Dr. MAHALINGAM
COLLEGE OF ENGINEERING AND TECHNOLOGY
Enlightening Technical Minds Estd. 1998
An Autonomous Institution
(Since 2011)

Dr. MAHALINGAM
COLLEGE OF ENGINEERING AND TECHNOLOGY
Affiliated to Anna University, Chennai; Approved by AICTE ; Accredited by NAAC with Grade 'A++'
Accredited by NBA - Tier1 (Mech, Auto, Civil, EEE, ECE, E&I and CSE)
Udumalai Road, Pollachi - 642 003. Tel: 04259-236030/40/50 Fax: 04259-236070 www.mcet.in

Curriculum and Syllabi

B.E – MECHATRONICS ENGINEERING

Semesters I to VIII

REGULATION 2019

Dr. Mahalingam College of Engineering and Technology, Pollachi - 642003.
(An Autonomous Institution approved by AICTE and Affiliated to Anna University)

Department of Mechatronics Engineering

Vision:

To develop competent Mechatronics Engineers and Entrepreneurs with the social and environmental awareness

Mission:

- To impart high quality inter disciplinary knowledge of Mechatronics Engineering through excellence in teaching, research and entrepreneurship.
- Develop Mechanical and Electronic design and test skills of the graduates to fulfill the industrial requirements.
- Create awareness among students for global needs of society and innovate machinery according to engineering needs.
- Enhance the Communication, learning and administrative skills of the graduates to become socially responsible engineers and entrepreneurs.

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Programme: B.E Mechatronics Engineering.

Programme Educational Objectives (PEOs) - Regulation 2019

PEO1: Develop innovative and sustainable products with multidisciplinary Engineering expertise

PEO2: Solve complex engineering problems by applying mechanical, electrical and computer knowledge and engage in lifelong learning in their profession.

PEO3: Work or pursue higher education in multicultural, multilingual and multinational environment with competent oral and written communication.

PEO4: Lead and contribute in a team entrusted with professional, social and ethical responsibilities.

Programme Outcomes (POs) - Regulations 2019

On successful completion of B.E. Mechatronics Engineering programme, graduating students/graduates will be able to:

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs)

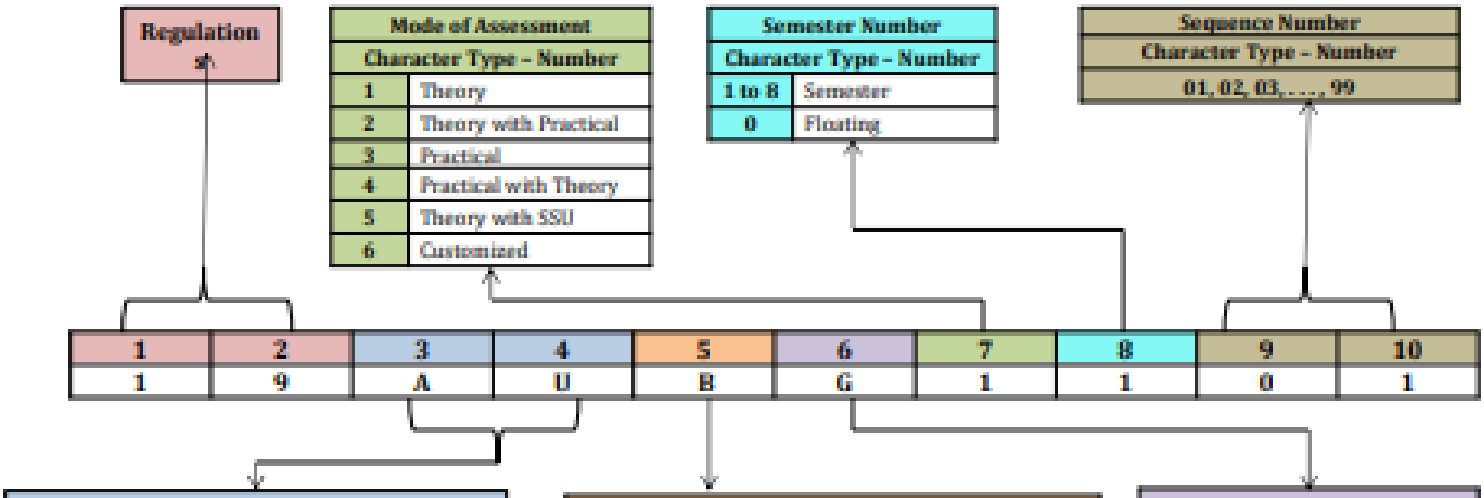
On successful completion of B.E. Mechatronics Engineering programme, graduating students/graduates will be able to:

PSO1: Design and develop Mechatronics systems to solve the complex engineering problem by integrating electronics, mechanical and control systems.

