Mechanics-S. P. Kuilla (New Central Book Agency)
4. Quantum Mechanics-Binayak Datta Roy (S. Chand Publishers)
5. Quantum Mechanics-Bransden (Pearson Education Ltd.)
6. Perspective of Modern Physics-A. Beiser (TMH)
7. Quantum mechanics -A.K. Ghatak and S Lokenathan
8. Modern Physics -E.E. Anderson
9. Physics Volume 2 -Haliday, Resnick & Krane, Published by Wiley India

Solid State Physics-I:

1. Solid state physics-Puri & Babbar (S. Chand publishers)
2. Materials Science & Engineering-Kakani Kakani
3. Solid state physics- S. O. Pillai
4. Introduction to solid state physics-Kittel (TMH)
5. Solid State Physics and Electronics-A. B. Gupta and Nurul Islam (Book & Allied Publisher)
6. Problem in Solid state physics -S.O. Pillai (a. b.)

Reference Books:

1. Refresher courses in physics (Vol. 1, Vol. 2 & Vol. 3)-C. L. Arora (S. Chand Publishers)
2. Basic Engineering Physics-Amal Chakraborty (Chaya Prakashani Pvt. Ltd.)
3. Perspective & Concept of Modern Physics -Arthur Baiser
4. Principles of engineering physics – Md. N Khan and S Panigrahi.

CO-PO/PSO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	2	3	3									2	2
CO2	2	3	2	3	3									2	2
CO3	2	3	2	3	3									2	2
CO4	2	3	2	3	3									2	2
CO5	2	3	2	3	2									2	2

Course Name: Basic Electronics Engineering
Course Code: EC101
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisites:
Electric current and voltage-D.C and A.C., Complex impedance, conductivity, resistivity, transformer charging and discharging of capacitor, active and passive elements.

Course Objective:
1. To understand the behavior of Conductors, Insulators, and Semiconductors based on energy-band theory and relevant problems.

2. To instill the knowledge of working principles of P-N Junction Diode, Zener diode and analyze their applications in the rectifier, clipper, clamper, regulator etc.
3. To familiarize with the characteristics of Bipolar junction transistor(BJT) under CE, CE, CC mode of operation and its biasing mechanisms.
4. To understand working principles of JFET, MOSFET and perform operations under CG, CS, CD configurations for parametric observation.
5. To determine the parameters due to the effect of feedback in amplifier to ,adder circuit , integrator and differentiator circuit using Operational Amplifier

Course Outcomes:

CO1	Demonstrate and understand the concept of Conductors, Insulators, and Semiconductors based on energy-band theory and analyze relevant problems
CO2	Apply the working principles of P-N Junction Diode, zener diode and analyze their applications in the rectifier, clipper, clamper, regulator etc.
CO3	Analyze characteristics of Bipolar junction transistor(BJT) under CE, CE, CC mode of operation and its biasing therein
CO4	Evaluate the operations of JFET, MOSFET and demonstrate their operations under CG, CS, CD configurations

Course Content:

Module-I: Basics of semiconductor (6L)
Conductors, Insulators, and Semiconductors- crystal structure, Fermi Dirac function, Fermi level, Energy band diagrams, valence band, conduction band, and band gap; intrinsic, and extrinsic (p-type and n-type) semiconductors, position of Fermi level in intrinsic and extrinsic semiconductor, drift and diffusion current – expression only (no derivation) , mass action law , charge neutrality in semiconductor, Einstein relationship in semiconductor , Numerical problems.

Module-II: P-N Junction Diode and its applications (8L)
p-n junction formation and depletion region, energy band diagram of p-n junction at equilibrium and barrier energy, built in potential at p-n junction, energy band diagram and current through p-n junction at forward and reverse bias, Static and Dynamic resistance of Diode, Transition capacitance and diffusion capacitance, V-I characteristics and current expression of diode, temperature dependencies of V-I characteristics of diode, p-n junction breakdown – conditions, avalanche and Zener breakdown, Concept of Junction capacitance, Zener diode and characteristics.

Diode half wave and full wave rectifiers (centre tapped and bridge) circuits and operation ($I_{DC,}$ I_{rms}, $V_{Dc,}$ $V_{rms)}$, ripple factor without filter, efficiency, PIV, TUF; Reduction of ac ripples using filter circuit (Qualitative analysis); Design of diode clipper and clamper circuit - explanation with example, application of Zener diode in regulator circuit. Numerical problems.

Module-III: Bipolar junction transistor (6L)
Concept of "Transistor", Formation of PNP/NPN Transistors, energy band diagram, current conduction mechanism, CE, CB, CC configurations, transistor static characteristics in CE, CB and CC mode, junction biasing condition for active, saturation and cut-off modes, current gain α, β and γ, early effect.
Biasing and bias stability; biasing circuits - fixed bias; voltage divider bias; collector to base bias, D.C. load line and Quiescent point, calculation of stability factors for different biasing circuits.
BJT as an amplifier and as a switch – Graphical analysis; Numerical Problems.

Module-IV: Field effect transistor (6L)
Concept of "field effect", Classification of FETs-JFET, MOSFET, operating principle of JFET. Drain and transfer characteristics of JFET (n-channel and p-channel), CS, CG, CD configurations, Relation between JFET parameters. FET as an amplifier and as a switch– graphical analysis. E-MOSFET (n-channel and p-channel), D-MOSFET (n-channel and p-channel), Numerical Problems.

Module-V: Feedback and Operational Amplifier (8L)
Concept of feedback with block diagram, positive and negative feedback, gain with feedback. Feedback topologies, effect of feedback on input and output impedance, distortion, concept of oscillation and Barkhausen criterion.
Operational amplifier – electrical equivalent circuit, ideal characteristics, non-ideal characteristics of op-amp – offset voltages; bias current; offset current; Slew rate; CMRR and bandwidth, Configuration of inverting and non-inverting amplifier using Op-amp, closed loop voltage gain of inverting and non-inverting amplifier, Concept of virtual ground, Applications op-amp – summing amplifier; differential amplifier; voltage follower; basic differentiator and integrator, Numerical Problems.

Module-VI: Cathode Ray Oscilloscope (2L)
Operating principle of CRO with block diagram, measurement of voltage, frequency and phase.

Text Books :
1.D. Chattopadhyay, P. C. Rakshit, Electronics Fundamentals and Applications, New Age International
2.Millman & Halkias, Integrated Electronics, Tata McGraw Hill.
3.Sedra & Smith, Microelectronics Engineering

Reference Books :
1.John D. Ryder, Electronic Fundamentals and Applications, PHI
2.J.B.Gupta, Basic Electronics, S.K. Kataria.
3.Malvino: Electronic Principle.
4. Boyelstad & Nashelsky: Electronic Devices & Circuit Theory, McGraw Hill, 1976.

CO-PO/PSO mapping:

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	-	-	-	-	-	2	-	-	2
CO2	3	3	2	-	-	-	-	-	2	-	-	2
CO3	3	3	2	-	-	-	-	-	2	-	-	2
CO4	3	3	3	-	-	-	-	-	2	-	-	2
CO5	3	2	3	-	-	-	-	-	2	-	-	2
EC 201	3	3	2	-	-	-	-	-	2	-	-	2

Course Name: English
Course Code: HU101
Contact: 2:0:0
Total Contact Hours: 24
Credits: 2

Prerequisites: The course presupposes a high school level knowledge of English grammar, punctuation, and elementary to intermediate reading and writing skills.

Course Objectives: The basic objectives of this course are to impart professional communication skills in the globalized workplace context, to enable functional competence in reading and writing so as to create industry-ready personnel.

After completion of the course students would be able to

CO1	Understand and communicate in English through exposure to communication skills theory and practice.
CO2	Understand and apply the basic grammatical skills of the English language and develop reading and comprehension skills.
CO3	Understand and know about and apply the basic formats, templates of business and official communication.
CO4	Understand and know about and employ formal communication modes in meetings and reports.
CO5	Understand and know about and use objective and culturally neutral language in interpersonal and business communication.

Course Content:

Module 1: Communication in a Globalized World **4L**

1.1 Definition, Process, Types of Communication
1.2 Verbal and Non-Verbal Communication
1.3 Barriers to Communication
1.4 Workplace Communication

Module 2: Functional Grammar **4L**

2.1Articles, Prepositions and Verbs
2.2 Verb-Subject Agreement
2.3 Voice, Modality and Modifiers
2.4 Direct and Indirect Speech
2.5 Common Errors in English

Module 3: Vocabulary and Reading **6L**

3.1 Word Roots, Prefixes and Suffixes
3.2 Antonyms, Synonyms and one word Substitution
3.3 Reading—Purposes and Skills (Skimming, Scanning & Intensive Reading)
3.4 Reading Comprehension (Fictional and Non-fictional prose)

Module 4: Professional Writing **10L**

4.1Writing Functions: Describing, Defining, Classifying

4.2 Structuring—coherence and clarity
4.3 Business Writing—Letters (Enquiry, Order, Sales, Complaint, Adjustment, Job Application letters), Memos, Notices, Circulars, Agendas and Minutes of Meetings).
4.4 E-mails—types, conventions, jargons and modalities.
4.5 Reports and Proposals
4.6 Précis writing
4.7 Essay writing
4.8 Punctuation and its importance in writing
4.9 Writing for an Audience

Text Books:

1. Ruskin Bond: The Night Train at Deoli OR Khushwant Singh: The Portrait of a Lady
2. Roald Dahl: Lamb to the Slaughter OR Somerset Maugham: The Man with the Scar
3. Anne Frank: The Diary of a Young Girl (Letters of 3rd February 1944, 12th February 1944 and 13th February 1944) OR Jawaharlal Nehru: "How Britain Ruled India" (Glimpses of World History, Chap 112)

Reference Books:

1. Raymond Murphy. English Grammar in Use. 3rd Edn. CUP, 2001.
2. A. J Thomson and A. V. Martinet. A Practical English Grammar Oxford: OUP, 1980.
3. Michael Swan. Practical English Usage. Oxford: OUP, 1980.
4. Simeon Potter. Our Language. Oxford: OUP, 1950.
5. Pickett, Laster and Staples. Technical English: Writing, Reading & Speaking. 8th ed. London: Longman, 2001.
6. Ben Heasley and Liz Hamp-Lyons. Study Writing. Cambridge: CUP, 2006.

CO-PO/PSO Mapping:

COs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO 1							2		3	3		3			
CO 2							2		3	3		3	2	2	2
CO 3							2		3	3		3			
CO 4							2		3	3		3			
CO 5							2		3	3		3			

Course Name: Physics I Lab
Course Code: PH 191
Contact: 0:0:3
Credits: 1.5

Pre requisites: Knowledge of Physics up to 12^{th} standard.

Course Outcomes:

Course Outcomes (COs):

After completion of the course students would be able to

CO1	Demonstrate experiments allied to their theoretical concepts
CO2	Conduct experiments using LASER, Optical fiber, Torsional pendulum.
CO3	Participate as an individual and as a member or leader in groups in laboratory sessions actively.
CO4	Analyze experimental data and graphical representations to communicate effectively in laboratory reports including innovative experiments.
CO5	Develop critical thinking skills to solve real life challenges.

General idea about Measurements and Errors (One Mandatory):

i) Error estimation using Slide calipers/ Screw-gauge/travelling microscope for one experiment.

ii) Proportional error calculation using Carrey Foster Bridge.

Any 6 to be performed from the following experiments

Experiments on Waves & Oscillations:

1. Study of Torsional oscillation of Torsional pendulum & determination of time period using various load of the oscillator.
2. Determination of elastic moduli of different materials (Young's modulus /Rigidity modulus)

Experiments on Classical Optics:

3. Determination of wavelength of light by Newton's ring method.
4. Determination of wavelength of light by Laser diffraction method.

Experiments on Quantum Physics-I:

5. Determination of Planck's constant using photoelectric cell.
6. Verification of Bohr's atomic orbital theory through Frank-Hertz experiment.
7. Determination of Stefan's Constant

Experiments on Solid State Physics-I:

8. Determination of Band gap of a semiconductor

**In addition it is recommended that each student should carry out at least one experiment beyond the syllabus/one experiment as Innovative experiment.

Probable experiments beyond the syllabus:

1. Determination of wavelength of light by Fresnel's bi-prism method (beyond the syllabus).
3. Study of dispersive power of material of a prism.

4. Study of viscosity using Poiseullie's caplillary flow method/using Stoke's law.
5. Measurement of nodal and antinodal points along transmission wire and measurement of wave length.
6. Any other experiment related to the theory

List of Experiments:

General idea about Measurements and Errors (One Mandatory):

i) Error estimation using Slide calipers/ Screw-gauge/travelling microscope for one experiment.
ii) Proportional error calculation using Carrey Foster Bridge.

Any 6 to be performed from the following experiments

Experiments on Waves & Oscillations:
1. Study of Torsional oscillation of Torsional pendulum & determination of time period using various load of the oscillator.
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Experiments on Classical Optics:
3. Determination of wavelength of light by Newton's ring method.
4. Determination of wavelength of light by Laser diffraction method.

Experiments on Quantum Physics-I:
5. Determination of Planck's constant using photoelectric cell.
6. Verification of Bohr's atomic orbital theory through Frank-Hertz experiment.
7. Determination of Stefan's Constant

Experiments on Solid State Physics-I:
8. Determination of Band gap of a semiconductor

In addition it is **recommended that each student should carry out at least one experiment beyond the syllabus/one experiment as Innovative experiment.

Probable experiments beyond the syllabus:
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3. Study of dispersive power of material of a prism.
4. Study of viscosity using Poiseullie's capillary flow method/using Stoke's law.
5. Measurement of nodal and antinodal points along transmission wire and measurement of wave length.
6. Any other experiment related to the theory**.**

CO-PO/PSO Mapping:

COs	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	2	3	2	3	3										
CO2	2	3	2	3	3										
CO3	2	3	2	3	3										
CO4	2	3	2	3	3									2	2
Avg	2	3	2	3	2										

Course Name: Basic Electronics Engineering Lab
Course Code: EC 191
Contact: 0:0:3
Credit: 1.5

Prerequisites: A basic course in electronics and Communication engineering Progresses from the fundamentals of electricity, active and passive components, basic electronics laws like Ohm's law, Ampere's law.

Course Objective:
The objectives of this course are
1. To prepare the students to have a basic knowledge of active and passive components.
2. To build knowledge to distinguish pure and impure DC signals.
3. To grow measuring ability of signals through multi meter and CRO
4. To understand characteristics of proper biasing for BJT and FET.
5. To encourage in developing circuits using diodes, transistors, FETs and OPAMPs.

Course Outcomes:

CO1	Knowledge of Electronic components such as Resistors, Capacitors, Diodes, Transistors measuring equipment like DC power supply, Multimeter, CRO, Signal generator, DC power supply.
CO2	Analyse the characteristics of Junction Diode, Zener Diode, BJT & FET and different types of Rectifier Circuits.
CO3	Determination of input-offset voltage, input bias current and Slew rate, Common- mode Rejection ratio, Bandwidth and Off-set null of OPAMPs.
CO4	Able to know the application of Diode, BJT & OPAMP.

List of Experiments:

1. Familiarization with passive and active electronic components such as Resistors, Inductors, Capacitors, Diodes, Transistors (BJT) and electronic equipment like DC power supplies, millimeters etc.
2. Familiarization with measuring and testing equipment like CRO, Signal generators etc.
3. Study of I-V characteristics of Junction diodes.
4. Study of I-V characteristics of Zener diodes.
5. Study of Half and Full wave rectifiers with Regulation and Ripple factors.
6. Study of I-V characteristics of BJTs.
7. Study of I-V characteristics of Field Effect Transistors.
8. Determination of input-offset voltage, input bias current and Slew rate of OPAMPs.
9. Determination of Common-mode Rejection ratio, Bandwidth and Off-set null of OPAMPs.
10. Study of OPAMP circuits: Inverting and Non-inverting amplifiers, Adders, Integrators and Differentiators.
11. Study of Logic Gates and realization of Boolean functions using Logic Gates.
12. Study of Characteristic curves for CB, CE and CC mode transistors.
13. Innovative Experiment

Text Books:

1.D. Chattopadhyay, P. C. Rakshit, Electronics Fundamentals and Applications, New Age International
2.Millman & Halkias, Integrated Electronics, Tata McGraw Hill.
3.Sedra & Smith, Microelectronics Engineering

Reference Books:

1.John D. Ryder, Electronic Fundamentals and Applications, PHI
2.J.B. Gupta, Basic Electronics, S.K. Kataria.
3.Malvino: Electronic Principle.
4. Boyelstad & Nashelsky: Electronic Devices & Circuit Theory, McGraw Hill, 1976.

CO-PO/PSO Mapping:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
EC191.1	3	2	2	-	-	-	-	-	2	2	-	2	2	2	3
EC191.2	3	3	2	-	-	-	-	-	3	2	-	2	2	2	3
EC191.3	3	3	2	-	-	-	-	-	3	2	-	2	2	2	3

EC191.4	3	3	3	-	-	-	-	-	3	2	-	2	2	2	2
5	3	2	3	-	-	-	-	-	3	2	-	2	2	2	3

Course Name: Workshop/Manufacturing Practices
Course Code: ME 192
Contact: 0:0:3
Credit: 1.5

Prerequisite: Higher Secondary with Mathematics, Physics and Chemistry

Course Objectives:
To understand the basic knowledge of Workshop Practice and Safety. To identify and use of different hand tools and other instruments like Hack Saw, Jack Plane, Chisels etc. and operations like Marking, Cutting etc. To expose students to different types of manufacturing/fabrication processes

Course Outcomes:
CO1: Fabricate components with their own hands.
CO2: Get practical knowledge of the dimensional accuracies and tolerances applicable for different manufacturing processes.
CO3: Produce small devices of their interest for project or research purpose.

Course Content:
(i) Theoretical discussion & videos: (3P)
Detailed contents:
1. Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods
2. Fitting operations & power tools
3. Carpentry
4. Welding (arc welding & gas welding), brazing
5. Electrical & Electronics
6. Metal casting
7. CNC machining, Additive manufacturing
8. Plastic moulding& Glass Cutting.

(ii) Workshop Practice:
Module 1 - Machine shop (6P)

Typical jobs that may be made in this practice module:
i. To make a pin from a mild steel rod in a lathe.
ii. To make rectangular and vee slot in a block of cast iron or mild steel in a shaping and / or milling

machine.

Module 2 - Fitting shop (6P)
Typical jobs that may be made in this practice module:
i. To make a Gauge from MS plate.

Module 3 - Carpentry (6P)
Typical jobs that may be made in this practice module:
i. To make wooden joints and/or a pattern or like.

Module 4 - Welding shop (Arc welding 3P + gas welding 3P) (3P)
Typical jobs that may be made in this practice module:
i. ARC WELDING (3P): To join two thick (approx 5mm) MS plates by manual metal arcwelding.
ii. GAS WELDING (3P): To join two thin mild steel plates or sheets by gas welding.

Module 5 - Electrical & Electronics (3P)
House wiring, soft Soldering

Module 6 – Smithy (3P)
Typical jobs that may be made in this practice module:
i. A simple job of making a square rod from a round bar or like.

For further study (Optional)
Module 7 - Casting
Typical jobs that may be made in this practice module:
i. One/ two green sand moulds to prepare, and a casting be demonstrated.

Module 8 - Plastic moulding & Glass Cutting (3P)
Typical jobs that may be made in this practice module:
i. For plastic moulding, making at least one simple plastic component should be made.
ii. At least one sample shape on glass should be made using laser cutting machine.
Examinations could involve the actual fabrication of simple components, utilizing one or more of the techniques covered above.

Text Books:

1. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements of WorkshopTechnology", Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.
2. Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata McGrawHill House, 2017.

Reference Books:

1. Gowri P., Hariharan and A. Suresh Babu, Manufacturing Technology – I, Pearson Education, 2008.
2. Roy A. Lindberg, "Processes and Materials of Manufacture", 4th edition, Prentice Hall India, 1998.
3. Kalpakjian S. and Steven S. Schmid, Manufacturing Engineering and Technology, 4th edition, Pearson Education India Edition, 2002.
4. Manufacturing Science by A.Ghosh and A.K.Mallick, Wiley Eastern.
5. Principles of Metal Cutting/Principles of Machine Tools by G.C.Sen and A.Bhattacharya, New Central Book Agency, Kolkata.

CO-PO/PSO Mapping:

CO Codes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
ME 191.1	3						2		2	2					
ME 191.2	3						2		2	2					
ME 191.3	3						2		2	2			2		2
ME 191.4	3						2		2	2			2		2
ME 191.5	3	2	2				2		2	2					

Curriculum for B.Tech 2nd Semester

Under Autonomy (**GR A:** ECE, EE, EIE, BME; **GR B:** CSE, IT, ME, CE, FT)

2nd Semester								
Sl No	**Course Type**	**Course Code**	**Theory**	**Credit Hours /Week**				**Credit Points**
				L	**T**	**P**	**Total**	
A. THEORY								
1	BS	M 201	Mathematics -II	3	1	0	4	4
2	BS	CH 201/ PH 201	Chemistry - (Gr. B) / Physics – I (Gr. A)	3	0	0	3	3
3	ES	EE 201/ ECEC 201	Basic Electrical Engineering (Gr. B) / Basic Electronics Engineering (Gr. A)	3	0	0	3	3
4	ES	CS 201	Programming for Problem Solving	3	0	0	3	3
5	ES	ME 201	Engineering Mechanics	3	0	0	3	3
Total of Theory							**16**	**16**
B. PRACTICAL								
6	ES	CS291	Programming for Problem Solving Lab	0	0	3	3	1.5
7	BS	CH 291/ PH 291	Chemistry Lab (Gr. B) / Physics - I Lab (Gr. A)	0	0	3	3	1.5
8	ES	EE 291/ EC 291	Basic Electrical Engineering Lab (Gr. B) / Basic Electronics Engineering Lab (Gr. A)	0	0	3	3	1.5
9	ES	ME 291/ ME 292	Engineering Graphics & Design (Gr B) / Workshop/Manufacturing Practice (Gr-A)	0	0	3	3	1.5
10	HS	HU 291	Language Lab	0	0	2	2	1
11	PROJ	PR 291	Project-II	0	0	1	1	0.5
12	PROJ*	PR 292	Innovative activities-I	0	0	0	0	0.5
C. MANDATORY ACTIVITIES / COURSES								
13	MC	MC 281	NSS/ Physical Activities/Meditation & Yoga/Photography/ Nature Club	0	0	0	3	
Total of Theory, Practical & Mandatory Activities/Courses							**34**	**24**

* Inter/ Intra Institutional Activities viz; Training with higher Institutions; Soft skill training organized by Training and Placement Cell of the respective institutions; contribution at incubation/ innovation /entrepreneurship cell of the institute; participation in conferences/ workshops/ competitions etc.; Learning at Departmental Lab/ Tinkering Lab/ Institutional workshop; Working in all the activities of Institute's Innovation

Council for eg: IPR workshop/Leadership Talks/ Idea/ Design/ Innovation/ Business Completion/ Technical Expos etc. (evaluation by Programme Head through certification)

Innovative activities to be evaluated by the Programme Head/ Event coordinator based on the viva voce and submission of necessary certificates as evidence of activities.

Detailed Syllabus- 2nd Semester

Course Name: Mathematics - II
Course Code: M 201
Contact: 3:1:0
Total Contact Hours: 48
Credit: 4

Prerequisites: The students to whom this course will be offered must have the concept of (10+2) standard calculus.

Course Objectives: The objective of this course is to disseminate the prospective engineers with techniques in multivariable calculus, ordinary differential equations and Laplace transform. It aims to equip the students with concepts and tools at an intermediate to advanced level of mathematics and applications that they would find useful in their disciplines.

Course Outcomes:
Course outcomes:

CO1	Determine and recall the properties and formula related to Ordinary differential equations, Basic Graph Theory and Laplace transform.
CO2	Determine the solutions of the problems related to Ordinary differential equations,Basic Graph Theory and Laplace transform.
CO3	Apply appropriate mathematical tools of Ordinary differential equations, Basic Graph Theory and Laplace transform.
CO4	Analyze Engineering problems on Ordinary Differential Equations, Basic Graph Theory and Laplace transform.
CO5	Apply engineering solutions by using Ordinary differential equations,Basic Graph Theory and Laplace transform.

Course Content:

Module I: Multivariable Calculus (Integration): (12 L)

Double integration, Change of order of integration in double integrals, Triple integrals, vector line integrals, scalar surface integrals, vector surface integrals, Green's theorem, Gauss divergence theorem and Stokes' theorem.

Module II: First Order Ordinary Differential Equations: (10 L)

Solution of first order and first degree ODE: Exact ODE, Rules for finding Integrating factors, Linear ODE, Bernoulli's equation, Solution of first order and higher degree ODE: solvable for pp, solvable for yy solvable for xx and Clairaut's equation.

Module III: Second Order Ordinary Differential Equations: (12 L)

Solution of second order ODE with constant coefficients: C.F. & P.I., Method of variation of parameters, Cauchy-Euler equations, Reduction of 2nd order ODE to a pair of first order ODEs, Solution of simultaneous linear ODEs.

Module IV: Laplace Transform: (14L)

Definition and existence of LT, LT of elementary functions, First and second shifting properties, Change of scale property, LT of $t\,f\,(t)t\,f\,(t)$, LT of $\frac{f\,(t)f\,(t)}{t\quad t}$, LT of derivatives of f (t), LT of $\int f(t)dt$ $\int f(t)dt$, Evaluation of improper integrals using LT, LT of periodic and step functions, Inverse LT: Definition and its properties, Convolution theorem (statement only) and its application to the evaluation of inverse LT, Solution of linear ODE with constant coefficients (initial value problem) using LT.

Text Books:

1. Kreyszig, E., Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. Ramana, B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
3. Veerarajan, T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
4. Grewal, B.S., Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.
5. Bali, N.P. and Goyal, M., A textbook of Engineering Mathematics, Laxmi Publications, Reprint, 2008.

Reference Books:

1. Thomas, G.B. and Finney, R.L., Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
2. Boyce, W. E. and DiPrima, R. C., Elementary Differential Equations and Boundary Value Problems, 9th Edn., Wiley India, 2009.
3. Ross, S. L., Differential Equations, 3rd Ed., Wiley India, 1984.
4. Piskunov, N., Differential and Integral Calculus, Vol. I & Vol. II, Mir Publishers, 1969.
5. Coddington, E. A., An Introduction to Ordinary Differential Equations, Prentice Hall, India, 1995.

CO-PO/PSO Mapping:

CO codes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
M201. 1	3	3	2	-								2			
M201. 2	3	3	3	3								2			
M201. 3	3	3	3	3								2	2	2	2
M201. 4	3	3	3	3								2	2	2	2
M201. 5	3	3	3	3								2	2	2	2

Course Name: Chemistry
Course Code: CH201
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Pre requisites: Knowledge of Chemistry up to 12^{th} standard.

Course Objective:

The concepts developed in this course will aid in quantification of several concepts in chemistry that have been introduced at the 10+2 levels in schools. Technology is being increasingly based on the electronic, atomic and molecular level modifications.

Course Outcomes:

CO1: Able to describe the fundamental properties of atoms & molecules, atomic structure and the periodicity of elements in the periodic table

CO2: Able to apply fundamental concepts of thermodynamics in different engineering applications.

CO3: Able to apply the knowledge of water quality parameters, corrosion control & polymers to different industries.

CO4: Able to determine the structure of organic molecules using different spectroscopic techniques.

CO5: Capable to evaluate theoretical and practical aspects relating to the transfer of the production of chemical products from laboratories to the industrial scale, in accordance with environmental considerations.

Course Content:

Module I: Inorganic Chemistry (9 L)

(i) Atomic structure (5 L)

Bohr's theory to hydrogen-like atoms and ions; spectrum of hydrogen atom. Quantum numbers, Introduction to the concept of atomic orbitals, diagrams of s, p and d orbitals, Pauli's exclusion principle, Hund's rule, exchange energy, Aufbau principle and its limitation, introduction to Schrodinger equation.

(ii) Periodic properties (4 L)

Modern Periodic table, group trends and periodic trends in physical properties: electron affinity, electronegativity, polarizability, oxidation states, effective nuclear charges, penetration of orbitals, variations of s, p and d orbital energies of atoms.

Module II: Physical Chemistry (8 L)

(i) **Use of free energy in chemical equilibria (6 L)**

Thermodynamic functions: internal energy, enthalpy, entropy and free energy. 2^{nd} Law of Thermodynamics, Estimations of entropy and free energies, Free energy and emf, Cell potentials, the Nernst equation and applications.

(ii) **Real Gases (2 L)**

Reason for deviation of real gases from ideal behavior, Equations of state of real gases, Vander Waals' equation, pressure & volume correction, validity, critical state of gas.

Module III: Organic Chemistry (8 L)

(i) **Stereochemistry (4 L)**

Representations of 3 dimensional structures, Chirality, optical activity, isomerism, structural isomerism, stereoisomers, enantiomers, diastereomers, configurations (D,L & cis trans), racemisation.

(ii) **Organic reactions (4L)**

Concepts of inductive effect, resonance, hyperconjugation, introduction to reactions involving substitution, addition, elimination, oxidation (Baeyer villiger oxidation), reduction (Clemmensen reduction, Wolff-Kishner reduction)

Module IV: Industrial Chemistry 8L

(i) **Water (2 L):** Hardness, alkalinity, numerical
(ii) **Corrosion. (2 L):** Types of corrosion: wet & dry, preventive measures
(iii) **Polymers (3 L):** Classification of polymers, conducting polymers, biodegradable polymers
(iv) **Synthesis of a commonly used drug molecule. (1 L):** Paracetamol, Aspirin

Module V: Spectroscopic techniques in Chemistry (3L)

Electromagnetic radiation, Principles of spectroscopy, spectrophotometer, infrared spectroscopy, fingerprint region, functional group region, UV-VIS spectroscopy, ^{1}H Nuclear magnetic resonance spectroscopy, chemical shift

Text Books

(i) A Text Book of Organic Chemistry, Arun Bahl & Arun Bahl
(ii) General & Inorganic Chemistry, P.K. Dutt
(iii) General & Inorganic Chemistry, Vol I, R.P. Sarkar
(iv) Physical Chemistry, P.C. Rakshit

Reference Books

(v) Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane (iii)Fundamentals of Molecular Spectroscopy, by C. N. Banwell
(iv) Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S.

Krishnan
(v) Physical Chemistry, by P. W. Atkins
(vi) Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore, 5th Edition
http://bcs.whfreeman.com/vollhardtschore5e/default.asp

CO-PO/PSO Mapping:

CO codes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CH201.1	**3**	**2**	**2**	**2**								**2**			
CH201.2	**3**	**3**	**3**	**3**								**2**			
CH201.3	**3**	**3**	**2**	**2**								**2**			
CH201.4	**3**	**2**	**3**	**2**								**2**			
CH201.5	**3**	**3**	**3**	**3**								**2**		2	2

Course Name: Basic Electrical Engineering
Course Code: EE201
Contact: 3:0:0
Total Contact hours: 36
Credits: 3

Prerequisites:
- Basic 12th standard Physics and Mathematics.
- Concept of components of electric circuits.

Course Objective:
To introduce the students to basic principles of DC and AC circuits, Electrical Machines and Electrical Systems.

Course Outcome: After completion of this course student will be able to

EE201.1:	Understand the behavior of any electrical and magnetic circuits.
EE201.2:	Formulate and solve complex AC, DC circuits.
EE201.3:	Identify the type of electrical machine used for that particular application.

Course contents:

Module I: DC Circuits (9L)
Definition of electric circuit, linear circuit, non-linear circuit, bilateral circuit, unilateral circuit, Dependent source, node, branch, active and passive elements, Kirchhoff's laws, Source equivalence and conversion, Network Theorems - Superposition Theorem, Thevenin's Theorem, Norton Theorem, Maximum Power Transfer Theorem, Star-Delta Conversions.

Module II: AC Fundamentals (9L)
Sinusoidal quantities, Average and RMS values, peak factor, Form factor, Phase and Phase difference, concept of phasor diagram, V-I Relationship in R, L, C circuit, Combination R-L-C in series and parallel circuits with phasor diagrams, impedance and admittance, impedance triangle and power triangle, Power factor, concept of resonance, Power in AC circuit, simple problems (series and parallel circuit only), Three-phase balanced circuits, Concept of three-phase power measurement.

Module III: Single-Phase Transformer (5L)
Brief idea on constructional parts, classifications, working principle. Problems on EMF equation. Phasor diagram, Equivalent circuit.

Module IV: Electrical Rotating Machines (8L)
a)DC Machines (4L)
Brief idea on constructional features, classifications, working principle of both motor and generator. Simple problems on Voltage equation.

b) Three-Phase Induction Motor (4L)
Basic concept of three phase circuit and production of rotating magnetic field. Working principle of three-phase induction motor and torque-speed characteristics (concept only). No numerical problem.