PSO2: Apply the engineering knowledge to conduct investigations of complex engineering problem related to instrumentation, control, automation, robotics and provide solutions.

Dr. Mahalingam College of Technology, Pollachi

2019 Regulations - Course Code Generation Procedure for UG Courses(v1)



Board/Department/Programme	
Character Type – Alphabet	
AU	Automobile
CE	Civil
CS	Computer Science
EC	Electronics and Communication
EE	Electrical and Electronics
EI	Electronics and Instrumentation
IT	Information Technology
MC	Mechatronics
ME	Mechanical
CH	Chemistry
EN	English
MA	Mathematics
PH	Physics
PS	Professional Skills
SH	Science and Humanities

Course Type	
Character Type – Alphabet	
B	Basic Science
S	Engineering Science
H	Humanities
C	Professional Core
E	Professional Elective
O	Open Elective
N	Online
I	Industry Offered
V	One Credit
P	Project/Skill Development/ Internship
M	Mandatory Non-Credit

Common to any Programme	
Character Type – Alphabet	
G	Generic
C	Common
N	Non-Common

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Programme: B.E Mechatronics Engineering
2019 Regulations
Curriculum for Semesters I to IV

Course Code	Course Title	Duration	Credits	Marks
19SHMG6101	Induction Program	3 Weeks	-	100

Semester I (2019 Batch)

Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
		L	T	P			
19MABC1101	Matrices and Calculus	3	1	0	4	100	AU, CE, MC, ME, PR, EC, EI, EE
19ENHG2101	Communication Skills - I	2	0	2	3	100	All
19PHBC2101	Physics for Mechanical Sciences	3	0	2	4	100	AU, CE, ME, MC, PR, EE
19CSSC2001	C Programming	3	0	2	4	100	AU, ME, MC, PR
19MESC4001	Engineering Drawing	1	0	3	2.5	100	AU, ME, MC, PR, CS, IT, EC, EI
19PSHG3001	Wellness for Students	0	0	2	1	100	All
Total		**13**	**1**	**11**	**18.5**	**600**	

Semester II (2019 Batch)

Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
		L	T	P			
19MABC1201	Ordinary Differential equations and Complex Variables	3	1	0	4	100	AU, CE, MC, ME, PR, EC, EI, EE
19ENHG2201	Communication Skills – II	2	0	2	3	100	All
19CHBC2201	Chemistry for Mechanical Sciences	3	0	2	4	100	AU, CE, ME, MC, PR, EE
19MESC2001	Introduction to Engineering	2	0	2	3	100	AU, MC, ME, PR, EC, EI, EE
19MESC2201	Engineering Materials	2	0	2	3	100	ME,PR,AU,MC
19MECC3201	Engineering Practices Laboratory	0	0	3	1.5	100	AU, ME, MC, PR
19PSHG3002	Personal Effectiveness	0	0	2	1	100	All
19CHMG6201	Environmental Sciences	1	0	0	0		All
Total		**13**	**1**	**16**	**19.5**	**700**	

Semester III (2019 Batch)

Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
		L	T	P			
19MABC1302	Numerical Methods and Linear Algebra	3	1	0	4	100	EE, EC, EI,MC
19MESC1301	Engineering Mechanics	3	1	0	4	100	AU, ME,MC
19MECC2301	Fluid Mechanics and Hydraulic Machinery	3	0	2	4	100	AU,ME,MC
19MCSN1301	Basics of Electrical and Electronics Engineering	3	0	0	3	100	-
19MCCN1301	Sensors and Instrumentation	3	0	0	3	100	-
19MCCN3301	Computer Aided Machine Drawing Laboratory for Mechatronics	0	0	3	1.5	100	-
19MCSN3301	Basics of Electrical, Electronics and Instrumentation Laboratory	0	0	3	1.5	100	-
XXXXXXXXXX	One Credit Course	0	0	2	1	100	-
Total		**15**	**2**	**10**	**22**	**800**	

Semester IV (2019 Batch)

Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
		L	T	P			
19MABG1401	Probability and Statistics	3	1	0	4	100	AU,ME,MC,CS,IT, EC,EE
19MECC2401	Strength of Materials	3	0	2	4	100	AU,ME,MC
19MCCN1401	Theory of Machines	3	1	0	4	100	-
19MCCN2401	Electrical Drives and Controls	3	0	2	4	100	-
19MCCN3401	Theory of Machines Laboratory For Mechatronics	0	0	3	1.5	100	-
19PSHG6002	Universal Human Values 2: Understanding Harmony	2	1	0	3	100	ALL
19MCPN6401	Mini–Project	0	0	4	2	100	-
XXXXXXXXXX	One Credit Course	0	0	2	1	100	-
Total		**15**	**2**	**11**	**23.5**	**800**	

Course Code	Course Title	Duration	Credits	Marks
XXXXXXXX	Internship or Skill Development*	2/4 Weeks	1	100

*Refer to clause:4.8 in UG academic regulations 2019

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Programme: B.E Mechatronics Engineering

2019 Regulations

Curriculum for Semesters I to VIII

Course Code	Course Title	Duration	Credits	Marks
19SHMG6101	Induction Program	3 Weeks	-	100

Semester I (2020Batch)

Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
		L	T	P			
19MABC1101	Matrices and Calculus	3	1	0	4	100	AU, CE, MC, ME, PR, EC, EI, EE
19ENHG2101	Communication Skills - I	2	0	2	3	100	All
19PHBC2101	Physics for Mechanical Sciences	3	0	2	4	100	AU, CE, ME, MC, PR, EE
19CSSC2001	C Programming	3	0	2	4	100	AU, ME, MC, PR
19MESC4001	Engineering Drawing	1	0	3	2.5	100	AU, ME, MC, PR, CS, IT, EC, EI
19PSHG6001	Wellness for Students*	0	0	2	-	-	All
Total		**12**	**1**	**11**	**17.5**	**500**	

Semester II (2020Batch)

Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
		L	T	P			
19MABC1201	Ordinary Differential equations and Complex Variables	3	1	0	4	100	AU, CE, MC, ME, PR, EC, EI, EE
19ENHG2201	Communication Skills – II	2	0	2	3	100	All
19CHBC2201	Chemistry for Mechanical Sciences	3	0	2	4	100	AU, CE, ME, MC, PR, EE
19MESC2001	Introduction to Engineering	2	0	2	3	100	AU, MC, ME, PR, EC, EI, EE
19MESC2201	Engineering Materials	2	0	2	3	100	ME,PR,AU,MC
19MECC3201	Engineering Practices Laboratory	0	0	3	1.5	100	AU, ME, MC, PR
19PSHG6001	Wellness for Students*	0	0	2	1	100	All
19CHMG6201	Environmental Sciences	1	0	0	-	-	All
Total		**13**	**1**	**13**	**19.5**	**700**	

*Annual Pattern

Semester III (2020Batch)

Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
		L	T	P			
19MABC1302	Numerical Methods and Linear Algebra	3	1	0	4	100	EE, EC, EI,MC
19MESC1301	Engineering Mechanics	3	1	0	4	100	AU, ME,MC
19MECC2301	Fluid Mechanics and Hydraulic Machinery	3	0	2	4	100	AU,ME,MC
19MCSN1301	Basics of Electrical and Electronics Engineering	3	0	0	3	100	-
19MCCN1301	Sensors and Instrumentation	3	0	0	3	100	-
19MCCN3301	Computer Aided Machine Drawing Laboratory for Mechatronics	0	0	3	1.5	100	-
19MCSN3301	Basics of Electrical, Electronics and Instrumentation Laboratory	0	0	3	1.5	100	-
XXXXXXXXXX	One Credit Course	0	0	2	1	100	-
Total		**15**	**2**	**10**	**22**	**800**	

Semester IV (2020Batch)

Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
		L	T	P			
19MABG1401	Probability and Statistics	3	1	0	4	100	AU,ME,MC,CS,IT, EC,EE
19MECC2401	Strength of Materials	3	0	2	4	100	AU,ME,MC
19MCCN1401	Theory of Machines	3	1	0	4	100	-
19MCCN2401	Electrical Drives and Controls	3	0	2	4	100	-
19MCCN3401	Theory of Machines Laboratory For Mechatronics	0	0	3	1.5	100	-
19PSHG6002	Universal Human Values 2: Understanding Harmony	2	1	0	3	100	ALL
19MCPN6401	Mini–Project	0	0	4	2	100	-
XXXXXXXXXX	One Credit Course	0	0	2	1	100	-
Total		**15**	**2**	**11**	**23.5**	**800**	