Module V: General Structure of Electrical Power System (1L)
Power generation to distribution through overhead lines and underground cables with single line diagram.

Module VI: Electrical Installations (4L)
Earthing of Electrical Equipment, ideas of basic components- MCB, MCCB, ELCB, SFU, Megger.

Text books:
1. D. P. Kothari & I. J. Nagrath, Basic Electrical Engineering, TMH.
2. V. Mittle & Arvind Mittal, Basic Electrical Engineering, TMH.
3. Ashfaq Hussain, Basic Electrical Engineering, S. Chand Publication.
4. Chakrabarti,Nath & Chanda, Basic Electrical Engineering, TMH.
5. C.L. Wadhwa, Basic Electrical Engineering, Pearson Education.

Reference books:
1. E. Hughes, "Electrical and Electronics Technology", Pearson, 2010.
2. V. D. Toro, "Electrical Engineering Fundamentals", Printice Hall India, 1989.

CO-PO/PSO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PS O1	PS O2	
EE 101. 1	3	3	3			3			3		2	3	2	2	
EE 101. 2	3	3	2			2			3		1	3	1	2	
EE 101. 3	3	3	3			1			3		1	3	3	3	

Course Name: Programming for Problem Solving
Course Code: CS 201
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisites: Number system, Boolean Algebra

Course Outcomes:

CO1	Understand and differentiate among different programming languages for problem solving.
CO2	Describe the way of execution and debug programs in C language.
CO3	Define, select, and compare data types, loops, functions to solve mathematical and scientific problem.
CO4	Understand the dynamic behavior of memory by the use of pointers.
CO5	Design and develop modular programs using control structure, selection structure and file.

Course Content:

Fundamentals of Computer: (8 L)
History of Computer, Generation of Computer, Classification of Computers, Basic structure of Computer System, Primary & Secondary Memory, Processing Unit, Input & Output devices. 2L

Binary and Allied number systems representation of signed & unsigned numbers, BCD, ASCII, Binary number. Arithmetic – Addition and Subtraction (using 1's complement and 2's complement). 2L

Overview of Procedural vs Structural language, compiler and assembler (basic concepts) 1L

Problem solving- Algorithm & flow chart. 2L

C Fundamentals: (28 L)

Variable and Data Types:

The C character set identifiers and keywords, data type & sizes, variable names, declaration, statements. 2L

C Operators & Expressions:

Arithmetic operators, relational operators, logical operators, increment and decrement operators, bitwise operators, assignment operators, conditional operators, special operators - type conversion, C expressions, precedence and associativity.

Input and Output: Standard input and output, formatted output - printf, formatted input scanf, bit fields. 4L

Branching and Loop Statements:

Statement and blocks, if - else, switch, goto and labels, Loops - while, for, do while, break and continue. 4L

Fundamentals and Program Structures:

auto, external, static and register variables Functions, function types, function prototypes, functions returning values, functions not returning values, scope rules, recursion, C preprocessor and macro. 5L

Arrays, Strings and Pointers:

One dimensional arrays, Two-dimensional arrays, Multidimensional arrays. Passing an array to a function Character array and string, array of strings, Passing a string to a function, String related functions, Pointers, Pointer and Array, Pointer and String, Pointer and functions, Dynamic memory allocation. 7L

Structures and Unions:

Basic of structures, arrays of structures, structures and pointers, structures and functions. 3L

Files handling with C:

formatted and unformatted files, Command line arguments, fopen, fclose, fgetc, fputc, fprintf, fscanf function. 3L

Text book:

Kerninghan B.W. & Ritchie D.M. - The C Programming Language ,PHI, 2nd Edition
Kanetkar Y. - Let us C, BPB Publication, 15th Edition

Reference Books:

E Balagurusamy – Programming in ANSI C, TMH, 3rd Edition
K R Venugopal & S R Prasad – MASTERING C, TMH, 2nd Edition
Reema Thareja – INTRODUCTION TO C PROGRAMMING, OXFORD UNIVERSITY PRESS, 2nd Edition

CO – PO/PSO Mapping:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CS201.1	3	3	3	2	2								**3**	**3**	**3**
CS201.2	3	2	2	2	2								3	3	3
CS201.3	3	3	3	2	2								3	3	3
CS201.4	3	3	3	2	2								3	3	3
CS201.5	3	3	3	2	2								3	3	3

Course Name: Engineering Mechanics
Course Code: ME 201
Contacts: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisites: Basic Concept of Physics

Course Objective:

This course teaches students how to apply Newtonian physics to relatively simple real life applications. This course covers statics, dynamics and elementary part of strength of materials.

Course Outcome: Upon successful completion of this course, the student will be able to:

1. Get the Knowledge about thermodynamic equilibrium, heat & work transfer,

2. Understand the First law of Thermodynamics and its application.

3. Apply the basic concepts of Heat Engine, Entropy from Second law of thermodynamics.

4. Analyse the thermodynamic characteristics of a pure substance and its application in power cycles (Simple Rankine cycles, Air Standard cycles)

5. Evaluation of basic principles of fluid mechanics, and ability to analyze fluid flow problems with the application of the momentum and energy equations.

Course Content:

Module 1: Introduction to Engineering Mechanics: Force Systems Basic concepts, Particle equilibrium in 2-D & 3-D; Rigid Body equilibrium; System of Forces, Coplanar Concurrent Forces, Components in Space – Resultant- Moment of Forces and its Application; Couples and Resultant of Force System, Equilibrium of System of Forces, Free body diagrams, Equations of Equilibrium of Coplanar Systems and Spatial Systems; Static Indeterminacy. 6L

Module 2: Friction: Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction; Motion of Bodies, wedge friction, screw jack & differential screw jack. 2L

Module 3: Basic Structural Analysis: Equilibrium in three dimensions; Method of Sections; Method of Joints; How to determine if a member is in tension or compression; Simple Trusses; Zero force members; Beams & types of beams; Frames & Machines. 3L

Module 4: Centroid and Centre of Gravity: Centroid of simple figures from first principle, centroid of composite sections; Centre of Gravity and its implications; Area moment of inertia- Definition, Moment of inertia of plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections and composite sections; Mass moment inertia of circular plate, Cylinder, Cone, Sphere, Hook. 5L

Module 5: Virtual Work and Energy Method: Virtual displacements, principle of virtual work for particle and ideal system of rigid bodies, degrees of freedom. Active force diagram, systems with friction, mechanical efficiency. Conservative forces and potential energy (elastic and gravitational), energy equation for equilibrium. Applications of energy method for equilibrium. Stability of equilibrium. 5L

Module 6: Review of particle dynamics: Rectilinear motion; Plane curvilinear motion (rectangular, path, and polar coordinates). 3-D curvilinear motion; Relative and constrained motion; Newton's 2^{nd} law (rectangular, path, and polar coordinates). Work-kinetic energy, power, potential energy.Impulse-momentum (linear, angular); Impact (Direct and oblique). 5L

Module 7: Introduction to Kinetics of Rigid Bodies: Basic terms, general principles in dynamics; Types of motion, Instantaneous centre of rotation in plane motion and simple problems; D'Alembert's principle and its applications in plane motion and connected bodies; Work energy principle and its application in plane motion of connected bodies; Kinetics of rigid body rotation. 5L

Module8: Mechanical Vibrations: Basic terminology, free and forced vibrations, resonance and its effects; Degree of freedom; Derivation for frequency and amplitude of free vibrations without damping and single degree of freedom system, simple problems, types of pendulum, use of simple, compound and torsion pendulums. 5L

Text books:

1. Irving H. Shames (2006), Engineering Mechanics, 4th Edition, Prentice Hall

2. F. P. Beer and E. R. Johnston (2011), Vector Mechanics for Engineers, Vol I - Statics, Vol II, – Dynamics, 9th Ed, Tata McGraw Hill
3. R.C. Hibbler (2006), Engineering Mechanics: Principles of Statics and Dynamics, Pearson Press.
4. Andy Ruina and Rudra Pratap (2011), Introduction to Statics and Dynamics, Oxford University Press
5. Shanes and Rao (2006), Engineering Mechanics, Pearson Education,
6. Hibler and Gupta (2010),Engineering Mechanics (Statics, Dynamics) by Pearson Education

Reference books:

1. Reddy Vijaykumar K. and K. Suresh Kumar(2010), Singer's Engineering Mechanics
2. Bansal R.K.(2010), A Text Book of Engineering Mechanics, Laxmi Publications
3. Khurmi R.S. (2010), Engineering Mechanics, S. Chand & Co.
4. Tayal A.K. (2010), Engineering Mechanics, Umesh Publications

CO – PO/PSO Mapping:

CO Codes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
ME201.1	3	2		2								2	2	2	
ME201.2	3	3		2								2	2	3	
ME201.3	3	3		3								3	3	3	
ME201.4	3	3		3								3	3	3	
ME201.5	3	3		2								2	3	3	

Course Name: Programming for Problem Solving Lab
Course Code: CS291
Contacts: 0:0:3
Credits: 1.5

Prerequisites: Number system, Boolean Algebra.

CourseOutcomes(COs):

After completion of the course students would be able to

CO1	Understand and propose appropriate command or function in the running system or developing program for engineering and mathematical problems depending on the platform used even in a changed environment leading to their lifelong learning.
CO2	Identify and propose appropriate data type, arithmetic operators, input/output functions and also conditional statements in designing effective programs to solve complex engineering problem using modern tools.
CO3	Design and develop effective programs for engineering and mathematical problems using iterative statements as well as recursive functions using modular programming approach possibly sateam maintaining proper ethics of collaboration.
CO4	Explain and organize data in arrays, strings and structures and manipulate them through programs and also define pointers of different types and use them in defining self-referential structures and also to construct and use files for reading and writing to and from leading to solution of engineering and mathematical problem.
CO5	Prepare laboratory reports on interpretation of experimental results and analyse it for validating the same maintaining proper ethics of collaboration.

List of Experiment:

- Some basic commands of DOS, Windows and Linux Operating System, File handling and Directory structures, file permissions, creating and editing simple C program, compilation and execution of C program.
- Writing C Programs on variable, expression, operator and type-casting.
- Writing C Programs using different structures of if-else statement and switch-case statement.
- Writing C Programs demonstrating use of loop (for loop, while loop and do-while loop) concept and use of break and continue statement.
- Writing C Programs demonstrating concept of Single & Multidimensional arrays.
- Writing C Programs demonstrating concept of Function and Recursion.
- Writing C Programs demonstrating concept of Pointers, address of operator, declaring pointers and operations on pointers.
- Writing C Programs demonstrating concept of structures, union and pointer to structure.
- Writing C Programs demonstrating concept of String and command line arguments.
- Writing C Programs demonstrating concept of dynamic memory allocation.
- Writing C Programs demonstrating the concept of File Programming.

CO-PO/PSO Mapping:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**PSO 1**	**PSO 2**	**PSO 3**
CS291. 1	3	3	3	3	3								3	3	3
CS291. 2	3	3	2	3	3								3	3	3
CS291. 3	3	3	3	3	3								3	3	3
CS291. 4	3	3	3	3	3								3	3	3
5	3	3	3	3	3								3	3	3

Course Name: Chemistry Lab
Course Code: CH 291
Contact: 0:0:3
Credits: 1.5

Prerequisites: Knowledge of Physics up to 12^{th} standard.

Course Objective:

- Study the basic principles of pH meter and conductivity meter for different applications.
- Analysis of water for its various parameters & its significance in industries.
- Learn to synthesis Polymeric materials and drugs.
- Study the various reactions in homogeneous and heterogeneous medium.

Course Outcomes (COs):

After completion of the course students would be able to

CO1	Understand different types of instruments for estimation of small quantities chemicals used in industries, scientific and technical fields.
CO2	Analyze and determine the composition of liquid and solid samples working as an individual and also as a team member.
CO3	Analyze different water quality parameters considering public health and environment
CO4	Synthesize drug and polymer materials considering public health and environmental safety
CO5	Design innovative experiments applying the fundamental theory of chemistry.

List of Experiment:

Choice of 10-12 experiments from the following:

- Determination of surface tension and viscosity
- Thin layer chromatography
- Determination of hardness of water
- Determination of chloride content of water
- Determination of the rate constant of a reaction
- Determination of cell constant and conductometric titration
- pH metric titrations
- Synthesis of a polymer/drug
- Saponification/acid value of an oil
- Chemical analysis of a salt
- Chemical oscillations- Iodine clock reaction
- Determination of the partition coefficient of a substance between two immiscible liquids
- Adsorption of acetic acid by charcoal

Innovative experiments (any one)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CH291.1	2	2	3	2		2						2			
CH291.2	2	2	3	2		2						2			
CH291.3	2	2	3	2		2						2			

CH291.4	2	2	3	2		2						2			
CH291.5	3	3	3	3		2						2		2	2

- Synthesis of silver nano particles
- Green synthesis

CO-PO/PSO Mapping:

Course Name: Basic Electrical Engineering Laboratory
Course Code: EE291
Contact: 0:0:3
Credits: 1.5

Prerequisites:
- Basic Physics and applied physics.
- Basic Mathematics.
- Basic concept of Electric Circuit

Course Objective:
To impart and apply knowledge about the Basic Electrical Components, Machineries, Instruments and Safety measures.

Course Outcome: After completion of this course student will be able to

EE291.1:	Understand the response of any electrical circuit and network
EE291.2:	Apply the operation of an electrical apparatus
EE291.3:	Analyse a suitable measuring instrument for a given application
EE291.4:	Evaluate the various parts and test of DC machine and transformer

List of Experiments:
1. Basic safety precautions – earthing, introduction to measuring instruments – Voltmeter, Ammeter, Multimeter, Wattmeter, Real life Resistor, Capacitor, Inductor.
2. Verification of Thevenin's and Norton's Theorem.
3. Verification of Superposition and Maximum Power Transfer Theorem.
4. Characteristics of Fluorescent, Tungsten and Carbon filament lamps.
5. Study of R-L-C series circuit.
6. Three-phase Power measurement with two wattmeter method.
7. Demonstration of cut-out sections of machines: DC Machine (commutator-brush arrangement), Induction Machine (squirrel cage rotor).
8. Measurement of primary and secondary voltage and current of single-phase transformer – Open Circuit and Short Circuit Test.
9. Starting, Reversing and speed control of DC shunt motor.

10. Torque-Speed characteristics of DC Machine.
11. Torque-Speed characteristics of Three-phase Induction Motor.
12. Test on single-phase Energy Meter.

CO-PO/PSO Mapping:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
EE 191. 1	2	2	3	3					3	3		2	2	2
EE 191. 2	3	3	2	3					3	3		3	2	2
EE 191. 3	2	3	3	2					2	3		2	2	2

Course Name: Engineering Graphics & Design
Course Code: ME 291
Contact: 0:0:3
Credits: 1.5

Prerequisites: Basic knowledge of geometry

Course Objectives:
To learn detailed drawing and modeling of a system, component, or process which meets desired needs within realistic constraints. It will help students to use the techniques, skills, and modern engineering tools and communicate effectively.

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

1. Learn the basics of drafting
2. Understand the use of drafting tools which develops the fundamental skills of industrial drawings.
3. Apply the concept of engineering scales, dimensioning and various geometric curves necessary to understand design of machine elements.
4. Analyse the concept of projection of line, surface and solids to create the knowledge base of orthographic and isometric view of structures and machine parts.
5. Evaluate the design model to different sections of industries as well as for research & development.

6. **List of Drawing:**

Traditional Engineering Graphics:
Principles of Engineering Graphics; Orthographic Projection; Descriptive Geometry; Drawing Principles; Isometric Projection; Surface Development; Perspective; Reading a Drawing; Sectional Views; Dimensioning & Tolerances; True Length, Angle; intersection, Shortest Distance.

Module 1: Introduction to Engineering Drawing
Principles of Engineering Graphics and their significance, Usage of Drawing instruments, lettering, Conic sections including Rectangular Hyperbola (General method only); Cycloid, Epicycloid and Involute; Scales – Plain, Diagonal and Vernier Scales.

Module 2: Orthographic & Isometric Projections
Principles of Orthographic Projections-Conventions - Projections of Points and lines inclined to both planes; Projections of planes inclined Planes - Auxiliary Planes; Projection of Solids inclined to both the Planes- Auxiliary Views; Isometric Scale, Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa.

Module 3: Sections and Sectional Views of Right Angular Solids
Drawing sectional views of solids for Prism, Cylinder, Pyramid, Cone and project the true shape of the sectioned surface, Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone; Draw sectional orthographic views of objects from industry and dwellings (foundation to slab only)

Computer Graphics:
Engineering Graphics Software; -Spatial Transformations; Orthographic Projections; Model Viewing; Co-ordinate Systems; Multi-view Projection; Exploded Assembly; Model Viewing; Animation; Spatial Manipulation; Surface Modeling; Solid Modeling.

Module 4: Overview of Computer Graphics
Demonstration of CAD software [The Menu System, Toolbars (Standard, Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), Zooming methods, Select and erase objects].

Module 5: CAD Drawing, Customization, Annotations, layering
Set up of drawing page including scale settings, ISO and ANSI standards for dimensioning and tolerancing; Using various methods to draw straight lines, circles, applying dimensions and annotations to drawings; Setting up and use of Layers, Changing line lengths (extend/lengthen); Printing documents; Drawing sectional views of solids and project the true shape of the sectioned surface; Drawing annotation, CAD modeling of parts and assemblies with animation, Parametric and non parametric solid, surface and wireframe modeling, Part editing and two dimensional documentation of models.

Module 6:
Demonstration of a simple team design project
Illustrating Geometry and topology of engineered components: creation of engineering models and their presentation in standard 2D blueprint form and as 3D wire-frame and shaded solids; Meshed topologies

for engineering analysis and tool-path generation for component manufacture, Use of solid-modeling software for creating associative models at the component and assembly levels.

Text Books:

1. Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House
2. (Corresponding set of) CAD Software Theory and User Manuals

Reference Books:

1. K. Venugopal**,** Engineering Drawing + AutoCAD, New Age International publishers
2. Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication.
3. Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education
4. Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers.

CO-PO/PSO mapping:

CO Codes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
ME 291.1	2			2									2	2	2
ME 291.2	2			2									2	2	2
ME 291.3	3			2									2	2	2
ME 291.4	3			3									3	3	2
ME 291.5	3	2		3	2								3	3	2

Course Name: Lang. Lab. and Seminar Presentation
Course Code: HU 291
Contact: 0:0:2
Credit: 1

Pre requisites: Basic knowledge of LSRW skills.

Course Objective: To train the students in acquiring interpersonal communication skills by focussing on language skill acquisition techniques and error feedback.

Course Outcomes:

CO1: Able to understand advanced skills of Technical Communication in English through Language Laboratory.
CO2: Able to apply listening, speaking, reading and writing skills in societal and professional life.
CO3: Able to demonstrate the skills necessary to be a competent Interpersonal communicator.
CO4: Able to analyze communication behaviours.
CO5: Able to adapt to multifarious socio-economical and professional arenas with the help of effective communication and interpersonal skills.

Course Content:

Module 1: Introduction to the Language Lab
a. The Need for a Language Laboratory
b. Tasks in the Lab
c. Writing a Laboratory Note Book

Module 2: Active Listening
a. What is Active Listening?
b. Listening Sub-Skills—Predicting, Clarifying, Inferencing, Evaluating, Note-taking
c. Academic Listening vs Business Listening
d. Listening in Business Telephony
e. Study of Contextualized Examples based on Lab Recordings

Module 3: Speaking
a. Speaking—Accuracy and Fluency Parameters
b. Pronunciation Guide—Basics of Sound Scripting, Stress and Intonation
c. Fluency-focussed activities—JAM, Conversational Role Plays, Speaking using Picture/Audio Visual inputs
d. Accuracy-focussed activities—Identifying Minimal Pairs, Sound Mazes, Open and Closed Pair Drilling, Student Recordings (using software)
e. Group Discussion: Principles and Practice

Module 4: Lab Project Work
a. Making a brief Animation film with voice over (5 minutes)OR
b. Making a brief Documentary film (10 minutes)

Reference Books:
1.IIT Mumbai**, Preparatory Course in English** syllabus
2. IIT Mumbai, **Introduction to Linguistics** syllabus
3. Sasikumar et al. *A Course in Listening and Speaking*. New Delhi: Foundation Books, 2005.
4. Tony Lynch, *Study Listening*. Cambridge: Cambridge UP, 2004.

CO – PO Mapping :

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO 1							2		3	3		2	2	2	3

CO 2							2		3	3		2	2	3	2
CO 3							2		3	3		2	1	1	3
CO 4							2		3	3		2	-	1	2
CO 5							2		3	3		2			

Course Name: NSS/Physical Activities/ Meditation & Yoga/ Photography/Nature Club
Course Code: MC 281
Contact: 0:0:3

Course Objectives:

- To increase student awareness about the weaker and unprivileged sections of society
- To expose students to environmental issues and ecological concerns
- To make students self aware about their participatory role in sustaining society and the environment

List of Activities:

a) Creating awareness in social issues
b) Participating in mass education programmes
c) Proposal for local slum area development
d) Waste disposal
e) Environmental awareness ``
f) Production Oriented Programmes
g) Relief & Rehabilitation work during Natural calamities

Creating awareness in social issues:

1. Women's development – includes health, income-generation, rights awareness.
2. Hospital activities – Eg. writing letters for patients, guiding visitors
3. Old age home – visiting the aging in-mates, arranging for their entertainment.
4. Children's Homes - visiting the young in-mates, arranging for their entertainment
5. Linking with NGOs to work on other social issues. (Eg. Children of sex-workers)
6. Gender issues- Developing an awareness, to link it with Women's Cell of college

Participating in mass education programmes: 1.Adult education 2. Children's education

Proposal for local slum area development : One or two slums to be identified and according to the needs, activities to be developed and proposals and reports are to be submitted.

Environmental awareness

• Resource conservation – Awareness to be developed on water, energy,soil.
• Preservation of heritage monuments- Marches, poster campaigns
• Alternative energy consciousness amongst younger school-children.
• Plantation and beautification- Plantation of trees, their preservation and upkeep, developing NSS parks.
• Waste disposal- Proper methods of domestic waste disposal.

Production Oriented Programmes

5. Working with people and explaining and teaching improved agricultural practices

6. Rodent control land pest control practices;
7. Soil-testing, soil health care and soil conservation;
8. Assistance in repair of agriculture machinery;
9. Work for the promotion and strengthening of cooperative societies in villages;
10. Assistance and guidance in poultry farming, animal husbandry, care of animal health etc.;
11. Popularization of small savings and
12. Assistance in procuring bank loans

Relief & Rehabilitation work during Natural calamities

g) Assisting the authorities in distribution of rations, medicine, clothes etc.;
h) Assisting the health authorities in inoculation and immunization, supply of medicine etc.;
i) Working with the local people in reconstruction of their huts, cleaning of wells, building roads etc.;
j) Assisting and working with local authorities in relief and rescue operation; Collection of clothes and other materials, and sending the same to the affected areas;

DEPARTMENT OF MECHANICAL ENGINEERING

3RD SEM CURRICULUM

3rd Semester								
SL No	**Course Type**	**Course Code**	**Theory**	**Contact Hours/Week**				**Credit Points**
				L	**T**	**P**	**Total**	
A. THEORY								
1	PC	ME 301	Engineering Thermodynamics	3	0	0	3	3
2	PC	ME 302	Strength of Material	3	0	0	3	3
3	PC	ME 303	Fluid Mechanics	3	0	0	3	3
4	PC	ME 304	Materials Engineering	3	0	0	3	3
5	BS	M 301	Mathematics -III	3	1	0	4	4
6	BS	PH(ME)301	Physics - II	3	0	0	3	3
Total of Theory							**19**	**19**
B. PRACTICAL								
7	PC	ME 391	Material Testing Lab	0	0	3	3	1.5
8	PC	ME 392	Machine Drawing	0	0	3	3	1.5
9	BS	PH(ME)391	Physics – II Lab	0	0	2	2	1
10	PROJ	PR 391	Project-III	0	0	2	2	1
11	PROJ*	PR 392	Innovative activities-II	0	0	0	1	0.5
C. MANDATORY ACTIVITIES / COURSES								
12	MC	MC 301	Environmental Science	3	0	0	3	
Total of Theory, Practical & Mandatory Activities/Courses							**32**	**24.5**

*Students may choose either to work on participation in all the activities of Institute's Innovation

Council for eg: IPR workshop/ Leadership Talks/ Idea/ Design/ Innovation/ Business Completion/ Technical Expos etc.

Innovative activities to be evaluated by the Programme Head/ Event coordinator based on the viva voce and submission of necessary certificates as evidence of activities.

Detailed Syllabus- 3rd Semester

Course Name: Engineering Thermodynamics
Course Code: ME 301
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisites: Physics (10+2 level)

Course Objectives:

- To learn about work and heat interactions, and balance of energy between system and its surroundings
- To learn about application of I law to various energy conversion devices
- To evaluate the changes in properties of substances in various processes
- To understand the difference between high grade and low grade energies and II law limitations on energy conversion

Course Outcomes:

CO1: Learn about the interrelationship of heat and work to draw an energy balance between a system and its surroundings.
CO2: Understand the second law limitation of energy conversion and differentiate realistic and unrealistic thermodynamic systems.
CO3: Carry out Entropy and Exergy analysis of thermal systems to evaluate sustainability of practical equipments in industries.
CO4: Evaluate the performance of energy conversion devices using utility thermodynamic cycles.

Course Contents:

Module	Syllabus	Contact Hrs
1 - Fundamentals	System & Control volume; Property, State & Process; Exact & Inexact differentials; Work-Thermodynamic definition of work; examples; Displacement work; Path dependence of displacement work and illustrations for simple processes; electrical, magnetic, gravitational, spring and shaft work.	4

2 - Temperature & First Law of Thermodynamics	Definition of thermal equilibrium and Zeroth law; Temperature scales; Various Thermometers- Definition of heat; examples of heat/work interaction in systems- First Law for Cyclic & Non-cyclic processes; Concept of total energy E ; Demonstration that E is a property; Various modes of energy, Internal energy and Enthalpy.	4
3- Pure substance	Definition of Pure substance, Ideal Gases and ideal gas mixtures, Real gases and real gas mixtures, Compressibility charts- Properties of two phase systems - Const. temperature and Const. pressure heating of water; Definitions of saturated states; P-v-T surface; Use of steam tables and R134a tables; Saturation tables; Superheated tables; Identification of states & determination of properties, Mollier's chart.	7
4 – First Law for Flow Processes	Derivation of general energy equation for a control volume; Steady state steady flow processes including throttling; Examples of steady flow devices; Unsteady processes; examples of steady and unsteady I law applications for system and control volume.	5
5 – Second law of Thermodynamics	Definitions of direct and reverse heat engines; Definitions of thermal efficiency and COP; Kelvin-Planck and Clausius statements; Definition of reversible process; Internal and external irreversibility; Carnot cycle; Absolute temperature scale	5
6 – Entropy and its application	Clausius inequality; Definition of entropy S ; Demonstration that entropy S is a property; Evaluation of S for solids, liquids, ideal gases and ideal gas mixtures undergoing various processes; Determination of entropy from steam tables- Principle of increase of entropy; Illustration of processes in Ts coordinates; Definition of Isentropic efficiency for compressors, turbines and nozzles. Irreversibility and Availability, Availability function for systems and Control volumes undergoing different processes, Lost work. Second law analysis for a control volume. Exergy balance equation and Exergy analysis.	7
7 – Thermodynamic cycles	Basic Rankine cycle; Basic Brayton cycle; Basic vapor compression cycle and comparison with Carnot cycle.	4
	Total Contact Hours	**36 lectures**

Text Books:

1. Yunus A. Cengel , Michael A. Boles , 2014, 8th Edition, Thermodynamics**:** An Engineering Approach, McGraw-Hill Education.
2. Nag, P.K, 1995, Engineering Thermodynamics, Tata McGraw-Hill Publishing Co. Ltd.

Reference Books:

1. Sonntag, R. E, Borgnakke, C. and Van Wylen, G. J., 2003, 6th Edition, Fundamentals of Thermodynamics, John Wiley and Sons.
2. Jones, J. B. and Duggan, R. E., 1996, Engineering Thermodynamics, Prentice-Hall of India
3. Moran, M. J. and Shapiro, H. N., 1999, Fundamentals of Engineering Thermodynamics, John Wiley and Sons.

CO-PO/PSO Mapping:

CO Codes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
ME301.1	3	2	3	-	-	-	-	-	-	-	-	-	-	2	-
ME301.2	2	3	2	3	-	-	2	-	-	-	-	3	-	3	-
ME301.3	2	3	3	3	-	-	2	-	-	-	-	2	-	3	-
ME301.4	2	2	3	2	-	-	2	-	-	-	-	2	-	1	-
Avrg.	**2.25**	**2.5**	**2.75**	**2.66**	-	-	**2**	-	-	-	-	**2.33**	-	**2.5**	-

Course Name: Strength of Materials
Course Code: ME 302
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisite: Engineering Mechanics

Course Objectives:

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

Course Outcomes:

CO1: Recognize various types loads applied on machine components of simple geometry and understand the nature of internal stresses that will develop within the components
CO2: Evaluate the strains and deformation in materials that will result due to the elastic stresses developed within the materials for simple types of loading.
CO3: Quantify mechanical integrity and failure in materials
CO4: Analyze application of materials with respect to their strength and weakness.

Course Contents:

Module	Syllabus	Contact Hrs
1 - Deformation in solids	Hooke's law, stress and strain- tension, compression and shear stresses, elastic constants and their relations- volumetric, linear and shear strains- principal stresses and principal planes- Mohr's circle.	**7**

2 – Failure Theories	Static failure theories: Ductile and brittle failure mechanisms, Tresca, Von-mises, Maximum normal stress, Mohr-Coulomb and Modified Mohr-Coulomb Theory	**4**
3 – Beams	Beams and types of transverse loading on beams- shear force and bend moment diagrams- Types of beam supports, simply supported and over-hanging beams, cantilevers. Theory of bending of beams, bending stress distribution and neutral axis, shear stress distribution, point and distributed loads.	**7**
4 – Moment of inertia	Moment of inertia about an axis and polar moment of inertia, deflection of a beam using double integration method, computation of slopes and deflection in beams, Maxwell's reciprocal theorems.	**6**
5 – Torsion	Torsional stresses and deformation in circular and hollow shafts, stepped shafts, deflection of shafts fixed at both ends, stresses and deflection of helical springs.	**6**
6 – Pressure Vessels	Axial and hoop stresses in cylinders subjected to internal pressure, deformation of thick and thin cylinders, deformation in spherical shells subjected to internal pressure	**6**
Total Hours (36 lectures)		

Text Books:

1. Egor P. Popov, Engineering Mechanics of Solids, Prentice Hall of India, New Delhi, 2001.
2. R. Subramanian, Strength of Materials, Oxford University Press, 2007.
3. Ferdinand P. Been, Russel Johnson Jr and John J. Dewole, Mechanics of Materials, Tata Mc Graw Hill Publishing Co. Ltd., New Delhi 2005.

CO – PO/PSO Mapping:

CO Codes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
ME302.1	3	3	-	3	-	-	-	-	-	-	-	-	3	-	-
ME302.2	2	3	3	3	-	-	-	-	-	-	-	2	3	-	-
ME302.3	3	3	-	3	-	-	-	-	-	-	-	-	3	-	-
ME302.4	3	3	-	3	2	-	-	-	-	-	-	-	3	-	-
Avrg.	**2.75**	**3**	**3**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**-**	**-**

Course Name: Fluid Mechanics
Course Code: ME 303
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisites: Physics and Mechanics (10+2 level)

Course Objectives: To introduce and explain fundamentals of Fluid Mechanics which is useful in the applications of Aerodynamics, Hydraulics, Marine Engineering, Gas dynamics, Heat Transfer, Power Plant etc.

Course Outcomes:
CO1: Get knowledge about fluid flow properties and analyze hydrostatic forces on flat or curved surfaces.
CO2: Explore the detailed analysis of kinematics and dynamics of fluid for laminar and turbulent flow and exploit the conservation equations for the flow regimes of practical interest.
CO3: Learn about boundary layer theory for a variety of constraints and understand the basics of a turbulent flow.
CO4: Explain the basics of compressible flow and apply for dimensional analysis for practical prototyping.