Course Code	Course Title	Duration	Credits	Marks
XXXXXXXX	Internship or Skill Development*	2/4 Weeks	1	100

*Refer to clause:4.8 in UG academic regulations 2019

Semester V

Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
		L	T	P			
19MCCN1501	Microprocessor and Microcontroller Applications	3	0	0	3	100	-
19MECC2501	Problem solving using PYTHON for Mechanical Sciences	2	0	2	3	100	MC,ME,AU
19MCCN1502	Control Systems for Mechatronics	3	1	0	4	100	--
19MECC1501	Mechanical Design	3	1	0	4	100	MC,ME
19MCECXXXX	Professional Elective – I	3	0	0	3	100	-
19MCECXXXX	Professional Elective – II (Online)	3	0	0	3	100	-
19MCOCXXXX	Open Elective – I	3	0	0	3	100	-
19MCCN3501	Microprocessor and Microcontroller Laboratory	0	0	3	1.5	100	-
19PSHG6501	Employability Skills 1: Teamness and Interpersonal Skills	0	0	2	1	100	ALL
Total		**20**	**2**	**7**	**25.5**	**900**	

Semester VI

Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
		L	T	P			
19MCCN2601	Fluid Power Systems	3	0	2	4	100	-
19MCCN2602	Manufacturing Technology	3	0	2	4	100	-
19MECC1602	Data Science for Engineers	3	0	0	3	100	AU,MC,ME
19MCECXXXX	Professional Elective – III	3	0	0	3	100	-
19MCECXXXX	Professional Elective – IV (Online)	3	0	0	3	100	-
19MCOCXXXX	Open Elective – II	3	0	0	3	100	-
19PSHG6601	Employability Skills 2: Campus to Corporate	0	0	2	1	100	ALL
19MCPN6601	Innovative & Creative Project	0	0	4	2	100	-
Total		**18**	**0**	**11**	**23**	**900**	

Course Code	Course Title	Duration	Credits	Marks
XXXXXXXX	Internship or Skill Development*	2/4 Weeks	1	100

*Refer to clause: 4.8 in UG academic regulations 2019

Semester VII

Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
		L	T	P			
19MCCN1701	Robotics and Machine Vision System	3	0	0	3	100	-
19MCCN1702	CAD/CAM/CIM	3	0	0	3	100	-
19MECC1701	Artificial Intelligence and Machine Learning	3	0	0	3	100	AU,MC,ME
19MCECXXXX	Professional Elective – V	3	0	0	3	100	-
19MCECXXXX	Professional Elective – VI	3	0	0	3	100	-
19MCOCXXXX	Open Elective – III	3	0	0	3	100	-
19MCCN3701	CAM/CAE Laboratory	0	0	3	1.5	100	-
19MCCN3702	Robotics And Control Laboratory	0	0	3	1.5	100	-
Total		**18**	**0**	**6**	**21**	**800**	

Semester VIII

Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
		L	T	P			
19MCPN6801	Project	0	0	16	8	200	-
Total		**0**	**0**	**16**	**8**	**200**	

Course Code	Course Title	Duration	Credits	Marks
XXXXXX	Internshipor Skill Development*	8/16 weeks	4	100