Course Contents:

Module No.	Syllabus	Contact Hrs.
1- Introduction	Introduction to Fluid Mechanics - Fluid, Fluid types, Newton's law of viscosity, surface tension	02
2- Analysis of Fluid Motion	**Fluid statics:** Forces on submerged surfaces; forces or vertical, horizontal, inclined and curved surfaces, Center of pressure. Stability of floating bodies. **Fluid kinematics:** fluid flow and classifications. Continuity equation in 1D & 3D. Potential flow & Stream function; types of flow lines. **Dynamics of fluid:** equations of motion; Euler's equation; Navier-Stokes equation; Bernoulli's equation; Applications of Bernoulli's equation.	03 03 03
3- Viscous and Turbulent Flow	Flow through circular pipes, Flow between parallel plates, momentum and energy correction factors**,** Reynold's experiment, characteristics of turbulent flow, velocity distribution in turbulent flow through pipes in terms of average velocity.	05

4- Flow through pipes	Fluid friction in pipes, head loss due to friction. Darcy–Weisbach equation of friction loss; hydraulic grade line and total energy line. Variation of friction factor with wall roughness – Moody's chart. Minor losses in pipes.	04
4- Flow Measurement	Orifices, notches and weirs: Basic principle for flow through orifices, rectangular and V-notches, rectangular and trapezoidal weir.	03
5- Boundary layer flow	Definition; Boundary layer separation – basic concept. Drag force on a flat plate due to boundary layer, Turbulent layer on a flat plate, displacement thickness, momentum thickness and energy thickness.	04
6- Submerged bodies	Flow of fluid and forces around submerged bodies; basic concepts of drag and lift.	03
7- Dimensional Analysis	Dimensions and dimensional homogeneity, Importance and use of dimensional analysis. Buckingham's π theorem with applications. Geometric, Kinematic and Dynamic similarity, Non Dimensional Numbers, Model studies	03
8- Compressible Flow	Thermodynamic relations, Basic equations of compressible flow, velocity of pressure wave in a fluid, Mach number, Stagnation properties, area velocity relationship, flow of compressible fluid through orifices and nozzles fitted to a large tank.	03

Text Books:

1. Introduction to Fluid Mechanics & Fluid Machines – Som & Biswas, TMH
2. Fluid Mechanics & Machinery – R.K.Bansal, Luxmi Publications.
3. A textbook on Fluid Mechanics and Hydraulic Machines – Sukumar Pati, TMH
4. Fluid Mechanics & Turbo Machines – M.M.Das, PHI, 2010.

Reference Books:

1. Introduction to Fluid Mechanics – Fox & Macdonald, Wiley.
2. Fluid Mechanics – Fundamentals & Applications – Cengel & Cimbala, TMH.
3. Mechanics of Fluid – Bernard Massey, Taylor & Francis.

CO-PO/PSO mapping:

CO Codes	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
ME303.1	2	2	3	-	-	-	-	-	-	-	-	-	3	2	-
ME303.2	3	3	-	2	-	-	-	-	-	-	-	-	3	2	-
ME303.3	3	2	-	2	-	-	-	-	-	-	-	3	2	2	-
ME303.4	2	2	2	2	-	-	2	-	-	-	-	-	3	-	-
Avrg.	**2.5**	**2.25**	**2.5**	**2**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**3**	**2.75**	**2**	**-**

Course Name: Materials Engineering
Course Code: ME 304
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisite: Engineering Physics and Engineering Chemistry.

Course Objectives:

a. Understanding of the correlation between the internal structure of materials, their mechanical properties and various methods to quantify their mechanical integrity and failure criteria.
b. To provide a detailed interpretation of equilibrium phase diagrams
c. Learning about different phases and heat treatment methods to tailor the properties of Fe-C alloys.

Course Outcomes:

CO1: Identify crystal structures for various materials and understand the defects in such structures
CO2: Analyze the effect of heat treatment of mechanical properties of a material
CO3: Understand how to tailor material properties of ferrous and non-ferrous alloys
CO4: Learn about advanced materials useful in modern industrial application.

Course Contents:

Module	Syllabus	Contact Hrs
1 – Crystal Structure	Unit cells, Metallic crystal structures, Imperfection in solids: Point, line, interfacial and volume defects; dislocation strengthening mechanisms and slip systems, critically resolved shear stress.	**6**
2 – Mechanical Property measurement	Tensile, compression and torsion tests; Young's modulus, relations between true and engineering stress-strain curves, generalized Hooke's law, yielding and yield strength, ductility, resilience, toughness and elastic recovery; Hardness: Rockwell, Brinell, Vickers and their relation to strength.	**7**
3 – Metals & Alloys	Alloys, substitutional and interstitial solid solutions- Phase diagrams: Interpretation of binary phase diagrams and microstructure development; Iron - Iron-carbide phase diagram, and microstructure analysis of ferrous materials, cast iron, steel.	**6**
4 – Heat treatment	Heat treatment of Steel: Annealing, tempering, normalising and spheroidising, isothermal transformation diagrams for Fe-C alloys and microstructure development. Continuous cooling curves and interpretation of final microstructures and properties- austempering, martempering, case hardening, carburizing, nitriding, cyaniding, carbo-nitriding, flame and induction hardening, vacuum and plasma hardening	**7**

5 – Alloying of steel	Properties of stainless steel and tool steels, maraging steels- cast irons; - copper and copper alloys; brass, bronze and cupro-nickel; Aluminium and Al -Cu – Mg alloys- Nickel based superalloys and Titanium alloys	**5**
6- Ceramics and Advanced Materials	Structure, properties and application of ceramics, Composite Types, Types and properties of main composition, Smart Materials, Ferroelastic and Piezoelectric materials, Nanomaterials, Biomaterials, Shape memory alloys	**5**
	Total Contact Hours	**36 L**

Text Books:

1. W. D. Callister, 2006, Materials Science and Engineering-An Introduction, 6th Edition, Wiley India.
2. V. Raghavan, Material Science and Engineering, Prentice Hall of India Private Limited, 1999.
3. U. C. Jindal, Engineering Materials and Metallurgy, Pearson, 2011.

Reference Books:

1. Kenneth G. Budinski and Michael K. Budinski, Engineering Materials, Prentice Hall of India Private Limited, 4th Indian Reprint, 2002.

CO-PO/PSO mapping:

CO Codes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
ME403.1	3	2	3	2	-	-	-	-	-	-	-	-	-	2	3
ME403.2	3	3	2	2	-	-	-	-	-	-	-	-	-	3	2
ME403.3	3	3	2	-	3	-	-	-	-	-	-	2	-	3	2
ME403.4	3	2	2	-	-	-	-	-	-	-	-	-	-	2	2
Avrg.	**3**	**2.5**	**2.25**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**2.5**	**2.25**

Course Name: Mathematics- III
Course Code: M 301
Contact: 3:1:0
Total Contact Hours: 48
Credits: 4

Prerequisites:

The students to whom this course will be offered must have the concept of (10+2) standard calculus, basic probability and differential equations.

Course Objectives:

The objective of this course is to disseminate the prospective engineers with advanced techniques for solving ordinary differential equations and basic techniques for solving partial differential equations. It also aims to equip the students with concepts and tools of calculus of complex variables, Fourier series

and Fourier transform, and probability distribution as an intermediate to the advanced level of applications that they would find useful in their disciplines.

Course Outcomes:

CO 1	Recall the underlying principle and properties of Fourier series, Fourier transform, probability distribution of a random variable, calculus of complex variable, partial differential equation and ordinary differential equation.
CO 2	Exemplify the variables, functions, probability distribution and differential equations and find their distinctive measures using the underlying concept of Fourier series, Fourier transform, probability distribution of a random variable, calculus of complex variable, partial differential equation and ordinary differential equation.
CO 3	Apply Cauchy's integral theorem and the residue theorem to find the value of complex integration, and compute the probability of real world uncertain phenomena by indentifying probability distribution that fits the phenomena.
CO 4	Solve partial differential equation using method of separation of variables and ordinary differential equation using techniques of series solution and special function (Legendre's and Bessel's).
CO 5	Find the Fourier series and Fourier transform of functions by organizing understandings of underlying principles and also evaluate the integral using Parseval's identity.

Course Content:

MODULE I: Fourier series and Fourier Transform: (12 L)

Fourier series: Dirichlet's Conditions; Euler's Formula for Fourier Series; Fourier Series for functions of period $2\pi 2\pi$; Sum of Fourier series (examples); Theorem for the convergence of Fourier series (statement only); Fourier series of a function with its periodic extension; Half range Fourier series: Construction of half range Sine series and half range Cosine Series; Parseval's identity (statement only) and related problems.

Fourier Transform: Fourier Transform, Fourier Cosine Transforms, Fourier Sine Transforms (problems only); Properties of Fourier Transform: Linearity, Shifting, Change of Scale, Modulation (problems only); Fourier Transform of Derivatives (problems only); Convolution Theorem (statement only), Inverse of Fourier Transform (problems only).

MODULE II: Probability Distributions: (12 L)

Random Variable: Discrete and Continuous (definition & examples); Probability Distribution (definition & examples); Probability Mass Function, Probability Density Functionand Distribution Function for a single random variable only (definition, properties & related problems); Expectation, Varianceand Standard Deviation for a single random variable only (definition, properties & related problems); Binomial Distribution, Poisson Distribution, Binomial Approximation to Poisson Distribution and Normal Distribution (problems only), Mean, Variance and Standard Deviation of Binomial, Poisson and Normal Distribution (problems only).

MODULE III: Calculus of Complex Variable: (12 L)

Functions of a Complex Variable (definition and examples); Concept of Limit, Continuity and Differentiability (problems only); Analytic Functions (definition and examples); Cauchy-Riemann Equations (statement only& related problems); Sufficient condition for a function to be analytic (statement only & related problems).

Concept of Simple Curve, Closed Curve, Smooth Curve & Contour; Some elementary properties of

complex integrals (problems only); Cauchy's Theorem (statement only & related problems); Cauchy's Integral Formula(statement only & related problems); Cauchy's Integral Formula for the derivative of an analytic function(statement only & related problems); Cauchy's Integral Formula for the successive derivatives of an analytic function (statement only & related problems); Taylor's series and Laurent's series (problems only).

Zero of an Analytic Function and its order (definition & related problems); Singularities of an Analytic Function: Isolated Singularity and Non-isolated Singularity (definition & related problems); Essential Singularities, Poles (Simple Pole and Pole of Order □□) and Removable Singularities (definition & related problems); Determination of singularities and their nature (problems only); Residue (definition & examples); Determination of the residue of a given function; Cauchy's Residue theorem (statement only & related problems).

MODULE IV: Partial Differential Equation (PDE) and Series Solution of Ordinary Differential Equation (ODE): (12 L)

Solution of PDE: Method of Separation of Variables.

Solution of Initial Value & Boundary Value Problem: One Dimensional Wave Equation, One Dimensional Heat Equation, Two Dimensional Laplace Equation.

Series solution of ODE: General method to solve $□_0 □'' + □_1 □' + □_2 □ = 0$ $□_0 □'' + □_1 □' + □_2 □ = 0$ and related problems to Power series method**,** Bessel's Function, Legendre Polynomial.

Text Books:

1. Herman, R. L. *An Introduction to Fourier Analysis*, Chapman and Hall/CRC, 2016.
2. Grafakos, L. *Classical Fourier Analysis*, Springer, India, Private Ltd.
3. Das, N.G. *Probability and Statistics*; The McGraw Hill Companies.
4. Gupta, S. C. and Kapoor, V. K. *Fundamentals of Mathematical Statistics*, Sultan Chand & Sons.
5. Mathews, J. H. and Howell, R. W. *Complex Analysis for Mathematics & Engineering*, Jones & Bartlett Pub, 2006.
6. Chowdhury, B. *Elements of Complex Analysis*, New Age International, 1993.
7. Raisinghania, M .D. *Advanced Ordinary & Partial Differential. Equation*; S. Chand Publication.
8. Ross, S. L. *Differential Equations*, John Willey & Sons.
9. Grewal, B. S. *Higher Engineering Mathematics*, Khanna Pub.
10. Kreyszig, E. *Advanced Engineering Mathematics*, John Wiley & Sons, 2006.

Reference Books:

6. Gray, R. M. and Goodman, J. *Fourier Transforms: An Introduction for Engineers*, Springer, US, 1995.
7. Lipschutz & Lipson, *Schaum's Outline in Probability (2ndEd)*, McGraw Hill Education.
8. Spiegel, M. R. *Theory and Problems of Probability and Statistics (Schaum's Outline Series)*, McGraw Hill Book Co.
9. Goon, A.M., Gupta M .K. and Dasgupta, B. *Fundamental of Statistics*, The World Press Pvt. Ltd.
10. Soong, T. T. *Fundamentals of Probability and Statistics for Engineers*, John Wiley & Sons Inc, 2004.
11. Delampady, M. *Probability & Statistics*, Universities Press.
12. Spiegel, M. R. *Theory and Problems of Complex Variables (Schaum's Outline Series)*, McGraw Hill Book Co.
13. Sneddon, I. N. *Elements of Partial Differential Equations*, McGraw Hill Book Co.
14. Boyce, W. E. and DiPrima, R. C. *Elementary Differential Equations and Boundary Value Problems*, Wiley India, 2009.

15. Rao, B. *Differential Equations with Applications & Programs*, Universities Press.
16. Murray, D. *Introductory Courses in Differential Equations*, Universities Press.

CO-PO/PSO Mapping:

PO / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	-	-	-	-	-	-	-	-	1
CO2	3	2	1	-	-	-	-	-	-	-	-	1
CO3	3	2	2	-	-	-	-	-	-	-	-	1
CO4	3	2	2	-	-	-	-	-	-	-	-	1
CO5	3	3	2	3	-	-	-	-	-	-	-	1

Course Name: Physics - II
Course Code: PH (ME)301
Contact: 3:0:0
Total contact hours: 36
Credits: 3

Prerequisites: Physics I

Course Outcomes:
CO1: Explain electron transport in semiconductors using energy and theory.
CO2: Apply Schrödinger equation in variety of atomic scale problems including nanomaterials.
CO3: Analyze the physics of various kinds of electric and magnetic materials
CO4: Justify the importance of Fermi energy level in turning electronic properties of various semiconductors

Course Contents:

Module 1: Electric and Magnetic properties of materials (7L) Module
1.01: Insulating materials:
Dielectric Material: Concept of Polarization, the relation between **D, E** and **P**, Polarizability, Electronic (derivation of polarizability), Ionic, Orientation & Space charge polarization (no derivation), internal field, Claussius Mossotti equation, ferroelctric and piezoelectrics (Qualitative study).
3L
Module 1.02: Magnetic materials and storage devices:
Magnetic Field & Magnetization M, relation between **B, H, M**. Bohr magneton, susceptibility, Diamagnetism- & Paramagnetism - Curie law (qualitative discussion), Ferromagnetism– Curie Temperature, Weiss molecular field theory (qualitative) & Curie-Weiss law, concept of θp , Hysteresis, Hard ferromagnets, Comparison and applications of permanent magnets (storage devices) and Soft ferromagnets (Permalloys, Ferrites etc.) **4L**

Module 2: Ultrasound and infrasound (4L)
Ultrasound-Introduction, definition and properties –Production of ultrasonics by Piezo-electric crystal and magnetostriction method; Detection of ultrasonics; Engineering applications of Ultrasonics (Non-destructive testing, cavitations, measurement of gauge), **Infrasound** – Introduction and definition, production, application: 4L

Module 3: Quantum Mechanics-II (7L)

Formulation of quantum mechanics and Basic postulates- superposition principle, orthogonality of wave function, expectation value; operator correspondence, Commutator. Measurements in Quantum Mechanics-Eigen value, Eigen function, Schrödinger's equation as energy eigen value equation. 4L

Application of Schrödinger equation – Particle in an infinite square well potential (1-D and 3-D potential well; Discussion on degenerate levels), 1D finite barrier problem and concept of quantum tunnelling (solve only E<V0). 3L

Module 4: Statistical Mechanics (4L)

Concept of energy levels and energy states. Microstates, Macrostates and thermodynamic probability, MB, BE, FD, statistics (Qualitative discussions)- physical significance, conception of bosons, fermions, classical limits of quantum statistics, Fermi distribution at zero & non-zero temperature, Concept of Fermi level. 4L

Module 5: Solid state physics (8L)

5.1 : Introduction to Band theory (mention qualitatively improvement over free electron theory)-Kronig-Penny model (qualitative treatment)-Energy-band (E-k) diagram, formation of allowed and forbidden energy bands, Concept of effective mass – electrons and holes, crystal momentum. 3L

5.2 : Defects: Point defects; line defects; Dislocations, Types of dislocations, Planar defects, stacking faults, twins, grain boundaries, defect propagation (qualitative). 3L

5.3 : Vibration in solids: Lattice vibrations – Mono and diatomic lattice, concept of phonon, specific heat of solids-Dulong-Pettit law, Einstein, Debye theory (qualitative discussion). 2L

Module 6: Physics of Nanomaterials (3L)

Reduction of dimensionality, properties of nanomaterials, Quantum wells (two dimensional), Quantum wires (one dimensional), Quantum dots (zero dimensional); Quantum size effect and Quantum confinement. Carbon allotropes. Application of nanomaterials (CNT, grapheme,electronic, environment, medical). 3

CO-PO/PSO Mapping:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
PH-(ME)301.1	3	3	2	-	-	-	-	-	-	-	-	-	3	-	-
PH-(ME)301.2	2	2	-	-	-	-	-	-	-	-	-	-	2	-	-
PH-(ME)301.3	2	3	2	-	-	-	-	-	-	-	-	-	3	-	-
PH-(ME)301.4	2	-	2	-	-	-	-	-	-	-	-	-	3	-	-
Avrg.	2.25	2.66	2	-	-	-	-	-	-	-	-	-	2.75	-	-

Course Name: Materials Testing Laboratory
Course Code: ME 391
Contact: 0:0:3
Credits: 1.5

Prerequisites: Engineering Chemistry.

Course Objective:
To measure the mechanical properties of a material to understand the deformation behavior of materials and observe the microstructure of a material sample under heat treatment.

Course Outcomes:
1. To understand the deformation behavior of materials
2. To observe the microstructure of a material sample under heat treatment.
3. To measure the mechanical properties of a material

List of experiments:
At least 6 experiments need to be conducted.
1. Uniaxial tension test on mild steel rod
2. Torsion test on mild steel rod
3. Impact test on a metallic specimen
4. Brinnell and Rockwell hardness tests on metallic specimen
5. Bending deflection test on beams
6. Strain measurement using Rosette strain gauge
7. Microscopic examination of heat-treated and untreated metallic samples

CO – PO/PSO Mapping:

CO Codes	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	3	3	2	-	-	-	-	-	-	-	-	-	3	2	3
CO2	3	-	2	-	-	-	-	-	-	-	-	3	3	2	2
CO3	3	-	2	-	-	-	3	-	-	-	-	-	2	2	3
CO4	3	2	3	-	-	-	-	-	-	-	-	-	2	3	2
Avrg.	3	2.5	2.25	-	-	-	3	-	-	-	-	3	2.5	2.25	2.5

Course Name: **Machine Drawing**
Course Code: **ME 392**
Contact: **0:0:3**
Credits: **1.5**

Prerequisite: Basic knowledge of Machine elements, engineering drawing/drafting

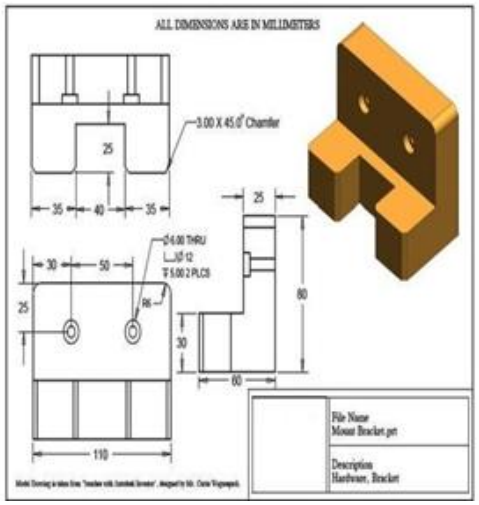
Course Objecive: The objective of this lab is to practically demonstrate the failure criteria of different mechanical elements or bodies.

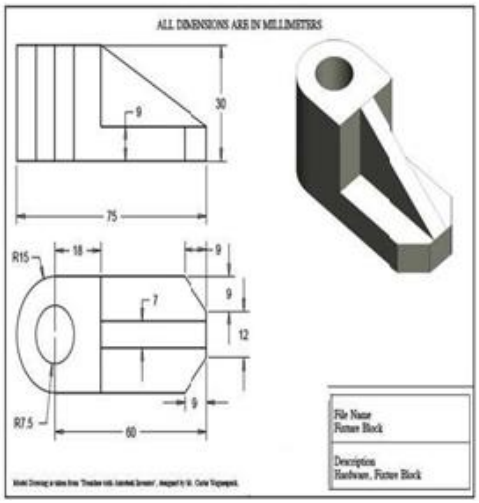
Course Outcomes:
CO1: Gain knowledge about the isometric views of a given three dimensional object/part.
CO2: Understand and draw the orthogonal projection of a solid body and assemble drawing using part drawings.
CO3: Learn and practice 3D modeling of machine parts using AutoCAD/Solidworks/Catia.
CO4: Draft the shape and structure of different types of screws, keys and Couplings

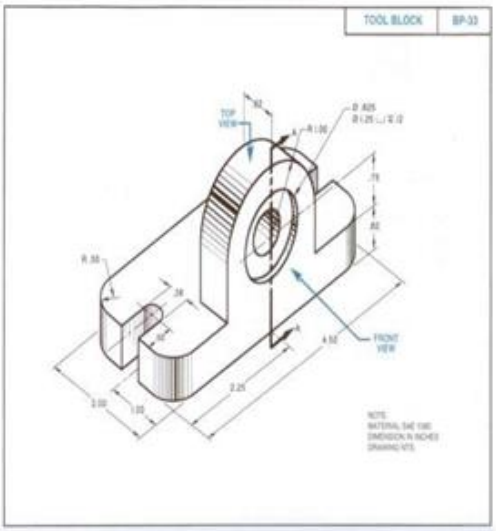
List of Drawing:

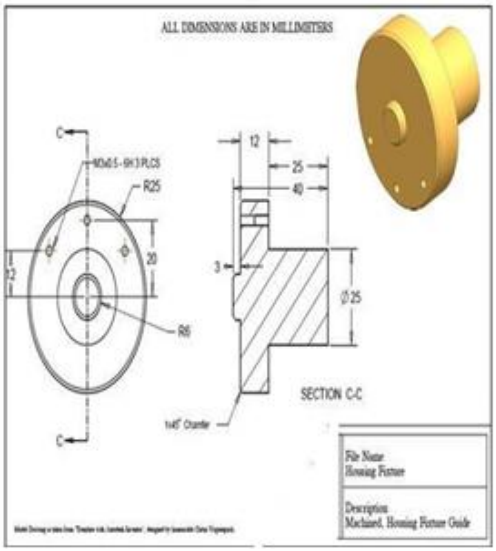
Experiment No.	Description
1	Schematic product symbols for standard components in welding and pipe joints
2	Orthographic projections of machine elements, different sectional views- full, auxiliary sections, Isometric projection of components (Manual and CAD)
3	Assembly and detailed drawings of a mechanical assembly (Manual Drafting) a) Plummer block b) Tool head of a shaping machine c) Tailstock of a lathe d) Welded pipe joints indicating work parts before welding

Experiment No.	Description
4	Basic 3D modeling practice of simple machine elements using AutoCAD or SolidWorks (At least 10, samples given)









Text Books:

1. Text Book on Engineering Drawing, Narayana/Kannaia H, Scitech
2. Mechanical Engineering Drawing and Design, S. Pal and M. Bhattacharyya
3. Machine Drawing by N.D. Bhatt
4. Machine Drawing by P.S. Gill
5. Engineering Drawing and Graphics + AutoCAD by K. Venugopal, New Age International Pub.
6. Engineering Drawing with an Introduction to AutoCAD by D.A. Jolhe, Tata-McGraw-Hill Co.
7. Introduction to Solid Modeling Using SolidWorks 2008, Joseph C. Musto and William E. Howard
8. SOLIDWORKS 2016 Basic Tools, Paul Tran.

CO-PO/PSO Mapping:

CO Codes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
1	3	3	2	-	-	-	-	-	-	-	-	-	2	-	2

2	3	3	3	-	3	-	-	-	-	-	-	-	2	-	2
3	3	3	2	-	3	-	-	-	-	-	-	-	3	-	3
4	3	3	2	-	3	-	-	-	-	-	-	-	3	-	3
Avrg.	3	3	2.25	-	3	-	-	-	-	-	-	-	2.5	-	2.5

Course Name: Physics – II Lab
Course Code: PH(ME)391
Contacts: 0:0:2
Credit: 1

Prerequisite: Physics – II Theory

Course Objectives: To enable students carry out several experiments on applied physics and apply the knowledge in innovative solution in mechanical engineering.

Course Outcomes:
CO1: Demonstrate experiments allied to their theoretical concepts
CO2: Conduct experiments using semiconductors , dielectric and ferroelectrics, ultrasounds
CO3: Classify various types of magnetic materials
CO4: Participate as an individual, and as a member or leader in groups in laboratory sessions actively
CO5: Analyze experimental data from graphical representations , and to communicate effectively them in Laboratory reports including innovative experiments

List of Experiments:

Experiments on Module 1: Electric and Magnetic properties of materials (9L)

1. Study of dipolar magnetic field behavior.
2. Study of hysteresis curve of a ferromagnetic material using CRO.
3. Use of paramagnetic resonance and determination of Lande-g factor using ESR setup.
4. Measurement of Curie temperature of the given sample.
5. Determination of dielectric constant of given sample (frequency dependent)/Measurement of losses in a dielectric using LCR circuits.

Experiments on Module 2: Ultrasound and infrasound (4L)
6. Determination of velocity of ultrasonic wave using piezoelectric crystal.

Experiments on Module 3: Quantum Mechanics-II (7L)
7. Determination of Stefan's radiation constant.
8. To study current-voltage characteristics, load response, areal characteristics and spectral response of photo voltaic solar cells & measurement of maximum workable power.
9. Measurement of specific charge of electron using CRT.

Experiments on Module 5: Solid state physics (8L)
10. Study of lattice dynamics.
11. Determination of band gap of a semiconductor.
12. Determination of Hall co-efficient of a semiconductor and measurement of Magneto-resistance of a given semiconductor

In addition to regular 7 experiments it is **recommended that each student should carry out at least one experiment beyond the syllabus/one experiment as Innovative experiment.

Probable experiments beyond the syllabus:
1. Determination of thermal conductivity of a bad conductor by Lees and Chorlton's method.
2. Determination of thermal conductivity of a good conductor by Searle's mothod.

3. Study of I-V characteristics of a LED.
4. Study of I-V characteristics of a LDR
5. Study of transducer property: Determination of the thermo-electric power at a certain temperature of the given thermocouple.

CO-PO/PSO Mapping:

COs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**	**PSO 3**
CO 1	3	3	2	2	-	-	-	-	-	-	-	-	3	2	-
CO 2	2	2	-	2	-	-	-	-	-	-	-	-	2	2	-
CO 3	2	3	2	2	-	-	-	-	-	-	-	-	3	2	-
CO 4	2	-	2	3	-	-	-	-	2	-	-	-	3	3	-
Avg.	2.25	2.66	2	2.25	-	-	-	-	2	-	-	-	2.75	2.25	-

Course Name: Environmental Science
Course Code: MC301
Contact: 3:0:0
Total Contact Hours: 36

Prerequisite: Basic Chemistry

Course Objective:

- Be able to understand the natural environment and its relationships with human activities.
- Be able to apply the fundamental knowledge of science and engineering to assess environmental and health risk.
- Be able to understand environmental laws and regulations to develop guidelines and procedures for health and safety issues.
- Be able to solve scientific problem-solving related to air, water, noise & land pollution.

Course Outcomes

CO1: Able to understand the natural environment and its relationships with human activities.
CO2: To apply the fundamental knowledge of science and engineering to assess environmental and health risk.
CO3: To develop guidelines and procedures for health and safety issues obeying the environmental laws and regulations.
CO4: Acquire skills for scientific problem-solving related to air, water, noise & land pollution.

Course Content:

1. General **11 L**

1.1 Natural Resources: Forest Resource, water resource, mineral resource, energy resources: alternative source of energy

1.2 Population Growth: Exponential Growth, logistic growth, Maximum sustainable yield, demography

1.3 Disaster Management: Types of disasters (Natural & Man-made), Floods, Earthquake, Tsunamis, Cyclones, landslides (cause, effect & control)

1.4 Ecology & Ecosystem: Elements of ecology, definition of ecosystem- components types and function, Food chain & Food web,
Structure and function of the following ecosystem: Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems

1.5 Environmental Management: Environmental impact assessment, Environmental laws and protection act of India(The Environment protection Act, Air pollution Act, Water Act, Wildlife Protection Act) , Hazardous waste(management and Handling) Rules.

2. Air pollution and control **10L**

2.1 Sources of Pollutants: point sources, nonpoint sources and manmade sources primary & secondary pollutant

2.2 Types of air pollutants: primary & secondary pollutant ; Suspended particulate matter, oxides of carbon, oxides of nitrogen, oxides of sulphur, particulate, PAN, Smog (Photochemical smog and London smog),

2.3 Effects on human health & climate: Greenhouse effect, Global Warming, Acid rain, Ozone Layer Depletion

2.4 Air pollution and meteorology: Ambient Lapse Rate, Adiabatic Lapse Rate, Atmospheric stability & Temperature inversion

2.5 control of air pollution (ESP, cyclone separator, bag house, catalytic converter, scrubber

(ventury),

3. Water Pollution **9L**

3.1 Classification of water (Ground & surface water)

3.2 Pollutants of water, their origin and effects: Oxygen demanding wastes, pathogens, nutrients, Salts, heavy metals, pesticides, volatile organic compounds.

3.3 Surface water quality parameters: pH, DO, 5 day BOD test, BOD reaction rate constants, COD. Numerical related to BOD

Lake: Eutrophication [Definition, source and effect].

3.4 Ground water: Aquifers, hydraulic gradient, ground water flow (Definition only),ground water pollution (Arsenic & Fluoride; sources, effects, control)

3.5 Quality of Boiler fed water: DO, hardness, alkalinity, TDS and Chloride

3.7 Layout of waste water treatment plant (scheme only).

4. Land Pollution **3L**

4.1 Types of Solid Waste: Municipal, industrial, commercial, agricultural, domestic, hazardous solid wastes (bio-medical), E-waste

4.2 Solid waste disposal method: Open dumping, Land filling, incineration, composting, recycling (Advantages and disadvantages).

4.3 Waste management: waste classification, waste segregation, treatment & disposal

5. Noise Pollution **3L**

5.1 Definition of noise, effect of noise pollution on human health,

5.2 Average Noise level of some common noise sources

5.3 Definition of noise frequency, noise pressure, noise intensity, noise threshold limit value, equivalent noise level, $L10$ (18 hr Index) .

5.4 Noise pollution control.

Text Books:

1. A Textbook of Environmental Studies, Shashi Chawla. Tata McGraw Hill Education Private Limited
2. Environmental Studies, Dr. J P Sharma, University Science Press
3. Environmental Engineering, J K Das Mohapatra, Vikas Publication

CO – PO/PSO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3	-	-	2	3	3	-	-	1	2
CO2	3	3	3	1	1	2	3	3	-	-	1	2
CO3	3	3	3	2	1	2	3	3	-	-	1	2
CO4	1	1	1	1	2	2	3	3	-	-	1	2

Detailed Syllabus - 4th Semester

4th Semester								
Sl No	**Course Type**	**Course Code**	**Theory**	**Contact Hours /Week**				**Credit Points**
				L	**T**	**P**	**Total**	
A. THEORY								
1	PC	ME401	Fluid Machinery	3	0	0	3	3
2	PC	ME402	Manufacturing Process	3	0	0	3	3
3	PC	ME403	Kinematics & Dynamics of Machines	3	0	0	3	3
4	PC	ME404	Applied Thermodynamics	3	0	0	3	3
5	ES	ME405	Data Structure and algorithm	2	0	0	2	2
6	ES	M(ME)401	Numerical Methods	2	0	0	2	2
Total of Theory							**16**	**16**
B. PRACTICAL								
7	PC	ME491	Fluid Mechanics & Fluid Machines Lab	0	0	3	3	1.5
8	PC	ME492	Manufacturing Process Lab	0	0	3	3	1.5
9	PC	ME493	Dynamics of Machine Lab	0	0	3	3	1.5
10	PROJ	PR 491	Project-IV	0	0	2	2	1
11	PROJ*	PR 492	Innovative activities-III	0	0	0	0	0.5
C. MANDATORY ACTIVITIES / COURSES								
12	MC	MC401	Constitution of India	3	0	0	3	
Total of Theory, Practical & Mandatory Activities/Courses							**30**	**22**

*Students may choose either to work on participation in all the activities of Institute's Innovation Council for eg: IPR workshop/ Leadership Talks/ Idea/ Design/ Innovation/ Business Completion/ Technical Expos etc.