*Refer to clause: 4.8 in UG academic regulations 2019

Total Credits (2019 Batch only): 166

Total Credits (2020 Batch onwards): 166

Professional Electives

Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
		L	T	P			
Design							
19MCEN1001	Finite Element Methods	3	0	0	3	100	-
19MCEN1002	Design of Mechatronic systems	3	0	0	3	100	-
19MCEN1003	Product Design and Development	3	0	0	3	100	-
19MEEC1001	Product Life cycle Management	3	0	0	3	100	MC,ME,AU
19MEEC1002	Design for Manufacture, Assembly and Environment	3	0	0	3	100	MC,ME,AU
19MEEC1003	Vibration and noise Engineering	3	0	0	3	100	ME, MC
19MEEC1004	Computational Fluid Dynamics	3	0	0	3	100	ME, MC
19MEEC1005	Design for Transmission systems	3	0	0	3	100	ME, MC
19MEEC1006	Automotive Engine and its systems	3	0	0	3	100	ME, MC
19MCEN1004	Design for Robotic Welding	3	0	0	3	100	-
19MEEC1008	Composite Materials	3	0	0	3	100	MC,ME,AU
Manufacturing and Management							
19MEEC1009	Additive Manufacturing	3	0	0	3	100	MC,ME,AU
19AUEC1001	Unconventional Machining Processes	3	0	0	3	100	MC,AU
19MEEC1010	Flexible Manufacturing systems	3	0	0	3	100	ME, MC
19MEEC1011	Non -Destructive Testing Methods	3	0	0	3	100	MC,ME,AU
19MCEN1006	Industrial Engineering For Mechatronics	3	0	0	3	100	-
19MEEC1015	Principles of Management	3	0	0	3	100	ME, MC
19MEEC1016	Quality Engineering	3	0	0	3	100	MC,ME,AU
19MEEC1017	Industrial safety Management	3	0	0	3	100	MC,ME,AU
19MEEC1018	Automobile Engineering	3	0	0	3	100	ME, MC
19MCEN1007	Disaster Management	3	0	0	3	100	-
19MCEN1008	Maintenance Engineering	3	0	0	3	100	-
19MEEC1023	Model Based Systems Engineering	3	0	0	3	100	MC,ME,AU

Electronics, Control and Networking							
19MCEN1010	Automotive Electronics	3	0	0	3	100	-
19MEEC1019	**I**ndustrial IoT	3	0	0	3	100	MC,ME,AU
19MCEN1011	Micro Electro Mechanical Systems	3	0	0	3	100	-
19MCEN1012	Hybrid Electric Vehicles	3	0	0	3	100	-
19MCEN1013	Digital Control Engineering	3	0	0	3	100	-
19MCEN1014	Power Electronics	3	0	0	3	100	-
19MCEN1015	Virtual Instrumentation	3	0	0	3	100	-
19MCEN1016	Analog and Digital Circuits	3	0	0	3	100	-
19MCEN1017	Industrial Automation	3	0	0	3	100	-

Open Electives

Course Code	Course Title	Hours/Week			Credits	Marks
		L	T	P		
19MCOC1001	Thermal Management in Electronic Equipment	3	0	0	3	100
19MCOC1002	Soft and Mobile Robotics	3	0	0	3	100
19MCOC1003	Field and service robots	3	0	0	3	100
19MCOC1004	Unmanned Aerial Vehicles	3	0	0	3	100
19MCOC1005	Optimization Techniques	3	0	0	3	100
19MCOC1006	Industrial Robotics And Expert Systems	3	0	0	3	100
19MCOC1007	Medical Mechatronics	3	0	0	3	100

SEMESTER I

Course Code: 19SHMG6101	Course Title: INDUCTION PROGRAM (common to all B.E/B.Tech programmes)
Course Category: Mandatory Non-Credit Course	Course Level: Introductory
Duration: 3 Weeks	Max. Marks:100

Pre-requisites:

- Nil

Course Objectives:

The course is intended to:

1. Explain various sources available to meet the needs of self, such as personal items and learning resources
2. Explain various career opportunities, opportunity for growth of self and avenues available in the campus
3. Explain the opportunity available for professional development
4. Build universal human values and bonding amongst all the inmates of the campus and society

List of Activities:

1. History of Institution and Management: Overview on NIA Education Institutions-Growth of MCET – Examination Process-OBE Practices – Code of Conduct – Centre of Excellence
2. Lectures by Eminent People, Motivational Talk – Alumni, Employer
3. Familiarization to Dept./Branch: HoD Interaction – Senior Interaction – Department Association
4. Universal Human Value Modules: Module 1, Module 2,Module 3 and Module 4
5. Orientation on Professional Skill Courses
6. Proficiency Modules – Mathematics, English, Physics and Chemistry
7. Introduction to various Chapters, Cell, Clubs and its events
8. Creative Arts: Painting, Music and Dance
9. Physical Activity: Games and Sports, Yoga and Gardening
10. Group Visits: Visit to Local areas and Campus Tour

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	

CO1: Explain various sources available to meet the needs of self, such as personal items and learning resources through visit to local areas and campus	Understand
CO2: Explain various career opportunities and avenues available in the campus through orientation sessions	Understand
CO3: Explain the opportunity available for professional development through professional skills, curricular, co-curricular and extracurricular activities	Understand
CO4: Build universal human values and bonding amongst all the inmates of the campus and society for having a better life	Apply