Innovative activities to be evaluated by the Program Head/ Event coordinator based on the viva voce and submission of necessary certificates as evidence of activities.

Course Name: Fluid Machinery
Course Code: ME 401
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisite: Fluid Mechanics

Course Outcomes:
CO1: Understand the mechanism of jet propulsion for a variety of conditions and analyze it's effects for practical applications.
CO2: Learn the design and working principle of hydraulic turbines and apply in a practical case study or project work on hydel plants.
CO3: Analyze the working of various pumps and evaluate their performance of practical interest in a plethora of applications.
CO4: Utilize knowledge of various modern hydraulic machines for varied industrial applications.

Course Contents:

Module No.	Syllabus	Contact Hrs.
1.	Impact of Jets and Jet Propulsions: Force exerted by a liquid jet on a stationary flat plate, force exerted by a liquid jet on a stationary curved vane, force exerted by a liquid jet on a hinged plate, force exerted by a liquid jet on moving flat plates, force exerted by a liquid jet on moving curved vane, jet propulsion.	4
2.	Hydraulic Turbines: Essential element of a hydroelectric power plant; head and efficiencies of hydraulic turbines; classifications of hydraulic turbines, Pelton turbine, reaction turbine, Francis turbine, Kaplan turbine; draft tube; cavitation in hydraulic machines; dimensional analysis and similarity laws for rotodynamic machines; specific speed of hydraulic turbines; unit quantities of hydraulic turbines; characteristic curves of hydraulic turbines; governing of turbines.	8
3.	Centrifugal Pump: Components of a centrifugal pump, working principle, work done, different heads in a pumping system, different efficiencies, characteristics, minimum speed for starting a centrifugal pump, multistage centrifugal pumps, specific speed, model testing, cavitation, net positive suction head.	8
4.	Positive Displacement Pump: Components of a reciprocating pump, working principle, types of reciprocating pumps, discharge and power requirement, slip and coefficient of discharge, variation of velocity and acceleration in the suction and delivery pipes due to acceleration of the piston, frictional head on suction and delivery pipes, indicator diagram, air vessels. Introduction gear pump, lobe pump, vane pump, piston pump,	8
5.	Miscellaneous Hydraulic Machines: Hydraulic press, hydraulic accumulator, hydraulic intensifier, hydraulic ram, hydraulic lift, hydraulic crane, hydraulic coupling, hydraulic torque converter, hydraulic actuators, hydraulic valves.	8
Total Contact Hours		**36 L**

Text Books:

1. A textbook on Fluid Mechanics and Hydraulic Machines – Sukumar Pati, TMH
2. Fluid Mechanics & Machinery – R. K. Bansal, Luxmi Publications.
3. Introduction to Fluid Mechanics & Fluid Machines – Som Biswas, Chakraborty, TMH.
4. Fluid Mechanic s & Turbo Machines – M.M. Das, PHI, 2010.

Reference Books:

1. Fluid Mechanics & Machinery – C. Ratnam, A.V. Kothapalli, I.K. International Publishing House Ltd, 2010.
2. Fluid Mechanics & Machinery – C.S.P Ojha, R. Berndtsson, P.N. Chandramouli, OUP.
3. Introduction to Fluid Mechanics – Fox & Macdonald, Wiley.
4. Fluid Mechanics – Fundamentals & Applications – Cengel & Cimbala, TMH.

CO-PO/PSO mapping:

CO Codes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
ME401.1	3	2	3	2	2	2	2	-	2	-	-	-	3	3	-
ME401.2	2	3	3	2	2	3	2	-	2	-	-	-	3	3	-
ME401.3	2	2	2	2	2	2	2	-	2	-	-	-	3	3	-
ME401.4	2	3	3	2	3	3	3	-	3	-	-	-	2	-	-
Avrg.	2.25	2.5	2.75	2	2.25	2.5	2.25	-	2.25	-	-	-	2.75	2.25	-

Course Name: Manufacturing Processes
Course Code: ME 402
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisite: Materials Engineering

Course Outcomes:
CO1: Understand the basics of manufacturing processes and concerned behavior of material properties.
CO2: Explain various casting processes for different molding designs and forming techniques for metal works.
CO3: Understand welding methods and analyze solid or liquid state joining
CO4: Analyze the principle of cutting tools and practice machining processes

Course Contents:

Module	Syllabus	Contact Hrs
1– Metal Casting	Casting and Molding: Metal casting processes and equipment, Heat transfer and solidification, shrinkage, riser design, casting defects and residual stresses.	**8**
2– Metal Forming	Plastic deformation and yield criteria; fundamentals of hot and cold working processes; load estimation for bulk forming (forging, rolling, extrusion, drawing) and sheet forming (shearing, deep drawing, bending), principles of powder metallurgy.	**8**
3– Joining Processes	Physics of welding, brazing and soldering; Design considerations in welding, Solid and liquid state joining processes; Adhesive bonding.	**10**
4– Metal Cutting	Single and multi-point cutting; Orthogonal cutting, various force components: Chip formation, Tool wear and tool life, Surface finish and integrity, Machinability, Cutting tool materials, Cutting fluids; Turning, Drilling, Milling and finishing processes, Coating	**10**
	Total Contact Hours	**36 L**

Text Books:
1. Kalpakjian and Schmid, Manufacturing processes for engineering materials (5th Edition)- Pearson India, 2014
2. Mikell P. Groover, Fundamentals of Modern Manufacturing: Materials, Processes and Systems.
3. Degarmo, Black & Kohser, Materials and Processes in Manufacturing

CO – PO/PSO Mapping:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	2	-	2	-	-	-	-	-	-	2	-	2	-	3
CO 2	3	3	3	2	-	-	-	-	-	-	2	-	2	-	2
CO 3	3	3	2	3	-	-	-	-	-	-	3	-	2	-	3
CO 4	3	3	-	2	-	-	-	-	-	-	2	-	-	-	3
Avg.	**3**	**2.75**	**2.5**	**2.25**	**-**	**-**	**-**	**-**	**-**	**-**	**2.25**	**-**	**2**	**-**	**2.75**

Course Name: Kinematics & Dynamics of Machines
Code: ME 403
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisite: Physics successful completion of this course Students will be able to

Course Outcomes:
CO1: Understand the kinematics and rigid- body dynamics of kinematically driven machine components
CO2: Understand the motion of linked mechanisms in terms of the displacement, velocity and acceleration at any point in a rigid link
CO3:. Design and analyze cam and gear based mechanisms to generate specified output motion
CO4: Explore the mechanism of bearings and understand vibration based systems

Course Contents:

Module	Syllabus	Contact Hrs
1– Mechanisms	Classification of mechanisms- Basic kinematic concepts and definitions- Degree of freedom, mobility- Grashof's law, Kinematic inversions of four bar chain and slider crank chains Limit positions- Mechanical advantage- Transmission angle- Description of some common mechanisms- Quick return mechanism, straight line generators- Universal Joint- Rocker mechanisms	6
2– Velocity & Acceleration	Displacement, velocity and acceleration analysis of simple mechanisms, graphical velocity analysis using instantaneous centers, velocity and acceleration analysis using loop closure equations- kinematic analysis of simple mechanisms- slider crank mechanism dynamics- Coincident points- Coriolis component of acceleration- introduction to linkage synthesis three position graphical synthesis for motion and path generation	**8**
3– Cam Drive	Classification of cams and followers- Terminology and definitions- Displacement diagrams, Uniform velocity, parabolic, simple harmonic and cycloidal motions- derivatives of follower motions- specified contour cams- circular and tangent cams- pressure angle and undercutting, sizing of cams, graphical and analytical disc cam profile synthesis for roller and flat face followers	**6**
4- Gear Drive	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.	**6**

5- Friction & Bearings	Surface contacts- sliding and rolling friction- friction drives- bearings and lubrication friction clutches- belt and rope drives- friction in brakes	**6**
6 - Vibration	Natural and Transverse vibration, Free and forced Vibration, Damping, Torsional vibration	**4**
Total Contact Hours		**36**

Text Books:

1. Thomas Bevan, Theory of Machines, 3rd edition, CBS Publishers & Distributors, 2005.
2. CleghornW.L. , Mechanisms of Machines, Oxford University Press, 2005.
3. Robert L. Norton, Kinematics and Dynamics of Machinery, Tata Mc Graw Hill, 2009.
4. Ghosh A. and Mallick A.K., Theory of Mechanisms and Machines, Affiliated East West Pvt. Ltd, New Delhi, 1988.

CO – PO/PSO Mapping:

COs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO 1	3	2	2	-	-	-	-	-	-	-	-	-	-	2	2
CO 2	2	2	3	-	-	-	-	-	-	-	-	-	-	3	2
CO 3	2	3	3	3	-	-	-	-	-	-	-	-	2	2	2
CO 4	2	2	3	2	-	-	-	-	-	-	-	-	-	3	3
	2.25	**2.25**	**2.75**	**2.5**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2.5**	**2.25**

Course Name: Applied Thermodynamics
Course Code: ME 404
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisite: Engineering Thermodynamics

Course Outcomes:
CO1: Get a good understanding of various practical power cycles and heat pump cycles.
CO2: Analyze energy conversion in various thermal devices such as combustors, air coolers, nozzles, diffusers.
CO3: Understand phenomena occurring in high speed compressible flows and study the functioning and application of compressors.
CO4: Learn the concepts, types and working principles and define their different types of efficiencies

Course Contents:

Module	Syllabus	Contact Hrs
I – Fuels and combustion analysis	Introduction to solid, liquid and gaseous fuels – Stoichiometry, exhaust gas analysis - First law analysis of combustion reactions- Heat calculations using enthalpy tables- Adiabatic flame temperature- Chemical equilibrium and composition calculations using free energy	**6**
II – Vapor Based Cycles	Vapor power cycles, Rankine cycle with superheat, reheat and regeneration, exergy analysis. Supercritical and ultra-supercritical Rankine cycle - Vapor compression refrigeration cycles, refrigerants and their properties.	**8**
III – Gas Based Cycles	Gas power cycles, Air standard Otto, Diesel and Dual cycles - Air standard Brayton cycle, effect of reheat, regeneration and intercooling- Combined gas and vapor power cycles	**8**
IV– Psychrometry	Properties of dry and wet air, use of psychrometric chart, processes involving heating/cooling and humidification/dehumidification, dew point.	**4**
V – Reciprocating compressors	Reciprocating compressors, staging of reciprocating compressors, optimal stage pressure ratio, effect of intercooling, minimum work for multistage reciprocating compressors.	**5**
VI – Nozzle and Diffuser	Isentropic flow of a perfect gas through a nozzle, choked flow, subsonic and supersonic flows- Flow of steam and refrigerant through nozzle, supersaturation, compressible flow in diffusers, efficiency of nozzle and diffuser	**5**
Total Contact Hours		**36**

Text Books:
1. Sonntag, R. E, Borgnakke, C. and Van Wylen, G. J., 2003, 6th Edition, *Fundamentals of Thermodynamics*, John Wiley and Sons.
2. Nag, P.K, 1995, *Engineering Thermodynamics*, Tata McGraw-Hill Publishing Co. Ltd

Reference Books

1. Jones, J. B. and Duggan, R. E., 1996, *Engineering Thermodynamics*, Prentice-Hall of India
2. Moran, M. J. and Shapiro, H. N., 1999, *Fundamentals of Engineering Thermodynamics*, John Wiley and Sons.

CO – PO/PSO Mapping:

COs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	3	2	3	-	-	-	-	-	-	-	-	-	-	2	-
CO2	2	3	2	3	-	-	2	-	-	-	-	3	-	3	-
CO3	2	3	3	3	-	-	2	-	-	-	-	2	-	3	-
CO4	2	2	3	2	-	-	2	-	-	-	-	2	-	1	-
	2.25	**2.5**	**2.75**	**2.66**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**2.33**	**-**	**2.5**	**-**

Course Name: Data Structure and Algorithm
Course Code: ME 405
Contact: 2:0:0
Total Contact hours: 24
Credits: 2
Prerequisite: C language
Course outcomes:
CO1: For a given algorithm student will able to analyze the algorithms to determine the time and computation complexity and justify the correctness.
CO2: For a given Search problem (Linear Search and Binary Search) student will able to implement it.
CO3: For a given problem of Stacks, Queues and linked list student will able to implement it and analyze the same to determine the time and computation complexity.
CO4: Students will able to write algorithms and practice programming in C++.

Course contents:

Module	Syllabus	Contact Hrs
I – Introduction	Basic Terminologies: Elementary Data Organizations, Data Structure Operations: insertion, deletion, traversal etc.; Analysis of an Algorithm, Asymptotic Notations, Time-Space trade off. Searching: Linear Search and Binary Search Techniques and their complexity analysis.	**5**
II – Stacks and Queues	ADT Stack and its operations: Algorithms and their complexity analysis, Applications of Stacks: Expression Conversion and evaluation – corresponding algorithms and complexity analysis. ADT queue, Types of Queue: Simple Queue, Circular Queue, Priority Queue; Operations on each types of Queues: Algorithms and their analysis.	**5**
III – Linked Lists and Trees	Singly linked lists: Representation in memory, Algorithms of several operations: Traversing, Searching, Insertion into, Deletion from linked list; Linked representation of Stack and Queue, Header nodes, Doubly linked list: operations on it and algorithmic analysis; **Trees:** Basic Tree Terminologies, Different types of Trees: Binary Tree, Threaded Binary Tree, Binary Search Tree, AVL Tree; Tree operations on each of the trees and their algorithms with complexity analysis. Applications of Binary Trees. B Tree, B+ Tree: definitions, algorithms and analysis.	**8**
IV– Sorting and Hashing	Sorting and Hashing: Objective and properties of different sorting algorithms: Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort; Performance and Comparison among all the methods, Hashing.	**4**
V – C++	Object oriented Programming using C++	**2**
Total Contact Hours		**24**

Text Book:

1. "Fundamentals of Data Structures", Illustrated Edition by Ellis Horowitz, Sartaj Sahni, Computer Science Press.

Reference books:

1. Algorithms, Data Structures, and Problem Solving with C++", Illustrated Edition by Mark Allen Weiss, Addison-Wesley Publishing Company
2. "How to Solve it by Computer", 2nd Impression by R.G. Dromey, Pearson Education.

CO – PO/PSO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	-	-	-	-	-	-	-	1	1
CO2	1	1	-	-	-	-	-	-	-	-	1	1
CO3	1	1	-	-	-	-	-	-	-	-	1	1
CO4	2	1	1	2	-	-	-	-	-	-	2	1

Course Name: Numerical Methods
Course Code: M(ME) 401
Contact: 2:0:0
Total Contact Hours: 24
Credits: 2

Prerequisite: Concept of differential Calculus and Algebra

Course Outcomes:

CO1	Recall the distinctive characteristics of various numerical techniques and the associated error measures
CO2	Understand the theoretical workings of various numerical techniques to solve the engineering problems and demonstrate error
CO3	Apply the principles of various numerical techniques to solve various problems

Course Content:

Module	**Syllabus**	**Contact Hours**
Approximation in numerical computation	Truncation and rounding errors, Propagation of errors, Floating-point arithmetic.	(2L)
Interpolation	Calculus of Finite Differences, Newton forward and backward interpolation, Newton's divided difference interpolation, Lagrange's interpolation.	(8L)
Numerical Integration	Trapezoidal rule, Simpson's 1/3 rule, Weddle's rule, Expression for corresponding error terms.	(4L)
Numerical solution of a system of linear equations:	Gauss elimination method, LU Factorization method, Gauss-Seidel iterative method.	(4L)
Solution of transcendental equations	Bisection method, Regula-Falsi method, Newton-Raphson method.	(3L)
Numerical solution of ordinary differential equation	Euler's method, Modified Euler method, Fourth order Runge-Kutta method.	(3L)
Total Contact Hours		**24**

Text Books:

1. Shishir Gupta & S. Dey, Numerical Methods, TMH
2. C.Xavier: C Language and Numerical Methods, New Age International Publishers.
3. Jain, Iyengar & Jain: Numerical Methods (Problems and Solution), New Age International Publishers.
4. S. S. Sastry: Introductory methods of numerical analysis, PHI

References Books:

1.Balagurusamy: Numerical Methods, McGraw Hill Education.
2. Baburam: Numerical Methods, Pearson Education.
3. N. Dutta: Computer Programming & Numerical Analysis, Universities Press.
4. Soumen Guha & Rajesh Srivastava: Numerical Methods, OUP.
5. Srimanta Pal: Numerical Methods, OUP.
6. Numerical Analysis, Shastri, PHI

7. Numerical Analysis, S. Ali Mollah
8. Numerical Analysis, James B. Scarbarough
9. Numerical Methods for Mathematics, Science & Engg., Mathews, PHI
10. Numerical Analysis,G.S.Rao, New Age International

CO-PO/PSO Mapping:

PO / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12	PSO1	PSO2	PSO3
CO1	-	3	-	-	-	-	-	-	-	-	-	2	3	-	
CO2	-	3	2	-	-	-	-	-	-	-	-	-	2	-	
CO3	-	-	3	-	-	-	-	-	-	-	-	2	2	-	

Course Name: Fluid Mechanics & Fluid Machines Lab
Course Code: ME 491
Contact: 0: 0: 3
CreditS: 1.5

Prerequisite: Fluid Mechanics and Fluid Machines

Course Outcomes:
CO1: Recall the coefficient of discharge for several flow measuring devices to explore the reasons of differences in theoretical calculation and practical measurements.
CO2: Demonstrate hydraulic turbine and carry out their performance.
CO3: Examine and understand pump working characteristics under given constraints.
CO4: Estimate frictional forces applicable in a flow channel to determine major and minor losses.

List of Experiments:
1. Measurement of Coefficient of Discharge of an Orifice
2. Measurement of Coefficient of Discharge of a Venturimeter
3. To verify the Bernoulli's Theorem
4. To find the critical Reynolds number for pipe flow
5. To determine friction factor for a flow through pipe
6. Determination of the density & viscosity of an oil and friction factor of oil flow in a pipe
7. Determination of the performance characteristics of a centrifugal pump
8. Determination of the performance characteristics of a Pelton Wheel
9. Determination of the performance characteristics of a Francis Turbine.
10. Determination of the performance characteristics of a Kaplan Turbine

CO – PO/PSO Mapping:

COs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO 1	3	-	3	-	-	-	-	-	-	-	-	-	3	3	-
CO 2	2	3	2	-	-	-	-	-	-	-	2	-	3	2	-
CO 3	1	3	3	-	-	-	-	-	-	-	-	-	3	2	-
CO 4	2	3	3	-	-	-	-	-	-	-	-	-	2	2	-
	2	**3**	**2.75**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**2.75**	**2.25**	**-**

Course Name: Manufacturing Process Lab
Course Code: ME 492
Contacts: 0: 0: 3
CreditS: 1.5

Prerequisite: Manufacturing Process

Course Outcomes:

CO1: Fabricate basic parts and assemblies using machine shop equipment
CO2: Ascertain product and process quality levels through the use of precision measurement tools and statistical quality control charts.
CO3: Practice basic welding and forming techniques and modern improvements for sophisticated metal works.

List of Experiments:

Experiment No.	Description
1	To determine the percentage of clay content in dry sand
2	To determine the grain fineness number of dry and clay free sand.
3	To determine the moisture content quickly is fresh sand and mounding sand.
4	To determination the compressive strength, splitting strength and shearing strength of green sand by Pendulum Type Universal Strength Testing Machine
5	To determine the permeability number of Green sand, Core sand and Raw sand.
6	Mould preparation and casting of metals after preparation of suitable moulds.
7	Study of post casting operation like fettling, cleaning, deburring and polishing.
8	Practicing smithy or forging of carbon steels and testing for its property changes.
9	Laboratory experiments in Fabrication processes to observe effects of varying process parameters in GMAW and SMAW and Testing for Joint defects.
10	Machining practice in a Lathe, Shaping, Milling, Drilling machine.

CO – PO/PSO Mapping:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	3	3	-	-	-	-	-	-	-	-	-	3	-	3
CO 2	2	2	2	3	-	-	-	-	-	-	-	-	3	-	2
CO 3	3	2	3	3	-	-	2	-	-	-	-	-	-	-	2
CO 4	2	2	3	3	-	-	3	-	3	-	3	-	-	-	3
Avg.	2.5	2.25	**2.75**	3	-	-	2.5	-	3	-	3	-	3	-	2.5

Course Name: Dynamics of Machines Lab
Course Code: ME 493
Contact: 0:0:3
Credits: 1.5

Prerequisite: Kinematics & Theory of Machines

Course Outcomes:

CO1: Select several type of vibrating systems by using measuring instruments regarding vibration of continuous systems and random vibrations.
CO2: Demonstrate methods of balancing of rigid rotors, reciprocating machines, flywheels, planar linkages and instruments.
CO3: Define the working principle of gyroscope and governors to apply in future projects
CO4: Get practical knowledge on Cam dynamics used in various industrial applications.

List of Experiment:

1. Velocity ratios of simple, compound, epicyclic and differential gear trains
2. Kinematics of four bar, slider crank, crank rocker, double crank, double rocker and oscillating cylinder mechanisms
3. Study of Cam & follower motion
4. Determination of natural frequency and damping coefficient for a Single DOF Spring-mass-damper system
5. Determination of torsional natural frequency of single and double rotor systems- undamped and Damped natural frequencies

CO – PO/PSO Mapping:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	3	-	-	-	-	-	-	-	-	2	-	2	3
CO2	3	3	2	3	3	-	-	-	-	-	-	-	-	2	3
CO3	2	3	3	2	-	-	-	-	2	-	-	-	-	-	2
CO4	3	-	3	2	-	-	-	-	-	-	-	-	-	-	2
Avg.	**2.75**	**3**	**2.75**	**2.33**	**3**	**-**	**-**	**-**	**2**	**-**	**-**	**2**	**-**	**2**	**2.5**

Course Name: Constitution of India
Course Code: MC401
Contact: 3: 0: 0
Total Contact Hours: 36

Course Contents:

Module	Syllabus	Contact Hrs
1 – Indian Constitution	Sources and Constitutional history, Features: Citizenship, Preamble, Fundamental Rights and Duties, Directive Principles of State Policy	**6**
2 – Government and Administration	Union government and its administration: Structure of the Indian Union: Federalism, Centre- State relationship, President: Role, power and position, PM and Council of ministers, Cabinet and Central Secretariat, Lok Sabha, Rajya Sabha. State Secretariat: Organization, Structure and Functions.	**10**
3 – Court and Law	Supreme court: Organization of supreme court, procedure of the court, independence of the court, jurisdiction and power of supreme court. High court: Organization of high court, procedure of the court, independence of the court, jurisdiction and power of supreme court. Subordinate courts: constitutional provision, structure and jurisdiction. National legal services authority, Lok adalats, family courts, gram nyayalays. Public interest litigation (PIL): meaning of PIL, features of PIL, scope of PIL, principle of PIL, guidelines for admitting PIL	**10**
4– Local Administration	Districts administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation, Panchayati raj: Introduction, PRI: Zila Panchayat, Elected officials and their roles, CEO Zila Pachayat: Position and role, Block level. Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy.	**10**
Total Contact Hours		**36**

Text book
1. Indian polity, M, Laxmikanth, MC Graw Hill education, 5th Edition.

Detailed Syllabus - 5th Semester

5th Semester								
Sl No	**Course Type**	**Course Code**	**Theory**	**Contact Hours /Week**				**Credit Points**
				L	**T**	**P**	**Total**	
A. THEORY								
1	PC	ME 501	Heat Transfer	3	0	0	3	3
2	PC	ME 502	Manufacturing Technology	3	0	0	3	3
3	PC	ME 503	Design of Machine Elements	3	0	0	3	3
4	PC	ME 504	Refrigeration and Air Conditioning	3	0	0	3	3
5	PE	ME 505	A. Composite Materials B. Solid Mechanics C. Computer Aided Design	3	0	0	3	3
Total of Theory							**15**	**15**
B. PRACTICAL								
6	PC	ME591	Heat Transfer and Refrigeration Lab	0	0	3	3	1.5
7	PC	ME592	Manufacturing Technology Lab	0	0	3	3	1.5
8	PROJ	PR 591	Project-V	0	0	2	2	1
9	PROJ*	PR 592	Innovative activities-IV	0	0	0	0	0.5
C. MANDATORY ACTIVITIES / COURSES								
10	MC	MC 581	Technical Seminar Presentation	0	0	3	3	
Total of Theory, Practical & Mandatory Activities/Courses							**26**	**19.5**

* Students may choose either to work on participation in Hackathons etc. Development of new product/ Business Plan/ registration of start-up.
Students may choose to undergo Internship / Innovation / Entrepreneurship related activities. Students may choose either to work on innovation or entrepreneurial activities resulting in start-up or undergo internship with industry/ NGO's/ Government organizations/ Micro/ Small/ Medium enterprises to make themselves ready for the industry/ Long Term goals under rural Internship. (Duration 4-6 weeks)

Innovative activities to be evaluated by the Programme Head/ Event coordinator based on the viva voce and submission of necessary certificates as evidence of activities.

Course Name: Heat Transfer
Course Code: ME 501
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisite: Thermodynamics, Fluid mechanics,

Course Outcomes:
CO1: Understand the basic laws & constraints of heat transfer to analyze problems involving steady state or transient heat conduction in simple geometries.
CO2: Survey the analytical solutions of free and forced convection problems to apply in modern research sectors of heat and mass transfer.
CO3: Evaluate the radiation heat transfer between black body and gray body surfaces and obtain numerical solutions of combined mode heat transfer problems in practice.
CO4: Analyze the effectiveness of several type of heat exchanger and develop skills for industrial design solutions regarding boiling and condensation.

Course Contents:

Module No.	Syllabus	Contact Hrs.
1 Conduction	Introduction to three modes of heat transfer, Derivation of heat balance equation- Steady one dimensional solution for conduction heat transfer in Cartesian, cylindrical and spherical geometry, concept of conduction and film resistances, critical insulation thickness, lumped system approximation and Biot number, heat transfer through pin fins- Two dimensional conduction solutions for both steady and unsteady heat transfer-approximate solution to unsteady conduction heat transfer by the use of Heissler charts	**10**
2 Convection	Heat convection, basic equations, boundary layers- Forced convection, external and internal flows-Natural convective heat transfer- Dimensionless parameters for forced and free convection heat transfer-Correlations for forced and free convection-Approximate solutions to laminar boundary layer equations (momentum and energy) for both internal and external flow-Estimating heat transfer rates in laminar and turbulent flow situations using appropriate correlations for free and forced convection.	**9**

3 Radiation	Interaction of radiation with materials, definitions of radiative properties, Stefan Boltzmann's law, black and gray body radiation, Calculation of radiation heat transfer between surfaces using radiative properties, view factors and the radiosity method	**7**
4 Heat Exchangers	Types of heat exchangers, Analysis and design of heat exchangers using both LMTD and ε-NTU methods.	**5**
5 Boiling & Condensation	Boiling and Condensation heat transfer, Pool boiling curve	**3**
6 Mass Transfer	Introduction mass transfer, Similarity between heat and mass transfer	**2**
Total Hours (36 L)		

Text Books:

1. A. Bejan, Heat Transfer John Wiley, 1993
2. J. P. Holman, Heat Transfer, Eighth Edition, McGraw Hill, 1997.
3. F. P. Incropera, and D.P. Dewitt, Fundamentals of Heat and Mass Transfer, John Wiley, Sixth Edition, 2007.
4. P.K. Nag, Heat & Mass Transfer,
5. Yunus A Cengel, Heat Transfer : A Practical Approach, McGraw Hill, 2002

Reference Books:

6. S.K. Som, Introduction to Heat Transfer, PHI.
7. Kreith, Principles of Heat Transfer, Cengage learning.
8. O.P. Single, Heat & Mass Transfer, Macmillan India.

CO – PO/PSO Mapping:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	2	3	-	-	-	-	-	-	-	2	3	3	-
CO2	3	3	3	3	-	-	-	-	-	-	-	2	3	3	-
CO3	2	2	2	2	-	-	-	-	-	-	-	-	2	3	-
CO4	3	2	3	3	-	-	-	-	-	-	-	-	2	3	-
Avg.	**2.75**	**2.5**	**2.5**	**2.75**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2.5**	**3**	**-**

Course Name: Manufacturing Technology
Course Code: ME 502
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisite: Materials Engineering

Course Outcomes:
CO1: Understand the basics of tooling needed for manufacturing
CO2: Explain the dimensional accuracy and tolerances of products
CO3: Explore and use the knowledge of the assembly of different components in practical projects
CO4: Apply the optimization methods in manufacturing
Course Contents:

Module	Syllabus	Contact Hrs
1 Machine Tools	Tooling for conventional and non-conventional machining processes: Mould and die design, Press tools, Cutting tools; Holding tools: Jigs and fixtures, principles, applications and design; press tools configuration, design of die and punch; principles of forging die design, purpose and application of conventional machine tools.	**12**
2 Metrology	Dimensions, forms and surface measurements, Limits, fits and tolerances; linear and angular measurements; comparators; gauge design; interferometry; Metrology in tool wear and part quality including surface integrity; Process metrology for emerging machining processes such as microscale machining, Inspection and workpiece quality	**8**
3 Assembly Practices	Manufacturing and assembly, alignment and testing methods, tolerance analysis, process planning, selective assembly, Material handling and devices	**6**
4 Optimization methods	Linear programming, objective function and constraints, graphical method, Simplex and duplex algorithms, transportation assignment, Traveling Salesman problem; Network models: shortest route, minimal spanning tree, maximum flow model- Project networks: CPM and PERT, critical path scheduling; Production planning& control: Forecasting models, aggregate production planning, materials requirement planning.	**10**
Total Hours (36 L)		

Text Books:
4. Kalpakjian and Schmid, Manufacturing processes for engineering materials (5th Edition)- Pearson India, 2014
5. Mikell P. Groover, Fundamentals of Modern Manufacturing: Materials, Processes and Systems.

6. Degarmo, Black & Kohser, Materials and Processes in Manufacturing
7. Taha H. A., Operations Research, 6th Edition, Prentice Hall of India, 2003.
8. Shenoy G.V. and Shrivastava U.K., Operations Research for Management, Wiley Eastern, 1994.

CO – PO/PSO Mapping:

COs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**	**PSO 3**
CO 1	3	2	3	3	3	-	2	-	-	-	3	3	3	-	3
CO 2	3	2	2	2	3	-	-	-	-	-	2	2	3	-	-
CO 3	3	-	3	2	3	-	-	-	-	-	2	3	-	-	2
CO 4	3	3	2	2	2	-	2	-	-	-	2	2	3	-	-
	3	2.5	2.5	**2.25**	**2.75**	-	2	-	-	-	**2.25**	2.5	**2.25**	-	**1.25**

Course Name: Design of Machine Elements
Course Code: ME 503
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisite: Materials Engineering, Strength of Materials

Course Outcomes:
CO1: Explore mechanics of materials based failure criteria for the safety-critical design of machine components and applicability of empirical design principles, codes and standards.
CO2: Design shafts, brakes and clutches subjected to static or dynamic loads and present their designs orally and in writing.
CO3: Gain design knowledge of the different types of elements like shafts, couplings, fasteners and will be able to design these elements for each application.
CO4: Formulate and solve engineering problems based on design of various type of joints and transmission drives like gears, belt and chain drives

Course Contents:

Module No.	**Syllabus**	**Contact Hrs.**
1 Design considerations	Review of failure theories for static and dynamic loading including fatigue failure; codes and standards	**4**
2	Design of shafts under static and fatigue loadings, Analysis and	**8**

Design of Shaft and Bearings	design of sliding and rolling contact bearings	
3 Design of transmission elements	Spur, helical, bevel and worm gears; static & dynamic load calculation, belt and chain drives	**8**
4 Design of springs	helical compression, tension, torsional and leaf springs,	**4**
5 Design of joints	Threaded fasteners, pre-loaded bolts and welded joints, joint efficiencies, Analysis and applications of power screws and couplings	**6**
6 Design of Clutch and Brakes	Analysis of clutches and brakes	**6**
Total Hours (36 L)		

Text Books:

1. V. B. Bhandari, Design of Machine Elements, TMH.
2. Shigley, J.E. and Mischke, C.R., Mechanical Engineering Design, Fifth Edition, McGraw-Hill International; 1989.
3. Deutschman, D., Michels, W.J. and Wilson, C.E., Machine Design Theory and Practice, Macmillan, 1992.
4. Juvinal, R.C., Fundamentals of Machine Component Design, John Wiley, 1994.
5. Spottes, M.F., Design of Machine elements, Prentice-Hall India, 1994.
6. R. L. Norton, Mechanical Design – An Integrated Approach, Prentice Hall, 1998

CO – PO/PSO Mapping:

COs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO 1	3	2	3	2	2	-	-	-	2	-	-	-	2	-	2
CO 2	2	2	2	2	-	-	-	-	-	-	-	-	2	-	2
CO 3	2	3	3	3	2	-	-	-	-	-	-	-	3	-	3
CO 4	2	2	2	2	-	-	-	-	-	-	-	2	2	2	2
Avg	**2.25**	**2.25**	**2.5**	**2.25**	**2**	**-**	**-**	**-**	**2**	**-**	**-**	**2**	**2.25**	**2**	**2.25**

Course Name: Refrigeration & Air Conditioning
Course Code: ME504
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisite: Applied Thermodynamics

Course Outcomes:
CO1: Explain different types of Refrigeration cycles and its applications in multi compressor and multi evaporator systems.
CO2: Evaluate the selection and design of different components of Refrigeration systems
CO3: Interpret the knowledge of psychometric processes and air conditioning systems.
CO4: Design the air-conditioning system for a given conditions including refrigerating equipments as well as ducting systems.

Course Contents:

Module No.	Syllabus	Contact Hrs.
1 Refrigerants & VCRS	Classification of refrigeration systems, Refrigerants and their mixtures: properties and characteristics -Ozone depletion and global warming issues- Advanced vapour compression cycles	**6**
2 System components	Compressors, Condensers, Expansion devices and Evaporators- Performance matching of components of refrigeration systems	**8**
3 VARS	Vapour Absorption Refrigeration System, Advanced sorption refrigeration systems and their components, Lithium bromide - water System; Aqua-ammonia systems.	**6**
4 Air Conditioning	Review of Psychrometry and Air-conditioning processes- Comfort air conditioning and Cooling load calculations - Applications of AC systems	**6**
5 Application & Duct Design	Concept of enthalpy potential - Air washers, Cooling towers, Evaporative condensers, Cooling and dehumidifying coils, Duct Sizing & Design	**6**
6 ARS	Air Refrigeration System (ARS): Bell-Coleman refrigerator. COP determination, actual air refrigeration cycle.	**4**
Total Hours (36 L)		

Text Books:
1. Stocker & Jones, Refrigeration and Air Conditioning, McGraw Hill.
2. C. P. Arora, Refrigeration and Air Conditioning.
3. P. L. Ballaney, Refrigeration and Air Conditioning.
4. R. C. Arora, Refrigeration and Air Conditioning, TMH.
5. Arora and Domkundwar, Refrigeration and Air Conditioning, Dhanpat Rai Publication.

CO – PO/PSO Mapping:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	2	2	3	-	-	2	-	-	-	-	2	3	2	-
CO 2	3	2	2	-	-	-	-	-	-	-	2	2	2	2	-
CO 3	3	3	3	-	-	-	-	-	-	-	-	3	3	3	-
CO 4	3	2	3	-	-	-	3	-	-	-	2	2	2	2	-
Avg	3	2.25	2.5	3	-	-	2.5	-	-	-	2	2.25	2.5	2.25	-

Course Name: Composite Materials
Course Code: ME505A
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisite: Engineering Materials

Course Outcomes:
CO1: Know the structure and basic properties of composite and nano-composite materials.
CO2: Explore and understand the several methods of composite fabrication.
CO3: Predict the characteristics and performance of composite materials.
CO4: Apply varying composite materials in automotive, aerospace and other applications.

Module	Syllabus	Contact Hours
1 Introduction to composites	Definition and applications of composite materials, Fibers-glass, carbon, ceramic and aramid fibers; Matrices-polymer, graphite, ceramic and metal matrices; characteristics of fibers and matrices. Lamina-assumptions, macroscopic viewpoint, generalized Hookes law, reduction of homogeneous orthotropic lamina, isotropic limit case, orthotropic stiffness matrix, commercial material properties, rule of mixtures, transformation matrix, transformed stiffness.	10
2 Characterization of Composites	Basic assumptions of laminated anisotropic plates, symmetric laminates, angle ply laminates, crossply laminates, laminate structural moduli, evaluation of lamina properties, determination of lamina stresses, maximum stress and strain criteria, von Mises Yield criterion for isotropic materials, generalized Hill's criterion for anisotropic materials, Tsai-Hill's criterion for composites, prediction of laminate failure, thermal analysis of composite laminates	10
3 Performance Analysis of Composites	Analysis of laminated plates- equilibrium equations of motion, energy formulation, static bending analysis, buckling analysis, free vibrations, natural frequencies	8
4 Fabrication and application of Composites	Manufacturing of composite materials, bag molding, compression molding, pultrusion, filament welding, other manufacturing processes, Industrial Application of Composite Materials	8
Total Hours (36 L)		

Text Books:
1. Composite materials, K.K. Chawala, 2nd ed., (1987) Springer-Verlag, New York.
2. Nanocomposite Science and Technology, P. M. Ajayan, L. S. Schadler, P. V. Braun, (2003),

Wiley-VCH Verlag GmbH Co. KgaA, Weinheim.
3. Mechanics and Analysis of Composite Materials, V.V. Vasiliev and E.V. Morozov, (2001), Elsevier Science Ltd, The Boulevard, Kidlington, Oxford OX5Lgb, UK.
4. Ceramic matrix composites, K.K. Chawala, 1st ed., (1993) Chapman & Hall, London.
5. Advances in composite materials, G. Piatti, (1978) Applied Science Publishers Ltd., London.

CO – PO/PSO Mapping:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	2	3	-	-	-	-	-	-	-	3	-	3	-	-
CO 2	2	-	-	-	2	-	-	-	-	-	2	-	3	-	2
CO 3	2	3	2	-	-	-	-	-	-	-	2	-	3	-	3
CO 4	2	-	2	-	2	-	-	-	-	-	2	-	2	-	3
Avg	**2.25**	**2.5**	**2.33**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**2.25**	**-**	**2.75**	**-**	**2.636**

Course Name: Solid Mechanics
Course Code: ME 505 B
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisite: Strength of Materials

Course Outcomes:

CO1: Understand the theory of elasticity including strain/displacement and Hooke's law relationships
CO2: Analyze solid mechanics problems using classical methods and energy methods;
CO3: Solve the problems in mechanical members like cylinder, disc etc under different types of loading.
CO4: Apply various failure criteria for general state of stress at points.

Course Contents:

Module	Syllabus	Contact Hrs
1 Introduction	Introduction to Cartesian tensors, Strains: Concept of strain, derivation of small strain tensor and compatibility, Stress: Derivation of Cauchy relations and equilibrium and symmetry equations, principal stresses and directions	**8**
2 Constitutive equations	Generalized Hooke's law, Linear elasticity, Material symmetry; Boundary Value Problems: concepts of uniqueness and superposition.	**8**
3 Analysis of stress and strain	Plane stress and plane strain problems, introduction to governing equations in cylindrical and spherical coordinates, axisymmetric problems.	**7**
4 Two-Dimensional classical elasticity	Application to thick cylinders, rotating discs, torsion of non-circular cross-sections, stress concentration problems, thermo-elasticity, 2-d contact problems.	**7**
5 Theory of plasticity	Solutions using potentials. Energy methods. Introduction to plasticity.	**6**
Total Hours (36 L)		

Text Books:
4. Irving H. Shames, Introduction to Solid Mechanics: Prentice Hall.
5. Stephen Timoshenko and J.N Goodier, Theory of Elasticity, 3rd Edition: McGraw Hill Book

Copany
3. Maceri, Aldo, Theory of Elasticity: Springer.
4. Ferdinand P. Beer, E. Russell Johnston, Jr and John T. DeWolf, Mechanics of Materials: Tata McGraw Hill Publishing Co. Ltd.

CO – PO/PSO Mapping:

COs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO 1	3	3	-	3	-	-	-	-	-	-	-	-	3	-	-
CO 2	2	3	3	3	-	-	-	-	-	-	-	2	3	-	-
CO 3	3	3	-	3	-	-	-	-	-	-	-	-	3	-	-
CO 4	3	3	-	3	2	-	-	-	-	-	-	-	3	-	-
Avg	**2.75**	**3**	**3**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**-**	**-**

Course Name: Computer Aided Design
Course Code: ME 505 C
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisite: Intro to Mechanical Engineering, Linear Algebra and concept of Programming

Course Outcomes:
CO1: Describe the mathematical basis of representing geometric entities like points, lines etc.
CO2: Create surface primitives using parametric modeling.
CO3: Apply geometric transformations on the created wireframe, surface and solid models.
CO4: Design and develop of mechanical components with CAD software.

Course Contents:

Module	Syllabus	Contact Hrs
1 Fundamentals of Computer Graphics	Product cycle, sequential and concurrent engineering, Computer Aided Design, CAD system architecture, computer graphics, Coordinate systems, 2D and 3D transformations, viewing transformation	9
2 Geometric Modeling	Representation of curves, Hermite curves, Bezier curves, B-spline curves, rational curves, Techniques of surface modelling, surface patch, Coons and bicubic patches, Bezier and B-spline surfaces, Solid modelling techniques, CSG and B-rep.	9
3 Visual realism	Hidden line-surface-solid removal algorithms, shading, colouring, computer animation	6
4 Assembly of parts	Assembly modelling, interferences of positions and orientation, tolerance analysis, mass property calculations, mechanism simulation and interefence checking CAD standards- Graphical Kernel System (GKS), standards for vexchange images, Open Graphics Library (OpenGL), Data exchange standards- IGES, STEP, CALS etc., Communication standards	12
Total Hours (36 L)		

Text Books:
1. M.P. Groover and E.W. Zimmers Jr., CAD/CAM, Prentice Hall of India
2. P.N. Rao, CAD/CAM, Tata McGraw Hill Publication.
3. Ibrahim Zeid, Mastering CAD CAM, Tata McGraw Hill Publishing Co.
4. C. McMohan and J. Browne, CAD/CAM Principles, II edition, Pearson Education.
5. W. M. Neumann and R.F. Sproul, Principles of Computer Gra[hics, McGraw Hill.
6. D. Hearn and M.P> Baker, Computer Graphics, Prentice Hall Inc.

CO – PO/PSO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	-	1	1	1	1	-	-	1	1
CO2	2	2	2	1	1	1	1	1	1	-	1	1
CO3	3	3	2	1	1	2	1	-	1	-	1	2
CO4	2	2	3	2	2	2	2	-	2	1	2	2

Course Name: Heat Transfer & Refrigeration Lab
Course Code: ME 591
Contact: 0: 0: 3
Credits: 1.5

Prerequisite: Heat Transfer, Refrigeration & Air Conditioning

Course Outcomes:
CO1: Evaluate the problems involving steady state conduction and convection in simple geometries.
CO2: Differentiate radiation capabilities of black and grey surfaces by practical observation
CO3: Analyze the effectiveness of heat exchanger and develop skills for industrial design solutions.
CO4: Design and evaluate the performance of refrigeration and air-conditioning systems

List of Experiments:
1. Determination of the thermal conductivity and specific heat of given objects
2. Determination of the thermal conductivity of insulating materials
3. Determination of the effectiveness of pin fin.
4. Determination of the convective heat transfer coefficient for flow over a heated plate
5. Determination of the emissivity of a given sample.
6. Determination of the effectiveness of a heat exchanger.
7. Determination of the performance characteristics of a vapour compression system
8. Determination of the performance characteristics air conditioning system.

CO – PO/PSO Mapping:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	-	-	-	-	-	-	-	-	-	2	3	3	-
CO2	2	2	2	-	-	-	-	-	-	-	-	-	2	2	-
CO3	3	3	-	-	-	-	-	-	-	-	-	-	3	3	-
CO4	3	3	2	3	-	-	2	-	-	-	-	2	3	3	-
Avg	**2.75**	**2.75**	**2**	**3**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**2**	**2.75**	**2.75**	**-**

Course Name: Manufacturing Technology Lab
Course Code: ME 592
Contacts: 0: 0: 3
Credits: 1.5

Prerequisite: Manufacturing Technology

Course Outcomes:

CO1: Demonstrate operation such as Turning, Facing, Threading, gear cutting on Centre Lathe and milling.

CO2: Analyze the cutting forces during metal cutting.

CO3: Understand principle of engineering metrology, measurement standards and instruments

CO4: Perform the job of an inspector and help the industries to produce quality products.

List of Experiments:

Experiment No.	Description
1	Taper turning and external thread cutting using lathe
2	Contour milling using vertical milling machine
3	Spur gear cutting in milling machine
4	Measurement of cutting forces in Milling/ Turning process
5	Use of Tool Maker's Microscope
6	Comparator and sine bar
7	Surface finish measurement equipment
8	Bore diameter measurement using micrometer and telescopic gauge
9	Use of Autocollimator

CO – PO/PSO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	-	2	-	3	-	-	-	3	-	3
CO2	3	2	2	2	3	-	-	-	2	-	-	-	3	-	2
CO3	3	3	3	2	3	-	-	-	2	-	-	-	-	-	3
CO4	3	2	2	2	2	-	2	-	2	-	-	-	3	-	2
Avg	3	2.5	2.5	2.25	**2.75**	-	2	-	2.25	-	-	-	**2.25**	-	2.5

Course Name: Technical Seminar Presentation
Course Code: MC 581
Contacts: 0:0:3
Credits: 0

Prerequisite: Basic Communication Skill

Course Outcomes:

CO1: Prepare technical seminar presentations in power point format which will be visually effective to reach any number of audiences.

CO2: Understand the methods of delivering and explaining technical terms through effective diagram selection and use of white board.

CO3: Analyze all core areas of Mechanical Engineering for variety of topics and enhance presentation skill by increasing level of detailing.

CO4: Produce confidence to face any audience, communicate with them in a disciplined manner and reply queries patiently

Course Articulation Matrix:

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

Course Contents:

Students in small groups or individual will prepare at least 5 power point presentations on any technical topic of engineering importance / Industrial equipment / case study etc, effectively present in front of the audience on weekly basis, submit a brief technical report during their presentations.

Detailed Syllabus- 6th Semester

6th Semester								
Sl No	**Course Type**	**Course Code**	**Theory**	**Contact Hours /Week**				**Credit Points**
				L	**T**	**P**	**Total**	
A. THEORY								
1	PC	ME601	Internal Combustion Engine and Gas Turbine	3	0	0	3	3
2	PE	ME602	A. Power Plant Engineering B. Finite Element Analysis C. Total Quality Management	3	0	0	3	3
3	OE	ME 603	A. Electrical Machines B. Database Management System C. Internet Of Things	3	0	0	3	3
4	OE	ME 604	A. Mechatronic Systems B. Computational Fluid Dynamics C. Fluid Power control	3	0	0	3	3
5	HS	HU601	Values & Ethics in Profession	2	0	0	2	2
Total of Theory							14	14
B. PRACTICAL								
6	PC	ME 691	Internal Combustion Engine Lab	0	0	3	3	1.5
7	OE	ME 692	A. Mechatronics Systems Lab B. Computational Fluid Dynamics Lab C. Fluid Power control Lab	0	0	3	3	1
7	PROJ	PR 691	Project-VI**	0	0	2	2	1
8	PROJ*	PR 692	Innovative activities-V	0	0	0	0	0.5
C. MANDATORY ACTIVITIES / COURSES								
10	MC	MC 681	Group Discussion	0	0	3	3	
Total of Theory, Practical & Mandatory Activities/Courses							**22**	**18**

*Students may choose either to work on participation in all the activities of Institute's Innovation Council for eg: IPR workshop/ Leadership Talks/ Idea/ Design/ Innovation/ Business Completion/ Technical Expos etc.

** Design and Modelling of 3D Machine Elements using AUTOCAD/SOLIDWORKS/CATIA/CREO

Innovative activities to be evaluated by the Programme Head/ Event coordinator based on the viva voce and submission of necessary certificates as evidence of activities.

Course Name: Internal Combustion Engine and Gas Turbine
Course Code: ME 601
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisite: Applied Thermodynamics, Fluid mechanics,

Course Outcomes:
CO1: Get the knowledge of engine nomenclature, performance parameters and characteristics of different fuels to differentiate several types of I C engine designs.
CO2: Understand real characteristics of engine performance parameters and several losses due to various operational constraints in the presence of fuel.
CO3: Predict performance and fuel economy trends with good accuracy, based on an in-depth analysis of the fuel air mixing and combustion process.
CO4: Develop an understanding of modern injection systems, cooling & lubrication systems and supercharging to optimize the thermal efficiency and emission standards.

Course Contents:

Module No.	Syllabus	Contact Hrs.
1 Engine Fundamentals	Classification and working of basic engine types: 2-stroke & 4-stroke Engines, SI & CI Engines, Engine Nomenclature, Performance parameters; Measurement of speed, torque, fuel consumption, IHP, BHP and FHP, SFC, thermal efficiency,	5
2 Fuel Air Cycle & Actual Cycle	Review of Air Standard Cycles, Fuel-Air cycles: Assumptions, Effect of specific heat & Dissociation, Performance analysis of fuel air cycle. Actual cycles: Assumptions, Heat Loss, Time loss and Blowdown loss, Optimum spark advance	6
3 Fuels & Combustion	Fuels: classification and desirable characteristics, HCV and LCV, Rating of fuels, Alternative fuels. Combustion of fuels in S.I and C.I engines, Parameters influencing combustion, Detonation and knocking in S.I. and C.I. engines and their preventions, Types of combustion chambers, Analysis of combustion product	7

4 Fuel Mixing, Injection and Ignition Systems	Fuel-Air mixing in SI Engines, Analysis of a simple carburetor, Disadvantages. Fuel injection systems: Working principle, Injection pumps and nozzles, electronic fuel injection system, MPFI systems, Ignition systems: ignition timing and spark advance, firing order.	8
5 Engine Cooling, Scavenging & Supercharging	Cooling and Lubrication: Properties of lubricating oil, Air and liquid cooling. Scavenging: ideal and actual, scavenging pumps, Supercharging and Turbo charging	5
6 Gas Turbines	Introduction to Gas Turbine Cycles & Performance, Effect of Intercooling, Reheating and Regeneration, Applications of Gas Turbines	5
Total Hours (36L)		

Text Books:

1. V. Ganesan, Internal Combustion Engines, The McGraw-Hill Companies.
2. M.L. Mathur and R.P. Sharma, A course in Internal Combustion Engines, Dhanpat Rai & Sons.
3. H.N. Gupta, Fundamentals of Internal Combustion Engines, PHI Learning Private Ltd.

Reference Books:

6. S.K. Som, Introduction to Heat Transfer, PHI.
7. Kreith, Principles of Heat Transfer, Cengage learning.
8. O.P. Single, Heat & Mass Transfer, Macmillan India.

CO – PO/PSO Mapping:

COs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	2	2	2	2	-	-	-	-	-	-	-	-	3	2	-
CO2	3	3	3	-	-	-	2	-	-	-	-	-	3	2	-
CO3	3	-	-	2	-	-	3	-	-	-	-	3	3	2	-
CO4	2	-	-	2	-	-	-	-	-	-	-	-	-	3	-
	2.5	2.5	2.5	2	-	-	2.5	-	-	-	-	3	3	**2.25**	-

Course Name: Power Plant Engineering
Course Code: ME 602A
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisite: Applied Thermodynamics

Course Outcomes:

CO1: Explore minute details of all components of coal based power plant including steam generation, fuel and ash handling equipment.
CO2: Understand the principle of steam and gas based turbines to analyze their performance for a of a variety of design conditions.
CO3: Describe brief functionalities of Nuclear, Hydel and other renewable energy based power plants.
CO4: Evaluate plant performance with the knowledge of plant economics.

Course Contents:

Module	Syllabus	Contact Hrs
1 Thermal Power Plant	Coal based thermal power plants, Coal properties, Combustion analysis, layout of modern coal power plant, super critical boilers, FBC boilers, turbines, condensers & Cooling Towers, Steam and heating rates, subsystems of thermal power plants, fuel and ash handling, draught system, feed water treatment, Losses in boilers, boilers efficiency binary cycles and cogeneration systems.	10
2 Steam Turbine	Steam turbine- Major classification, Nozzles types and efficiency, Impulse turbine - velocity diagram, work done and blade efficiency. Pressure compounding and velocity compounding of steam turbine. Impulse reaction turbine - Velocity diagram, degree of reaction and Parsons turbine. Governing in Steam turbine.	6
4 Combined Cycle Power Generation	Gas turbine and combined cycle power plants, Brayton cycle analysis and optimization, components of gas turbine power plants, combined cycle power plants, Integrated Gasifier based Combined Cycle (IGCC) systems.	5
5 Nuclear Power Plants	Basics of nuclear energy conversion, Layout and subsystems of nuclear power plants, Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANDU Reactor, Pressurized Heavy Water Reactor (PHWR), Fast Breeder Reactors (FBR), gas cooled and liquid metal cooled reactors, safety measures for nuclear power plants.	5
6 Hydel and Other plants	Hydroelectric power plants, classification, typical layout and components, principles of wind, tidal, solar PV and solar thermal, geothermal, biogas and fuel cell power systems.	6

7 **Plant Economics**	Energy, economic and environmental issues, power tariffs, load distribution parameters, load curve, capital and operating cost of different power plants, pollution control technologies including waste disposal options for coal and nuclear plants	4
Total Hours (36 L)		

Text Books:

1. P.K. Nag, "Power plant Engineering," Tata McGraw - Hill.
2. Arora and Domkundwar, "A course in Power Plant Engineering" Dhanpat Rai & Sons.
3. M. M. EI- Wakil, "Power plant technology," Tata McGraw - Hill.

CO – PO/PSO Mapping:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	3	-	-	2	2	-	-	-	-	-	3	2	-
CO2	3	2	-	-	-	2	2	-	-	-	-	-	3	3	-
CO3	2	2	3	-	-	2	2	-	-	-	-	-	3	2	-
CO4	2	2	-	-	-	2	2	-	-	-	-	-	3	3	-
Avg	2.5	2	1.5	-	-	2	2	-	-	-	-	-	3	2.5	-

Course Name: Finite Element Analysis
Course Code: ME 602B
Contact: 3:0:0
Total Contact Hours: 36L
Credit: 3

Course Outcomes:
CO 1: Understand of the fundamental theory of the FEA method.
CO 2: Develop the ability to generate the governing FE equations for systems governed by partial differential equations.
CO 3: Use of the basic finite element methods for structural applications using truss, beam frame, and plane elements.
CO 4: Analyze of the FE method and comparing result with FEA package like Ansys.

Course Contents:

Module No.	Syllabus	Contact Hrs.
1.	Introduction: Historical background, Relevance of FEM to design problems, Application to the continuum– Discretization, Matrix approach, Matrix algebra– Gaussian elimination, Governing equations for continuum, Classical Techniques in FEM, Weighted residual method, Ritz method, Galerkin method	8
2.	One dimensional problems: Finite element modeling– Coordinates and shape functions, Potential energy approach– Element matrices and vectors, Assembly for global equations, Boundary conditions, Higher order elements- Shapes functions, Applications to axial loadings of rods– Extension to plane trusses, Bending of beams– Finite element formulation of stiffness matrix and load vectors, Assembly to Global equations, boundary conditions, Solutions and Post processing, Example Problems.	8
3.	Two dimensional problems– scalar variable problems: Finite element modeling– CST element, Element equations, Load vectors and boundary conditions, Assembly, Application to heat transfer, Examples	4
4.	Two dimensional problems– vector variable problems: Vector Variable problems, Elasticity equations– Plane Stress, Plane Strain and Axisymmetric problems, Formulation, element matrices, Assembly, boundary conditions and solutions Examples	8

5.	Isoparametric elements for two dimensional problems: Natural coordinates, Iso parametric elements, Four node quadrilateral element, Shape functions, Element stiffness matrix and force vector, Numerical integration, Stiffness integration, Displacement and Stress calculations, Examples.	6
6.	Computer implementation: Pre-processor, Processor, Post-processor. Discussion about finite element packages.	2

Text Books:

1. R.D. Cook, D.S. Malkus and M.E. Plesha, Concepts and Applications of Finite Element Analysis, Prentice Hall-India, New Delhi.

2. T.R. Chandrupatla and A.D. Belegundu, Introduction to Finite Elements in Engineering, Prentice Hall of India.

3. C.S. Krishnamoorthy, Finite Element Analysis, TMH.

4. K-J. Bathe, Finite Element Procedures, Prentice Hall.

5. O.C. Zienkiewicz, R.L. Taylor, J.Z. Zhu, The Finite Element Method: Its Basis and Fundamentals, Elsevier.

6. J.N. Reddy, An Introduction to the Finite Element Method, McGraw-Hill.

CO – PO/PSO Mapping:

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

Course Name: Total Quality Management
Course Code: ME 602C
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3
Prerequisite: The behavioral sciences, Supply Chain and Process analysis.

Course Outcomes:
CO1: Understand the concept of Quality
CO2: Operate the methodologies, methods, and tools of lean manufacturing system.
CO3: Identify requirements of quality improvement programs.
CO4: Organize for quality and development of quality culture through small group activities.

Course Contents:

Module No.	Syllabus	Contact Hrs.
1 Introduction	Introduction, need for quality, evolution of quality; Definitions of quality, product quality and service quality; Basic concepts of TQM, TQM framework, contributions of Deming, Juran and Crosby. Barriers to TQM; Quality statements, customer focus, customer orientation & satisfaction, customer complaints, customer retention; costs to quality.	**8**
2 TQM Principles	TQM principles; leadership, strategic quality planning; Quality councils-employee involvement, motivation; Empowerment; Team and Teamwork; Quality circles, recognition and reward, performance appraisal; Continuous process improvement; PDCE cycle, 5S, Kaizen; Supplier partnership, Partnering, Supplier rating & selection.	**8**
3 Statistical Process Control	The seven traditional tools of quality; New management tools; Six sigma-concepts, methodology, applications to manufacturing, service sector including IT, Bench marking process; FMEA- stages, types.	**8**
4 TQM Tools	TQM tools and techniques, control charts, process capability, concepts of six sigma, Quality Function Development (QFD), Taguchi quality loss function; TPM- concepts, improvement needs, performance measures.	**8**
5 Quality System	Quality systems, need for ISO 9000, ISO 9001-9008; Quality system- elements, documentation,; Quality auditing, QS 9000, ISO 14000- concepts, requirements and benefits; TQM implementation in manufacturing and service sectors.	**4**
Total Hours (36 L)		

Text Books:

1. Paul James, Total Quality Management – An Introductory Text, Prentice Hall

2. Housen & Ghose, Quality Control and Applications.

3. O.P. Khanna, Industrial Engineering Management.

4. B. Dale, Total quality management, John Wiley & Sons, Ltd.

CO – PO/PSO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	2	2	3	3	3	3	3	1
CO2	3	3	3	3	3	2	1	1	1	1	3	2
CO3	3	3	3	1	1	2	1	3	3	3	3	1
CO4	3	3	3	2	3	3	3	2	2	3	3	1

Course Name **Electrical Machine**
Course Code **ME603A**
Course Credit **3:0:0**
Contact Hours **34 L**
Credit: 3

Pre-requisite Basic Electrical Engineering

Course Outcome : On completion of the course students will be able to
1. Understand and remember the working of any electrical machine under loaded and unloaded conditions.
2. Apply and explain the principle of operation and performance of DC machine, Three Phase Induction Motor, Synchronous Machine and Fractional kW Motors.
3. Analyze the response of DC machine, Three Phase Induction Motor, Synchronous Machine and Fractional kW Motors.
4. Evaluate the operation of DC machine, Three Phase Induction Motor, Synchronous Machine and Fractional kW Motors.

Course Content

Module No.	Syllabus	Contact Hrs.
1 DC Machines	EMF generated in the armature, OCC and Voltage build-up in d.c. generator - concept of critical resistance & critical speed. External Characteristics. Armature reaction - function of Interpoles & Compensating windings. Commutation process, Concept of back e.m.f. - Speed & Torque equation of d.c. motor, Speed control of DC motor, Losses and Efficiency, Application of d.c. Machine	**9**
2 3-Phase Induction machine	Construction of 3-phase induction motor. Production of rotating magnetic field (concept only) - Working principle of 3-phase induction motor. Concept of synchronous speed & slip. Phasor diagram (at no-load & running condition). Equivalent circuit - No-load and Blocked rotor test. Torque equation. Torque-slip characteristic. Power flow in 3-phase induction motor (Numerical). Speed control & Braking of Induction motor. Starting methods of 3-phase induction motor – DOL, Auto-transformer & Star-Delta starter. Industrial application of 3-phase Induction motor	**9**

3 Synchronous Machines	Construction & Types of synchronous machines. Method of excitation system. Working principle of synchronous machines - generator & motor modes. Armature reaction at different power factor - concept of synchronous reactance. Theory of salient pole machine, Two reaction theory Voltage regulation by synchronous impedance method (with Numerical). Synchronous machine connected to infinite bus, Synchronization of two or more alternators and an alternator with infinite bus. Load sharing between them. Principle of operation of synchronous motor- its starting techniques - Damper winding & Hunting. 'V' Curves – Synchronous condenser.	**9**
4 Fractional Kilowatt motors	Single phase Induction motor: Construction, Double revolving field theory. Starting methods, Speed - torque characteristics & Application Principle of operation & Application of Stepper motors Principle of operation of Welding Transformer	**7**
	Total Hours (34 L)	

Text Books:

1. P.S. Bhimra, Electrical Machinery, Khanna Publishers.
2. D.P. Kothari & I.J Nagrath, Electric machines, Tata Mc Graw-Hill Publishing Company Limited.
3. P.K. Mukherjee & S. Chakrabarty, Electrical Machines, Dhanpat Rai Publication.

Reference Books:

1. Bhag S. Guru and H.R. Hiziroglu, Electric Machinery & Transformers, Oxford University press.
2. R.K. Srivastava, Electrical Machines, Cengage Learning.
3. Alexander S Langsdorf, Theory of Alternating Current Machinery, Tata Mc Graw Hill.
4. M.G.Say, The performance and Design of Alternating Current Machines, CBS Publishers & Distributors.
5. Irving L Koskow, Electric Machinery & transformer, Prentice Hall India.

CO – PO/PSO Mapping:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO 1	2	3	2	3	2	2	-	-	-	-	-	-	-	3	2
CO 2	-	2	3	2	3	3	-	-	-	2	-	-	-	3	-
CO 3	2	3	3	2	3	-	3	-	-	-	-	-	-	2	-
CO 4	-	-	3	1	2	-	-	-	-	2	-	-	-	2	3
Avg	**2**	**2.66**	**2.75**	**2**	**2.5**	**2.5**	**3**	**-**	**-**	**2**	**-**	**-**	**-**	**2.5**	**2.5**

Course Name: Database Management System
Course Code: ME 603B
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisites:
1. Logic of programming language
2. Basic concepts of data structure and algorithms

Course Outcomes (COs):
CO1: Apply the knowledge of Entity Relationship (E-R) diagram for an application.
CO2: Create a normalized relational database model
CO3: Analyze real world queries to generate reports from it.
CO4: Determine whether the transaction satisfies the ACID properties.
CO5: Create and maintain the database of an organization.

Course Contents:

Module No.	Syllabus	Contact Hrs.
1 Introduction	Concept & Overview of DBMS, Data Models, Database Languages, Database Administrator, Database Users, Three Schema architecture of DBMS.	**3**
2 Entity-Relationship and Relational Database Model	Basic concepts, Design Issues, Mapping Constraints, Keys, Entity-Relationship Diagram, Weak Entity Sets, Extended E-R features, case study on E-R Model. Structure of relational Databases, Relational Algebra, Relational Calculus, Extended Relational Algebra Operations, Views, Modifications Of the Database.	**9**
3 SQL and Integrity Constraints	Concept of DDL, DML, DCL. Basic Structure, Set operations, Aggregate Functions, Null Values, Domain Constraints, Referential Integrity Constraints, assertions, views, Nested Subqueries, Database security application development using SQL, Stored procedures and triggers.	**6**
4 Relational Database Design	Functional Dependency, Different anomalies in designing a Database., Normalization using functional dependencies, Decomposition, Boyce-Codd Normal Form, 3NF, Normalization using multi-valued dependencies, 4NF, 5NF , Case Study	**6**

5 Internals of RDBMS	Physical data structures, Query optimization: join algorithm, statistics and cost bas optimization. Transaction processing, Concurrency control and Recovery Management: transaction model properties, state serializability, lock base protocols; two phase locking, Dead Lock handling	**6**
6 File Organization & Index Structures	File & Record Concept, Placing file records on Disk, Fixed and Variable sized Records, Types of Single-Level Index (primary, secondary, clustering), Multilevel Indexes	**6**
Total Hours (36 L)		

Text Books:

1. Henry F. Korth and Silberschatz Abraham, "Database System Concepts", Mc.Graw Hill.
2. Elmasri Ramez and Novathe Shamkant, "Fundamentals of Database Systems", Benjamin Cummings
Publishing. Company.

Reference Books:

1. Jain: Advanced Database Management System CyberTech
2. Date C. J., "Introduction to Database Management", Vol. I, II, III, Addison Wesley.
3. "Fundamentals of Database Systems", Ramez Elmasri, Shamkant B.Navathe, Addison Wesley Publishing Edition
4. Gray Jim and Reuter Address, "Transaction Processing : Concepts and Techniques", Moragan Kauffman Publishers.
5. Ullman JD., "Principles of Database Systems", Galgottia Publication.

CO-PO/PSO Mapping:

CO s	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2				3						3	3
CO2		3	3	3	3		3	3			3	3
CO3	3					2	2	2	3	3	3	3
CO4	3	3	2	2	2			2	2	2		3
CO5	3	3	3	3	3				3	3	3	3

Course Name: Internet of Things
Course Code: ME 603C
Contact: 3:0:0
Total Contact Hours: 36L
Credit: 3

Prerequisites: Fundamental knowledge in computer networking and wireless sensor network.

Course Outcome:
CO1: To understand the concepts of Internet of Things.
CO2: To analyze basic protocols in wireless sensor network.
CO3: To design IoT applications in different domain and be able to analyze their performance.
CO4: To implement basic IoT applications on embedded platform.

Course Contents:

Module No.	Syllabus	Contact Hrs.
1 Fundamental of IoT	The Internet of Things, Time for Convergence, Towards the IoT Universe, Internet of Things Vision, IoT Strategic Research and Innovation Directions, IoT Applications, Future Internet Technologies, Infrastructure, Networks and Communication, Design challenges, Development challenges, Security challenges, Other challenges.	**7**
2 IoT and M2M	A Basic Perspective– Introduction, Some Definitions, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT, The international driven global value chain and global information monopolies. M2M to IoT-An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations.	**7**
3 Wireless Sensor Network	Network and Communication aspects, Wireless medium access issues, MAC protocol, routing protocols, Sensor deployment and Node discovery, Data aggregation and dissemination.	**6**
4 IoT Architecture	Introduction, Architecture Reference Model- Introduction, Reference Model and architecture, IoT reference Model, IoT Reference Architecture- Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views.	**7**

5 IoT Applications for Value Creations	Introduction, IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications, Four Aspects in your Business to Master IoT, Value Creation from Big Data and Serialization, IoT for Retailing Industry, IoT For Oil and Gas Industry, Opinions on IoT Application and Value for Industry, Home Management, Real-time monitoring and control of processes - Deploying smart machines, smart sensors, and smart controllers with proprietary communication and internet technologies, Maximize safety, security and reliability through high precision automation and control, Advanced Metering Infrastructure (AMI), Smart Inverters, Remote control operation of energy consuming devices.	**5**
6 IoT Privacy, Security and Governance	Introduction, Overview of Governance, Privacy and Security Issues, Trust in IoT-Data-Platforms for Smart Cities, First Steps Towards a Secure Platform, Smartie Approach. Data Aggregation for the IoT in smart cities, Security.	**4**
Total Hours (36 L)		

Text Books:

1. Vijay Madisetti and Arshdeep Bahga, ―Internet of Things (A Hands-on-Approach)‖, 1st Edition, VPT, 2014.
2. Francis daCosta, ―Rethinking the Internet of Things: A Scalable Approach to Connecting Everything‖, 1st Edition, Apress Publications, 2013.

Reference Books:

1. Cuno Pfister, Getting Started with the Internet of Things, O‟Reilly Media, 2011, ISBN: 978-1-4493-9357-1
2. Waltenegus Dargie,Christian Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice‖.

CO-PO/PSO Mapping:

CO s	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	3	-	-	-	-	-	1	2
CO2	2	3	3	3	3	-	3	3	-	-	1	2
CO3	1	-	-	-	-	2	2	2	3	3	1	2
CO4	1	3	2	2	2	-	-	2	2	2	-	2
CO5	2	3	3	3	3	-	-	-	3	3	1	2

Course Name: Mechatronics Systems
Course Code: ME 604A
Contact: 3:0:0
Total Contact Hours: 36L
Credit: 3

Prerequisite: Fluid Mechanics, Basic Electronics

Course Outcomes
CO1: Describe Mechatronics systems and have an overview of the types of actuators.
CO2: Distinguish between various sensors, transducers, actuators and their applications.
CO3: Understand the basic concept of microprocessor.
CO4: Interpret various signal conditioning units, amplifiers, logic gates and their role in Programmable logic controllers.

Course Contents:

Module No.	Syllabus	Contact Hrs.
1. Introduction	Definition of Mechanical Systems, Philosophy and approach; Systems and Design: Mechatronic approach, Integrated Product Design, Modeling, Analysis and Simulation, Man-Machine Interface;	**3**
2. Sensors and transducers	classification, Development in Transducer technology, Opto-electronics- Shaft encoders, CD Sensors, Vision System, etc.	**6**
3. Drives and Actuators	Hydraulic and Pneumatic drives, Electrical Actuators such as servo motor and Stepper motor, Drive circuits, open and closed loop control; Embedded Systems: Hardware Structure, Software Design and Communication, Programmable Logic Devices, Automatic Control and Real Time Control Systems;	**5**
4. Smart Materials	Shape Memory Alloy, Piezoelectric and Magnetostrictive Actuators: Materials, Static and dynamic characteristics, illustrative examples for positioning, vibration isolation, etc. Mechatronic systems such as automatic brake, door closing and opening, robot, CNC machine, AGV, etc.	**6**
5. Micromechatronic systems	Microsensors, Microactuators; Micro-fabrication techniques LIGA Process: Lithography, etching, Micro-joining etc. Application examples; Case studies Examples of Mechatronic Systems from Robotics Manufacturing, Machine Diagnostics, Road vehicles and Medical Technology.	**6**

6. Introduction to Microprocessors	Introduction to 8085 Functional Block Diagram, Registers, ALU, Bus systems, Timing and control signals. Assembly Language Programming: Addressing modes, Instruction set, simple programs in 8085; Programmable peripheral interface (8255). Use of On-Off, PI and PID controllers to control different drives, Programming in PLC controller. Use of Ladder diagram	**6**
Total Hours (36 L)		

Text Books:

1. W. Bolton, Mechatronics, Pearson Education
2. Mechatronics System Design, Devdas Shetty & Richard A. Kolk, PWS Publishing Company (Thomson Learning Inc.)
3. Mechatronics: A Multidisciplinary Approach, William Bolton, Pearson Education
4. A Textbook of Mechatronics, R.K.Rajput, S. Chand & Company Private Limited

Reference Books:

1. Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, William Bolton, Prentice Hall
2. N.P. Mahalik, Mechatronics, Tata McGraw Hill Publication
3. K. Ogata, Modern Control Engineering, Prentice Hall.
4. B.C. Kuo, Automatic Control Systems, Prentice Hall.

CO-PO/PSO Mapping:

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

Course Name : COMPUTATIONAL FLUID DYNAMICS
Course Code: ME 604B
Contact: 3:0:0
Total Contact Hours: 34L
Credit: 3

Prerequisite: Fluid Mechanics, Finite Element Methods

Course Outcomes:
CO1: Understand the conservation equations and boundary conditions of fluid flow for varying cases.
CO2: Explore and analyze finite difference and finite volume methods of discretization.
CO3: Apply several computational solution methods based on finite element analysis.
CO4: Recognize the need and application of new methods in computational fluid dynamics.

Course Contents:

Module	Syllabus	Contact Hours
1. **Introduction**	Conservation equation; mass; momentum and energy equations; convective forms of the equations and general description. Boundary and initial conditions; overview of numerical methods.	6
2. **Finite Difference Technique**	Finite difference methods; different means for formulating finite difference equation; Taylor series expansion; treatment of boundary conditions; boundary layer treatment; accuracy of f.d. method.	6
3. **Finite Volume Technique**	Finite volume methods; different types of finite volume grids; approximation of surface and volume integrals; interpolation methods; central, upwind and hybrid formulations and comparison for convection-diffusion problem.	5
4. **Finite Element Methods**	Finite element methods; Rayleigh-Ritz, Galerkin and Least square methods; interpolation functions; one and two dimensional elements; applications.	5
5. **Methods of Solution**	Solution of finite difference equations; iterative methods; matrix inversion methods; ADI method; operator splitting; fast Fourier transform.	6
6. **Time integration Methods**	Single and multilevel methods; predict or corrector methods; stability analysis; Applications to transient conduction and advection-diffusion problems. Basics of numerical grid generation.	6
Total Hours (34 L)		

References:
1. S. V. Patankar, Numerical Heat Transfer and Fluid Flow, McGraw-Hill. T. J. Chung, Computational Fluid Dynamics, Cambridge University Press.
2. H. K. Versteeg & W. Malalasekera, An Introduction to Computational Fluid Dynamics, Longman

Scientific & Technical. J. H. Ferziger and M. Peric, Computational Methods for Fluid Dynamics, Springer.
3. John C. Tannehill, Dale A. Anderson and Richard H. Pletcher, Computational Fluid Mechanics and Heat Transfer
4. Taylor &Francis. John D.Anderson Jr, Computational Fluid Dynamics, McGraw Hill Book Company

CO-PO/PSO Mapping:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	2	2	2	-	2	3	-	-	-	-	3	2	-	1
CO 2	2	-	2	-	-	2	3	-	-	-	-	2	2	-	3
CO 3	2	-	1	-	-	2	3	-	-	-	-	2	3	-	2
CO 4	-	-	-	-	-	2	3	-	-	-	-	3	**2**	-	3

Course Name: Fluid Power Control
Course Code: ME 604 C
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisite: Fluid Mechanics, Basic Electronics

Course Outcomes:
CO1: Understand the working principle of hydraulic and pneumatic systems.
CO2: Analyze the performance of pumps and actuators used in control devices.

CO3: Apply hydraulic valves in different industrial application.

CO4: Design and evaluate fluid powered control circuits and express through proper drawing.

Course Contents:

Module No.	Syllabus	Contact Hrs.
1 Introduction	Introduction to Fluid power; Hydraulic power generation and transmission. Applications and advantages; Components of a hydraulic and pneumatic system. Desired properties of a hydraulic fluid; advantage of mineral oil over water; definition of terms like pressure, head, force, density, specific gravity, kinematic and absolute viscosity, compressibility and incompressibility, Pascal's law; analysis of simple hydraulic jack, Mechanical advantage;	**6**

	continuity equation; hydraulic power of a cylinder.	
2 Hydraulic pumps, accumulators and intensifiers	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.	**6**
3 Actuators	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, flow rate, and hydraulic motor performance; numerical problems. Symbolic representation of hydraulic actuators. Application of cylinder through mechanical linkages; force, velocity and Power from a cylinder.	**7**
4 Components and hydraulic circuit design Components	Classification of control valves, Directional Control Valves-symbolic representation, sliding spool, 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. Hydraulic Circuit Design: Control of single and Double - acting hydraulic cylinder, 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. Pilot pressure operated circuits. Hydraulic circuit examples with accumulator	**7**
5 Pneumatic control circuits	Simple Pneumatic Control: Direct and indirect actuation pneumatic cylinders, speed control of cylinders – supply air throttling and exhaust air throttling. Signal Processing Elements: Use of Logic gates – OR and AND gates in pneumatic applications. Practical examples involving the use of logic gates. Multi- Cylinder Application: 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).	**6**
6 Electro-Pneumatic Control	Principles – signal input and output, pilot assisted solenoid control of directional control valves, use of relay and contactors. Control circuitry for simple signal cylinder application. Gives an overview of control systems associated with Electro hydraulic and pneumatic applications.	**4**
Total Hours (36 L)		

Text Books:

1. Anthony Esposito, Fluid Power with applications, Prentice Hall international, 1997.
2. Ahmed Abu Hanieh, Fluid Power Control: Hydraulics and pneumatics, Cambridge International Science Publishing.
3. Andrew Parr, Hydraulics and pneumatics, Jaico Publishing House, 2003.

CO – PO/PSO Mapping:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	2	2	-	-	-	-	-	-	-	-	-	2	-	1
CO 2	3	2	2	2	-	-	-	-	-	-	-	-	2	-	3
CO 3	3	3	3	2	-	-	-	-	-	-	-	-	3	-	2
CO 4	3	3	2	2	-	-	-	-	-	-	-	-	**2**	-	3
	3	**2.5**	**2.25**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2.25**	**-**	**2.25**

Course Name: Values and Ethics in Profession
Course Code: HU 601
Contact: 2:0:0
Total Contact Hours: 24
Credit: 2

Prerequisites: Basic knowledge of engineering and management.

Course Outcome: On Completion of this course student will be able to

CO1. Understand the core values that shape the ethical behavior of an engineer and Exposed awareness on professional ethics and human values.

CO2. Understand the basic perception of profession, professional ethics, various moral issues

CO3. Understand various social issues, industrial standards, code of ethics and role of professional ethics in engineering field

CO4. Aware of responsibilities of an engineer for safety and risk benefit analysis, professional rights and responsibilities of an engineer.

CO5. Acquire knowledge about various roles of engineers in variety of global issues and able to apply ethical principles to resolve situations that arise in their professional lives.

Course Contents:

Module 1: Introduction 4L

Definition, Relevance, Types of values, changing concepts of values, Concept of Morals and Ethics, Work ethic – Service learning – Civic virtue, Stress Management -Concept of stress, causes and consequences, managing stress.

Module 2: Theories of Self Development 4L

Emotional Intelligence (EI): Concept, Importance and Measurement, Concept of Motivation, Maslow's theory, Kohlberg's theory.

Module 3: Moral and Ethical Concerns 4L

Variety of Moral Issues, Moral Dilemmas, Nature of values, Value Crisis in contemporary society, Value Spectrum of a good life, Steven Covey's Pursuit of Excellence

Module 4: Engineering Ethics 4L

Engineering profession: Ethical issues in Engineering practice, Conflicts between business demands and professional ideals, Social and ethical responsibilities of Technologists, Codes of professional ethics, Ethical and Unethical practices – case studies, Whistle blowing and beyond, Case studies.

Module 5: Technology and Sustainable Development 8L

Rapid Technological growth and depletion of resources, Reports of the Club of Rome, Limits of growth, Sustainable Development, Energy Crisis, Renewable Energy Resources, Environmental degradation and pollution, Environmental Regulations, Environmental Ethics and appropriate Technology, Movement of Schumacher, Problems of Technology transfer, Technology assessment impact analysis, Human Operator in Engineering projects and industries, Problems of man, machine, interaction, Impact of assembly line and automation.

Text / Reference Books:

1. Stephen H Unger, Controlling Technology: Ethics and the Responsible Engineers, John Wiley & Sons, New York 1994 (2nd Ed)
2. Deborah Johnson: Ethical Issues in Engineering, Prentice Hall, Englewood Cliffs, New Jersey 1991.
3. A N Tripathi: Human values in the Engineering Profession, Monograph published by IIM, Calcutta 1996.
4. S. K. Chakraborty: Values and Ethics in Organization, OUP
5. Caroline Whitbeck: Ethics in Engineering Practice and Research, Cambridge University Press
6. Jaysree Suresh and B.S Raghavan: Human values and Professional Ethics, S. Chand Publication

CO-PO/PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	1	1	1	1	2	-	-
CO2	-	-	-	-	-	1	1	3	1	2	-	-
CO3	-	-	-	-	-	3	2	3	-	1	-	-
CO4	-	-	-	-	-	3	2	1	-	-	-	-
CO5	-	-	-	-	-	3	2	2	-	1	3	-

Course Name: Internal Combustion Engine Lab
Course Code: ME 691
Contacts: 3P
Credits: 2

Prerequisite: Applied Thermodynamics, Internal Combustion Engine

Course Outcomes:
CO1: Understand the practical operation of 2 stroke and 4 stroke I.C engines using valve timing diagram
CO2: Analyze the performance of multi cylinder engines with the variation of various performances like load and speed.
CO3: Determine the quality of Engine fuels by analyzing its calorific value.
CO4: Analyze the constituents of combustion products for emission characteristics related to public safety.

Course Contents:

Experiment No.	Description
1	Study of cut models of Two stroke and four stroke Petrol and Diesel Engines.
2	Study of valve timing diagram of Petrol & Diesel Engine.
3	Determination of flash point and fire point of sample oil.
4	Determination of calorific value of a fuel by Bomb calorimeter.
5	Performance Test of a Diesel Engine using Mechanical and Electrical dynamometer.
6	Morse Test on multi cylinder petrol engine by electrical break dynamometer.

CO – PO/PSO Mapping:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	2	2	2	-	-	-	-	-	-	-	-	3	2	-
CO2	3	3	3	-	-	-	-	-	-	-	-	-	3	3	-
CO3	3	-	-	2	-	-	-	-	-	-	-	-	3	-	-
CO4	2	-	-	2	-	-	-	-	-	-	-	-	-	-	-
Avg	2.5	2.5	2.5	2	-	-	-	-	-	-	-	-	3	2.5	-

Course Name: Mechatronics lab
Course Code: ME692B
Contacts: 0: 0: 3
Credits: 2

Prerequisite: Fluid Mechanics, Basic Electronics, Mechatronics Theory

Course Outcomes:

CO1: Describe and demonstrate Mechatronics systems and overview of control systems & actuators.
CO2: Distinguish between various sensors, transducers and actuators and their applications.
CO3: To understand the basic concept of microprocessor and perform simple operations on it.
CO4: Identify various signal conditioning units, amplifiers, logic gates and their role in programmable logic controllers

List of Experiments

1. Open loop position control;
2. Closed loop position control using positional and velocity feedback;
3. Use of analog and digital servosystems,
4. Use of PID control;
5. Experiments on pneumatic drives and actuators;
6. Experiments on hydraulic drives and actuators;
7. Use of logic gates;
8. Programming on a 8085 Microprocessor training kit.
9. Programming on a PLC for simple control operations.

Course Articulation Matrix:

CO Codes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	1		2		1				2	1	2				
CO2	1		2		1					1	3	1	2		1
CO3	1		2		2					1	2				
CO4	2		3		1					1	3		1		1
Avrg.	**1.25**		**2.25**		**1.25**				**0.5**	**1**	**2.5**	**0.25**	**0.75**		**0.5**

Course Name: Fluid Power Control Lab
Course Code: ME 692 C
Contacts: 0: 0: 3
Credits: 1

Prerequisite: Fluid Power Control

Course Outcomes:

CO1: Demonstrate the devices such as pumps, compressor, valves, actuators and sensors etc.
CO2: Differentiate hydraulic and pneumatic circuits.
CO3: Apply fluid control valves in different industrial application.
CO4: Design and evaluate fluid powered control circuits and express through proper drawing.

List of Experiments:

Experiment No.	Description
1	Study of Basic hydraulic circuits for the working of single and double acting cylinder, hydraulic pump and hydraulic motor.
2	To Study of Basic pneumatic circuits for the working of single and double acting cylinder, Compressor.
3	To Study of control valve (PCV, DCV, FCV) in a circuit for the working of single and double acting cylinder in a hydraulic and pneumatic system.
4	To Studies of Circuits for the Use of different direction control valves and valve actuation in single and double acting cylinder, and multi actuation circuit.
5	To Study and perform of Speed control circuits. Different Metering methods Inlet & outlet flow control (meter-in& meter-out circuit).
6	To Study Hydraulic or Pneumatic Sequencing circuit with magnetic sensor with Clamp, Direction Control Valves (Manual/External/Solenoid Operated), Flow Control Valves, Roller Lever Valve, Rapid Release Valve.
7	To perform AND & OR logic gate for a double acting cylinder using two cylinders by manual control.
8	To operate Two double acting cylinders, (Sequence of operation A+B+A-B-) using manual control & electrohydraulic control.
9	Study of circuit with cam operated pilot valves operating a pilot operated 4way direction control Valve or proximity/ limit switches, solenoid operated 4way direction control valve for Auto reversing circuit.

CO – PO/PSO Mapping:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO	3	2	2	-	-	-	-	-	-	-	-	-	2	-	1

1															
CO 2	3	2	2	2	-	-	-	-	-	-	-	-	2	-	3
CO 3	3	3	3	2	-	-	-	-	-	-	-	-	3	-	2
CO 4	3	3	2	2	-	-	-	-	-	-	-	-	**2**	-	3
Avg	**3**	**2.5**	**2.25**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2.25**	**-**	**2.25**

Course Name: Group Discussion
Course Code: MC 681
Contact Hours: 2P
Credit: 0

Course Outcomes:
CO1: Communicate effectively in an interview
CO2: Grow leadership and negotiation skills.
CO3: Learn discipline, body language, positive attitude and ethics to follow whole life.

Course Contents:
Students in small groups will perform discussion on educational, societal, economic and current affairs.
Group of students will discuss on a given topic or debate demonstrating their communication and interpersonal skills.

CO – PO/PSO Mapping:

CO Codes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	1	1	-	-	**1**	-	1	-	3	2	2
CO2	1	1	1	-	-	**1**	-	1	-	3	2	2
CO3	1	1	1	-	-	1	-	1	-	3	2	2

Detailed Syllabus - 7th Semester

7th Semester								
Sl No	**Course Type**	**Course Code**	**Theory**	**Contact Hours/Week**				**Credit Points**
				L	**T**	**P**	**Total**	
A. THEORY								
1	HS	HU 704	Principle of Management	2	0	0	2	2
2	PC	ME 701	Advanced Manufacturing Technology	3	0	0	3	3
3	PE	ME 702	A. Materials Handling B. Design Of Transmission System C. Nuclear Power Generation & Supply	3	0	0	3	3
4	PE	ME 703	A. Renewable Energy System B. Tribology C. Reliability & Maintenance	3	0	0	3	3
5	OE	ME 704	A. Operations Research B. Robotics C. Biomechanics & Biomaterials	3	0	0	3	3
Total of Theory							**14**	**14**
B. PRACTICAL								
6	PC	ME 791	Advanced Manufacturing Lab	0	0	3	3	1.5
7	PROJ	PR 791	Project-VII (Part 1)	0	0	6	6	3
8	PROJ	PR 792	Minor Project**	0	0	3	3	1.5
9	PROJ*	PR 793	Innovative activities-VI	0	0	0	0	0.5
C. MANDATORY ACTIVITIES / COURSES								
10	MC	MC 781	Behavioural and Interpersonal Skills	0	0	3	3	
Total of Theory, Practical & Mandatory Activities/Courses							**29**	**20.5**

*Students may choose either to work on participation in Hackathons etc. Development of new product/ Business Plan/ registration of start-up.
Students may choose to undergo Internship / Innovation / Entrepreneurship related activities. Students may choose either to work on innovation or entrepreneurial activities resulting in start-up or undergo internship with industry/ NGO's/ Government organizations/ Micro/ Small/ Medium enterprises to make themselves ready for the industry/ Long Term goals under rural Internship. (Duration 4-6 weeks)

Innovative activities to be evaluated by the Programme Head / Event Coordinator based on the viva voce and submission of necessary certificates as evidence of activities.

** PR792 - Part Modelling, Assembly, Design & Simulation of Mechanical Systems based on Structural and Thermal Hydraulic analysis using ANSYS/SOLIDWORKS/CATIA/NASTRAN/SOLIDEDGE or similar software.

DETAILED SYLLABUS OF 7TH SEMESTER COURSES

Theory Courses

Course Name: Principles of Management
Course Code: HU 704
Contact hour: 2L
Total contact hour- 24
Credits: 2
Prerequisites: NIL

Course outcome:
On completion of the course students will be able to
CO1: To recall and identify the relevance of management concepts.
CO2: To apply management techniques for meeting current and future management challenges faced by the organization
CO3: To compare the management theories and models critically to solve real-life problems in an organization.
CO4: To apply principles of management in order to execute the role as a manager in an organization.

Course Content:
Module-1: Management Concepts: Definition, roles, functions and importance of Management, Evolution of Management thought-contribution made by Taylor, Fayol, Gilbreth, Elton Mayo, McGregor, Maslow **(4L)**

Module - 2: Planning and Control: Planning: Nature and importance of planning, -types of planning, Levels of planning - The Planning Process. –
MBO, SWOT analysis, McKinsey's7S Approach.
Organizing for decision making: Nature of organizing, span of control, Organizational structure –line and staff authority.
Basic control process -control as a feedback system – Feed Forward Control –
Requirements for effective control – control **(4L)**

Module - 3: Group dynamics: Types of groups, characteristics, objectives of Group Dynamics.
Leadership: Definition, styles & functions of leadership, qualities for good leadership, Theories of leadership **(4L)**
Module – 4: Work Study and work measurement: Definition of work study**,** Method Study Steps, Tools and Techniques used in the Method Study and Work Measurement Time Study: Aim & Objectives, Use of stopwatch procedure in making Time Study. Performance rating, allowances and its types. Calculation of Standard Time. Work sampling **(4L)**
Module - 5: Marketing Management: Functions of Marketing, Product Planning and development, Promotional Strategy **(2L)**
Module - 6: Quality management: Quality definition, Statistical quality control, acceptance sampling, Control Charts –Mean chart, range chart, c chart, p chart, np chart, Zero Defects, Quality circles, Kaizen & Six Sigma, ISO -9000 Implementation steps, Total quality management **(6L)**

Text Books:

1. Essentials of Management, by Harold Kooritz & Heinz Weihrich Tata McGraw
2. Production and Operations Management-K. Aswathapa, K. Shridhara Bhat, Himalayan Publishing House

References:

1. Organizational Behavior, Stephen Robbins Pearson Education, New Delhi

2. New era Management, Daft, 11th Edition, Cengage Learning

3. Principles of Marketing, Kotlar Philip and Armstrong Gary, Pearson publication

CO – PO/PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1									3		3	
CO2						2		3	3		3	3
CO3									2		3	3
CO4						2			3		3	

Course Name: Advanced Manufacturing Technology
Course Code: ME 701
Contact: 3:0:0
Contact Hours: 36
Credit: 3
Prerequisite: Manufacturing Process.

Course Outcomes:

1. Learn the basics of automation and its application in flexible manufacturing systems.
2. Understand the principle of CNC machines and learn their programming language.
3. Evaluate the process parameters involved in machining process and analyze their effect on surface finish achieved in various nonconventional processes.
4. Get an overview of rapid prototyping and use of 3D printing.

Course Contents

Module No.	Syllabus	Contact Hrs.
1	Introduction to Advanced Manufacturing Technology Manufacturing Systems and Automation: Job shop, Flow lines, Transfer lines, Project shop, Continuous processes, Cellular manufacturing system, Flexible Manufacturing System. Automation: (i) degree of automation and their justified application in different levels of production (ii) benefits and draw backs of employing automation (iii) examples of conventional non-automatic, semi-automatic and automatic machine tools (iv) extent of automation in transfer machines Integrated Manufacturing System: Steps involved in implementation, forming the linked-cell factory, Introduction to Robotics for its implementation in manufacturing	10
2	Basic systems of NC and CNC machines: coordinate system, control – open loop and closed loop, dimensioning – absolute and incremental CNC machine tools ; structure and working principle machining centre (MC) – characteristics and applications. Control of tool – work travel, point – to – point and contouring, interpolation – linear and circular Part programming for NC, CNC and MC systems, Codes used, sequential steps, examples; part programming for machining in CNC lathes, drilling machines and milling, Computer aided part programming, advantages, programming languages, statements in APT, examples	8
3.	Non Traditional Manufacturing -Advantages, classification, characteristics Abrasive Jet Machining (AJM): principle, material removal rate Water Jet Machining, Applications, Advantages and limitations. Ultrasonic Machining (USM): Working principle, Influence of Process parameters, Applications. Plasma Arc Machining- principle, applications. Chemical Machining- Blanking, Design factors, advantages and	12

	disadvantages. Electro-Chemical Machining, Applications. Electrical Discharge Machining (EDM), Wire-cut EDM: working principle, Dielectric fluid, Advantages & Disadvantages. Electron Beam Machining Principle and Applications. Die sinking. Laser Beam Machining (LBM): Characteristics of Ruby laser, Carbon Dioxide laser, Welding Heat treating, cladding. Hybrid Machining	
4.	Rapid Prototyping- Overview of Rapid Prototyping, Basic Process- CAD Model Creation, Conversion to STL format, Slice the STL File, Layer by layer construction, Clean and finish. Principles, systems, relative advantages and applications of the common RP methods; (i) stereo lithography (SLG) (ii) selective laser sintering (SLS) (iii) fused deposition modeling (FDM) (iv) laminated objects manufacturing (LOM) (v) 3-D Inkjet Printing	6

Text Books :

1. Fundamentals of Modern Manufacturing by Mikeel P. Grover– 3E Wiley
2. Automation, Production systems and CIM – M.P. Groover, Prentice Hall
3. Non-conventional machining – P.K. Mishra, Narosa
4. Manufacturing science – Ghosh & Mullick, EWP

References :

5. Rapid prototyping – A. Ghosh, EW Press
6. Non-traditional Manufacturing Processes by Gary F. Benedict– Marcel Dekker
7. Micromaching of Engineering Material by McGeogh, J.A. – Marcel Dekker
8. Advanced Machining Process, Non-traditional and Hybrid Machining Processes by Hassan Abdel- Gawad El- Hofy – McGraw Hill, Mechanical Engineering Science

CO – PO/PSO Mapping:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO 1	3	2	3	3	3	-	2	-	-	-	3	3	3	-	3
CO 2	3	2	2	2	3	-	-	-	-	-	2	2	3	-	-
CO 3	3	-	3	2	3	-	-	-	-	-	2	3	-	-	2
CO 4	3	3	2	2	2	-	2	-	-	-	2	2	3	-	-
Avg	3	2.5	2.5	**2.25**	**2.75**	-	2	-	-	-	**2.25**	2.5	**2.25**	-	**1.25**

Course Name: Materials Handling
Course Code: ME 702A
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3
Prerequisite: Manufacturing Technology, Kinematics & Dynamics of Machines.

Course Outcomes:
CO1: Understand the importance of material handling and plant layout.
CO2: Study the design procedures of various material handling equipment & component.
CO3: Analyse the variety of load & selection of material handling system based on application through general analysis procedure.
CO4: Apply the fundamentals of load lifting, automation and auxiliary equipment in material handling with proper design consideration.

Course Contents:

Module No.	Syllabus	Contact Hrs.
1	**Introduction:** Elements of Material Handling System-Importance, Terminology, Objectives and benefits of better Material Handling; Principles and features of Material Handling System; Interrelationships between material handling and plant layout, physical facilities and other organizational functions; Classification of Material Handling Equipment.	4
2	**Study of Systems & Material Handling Equipment:** Objectives of storage; Bulk material handling; Gravity flow of solids through slides and chutes; Storage in bins and hoppers; Belt conveyors Bucket-elevators; Screw conveyors; Vibratory Conveyors; Cabin conveyors; Mobile racks, etc. **Auxiliary Equipment:** Descriptive specification and use of – (i) Slide and trough gates, (ii) belt, screw and vibratory feeders, (iii) positioners like elevating platform, ramps, universal vice; (v) ball table	10
3	**Selection of Material Handling Equipment**: Factors affecting for selection; Material Handling Equation; Choice of Material Handling Equipment; General analysis Procedures; Basic Analytical techniques; The unit load concept; Selection of suitable types of systems for applications; Activity cost data and economic analysis for design of components of Material Handling Systems; functions and parameters affecting service; packing and storage of materials	8
4	**Hoisting Equipment:** Advantage of using steel wire rope over chain; constructional features of wire ropes; Rope drum design; Pulley system-simple vs. multiple pulley; Load handling attachments: hooks, grabs, tongs, grab bucket; Arrangement of hook suspension with cross piece and pulleys (sheaves); Use and constructional features of (i) hand operated trolley hoist, (ii) winch; (iii) bucket elevator, (iv) Jib crane, (v) overhead traveling crane and (vi) wharf crane; Level luffing system of a wharf crane; Utility of truck mounted and crawler crane. Safety	10

	precautions.	
5	**Robotic Handling:** Materials handling at workplace; Major components of a robot; Applications of robotic handling.	**4**

Text Books:

1. S. Ray, Introduction to Materials Handling, New Age Int. Pub.
2. T. K. Ray, Mechanical Handling of Materials, Asian Books Pvt. Ltd.
3. T.H. Allegri, Materials Handling: Principles and Practices, CBS Publishers and Distributors.
4. J.A. Apple, Material Handling System Design, John Wiley & Sons

CO – PO/PSO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	3	1	1	-	2	2	2	-	1	1
CO2	3	2	1	-	-	1	-	1	-	-	1	2
CO3	3	2	3	2	1	2	1	1	-	-	1	1
CO4	3	1	3	2	1	2	1	1	1	-	1	2

Course Name: Design of Transmission Systems
Course Code: ME 702B
Contact: 3:0:0
Contact Hours: 36
Credit: 3
Prerequisite: Theory of Machine
Course Outcomes:

1. Recognize the importance of transmission systems for engines and machines.
2. Design transmission systems for engines and machines.
3. Evaluate their abilities in Key areas such as car bodies, heavy machineries etc.
4. Analyze each part of transmission mechanism for optimum design.

Course Contents:

Module No.	Syllabus	Contact Hrs.
1.	Flexible transmission elements- design of flat belts & pulleys, selection of V-belts and pulleys, selection of hoisting wire ropes and pulleys, design of chains and sprockets. Use of Data Books and Standards.	4
2.	Gear transmission- speed ratios and number of teeth, force analysis, tooth stresses, dynamic effects, fatigue strength, factor safety, gear materials; Design of straight tooth spur gear and parallel axis helical gears based on strength and wear considerations, pressure angle in the normal and transverse plane; equivalent number of teeth and forces for helical gears. Use of Data Books and Standards.	8
3.	Straight bevel gear- tooth terminology, tooth forces and stresses, equivalent number of teeth. Estimating the dimensions of a pair of straight bevel gears; Worm gear, merits & demerits, terminology, thermal capacity, materials, forces & stresses, efficiency, estimating the size of worm gear pair. Cross helical gears, terminology, helix angles, sizing of a pair of helical gears. Use of Data Books and Standards.	8
4.	Gear box- geometric progression, standard step ratio; Ray diagram, kinematics layout; Design of sliding mesh gear box- Design of multispeed gear box for machine tool applications; constant mesh gear box, speed reducer unit; Variable speed gear box; Fluid couplings, Torque converters for automotive applications. Use of Data Books and Standards.	8
5.	Cam design, types: pressure angle and undercutting base circle determination, forces and surface stresses; Design of plate clutches, axial clutches, cone clutches, internal expanding rim clutches; Electromagnetic clutches; Band and Block brakes, external shoe brakes, internal expanding shoe brake. Use of Data Books and Standards.	8

Text Books:

1. Shigley J., Mischke C., Budynas R. and Nisbett K., Mechanical Engineering Design, 8th ed., Tata McGraw Hill, 2010.
2. Jindal U.C., Machine Design: Design of Transmission System, Dorling Kindersley, 2010.
3. Maitra G. and Prasad L., Handbook of Mechanical Design, 2nd ed., Tata McGraw Hill, 2001.

CO – PO/PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2			2		2			1	2
CO2	3	2	3			1					1	2
CO3	2	2	2	1		1					1	2
CO4	3	2	1	1		2		1			1	1

Course Name: NUCLEAR POWER GENERATION AND SUPPLY
Course Code: ME 702 C
Contact: 3:0:0
Contact Hours: 36
Credit: 3
Prerequisite: Physics, Chemistry, Heat Transfer, Power plant Engineering.
Course Outcomes:
1. Detailed knowledge of nuclear reactor types and associated systems
2. Analyze variety of nuclear power plants based on fission and fusion.
3. Evaluate the safety assessments and waste management.
4. Design and simulate equivalent conditions for practical problem solving.

Course Contents:

Module No.	Syllabus	Contact Hrs.
1.	Basics of a Nuclear Power Generation, energy from fission and fusion reactions	4
2.	**Systems in nuclear reactor:** Reactor fuel system: Natural and enriched fuels, sources, merits and demerits of different fuels for reactor use, fabrication, handling of fuels and irradiated fuels, fuel management, storage, reprocessing of irradiated fuels. Reactor shutdown systems: Materials for reactor control and choices, liquid vs. solid shut down systems, design aspects Primary heat transport (cooling) system: Heat generation and distribution, Coolant characteristics, Selection of coolants, Coolant Circuit, Core thermal hydraulics, Decay heat removal system. Reactor structure: Core composition, Reflector, Reactor vessel, Safety vessel, Shielding. Thermal, biological, Shield cooling system, Moderator system: Materials, Selection, Design consideration, Circuit, Radioactivity aspects. Cover gas system: Purpose, Selection of material, Design considerations, Circuit. Reactor regulating system: Purpose, Methodology, Design considerations, Actuating mechanism.	10
3.	**Reactor Design:** Principles, Safety classifications, Seismic quality group, Loading considerations under normal operations, design basis accidents such as earthquake, loss of coolant accident (LOCA), blackout, flood, missiles, operator error, Safety features for server accidents, standards, software, verifications etc.	6
4.	**Nuclear power plants:** Types. Thermal reactors: BWR, PWR, PHWR, GCR, APWR, AHWR etc. Fast reactors Breeders; Fusion power; Off-land NPPs - space power unit, nuclear ships, submarines. Economics of NPPs: Various costs, ROI, Sizing, Operational characteristics.	8

5.	**Radiation protection:** Radiation hazard, Exposure pathways, dose unit, measurement, CRP Radioactive Waste Management: Waste categorization, Generation, Handling of wastes.	4
6.	Reactor Stages and Safety Assurances: Nuclear safety assurance.	4

Text Books:

1. A.K. Raja, A.P. Srivastava & M. Dwivedi, An Introduction on Nuclear Engineering,
2. Glasstone & Sesons- Nuclear Engineering.
3. P.K. Nag., Nuclear Power Plant, Power Plant Engg. (Steam & Nuclear)
4. Arora & Domkundwar, A course in Power Plant Engg.

CO – PO/PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	1		1	1				1	1
CO2	2	1	1	2		2	1				1	2
CO3	2	2	3	1		3	2				1	2
CO4	1	1	1	1	2	3	2				2	2

Course Name : Renewable Energy Systems
Course Code : ME 703A
Contact 3:0:0
Total Contact Hours : 36
Credits : 3

Prerequisite: Thermodynamics, Power Plant Engineering

Course Outcomes: On successful completion of the course, the learner will be able to
1.Create awareness among students about renewable sources of energy and application of renewable technologies in different areas of country.
2. Understand the working principle of various renewable energy technologies and systems like solar, wind, tidal and geothermal resources.
3. Explain the knowledge of Storage technologies from renewable energy sources.
4. Recognize the need and application of alternative biofuels in the field of power production.

Course Contents:

Module No.	Syllabus	Contact Hrs.
1.	Principles of Renewable Energy: The history and future of energy scenario, Sustainable Development and role of renewable energy, Scientific Principles of renewable energy. Review of principles: thermodynamics, fluid dynamics and heat transfer	4
2.	Solar radiation: (i) Sun-Earth geometry (ii) Extra-terrestrial Solar Radiation (iii) Measurement and estimation of solar radiation. Photovoltaic Generation: (i) Photon absorption at Silicon p-n junction (ii) Solar Cell (iii) Application and Systems. Designing a solar system and its implementation.	8
3.	Solar Water Heating: (i) Flat Plate Collectors: Heat Transfer analysis, Testing (ii) Evacuated Tube Collectors. Applications: (i) Air heaters (ii) Water Desalination (iii) Space Cooling (iv) Solar Concentrators (v) Solar ponds. Designing a solar heating system and its implementation.	7
4.	Wind Power: Wind Turbine types & Principles, Calculation of Power production from Wind mills, Betz Criteria	4
5.	Wave Power & tidal Power: Basic Concepts of Wave Power, Tidal Basins, Determination of energy conversion. Ocean Thermal Energy Conversion.	5
6.	Geothermal Energy: Location and Extraction, Petrothermal systems, Geothermal energy based vapor power cycles	4
7.	Biomass & Bio fuels: (i) Use of Biomass (ii) Classification & Use of Bio fuels. Energy Storage, Pumped Hydro Systems	4

Text Books:

1. Renewable Energy – G. Boyle, 2nd edition, OUP, 2010.
2. Renewable Energy Resources- Twidell, J & Weir, T, 2nd edition, Taylor & Francis, 2006.
3. Non-Conventional Energy Resources- B.H. Khan, T M H, 2010.
4. Non-Conventional Energy Sources- G.D. Rai, Khanna Publishers.

CO – PO/PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	2	-	2	3	-	-	-	-	3
CO2	2	-	2	-	-	2	3	-	-	-	-	2
CO3	2	-	1	-	-	2	3	-	-	-	-	2
CO4	-	-	-	-	-	2	3	-	-	-	-	3

Course Name: TRIBOLOGY
Course Code: ME 703B
Contact: 3:0:0
Contact Hours: 36
Credit: 3
Prerequisites: Machine Design

Course Outcomes: On successful completion of the course, the learner will be able to
1. Become familiar with mathematical tools used to analyze Tribological processes.
2. Have awareness of Tribological issues in the design of machine components, such as rolling element bearings, journal bearings, thrust bearings, seals, and braking systems.
3. Become familiar with common anti-friction and anti-wear components.
4. Design a Tribological system for optimal performance.

Course Contents:

Module No.	Syllabus	Contact Hrs.
1.	Introduction: History, Industrial Importance. Engineering Surfaces: Properties and Measurement: Measurement Methods, Surface Profilometry, Statistical Description of Roughness.	4
2.	Surface Contact: Hertz contact theory, Greenwood-Williamson model, Elastic-plastic contact. Adhesion: Basic Models, Factors influencing Adhesion.	5
3.	Friction: Measurement Methods, Origin of Friction, Friction Theories – adhesion and ploughing, Mechanisms, Friction of Metals, Non-metallic Materials.	4
5.	Surface Engineering: Surface Treatments: Microstructural and Thermochemical Treatments, Surface Coatings: Hard Facing, Vapour Deposition Processes: PVD, CVD, PECVD etc.	5
6.	Lubrication: Basic Equations for Fluid Film Lubrication. Hydrodynamic lubrication -Thrust and Journal bearings, Squeeze Film Bearings, Hydrostatic lubrication, Gas-Lubrication. Lubrication of rolling element bearings. Boundary lubrication – metal working lubrication, solid film lubrication. Hygiene of lubricants.	8
7.	Nanotribology: Measurement Tools: Surface Force Apparatus, Scanning Tunneling Microscope, Atomic / Friction Force Microscope.	4

Text Books:

1. P. Sahoo, Engineering Tribology, Prentice Hall-India, New Delhi, 2009.
2. B. Bhushan, Introduction to Tribology, Wiley, 2002.
3. G W Stachowiak and A W Batchelor, Engineering Tribology, Butterworth-Heinemann,2005.
4. S.K. Basu, S.N. Sengupta, B.B. Ahuja, Fundamentals of Tribology, Prentice Hall-India, 2005.
5. B C Majumdar, Introduction to Tribology of Bearings, S Chand & Co, 2012.

CO – PO/PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12
CO1	3	2	2	1								1
CO2	2	1	1	1								1
CO3	3	2	1	2								1
CO4	2	1	2	1								1

Course Name: Reliability & Maintenance
Course Code: ME703C
Contact: 3:0:0
Contact Hours: 36
Credit: 3
Prerequisite: Strength of Material, Machine Design, Measurement and Instrumentation

Course Outcomes: On successful completion of the course, the learner will be able to
1. Get Basic knowledge about types and procedure of maintenance, instruments and tools.
2. Understand organizational and economic structure of maintenance.
3. Evaluate of performance of tools associated with maintenance and lubrication.
4. Design maintenance tools for various applications like bearings, drives, pumps, piping etc.

Course Contents:

Module No.	Syllabus	Contact Hrs.
1.	Introduction: Definitions of repair and maintenance; Importance of maintenance; Different maintenance systems with examples - breakdown, preventive, planned; predictive maintenance through condition monitoring; Bath Tub Curve, RCM, Maintainability, failure pattern, availability of equipment/systems, design for maintainability.	5
2.	Total Productive Maintenance (TPM): Definition, objective & methodology; Implementation of TPM; Lean maintenance; Overall equipment effectiveness (OEE) Reliability and machine availability – MTBF, MTTR and MWT – Factors of availability –Maintenance organization – Maintenance economics.	5
3.	Organizational structures for maintenance: Objective; Maintenance functions and activities; Organizational requirements; Types of maintenance organizations, Manpower planning; Engineering stores & inventory management.	4
4.	Economic Aspect of Maintenance: Life cycle costing; Maintenance cost & its impact; Maintenance budget; Cost control; Maintenance audit- Procedure, tools, planning, reports.	4
5.	Function and use of Maintenance Equipment, Instruments & Tools: Tools like different types of wrenches, torque wrench, pipe wrench, plier, screw driver, dimension measuring instruments, feeler gauge, scraper, fitting shop tools, spirit level, hand grinder & drill, screw jack, etc. Facilities like NDT, painting, coating and cladding, Gas cutting and welding, crack detection, vibration monitor, balancing equipment, compressor, basic machine tools, lubricators and lubricants, chain pulley block.	6
6.	Lubrication: Purpose & importance; Type of lubricants, Properties of lubricants; Types of lubrication and their typical applications, lubrication devices, centralized lubrication system; Gasket, packing and seals.	4
7.	Repair & Maintenance Procedures: Repair of cracks, threads, worn shafts, keyways, bush bearing, damaged gear	8

	tooth. Assembly and dismantling of antifriction bearing; Maintenance of bearing, clutches, coupling, brakes, Alignment of shafts, belt and chain drives, gear drives, centrifugal pump, pipe and pipe fittings, electrical wiring, isolators and main switches, small induction motors; Steps for installation of a machine.	

Text Books:

1. Mishra and Pathak, Maintenance Engineering and Management, PHI
2. Srivastava, Maintenance Engineering and Management, S. Chand & Company Ltd., New Delhi.
3. K. Venkataraman, Maintenance Engineering and Management, PHI

CO – PO/PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	2	-	-	3	-	-	-	-	2	-	-	3	2
CO2	3	-	3	-	-	3	-	-	-	-	3	-	-	3	3
CO3	3	-	3	-	-	3	-	-	-	-	3	-	-	3	-
CO4	2	-	2	-	-	3	-	-	-	-	2	-	-	2	-
Avg	2.5	-	2.5	-	-	3	-	-	-	-	2.5	-	-	2.75	2.5

Course Name: Operations Research
Course Code: ME 704 A
Contact: 3:0:0
Contact Hours: 36
Credit: 3
Prerequisite: LPP

Course Outcomes: On successful completion of the course, the learner will be able to:

CODE	DESCRIPTION
CO1	Understand the characteristics of different types of decision-making environments to formulate and solve a real-world problem as a mathematical programming model.
CO2	Understand the theoretical workings of appropriate decision making approaches and tools to identify the optimal strategy in competitive world.
CO3	Solve network models like the shortest path, minimum spanning tree, and maximum flow problems
CO4	Create Model of a dynamic system as a queuing model and compute important performance measures.

Course Contents:

Module No.	Syllabus	Contact Hrs.
1.	**Introduction:** Brief history; different O.R. problems and techniques, Inventory control, Metaheuristics	2
2.	**Decision Theory:** Structure of the problem (decision table); Decision making under uncertainty with optimistic, pessimistic and average outcome criteria; Decision making under risk with expected value and expected loss criteria; Sequential decision using decision trees.	4
3.	**Linear Programming (LP):** Nature of LP problems through examples; Formulation of LP Problems; Graphical solutions of two decision variable problems; Properties of a solution to LP problems: convex solution space and extreme point solution; General form of LP model; Simplex method and its meaning; Steps of simplex method in tabular form; Solving LP problems by Simplex Method; Sensitivity analysis.	6
4.	**Project Evaluation:** PERT, CPM	2
5.	**Transportation & Assignment Problems:** Nature of a transportation or distribution problem; Tabular representation of a transportation problem; North-West Corner initial solution; Stepping stone method; Concept of dummy source or destination; Vogel's approximation method. Nature of an Assignment problem; Tabular representation; Hungarian method for solving assignment problems.	6
6.	**Network Analysis:** Network models and terminologies like arcs, nodes, paths, tree, spanning tree; shortest path/route problem; The minimum spanning tree problem; The maximal flow problem.	5
7.	**Waiting Line Problems:** Structure of a waiting line System: Single-channel waiting line, process of arrivals, distribution of service times, queue discipline, steady stage operation; Single channel model with Poisson arrivals	6

	and exponential service time; Multiple channel model with Poisson arrival and exponential service times; Single channel model with Poisson arrivals and arbitrary service time (M/G/1); Economic analysis of waiting lines	
8.	**Non-Linear Programming:** Graphical illustration; Unconstrained optimization by (i) direct search method, (ii) steepest decent method; Constrained optimization by Lagrange multipliers; Integer linear programming by branch & bound technique; Dynamic programming problems and their characteristics.	5

Text Books:

1. Kanti Swarup, P.K. Gupta and Man Mohan, Operations Research, Sultan Chand & Sons, New Delhi.
2. I.A. Taha, Operations Research: An Introduction, Pearson Publication
3. C.K. Musatfi, Operations Research, New Age International Publishers
4. S.S. Rao, Engineering Optimization, New Age International Publishers
5. R. Panneerselvam, Operations Research, Prentice Hall of India
6. F.S. Hillier and G.J. Lieberman, Introduction to Operations Research, The McGraw Hill Companies.

Course Articulation Matrix:

POs / COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	3	3	-	-	-	-	-	-	-	-	-	3	-	3
CO2	-	-	-	3	-	-	-	-	-	-	-	2	3	-	3
CO3	2	2	-	2	-	-	-	-	-	-	-	2	-	-	3
CO4	-	-	3	-	-	-	-	-	-	-	-	2	-	-	3
Avg	2	2	3	2.5	-	-	-	-	-	-	-	2	**3**	**-**	**3**

Course Name: Robotics
Course Code: ME 704 B
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3
Prerequisite: Basic Electronics, mechanism, manufacturing technology.

Course Outcomes: Upon successful completion of this course, students will be able to
CO1: Understand the various robot structures and their workspace.
CO2: Learn about robot kinematics.
CO3: Analyze the different control drives in robot operation system.
CO4: Apply programming for controlling the robotic operation.

Course Contents:

Module No.	Syllabus	Contact Hrs.
1	**Introduction:** Brief history of robotics; definition of robot; Main components of robot: manipulator, sensors, controller, power conversion unit; Robot geometry: types of joints, workspace, number of degrees of freedom; Common configurations used in arms: rectangular, cylindrical, spherical, joined; Classification of robot according to coordinate system: cartesian, cylindrical, polar, articulated or jointed; Classification of robots according to control method: non-servo, servo; Robot specifications: payload, accuracy, repeatability resolution, maximum tip speed, reach stroke:	7
2	**Robot kinematics:** Definition of Robot kinematics, Tool frame and base frame. Forward kinematics, Inverse kinematics, Describing position and orientation of an object in space, Homogenous transformation, Translational transformations, Rotational transformations, Denavit-Hartenberg representation.	6
3	**End effectors:** End effectors- classification- mechanical, magnetic, vacuum and adhesive gripper- gripper force analysis and design. Robot control- Unit control system concept- servo and non-servo control of robot joints, adaptive and optimal control.	5
4	**Robot actuators:** Definition; Characteristics: power to weight ratio, stiffness, compliance, reduction gears; Conventional actuators: hydraulic actuator, pneumatic actuator, electric motor, direct drive motor, stepper motor, servo motor; Special actuators: magnetostrictive, shape memory alloy, elastomer.	4
5	**Robot Sensors:** Sensor devices, Types of sensors- contact, position and displacement sensors, Force and torque sensors- Proximity and range sensors- acoustic sensors- Robot vision systems- Sensing and digitizing-Image processing and analysis.	5
6	**Robot Programming:** Robot language classification- programming methods- off and on line programming- Lead through method-Teach pendent method- VAL systems and language, simple program.	4
7	**Industrial Application:** Application of robots- Material handling-Machine loading and unloading, Assembly, Inspection, Welding, Spray painting, Mobile robot, Microbots- Recent developments in robotics- safety consideration.	5

Text Books:

1. S.R. Deb, Robotics Technology and Flexible Automation, Tata McGraw-Hill Publication, New Delhi, 1994.
2. M.P. Groover. Industrial Robotics Technology Programming and Applications, McGrawHill Book Co, Singapore, 1987.
3. S. K. Saha, Introduction to Robotics, McGraw-Hill Publication, 2014.
4. Y. Koren, Yoram, Robotics for Engineers, McGraw-Hill Book Company, Singapore.
5. W. Stadler, Analytical Robotics and Mechatronics, McGraw Hill Book Co., 1995.

CO – PO/PSO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	1	-	-	-	-	1	1	-	-
CO2	2	1	1	2	1	-	-	1	-	1	2	1
CO3	2	2	2	1	1	1	-	-	-	-	1	1
CO4	2	1	2	2	1	1	-	1	-	-	2	3

Course Name: Biomechanics & Biomaterials
Course Code: ME 704C
Contact: 3:0:0
Contact Hours: 36
Credit: 3
Prerequisite: Engineering Mechanics, Materials engineering

Course Outcomes: On successful completion of the course, the learner will be able to
1. Understand the fundamentals of biomechanics and its relation with human motion.
2. Apply a broad knowledge of different types of biomaterials including metals, polymers, ceramics and composites and their use in typical biomedical devices and clinical applications.
3. Design an implant using fundamental concept and modern engineering tools to develop hard tissue and soft tissue replacement materials by suitable material selection.
4. Analyze the design of various biocompatible implants and artificial organ to develop and improve Health Care Service to serve mankind and society.

Course Contents:

Module No.	Syllabus	Contact Hrs.
1	**Musculoskeletal Anatomy**: Basic Statics and Joint Mechanics (elbow, shoulder, spine, hip, knee, ankle)	6
2	**Basic Dynamics to Human Motion**: Review of linear and angular kinematics; Kinetic equations of motion; Work & energy methods; Momentum methods; Examples in biomechanics; Modern kinematic measurement techniques; Applications of human motion analysis Structure, Function, and Adaptation of Major Tissues and Organs	6
3	**Fundamental Strength of Materials in Biological Tissues**: Introduction to Viscoelasticity, Fundamentals of biomaterials science, Concept of biocompatibility, Classes of biomaterials used in medicine, basic properties, medical requirements and clinical significance, Disinfection and sterilization of biomaterials.	6
4	**Physico-chemical properties of biomaterials**: Mechanical (elasticity, yield stress, ductility, toughness, strength, fatigue, hardness, wear resistance), tribological (friction, wear, lubricity), morphology and texture, physical (electrical, optical, magnetic, thermal), chemical and biological properties	6
5	**Elements in contact with the surface of a biomaterial**: Blood composition, plasma proteins, cells, tissues. Phenomena at the biointerfaces. Molecular and cellular processes with living environment, blood-materials interaction, short and long term reactions to the body.	6
6	**Testing of biomaterials**: in vitro, in vivo preclinical and in vivo clinical tests. Technologies of biomaterials processing, as implants and medical devices; improvement of materials biocompatibility by plasma processing.	6

Text Books:

1. Fundamentals of Biomechanics: D V Knudson, Springer.
2. Fundamentals of Biomechanics: Equilibrium, Motion, and Deformation, by Ozkaya and Nordin, Springer.
3. Biomechanics: Mechanical Properties of Living Tissues, by Fung, Springer
4. Basic Biomechanics of the Musculoskeletal System, by Nordin& Frankel, Barnes & Noble.
5. Biomaterials Science, An Introduction to Materials in medicine, Eds. B. D. Ratner and A. S. Hoffman, Academic Press, New York.

CO – PO/PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1									2
CO2	2	2	1	1					1			3
CO3	1	2	2	1	2				2			3
CO4	1	3	3	2	1	2	1		1		2	3

Practical Courses

Course Name: Advanced Manufacturing Lab
Course Code: ME791
Contact: 0:0:3
Contact Hours: 36
Credit: 2
Course Outcomes: After successful completion of the course, the student would be able to

1. Program a CNC turning or milling machine for preparing a job.
2. Evaluate the process parameters involved in CNC machining
3. Analyze the principles of Robot programming and carryout hands-on practice
4. Study any nonconventional machining process and 3D printing.

Course Contents:
1) Programming on CNC Lathe.
2) Programming on CNC Milling Machine
3) Study of geometry of robot manipulator, actuators and grippers
4) Robot Programming.
5) Parametric Study of Electric-Discharge Machining
6) Study of AJM/USM/ECM

CO – PO Mapping

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	3	3	-	2	-	3	-	-	-	3	-	3
CO2	3	2	2	2	3	-	-	-	2	-	-	-	3	-	2
CO3	3	3	3	2	3	-	-	-	2	-	-	-	-	-	3
CO4	3	2	2	2	2	-	2	-	2	-	-	-	3	-	2
Avg	3	2.5	2.5	2.25	**2.75**	-	2	-	2.25	-	-	-	**2.25**	-	2.5

Course Name: Behavioural & Interpersonal Skills
Course Code: MC-381
Contact: 3:0:0
Total Contact Hours: 36

Course Outcome:
CO1: It will equip the student to handle workplace interpersonal communication in an effective manner.
CO2: To enable students with strong oral and written interpersonal communication skills.
CO3: To prepare students to critically analyze workplace situations and take appropriate decisions.
CO4: To make students campus ready through proper behavioral and interpersonal grooming.
CO5: Integration of enhanced skill set to design and frame team based Project Report and Presentation.

Course Content:
MODULE ONE – INTERPERSONAL COMMUNICATON
1. The skills of Interpersonal Communication.
2. Gender/Culture Neutrality.
3. Rate of Speech, Pausing, Pitch Variation and Tone.
4. Corporate Communication.
5. Branding and Identity.

MODULE TWO- INTERPERSONAL COMMUNICATION BASED ON WORKPLACE COMMUNICATION
6. Workplace Communication.
7. Modes of Communication (Telephone, Conference Call, Team Huddle, Public Relation etc.)
8. Communication with Clients, Customers, Suppliers etc.
9. Organizing/Participating in Business Meeting.
10. Note Taking.
11. Agenda.
12. Minutes.

MODULE THREE – BUSINESS ETIQUETTE AND CORPORATE LIFE
13. Presenting oneself in the Business Environment.
14. Corporate Dressing and Mannerism.
15. Table Etiquette (Corporate Acculturation, Office parties, Client/Customer invitations etc.)
16. E-mail Etiquette.
17. Activity based Case Study.

MODULE FOUR – MOVIE MAKING: CORPORATE BUSINESS MEETING
18. Team based Brainstorming.
19. Process Planning and Developing Plot.
20. People management.
21. Documentation and Scripting.
22. Shooting the Movie: Location and Camera.
23. Post Production and Editing.
24. Movie Review: Feedback and Analysis

REFERENCE BOOKS:

1. Interpersonal Communication, Peter Hartley, Routledge, 1993.
2. Workplace Vagabonds: Career and Community in Changing Worlds of Work, Christina Garsten, Palgrave Macmillan, 2008.
3. Transnational Business Cultures Life and Work in a Multinational Corporation, Fiona Moore, Ashgate, 2005.
4. Global Business Etiquette: A Guide to International Communication and Customs, Jeanette S. Martin and Lillian H. Chaney, Praeger Publishers, 2006.
5. Making Teams Work: 24 Lessons for Working Together Successfully, Michael Maginn, McGraw-Hill, 2004.
6. Corporate Communications: Convention, Complexity, and Critique, Lars Thøger Christensen, Mette Morsing and George Cheney, SAGE Publications Ltd., 2008.
7. The Business Meetings Sourcebook: A Practical Guide to Better Meetings and Shared Decision Making, Eli Mina, AMACOM, 2002.
8. Moving Images: Making Movies, Understanding Media, Carl Casinghino, Delmar, 2011.

Detailed Syllabus of 8th Semester Courses

8th Semester								
Sl. No	**Course Type**	**Course Code**	**Theory**	**Contact Hours /Week**				**Credit Points**
				L	**T**	**P**	**Total**	
A. THEORY								
1	HS	HU 803	Industrial & Financial Management	2	0	0	2	2
2	PE	ME 801	A. Automobile Engineering B. Turbomachinery C. Gas Dynamics & Jet Propulsion	3	0	0	3	3
3	OE	ME802	A. 3D Printing and Design B. Nanotechnology C. Industrial Instrumentation D. Energy Conservation & Management	3	0	0	3	3
4	OE	ME803	A. Artificial Intelligence B. Safety & Occupational Health C. Microprocessor Application in Automation D. Introduction to Electric Vehicles	3	0	0	3	3
Total of Theory							**11**	**11**
B. PRACTICAL								
5	PROJ	PR 891	Project-VII (Part II)	0	0	0	6	3
C. MANDATORY ACTIVITIES / COURSES								
6	MC	MC 801	Essence of Indian Knowledge Tradition	3	0	0	3	
Total of Theory, Practical & Mandatory Activities/Courses							**20**	**14**

Course Name: INDUSTRIAL & FINANCIAL MANAGEMENT
Course Code: HU803
Contact: 2:0:0
Contact Hours: 24
Credit: 2
Prerequisite: Principle of Management

Course Outcome: On completion of the course students will be able to
CO1: Understand the concept of production planning and Forecasting.
CO2: Estimate the layout of a plant, required machineries and material requirements.
CO3: Identify source of finance and use financial management techniques for growth of the organization.
CO4: Understand and apply quality assurance techniques.

Course Content:

Module No.	Syllabus	Contact Hrs.
1	**Production Planning and Control:** Product: product design, customer requirements, value engineering, quality, reliability, service life, competitiveness.	3
2	**Forecasting** : Patterns of a time series – trend , cyclical, seasonal and irregular; Forecasting techniques : moving average, simple exponential smoothing, linear regression; Forecasting a time series with trend and seasonal component	4
3	**Plant:** Location, Layout, Material Handling, equipment selection, maintenance of equipment and facilities. Processes: Job, batch and flow production methods, Group Technology	4
4	**Materials Requirement Planning:** MRP concept – bill of materials (BOM), master production schedule; MRP calculations. **Machine Scheduling:** Concept of Single machine scheduling – shortest processing time (SPT) rule to minimize mean flow time, Earliest due date (EDD) rule to minimize maximum lateness, Total tardiness minimizing model.	3
5	**Sources of Finance -** Introduction; Short-term Finance; Long-term Funds	3
6	**Financial Planning:** Controlling, system and process of controlling, budgetary and non-budgetary control techniques, use of computers and IT in management control, productivity problems and management, control and performance, direct and preventive control, reporting.	3
7	**Quality Assurance**: Meaning of Quality; Quality assurance system; choice of process and quality; Inspection and control of quality; Maintenance function & quality; Process control charts: x-chart and R-chart, p-chart and c-chart; Acceptance sampling: Operating characteristic (O.C) curve, Single sampling plan, Double sampling plan, Acceptance sampling by variables; concept of Six Sigma.	4

Text Books:

1. Tripathy PC & Reddy PN, Principles of Management, Tata McGraw Hill, 1999.2. R. Panneerselvam, Production and Operations Management, PHI.
3. Russell & Taylor, Operations Management, PHI.
4. Adam and Ebert, Production and Operations Management, PHI.
5. Janakiraman B. and Gopal R.K., Total Quality Management, Prentice Hall India, 2006.

CO PO Mapping:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO 1	3	3	3	-	-	-	-	-	-	-	-	-	-	-	3
CO 2	-	-	-	3	-	-	-	-	-	-	-	-	-	3	3
CO 3	2	2	-	2	-	-	-	-	-	-	-	-	-	2	3
CO 4	-	-	3	-	-	-	-	-	-	-	-	-	-	-	3
Avg.	2	2	3	2.5	-	-	-	-	-	-	-	-	-	2.5	**3**

Course Name: Automobile Engineering
Course Code: ME 801A
Contact: 3:0:0
Contact Hours: 36
Credits: 3
Prerequisite: Thermodynamics, Kinematics & Theory of Machines.

Course Outcomes:

CO1: Understand the basic layout of an automobile.
CO2: Explain the operation of engine cooling, lubrication, ignition, electrical and air conditioning systems.
CO3: Analyze the principles of transmission, suspension, steering and braking systems.
CO4: Study latest developments in automobiles.

Course Contents:

Module No.	Syllabus	Contact Hrs.
1	**Introduction:** History & Development of Automobile. Various sub system of Automobile. **Prime Mover:** Engine for Two–Wheeler & Three-Wheeler vehicles, Engine for passenger cars, commercial and other vehicle, Fuel system for carburetted engine, MPFI engine and Diesel engine, Lubrication and cooling system.	**5**
2	**Transmission System:** Devis steering & Ackerman steering system. Rack & pinion, cam & lever, worm & sector system. Flywheel & clutch. Gearbox sliding and constant mesh type, Automatic Transmission, Universal joint, Propeller shaft. Construction & function of differential, Different types of front & rear axles. Wheel quality, assembly, types of wheels, wheel rims. Construction of tyres and tyre specifications.	**12**
3	**Suspension System** Conventional and independent suspension system, application. **Automotive Restraints:** Seat belt, automatic seat belt tightener system, collapsible steering column and air bags.	**5**
4	**Brake System:** Disc & drum brake, Hydraulic brake, Parking brake, Stopping distance.	**4**
5	**Electrical Systems:** Battery, generator, Ignition system, Starting system, lighting & signalling.	**4**
6	**Power Requirement:** Various resistances such as air resistance, gradient resistance, rolling resistance. Tractive effort. Torque- Speed curve. Horse power calculation.	**3**
7	Introduction to Electric Vehicles	**3**

Text Books:
1. Motor Vehicle by Newton, Steed and Garrette 2nd ed, Butter worth.
2. Automobile Mechanics by N.K. Giri, 7th ed, Khanna Publishers.
3. Automobile Mechanics by Heitner Joseph, East West Press.
4. K. Ramakrishna, Automobile Engineering, PHI Learning Pvt. Ltd., New Delhi, 2012.
5. Automobile Engineering by Amitosh De, Revised edition 2010, Galgotia Publication Pvt. Ltd.

CO – PO/PSO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	-	-	-	-	-	-	-	-	-	3	2	-
CO2	3	3	3	-	-	3	2	-	-	-	-	-	3	3	-
CO3	3	-	-	-	-	3	3	-	-	-	-	-	3	-	-
CO4	2	-	-	-	-	3	-	-	-	-	-	-	-	-	-
Avg	2.5	2.5	2.5	-	-	3	2.5	-	-	-	-	-	3	2.5	-

Course Name: TURBO MACHINERY
Course Code: ME 801B
Contact: 3:0:0
Contact Hours: 36
Credit: 3
Prerequisite: Fluid Mechanics and Fluid machinery

Course Outcomes: Upon successful completion of this course, students will be able to achieve:
1. Basic knowledge about rotary machines, nozzle, diffuser etc.
2. Understand about the calculation of efficiency, power etc. of steam turbines and hydraulic turbine.
3. Evaluate of efficiency, power required etc. of pumps and compressor
4. Design of various incompressible and compressible flow machines.

Course Contents:

Module No.	Syllabus	Contact Hrs.
1.	Introduction: Classification: Incompressible and compressible flow machines; Radial, axial and mixed flow machines; Turbines vs pumps, fans and compressors. Applications: Water supply, ventilation, power generation, propulsion.	4
2.	Incompressible- Flow Machines: Euler Head Equation Hydraulic Turbines: Headrace, penstock, nozzle, runner, draft tube and tail race; Gross head and net head; Velocity diagrams for impulse and reaction turbines; Discharge, head, power and efficiencies. Pumps: Reservoir, foot valve, suction line, pump, delivery line and overhead tank; Static head and losses; Velocity diagrams; Discharge, head, power and efficiencies.	10
3.	Compressible-Flow Machines: Static and stagnation states; Isentropic and adiabatic expansion and compression processes; Nozzle, diffuser and rows of stationary and moving blades; Efficiencies.	9
4.	Dimensional Analysis: Similarity laws, Volume-flow, mass-flow head and power coefficients, Specific speed and machine selection; Pressure ratio, enthalpy ratio, Reynolds number, Mach number; Surge and choking.	5
5.	Testing and Performance Analysis: Measurement devices; affinity laws and unit quantities. Set up and operating characteristics of pumps, turbines; fans and turbo-compressors. Cavitation–cause of cavitation and definition of Thoma's cavitation parameter.	8

Text Books:
1. S.M. Yahya, Turbine, Compressors and Fans.
2. J. Lal, Hydraulic Machines.
3. S.K. Som, G. Biswas and S. Chakraborty, Introduction to Fluid Mechanics & Fluid Machines, TMH.
4. M.M. Das, Fluid Mechanics & Turbo Machines, PHI, 2010.

5. R.K. Bansal, Fluid Mechanics & Machinery, Luxmi Publications.

References :

6. C. Ratnam, A.V. Kothapalli, Fluid Mechanics & Machinery, I.K. International Publishing House Ltd, 2010.
7. C.S.P. Ojha, R. Berndtsson, P.N. Chandramouli, Fluid Mechanics & Machinery, Oxford University Press.
8. Gupta, Fluid Mechanics and Hydraulic Machines, Pearson Publication.
9. A.T. Sayers, Hydraulic and Compressible Flow Turbomachines.
10. R.K. Bansal, Fluid Mechanics and Hydraulic Machines.

CO – PO/PSO Mapping:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	2	3	2	2	2	2	-	2	-	-	-	3	3	-
CO 2	2	3	3	2	2	3	2	-	2	-	-	-	3	3	-
CO 3	2	2	2	2	2	2	2	-	2	-	-	-	3	3	-
CO 4	2	3	3	2	3	3	3	-	3	-	-	-	2	-	-
Avg.	2.25	2.5	2.75	2	2.25	2.5	2.25	-	2.25	-	-	-	2.75	2.25	-

Course Name : GAS DYNAMICS AND JET PROPULSION
Course Code : ME 801C
Contact : 3:0:0
Contact Hours: 36
CREDITS : 3

Prerequisite: Fluid Mechanics, Thermodynamics.

Course Outcomes: On successful completion of the course, the learner will be able to
ME 801C.1. Understand the basics of compressible flow.
ME 801C.2. Analyze compressible flow characteristics in constant and variable area ducts.
ME 801C.3. Apply the knowledge of shock theories in complex engineering situations.
ME801C.4. Evaluate jet and rocket propulsion techniques applicable in aerospace industries.

Course Contents:

Module No.	Syllabus	Contact Hrs.
1.	COMPRESSIBLE FLOW - FUNDAMENTALS Energy and momentum equations for compressible fluid flows - various regions of flows - reference velocities - stagnation state - velocity of sound - critical states - Mach number – critical Mach number - types of waves - Mach cone - Mach angle - effect of Mach number on flow.	6
2.	FLOW THROUGH VARIABLE AREA DUCTS Isentropic flow through variable area ducts- T-s and h-s diagrams for nozzle and diffuser flows - Area ratio as a function of Mach number - Mass flow rate through nozzles and diffusers - Effect of friction in flow through nozzles.	7
3.	FLOW THROUGH CONSTANT AREA DUCTS Flow in constant area ducts with friction (Fanno flow) – Fanno curves and Fanno flow equation - variation of flow properties - variation of Mach number with duct length. Isothermal flow with friction in constant area ducts. Flow in constant area ducts with heat transfer (Rayleigh flow) - Rayleigh line and Rayleigh flow equation - variation of flow properties - Maximum heat transfer.	6
4.	NORMAL AND OBLIQUE SHOCKS Governing equations - Variation of flow parameters like static pressure, static temperature, static density, stagnation pressure and entropy across the normal shock - Prandtl Meyer equation - impossibility of shock in subsonic flows - flow in convergent and divergent nozzle with shock - normal shock in Fanno and Rayleigh flows, flow with oblique shocks, isentropic and shock tables.	9
5.	PROPULSION Jet Propulsion: Aircraft propulsion - types of jet engines – energy flow through jet engines- performance of turbo jet engines - thrust - thrust power - propulsive and overall efficiencies – thrust augmentation in turbo jet engine - ram jet, pulse jet and turboprop Engines. Space Propulsion: Types of rocket engines - Propellants - Ignition and combustion - Theory of rocket propulsion –Terminal and characteristic velocity - Applications.	8

Recommended Books

1. YAHYA. S.M. - "Fundamental of compressible flow"- New Age International (p) Ltd. - New Delhi 1996.
2. PATRICH.H. OOSTHVIZEN-WILLIAM E. CARSCALLEN- "Compressible fluid flow"- McGraw-
Hill- 1997
3. COHEN. H. - ROGERS R.E.C AND SRAVANAMUTOO- "Gas turbine theory"- Addison Wesley
Ltd. - 1987.
4. GANESAN. V. - "Gas Turbines"- Tata McGraw-Hill- New Delhi- 1999
5. RATHAKRISHNAN.E- "Gas Dynamics"- Prentice Hall of India- New Delhi- 2001
6. HILL.D and PETERSON .C, Mechanics & Thermodynamics of propulsion - Adisson Wesley Publishing Company, 1999.
7. G.P. Sutton- "Rocket Propulsion Elements "- John Wiley- 1986- New York.
8. ZUCROW N.J Principles of Jet Propulsion and Gas Turbines - John Wiley Newyork, 1970

CO – PO/PSO Mapping:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	2	2	2	-	-	-	-	-	-	-	-	3	2	-
CO2	3	3	3	-	-	-	2	-	-	-	-	-	3	2	-
CO3	3	-	-	2	-	-	3	-	-	-	-	3	3	2	-
CO4	2	-	-	2	-	-	-	-	-	-	-	-	-	3	-
Avg	2.5	2.5	2.5	2	-	-	2.5	-	-	-	-	3	3	**2.25**	-

Course Name: 3D Printing & Design
Course Code: ME 802 A
Contact: 3:0:0
Contact Hours: 36
Credits: 3
Prerequisite: Computer Aided Design & Drafting Engineering Materials
Course Outcomes: On successful completion of the course, the learner will be able to
CO1: Develop CAD models for 3D printing and Import and Export CAD data.
CO2: Select a specific material for the given application.
CO3: Select a 3D printing process for an application.
CO4: Produce a product using 3D Printing or Additive Manufacturing (AM).

Course Contents:

Module No.	Syllabus	Contact Hrs.
1	**Introduction:** Introduction to 3D Printing, Overview of additive manufacturing techniques, Additive v/s Conventional Manufacturing processes, Applications.	6
2	**CAD for Additive Manufacturing:** CAD Data formats, Slicing, Data translation, Data loss, STL format	10
3	**3D Printing:** Process, Equipment, Process parameter, Process Selection for various applications. Application Domains: Aerospace, Electronics, Health Care, Defence, Automotive, Construction, Food Processing, Machine Tools	8
4	**Materials:** Polymers, Metals, Non-Metals, Process parameter, Process Selection for various applications. Various forms of raw material and their desired properties, Support Materials	4
5	**Core issues in 3D Printing:** Design and process parameters, Governing Bonding Mechanism, Common faults and troubleshooting	4
6	**Post Processing: Requirement and Techniques** Support Removal, Sanding, Acetone treatment, polishing, Inspection and testing, Defects and their causes	4

Text Books:
1. Khanna Editorial, "3D Printing and Design", Khanna Publishing House, Delhi.
2. Andreas Gebhardt, "Understanding Additive Manufacturing: Rapid Prototyping, Rapid Tooling, Rapid Manufacturing", Hanser Publisher, 2011.
3. Amitava Ghosh, Rapid Prototyping, McGraw hill Publishers.

CO – PO/PSO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3	-	3	-	-	-	-	-	1	1
CO2	2	2	3	-	3	-	-	-	-	-	1	1
CO3	2	2	3	-	3	2	2	-	-	-	1	1
CO4	3	2	3	2	3	-	2	-	-	-	2	1

Course Name: Nanotechnology
Course Code: ME802B
Contact: 3:0:0
Contact Hours: 36
Credit: 3
Prerequisite: Material science

Course Outcomes: Upon successful completion of this course, students will be able to
CO 1: Identify 0D,1D,2D and 3D nanomaterials.
CO 2: Gain knowledge the optical and mechanical properties
CO 3: Interpret the magnetic and electrical properties.
CO 4: Illustrate the use of nanomaterials for different applications

Course Contents:

Module No.	Syllabus	Contact Hrs.
1.	Introduction of nanomaterials and nanotechnologies, Comparison of nanotechnology with micro-manufacturing, Features of nanostructures, Background of nanostructures, Techniques of synthesis of nanomaterials, Tools of the nanoscience, Applications of nanomaterials and technologies.	7
2.	Bonding and structure of the nanomaterials, Predicting the Type of Bonding in a Substance crystal structure, Metallic nanoparticles, Surfaces of Materials, Nanoparticle Size and Properties	7
3.	Mechanical properties of materials, theories relevant to mechanical properties, techniques to study mechanical properties of nanomaterials, adhesion and friction, thermal properties of nanomaterials.	7
4.	Electrical properties, Conductivity and Resistivity, Classification of Materials based on Conductivity, magnetic properties, electronic properties of materials, classification of magnetic phenomena.	8
5.	Nano thin films, nanocomposites, new application of nanoparticles in manufacturing of bearings, cutting tools, cutting fluids, medical science, soil science, etc.	7

Text Books:

1. Mick Wilson, Kamali Kannargare., Geoff Smith, "Nano technology: Basic Science and Emerging technologies", Overseas Press, 2005.
2. Charles P. Poole, Frank J. Owens, "Introduction to Nanotechnology", Wiley Interscience, 2008.
3. Mark A. Ratner, Daniel Ratner, "Nanotechnology: A gentle introduction to the next Big Idea", Prentice Hall P7R:1st Edition, 2002.

References:

4. T. Pradeep, "Nano the Essential Nanoscience and Nanotechnology", Tata McGraw hill, 2007. 5. J. Dutta, H. Hoffmann, "Nanomaterials", Topnano-21, 2003.
5. H. S. Nalwa (Ed.), "Encyclopedia of Nanoscience & Nanotechnology", American Scientific Publishers, California, 2004
6. I. Fujimasa, Micromachines, Oxford Science Publications, 1996.

CO – PO/PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12
CO1	1	2		3	1		1	2		2		
CO2	2	1	2			1	2	1	1	1		
CO3	2	3		2	1		3	2		2		
CO4	1		2			2		2		2		

Course Name: Industrial Instrumentation
Course Code: ME802C
Contact: 3:0:0
Contact Hours: 36
Credit: 3
Prerequisite: Metrology and control system

Course Outcomes: Upon successful completion of this course, students will be able to
CO1: Obtain knowledge about different instruments used to measure pressure, temperature, flow, level of liquids and data acquisition etc.
CO2: elucidate the construction and working of various industrial devices used to measure pressure, sound and flow
CO3: explicate the construction and working of various industrial devices used to measure temperature, level, vibration, viscosity and humidity
CO4: ability to analyze, formulate and select suitable sensor for the given industrial applications

Course Contents:

Module No.	Syllabus	Contact Hrs.
1.	**DISPLACEMENT** - LVDT, capacitive type transducers- Theory, applications. **ACCELEROMETER AND VIBROMETER** – Seismic instrument for acceleration measurement, velocity measurement, piezoelectric accelerometer, strain gauge accelerometer - theory and applications.	4
2.	**PRESSURE:** Absolute, gauge and vacuum pressures. **Elastic transducers:** Elastic diaphragm, Corrugated diaphragm, capsule type - relative merits and demerits, pressure ranges. Bourdon type pressure gauge- Theory, construction, installation, Pressure range, materials **Electrical Pressure gauges:** Strain gauges, Strain gauge half bridge and full bridge configurations, load cells **Vacuum gauges:** Mcleod gauge, thermal conductivity gauge, Calibration of pressure gauges, dead weight tester.	7
3.	**TEMPERATURE** **Non- Electrical gauges:** Liquid in glass thermometer, pressure thermometer. **Electrical gauges**- resistance temperature detector- 2, 3 and 4-wire configurations thermocouples and thermopiles, CJC, Compensating wires, thermistor- theory, applications, relative merits and demerits, operating range. **Non-contact type temperature gauges** - total radiation pyrometer, optical pyrometer, temperature measuring problem in flowing fluid. Thermo well.	6
4.	**FLOW** **Variable head type flow meters**: orifice plate, Venturi tube, Flow Nozzle- Theory, construction, installation, tapping, selection methods. **Variable Area flow meter**: Theory, construction and installation **Positive displacement type flow meters**: Nutating disc, reciprocating piston, oval gear and helix type-Theory, construction and installation **Open channel flow measurements**: Different shapes of weirs and	8

	corresponding flow relations. **Electrical type flow meters:** Theory, installation details of electromagnetic flow meter, ultrasonic flow meter **Guide lines for selection of flow meters, Calibration of flow meters**	
5.	**LEVEL** **Non-Electrical gauges:** Sight glass type, Float type, displacer type, Air purge system-Theory, arrangements, relative merits and demerits **Electrical level gauge:** Resistive and capacitive types- Theory, arrangement, limitations **Nuclear radiation type, ultrasonic type Differential pressure type level measurement:** open and closed tanks Boiler drum level measurement.	6
6.	**DATA Acquisition, Transmission and Recording:** Application in open loop and close loop/ feedback control system - Cable transmission of analog voltage and current signals; cable transmission of digital data; Analog voltmeters and potentiometers; digital voltmeters and multimeters; Electromechanical XT and XY recorders; Analog Cathode-ray oscilloscope.	5

Text Books:

1. R K Jain, “Mechanical and Industrial Measurements”, Khanna Publishers Co Ltd., New Delhi.
2. S.K.Singh, “Industrial instrumentation”, TMH
3. RK Rajput, “Mechanical Measurements and Instrumentation”, SK Kataria and Sons, New Delhi.
4. Donald P. Eckman, " Industrial Instrumentation”, Wiley

References:

5. E O Doeblin, Measurement Systems- Application and Design, McGraw Hill
6. T G Beckwith and N L Buck, “Mechanical Measurements”, Addition Wesley Publishing Company Limited.
7. J P Holman, “Experimental Methods for Engineers”, McGraw Hill
8. Alan S Morris, “Measurement and Instrumentation Principles”, Butterworth.

CO – PO/PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2		2	1		2	2		2		
CO2	2	1	2			1	2	1	1	1		
CO3	3	2		2	1		2	2		1		
CO4	3		2			2		3		2		

Course Name: Energy Conservation & Management
Course Code: ME802D
Contact: 3:0:0
Contact Hours: 36
Credit: 3
Prerequisite: Engineering Thermodynamics
Course Outcomes: Upon successful completion of this course, students will be able to
CO 1: Obtain knowledge about energy conservation policy, regulations and business practices
CO 2: Improve the thermal efficiency systems for heat recovery and co-generation using of energy management principles
CO 3: Analyze the energy audit methods learnt to identify the areas deserving tighter control to save energy expenditure
CO 4: Evaluate the cost- benefit analysis of various investment alternatives for meeting the energy needs of the organization

Course Contents:

Module No.	Syllabus	Contact Hrs.
1.	The Energy Resources; Finite & Renewable Sources	3
2.	The Need for Energy Conservation- estimation of Finite fuel resource; Hubbert's model for oil reserve	3
3.	Total Energy Concept- CHP Cycles & their applications, Case Study about CHP cycle.	7
4.	Waste Heat Recovery; Waste Heat Exchangers; Commercial Waste Heat Recovery Devices- Recuperators, Regenerative Heat Exchangers, Heat Pipes	7
5.	Industrial Energy Conservation- Industrial Insulations; Case Studies for HVAC, Air Compressor, Mechanical Handling & Other Systems, Study of energy efficient methods. Electric motors- motor efficiency computation, energy efficient motors; Illumination- Lux, Lumens, types of lighting, efficacy, LED lighting and scope of energy conservation in lighting.	6
6.	Energy Audit; Basic Steps; Graphical representation; Case Studies	6
7.	The Economics of Energy Saving Schemes; Costs; investment analysis	4

Text Books:

1. Energy Management- Murphy WR, G Mckay- Butterworth Heinmann, 2007
2. Energy Mangement, Audit & Conservation-De Barun, Vrinda Publications, Delhi, 2007
3. Eastop & Croft- Energy Efficiency, Longman, 1990
4. Turner- Energy management Handbook, 2nd Ed., Fairmont Press, 1993

CO – PO/PSO Mapping:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	3	3	3	-	-	-	-	-	-	-	-	-	-	-	3
CO2	-	-	-	3	-	-	-	-	-	-	-	-	-	3	3
CO3	2	2	-	2	-	-	-	-	-	-	-	-	-	2	3
CO4	-	-	3	-	-	-	-	-	-	-	-	-	-	-	3
Avg	2	2	3	2.5	-	-	-	-	-	-	-	-	-	2.5	**3**

Course Name: Artificial Intelligence
Course Code: ME 803 A
Contact: 3:0:0
Contact Hours: 36
Credit: 3
Prerequisite: Strength of Material, Machine Design, Measurement and Instrumentation
Course Outcomes: Upon successful completion of this course, students will be able to
1. Build intelligent agents for search and games.
2. Solve AI problems through programming with Python.
3. Learning optimization and inference algorithms for model learning.
4. Design and develop programs for an agent to learn and act in a structured environment.

Course Contents:

Module No.	Syllabus	Contact Hrs.
1.	Introduction: Concept of AI, history, current status, scope, agents, environments, Problem Formulations, Review of tree and graph structures, State space representation, Search graph and Search tree.	6
2.	Search Algorithms: Random search, Search with closed and open list, Depth first and Breadth first search, Heuristic search, Best first search, A* algorithm, Game Search.	9
3.	Probabilistic Reasoning: Probability, conditional probability, Bayes Rule, Bayesian Networks- representation, construction and inference, temporal model, hidden Markov model.	7
4.	Markov Decision process: MDP formulation, utility theory, utility functions, value iteration, policy iteration and partially observable MDPs.	7
5.	Reinforcement Learning: Passive reinforcement learning, direct utility estimation, adaptive dynamic programming, temporal difference learning, active reinforcement learning- Q learning.	7

Recommended Books:

1. S. Russell and P. Norvig, Artificial Intelligence: A Modern Approach, 3rd Edition, Prentice Hall.
2. E. Rich, K. Knight and K. Knight, Artificial Intelligence, McGraw Hill, 1991.
3. M.C. Trivedi, A Classical Approach to Artifical Intelligence, Khanna Publishing House, New Delhi, 2018.
4. S. Kaushik, Artificial Intelligence, Cengage Learning India, 2011.
5. D. Poole and A. Mackworth, Artificial Intelligence: Foundations for Computational Agents, Cambridge University Press, 2010.

CO – PO/PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2		3	1		2	2		2		
CO2	3	1	2			2	2	1	1	2		
CO3	1	2		2	1		2	2		1		
CO4	2		3			2		3		2		

Course Name: Safety & Occupational Health
Course Code: ME 803 B
Contact: 3:0:0
Contact Hours: 36
Credit: 3

Prerequisite: Strength of Material, Machine Design, Measurement and Instrumentation

Course Outcomes: Upon successful completion of this course, students will be able to achieve:
1. Primary knowledge of industrial and occupational safety and accident prevention
2. Help students to understand the fundamentals of Safety Management like the scope and nature of occupational health and safety.
3. enables the student to apply safety and health related theory and technology to analyze workplaces to identify occupational hazards
4. Manage real life problems in the industries related to accident prevention and safety.

Course Contents:

Module No.	**Syllabus**	**Contact Hrs.**
1.	Organizing for Health & Safety - setting goals & objectives – Management leadership – Employee involvement – Concept & significance of Safety Culture – Internal and external factors influencing Safety behavior – Improving safety culture and climate- Improving human reliability – Communication -consultation - Work site Analysis – Review of culture	4
2.	Accidents and their prevention Theory of accident, Anatomy of an accident, Causes of Accidents, Cost of Accidents, Principles of Accident Prevention, Techniques of Accident Prevention, Safe Work Environment, Housekeeping, Job Safety Analysis, Investigation of Accidents, Ergonomics, Personal Protective Equipment,	6

	Promotion of Health and Safety, Basic Safety Programming	
3.	Fire prevention & Control Classification of fire - General Causes of fire - Detection of fire - Extinguishing methods - First aid fire-fighting equipment - Fire bucket- Fire beater- hose real hose - Portable extinguisher - depends on weight - depends on operating method - depends on content - depends on position of nozzle - Construction - Operation - Maintenance – refilling – Building design and fire protection	5
4.	Occupational health and safety Occupational Health, Occupational Health Services in Places of Employment, Occupational Physician, Occupational Health in Developing Countries, Occupational Safety, Occupational Safety in Developing Countries, Promoting Occupational Health and Safety, Work Related Diseases, Occupational Health Hazards Recognition of Hazards, Industrial Hygiene, Occupational Diseases, basics of OHSAS 18001	6
5.	Health and safety at workplaces Health and Safety hazards, Occupational Health Requirements, Occupational Safety Requirements, Occupational Welfare Requirements, Abstracts and Notices, Obligations of a Worker, Obligations of Occupier, Personal protective equipment, Causes of Accidents, Prevention of Accidents, Safety Legislation, Safety Guidelines, emergency actions, related acts (related to chemical processes, mines, workshop practices, construction work, electrical installations)	6
6.	Safety- Health and Environment in Construction Introduction and stages in construction – stages of project construction – Safety during receiving-unloading- shifting and storage – guidelines for storage – General safety facilities in construction sites – Interface between civil & erection works - Construction Safety - Contractors Safety	5
7.	Role of National Governments & International bodies in Health & Safety Role of ILO – ILO Conventions & Recommendations – Responsibilities of Government- Social organizations & Public Authorities – Role of enforcement agencies – Consequence of noncompliance – Barriers to good standards of safety	4

Text Books:

1. Safety management Systems, A. Waring, (Chapman & Hall,1996)
2. Environmental Health & Safety Management – A Guide to Compliance, N.P. Cheremisinoff, M.L. Graffia, (Noyes Publin. 2003)
3. Safety at Work, J. Ridley & J. Channing (5th. Edn.), (Butterworth & Heinemann, 2001)
4. Occupational Health & Hygiene, J. Stranks, (Pitman Publn., 1995)

References:

5. Safety management: Strategy & Practice, R. Pybuss, (Butterworth & Heinemann, 1997)
6. Essentials of Safety management, H.L. Kalia, A. Singh, S. Ravishankar & S.V. Kamat, (Himalaya Publishing House, 2002)
7. Industrial Health & Safety Management, A.M. Sarma, (Himalaya Publishing House, 2002)

CO – PO/PSO Mapping:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	-	-	-	-	-	3	-	3	2	-	2	-	-	3	2
CO2	-	-	-	-	-	2	-	3	3	-	2	-	-	2	3
CO3	-	-	-	-	-	2	-	3	3	-	-	-	-	3	-
CO4	-	-	-	-	-	2	-	2	2	-	-	-	-	-	-
Avg	-	-	-	-	-	2.25	-	2.75	2.5	-	2	-	-	**2**	**2.5**

Course Name: Microprocessor Application in Automation
Course Code: ME 803C
Contact: 3:0:0
Contact Hours: 36
Credits: 3
Prerequisite: knowledge of digital electronics, knowledge of 8085 microprocessor
Course Outcomes:
CO1: Use data transfer techniques, describe architecture and operation of microcontroller 8051.
CO2: Develop assembly language programs using instruction set of 8051.
CO3: Design and develop microcontroller based systems.
CO4: Explain various applications of microcontrollers.

Course Contents:

Module No.	Syllabus	Contact Hrs.
1	**8086 and its Architecture** Intel 8086 processor, pin details for max. mode& min. mode. 8086 CPU architecture, bus interface unit & execution unit, pipelined architecture. Register organization & different addressing mode of 8086 Basic idea of some of the advanced features- concept of multi programming, interleaved memory, cache memory, multi processing.	**6**
2	**Memory Organisation 8086:** Memory Addressing, Instruction set of 8086, Writing Assembly Language Programme	**4**

3	**Microcontroller 8051 Architecture** Difference between microcontroller & Microprocessor. Explain the Block diagram of the Architectural of 8051. 3.3 Explain the PIN Diagram features of the 8051 core. Explain the 8051 Programming Model. Explain the Port Structure & Operation, Timer/Counters, serial Interface & External memory	**6**
4	**8051 Addressing Modes &Instruction Set** Explain different addressing modes of 8051. Explain the different types of Instruction sets of 8051. Data Transfer, Arithmetic Operations, Logical Operations, Boolean Variable Manipulation, Program Branching	**7**
5	**8051 Assembly Language Programming Tools** Programs using Jump, Loop and Call Instructions, Time Delay Generation and Calculation. I/O Port Programming, Bit manipulation, Arithmetic Programs a. Unsigned Addition and Subtraction b. Unsigned Multiplication and Division c. Signed number concept and Arithmetic operations d. Logic Programs Programs using Logic and Compare Instructions a. Programs using Rotate and Swap Instructions b. BCD and ASCII Application Programs, Counter / Timer Programming, Programming 8051 Timers Counter Programming, Serial Communication Programming a. Basics of Serial communication 8051 Connection to RS232, 8051 Serial Communication Programming, Interrupts Programming 8051 Interrupts a. Programming Timer Interrupts b. Programming External hardware Interrupts c. Programming the Serial Communication Interrupt d. Interrupt Priority in the 8051	**9**
6	**Application** Stepper motor control Speed/position control of ac/dc motor Control of physical parameter like temp, pressure, flow etc	**4**

Text Books:

1. Microprocessor architecture, programming & applications. R.S.Gaonkar. Wiely.
2. Microprocessor& Microcontroller. N Senthil. Oxford University press.
3. Microprocessor and Microcontroller Kumar, Saravanan, Jeevananthan. Oxford University Press.
4. The 8051 Microcontroller & Embeded Systems Mazidi, Mazidi.PHI.

CO – PO/PSO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12
CO1	3	1	2	1	-	-	-	-	-	-	1	1
CO2	2	1	1	-	-	1	-	1	-	-	1	1
CO3	3	2	2	-	2	2	1	1	-	-	1	1
CO4	2	1	3	1	1	2	1	1	-	-	2	3

Course Name: Introduction to Electric Vehicles
Course Code: ME 803D
Contact: 3:0:0
Contact Hours: 36
Credits: 3
Prerequisite: Knowledge of digital electronics, knowledge of 8085 microprocessor
Course Outcomes:
CO1: An ability to design and develop environment friendly electric Vehicle
CO2: To introduce application of smart grid and electric vehicle for conversion, control and automation
CO3: To understand controlling strategies of electrical vehicles.
CO4: To design and model electric vehicle systems and analyze the energy management strategies.

Course Contents:

Module	Syllabus	Contact Hours
1	Introduction: Electric vehicles (EV) development, past, present, and future, comparison with IC engine drive vehicles. Hybrid Electric Drivetrain, Tractive effort in normal driving, Energy consumption Concept of Hybrid Electric Drive Trains	8
2	Power Converters: Batteries, fuel cells, ultracapacitors. Power converters in EV. Different types of motors used in EV and their torque-speed characteristics, motor control techniques, high performance and efficiency optimized control, sensorless control.	10
3	EV modeling, Tier Characteristics, slip phenomena. Road condition estimation, driving force observer. Sizing the drive system, Design of Hybrid Electric Vehicle and Plug-in Electric Vehicle, Energy Management Strategies, Automotive networking and communication, EV and EV charging standards, V2G, G2V, V2B, V2H.	10
4	EV motion control: model following control, optimum slip ratio control, direct yaw movement control, lateral motion stabilization. Fuel cell Vehicles, Hybrid Electric Vehicles (HEV), series, parallel and series-parallel (split) systems.	8

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

CO – PO/PSO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12
CO1	3	2	2	-	3	2	3	1	-	-	1	2
CO2	2	1	2	-	3	2	3	1	-	-	1	2
CO3	3	2	2	-	3	2	3	1	-	-	1	2
CO4	2	1	3	-	3	3	3	1	-	-	1	3

Paper Name: Essence of Indian Knowledge Tradition
Paper Code: MC801
Contact: 3:0:0
Contact Hours: 36
Non-Credit Mandatory Course

Course Outcomes:
At the end of the Course, Student will be able to:
CO 1: Identify the concept of Traditional knowledge and its importance.
CO 2: Explain the connection between Modern Science and Indian Knowledge System.
CO 3: Understand the importance of Yoga for health care.
CO 4: Interpret the effect of traditional knowledge on environment.

Course Contents:
UNIT-I: Basic structure of Indian Knowledge System
Define traditional knowledge, nature and characteristics, scope and importance, kinds of traditional knowledge, Indigenous Knowledge (IK), characteristics, traditional knowledge vis-a-vis indigenous knowledge, traditional knowledge Vs western knowledge traditional knowledge

UNIT-2: Modern Science and Indian Knowledge System
Systems of traditional knowledge protection, Legal concepts for the protection of traditional knowledge, Patents and traditional knowledge, Strategies to increase protection of traditional knowledge

UNIT-3: Yoga and Holistic Health care
Yoga for positive health, prevention of stress related health problems and rehabilitation, Integral approach of Yoga Therapy to common ailments.

UNIT-4: Traditional Knowledge and Environment
Traditional knowledge and engineering, Traditional medicine system, Importance of conservation and sustainable development of environment, Management of biodiversity

References

- V. Sivaramakrishnan (Ed.), Cultural Heritage of India-course material, Bharatiya Vidya Bhavan, Mumbai. 5th Edition, 2014
- Swami Jitatmanand, Modern Physics and Vedant, Bharatiya Vidya Bhavan
- Swami Jitatmanand, Holistic Science and Vedant, Bharatiya Vidya Bhavan
- Fritzof Capra, The Wave of life
- VN Jha (Eng. Trans.), Tarkasangraha of Annam Bhatta, International Chinmay Foundation, Velliarnad, Arnakulam

- Yoga Sutra of Patanjali, Ramakrishna Mission, Kolkata
- RN Jha, Yoga-darshanam with Vyasa Bhashya, Vidyanidhi Prakashan, Delhi 2016 RN Jha, Science of Consciousness Psychotherapy and Yoga Practices, Vidyanidhi Prakashan, Delhi 2016

CO – PO/PSO Mapping:

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