Course Articulation Matrix

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

High-3; Medium-2;Low-1

Assessment Pattern

Component	Marks	Details
Attendance	10	Minimum 80% and 1 mark for every 2% observed
Knowledge Test	40	Objective type questions
Work plan for future	50	Career plan developed consulting mentor
Total	**100**	

Non-letter Grades

Marks Scored	Performance Level
70 & above	Good
30 – 69	Average
< 30	Fair

Course Code: 19MABC1101	Course Title: MATRICES AND CALCULUS (Common to AU, CE, MC, ME, PR, EC, EI &EE)		
Course Category: Basic Science		**Course Level: Introductory**	
L:T:P (Hours/Week) 3: 1: 0	**Credits:4**	**Total Contact Hours:60**	**Max. Marks:100**

Pre-requisites:

- Nil

Course Objectives:

The course is intended to:

1. Determine the canonical form of a Quadratic form using Orthogonal transformation
2. Use different testing methods to check the convergence of infinite series.
3. Apply differential and integral calculus to determine the evolute of a curve and improper integrals
4. Apply partial derivatives to find extreme values of functions of two variables.
5. Apply multiple integrals to find area of plane curves and volume of solids.

UNIT I Matrices 9+3 Hours

Rank of a matrix, System of linear equations, Symmetric, Skew symmetric and orthogonal matrices- (Definitions and examples only), Eigenvalues and Eigenvectors, Diagonalization of symmetric matrices through orthogonal transformation, Cayley-Hamilton Theorem, Transformation of quadratic forms to canonical forms through orthogonal transformation.

UNIT II Sequences And Series 9+3 Hours

Sequences- Definition and Examples, Series- Tests for convergence- Power series-series for exponential, trigonometric and logarithm functions - Comparison Test, Integral Test, Cauchy's root test, D Alembert's ratio test, Alternating series- Leibnitz's test.

UNIT III Differential And Integral Calculus 9+3 Hours

Curvature – Radius of curvature - Evolutes and Involutes, Evaluation of definite and improper integrals, Beta and Gamma functions and their properties.

UNIT IV Multivariable Differentiation 9+3 Hours

Limit, continuity, Mean value theorems and partial derivatives, Taylor's series and Maclaurin's series, Jacobian, Maxima, Minima and saddle points, Method of Lagrange's multipliers.

UNIT V Multivariable Integration 9+3 Hours

Multiple Integration: Double integrals (Cartesian), Change of order of integration in double integrals, Change of variables (cartesian to polar and cartesian to spherical), Triple integrals (Cartesian) Applications: areas and volumes.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Determine the canonical form of a Quadratic form using Orthogonal transformation	Apply
CO2: Use different testing methods to check the convergence of infinite series.	Apply
CO3: Determine the evolute of a curve and evaluate improper integrals using beta gamma functions	Apply
CO4: Apply partial derivatives to find extreme values of functions of two variables.	Apply
CO5: Apply multiple integrals to find area of plane curves and volume of solids	Apply

Text Book(s):

T1. Erwin kreyzig, "Advanced Engineering Mathematics", 10th edition, John Wiley & Sons, 2015.

T2. Veerarajan T., "Engineering Mathematics for First Year" , Tata McGraw-Hill, New Delhi, 2011.

T3. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw-Hill, New Delhi, 1st edition, 2017

Reference Book(s):

R1. G.B.Thomas and R.L Finney, Calculus and Analytic Geometry, 9th edition, Pearson, Reprint, 2010.

R2. N.P.Bali and Manish Goyel, "A Text book of Engineering Mathematics", Laxmi Publication, 9th edition, 2010.

R3. B.S.Grewal, "Higher Engineering Mathematics", Khanna Publishers, 43rd Edition, 2014

Web Reference(s):

1. **https://onlinecourses.nptel.ac.in/noc16_ma05**
2. **https://nptel.ac.in/courses/122101003/2**

Course Articulation Matrix

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	PSO1	PSO2
CO1	3	-	-	-	-	1	1	2	1	2	-	2	-	-
CO2	3	-	-	-	-	1	1	2	1	2	-	2	-	-
CO3	3	-	-	-	-	1	1	2	1	2	-	2	-	-
CO4	3	-	-	-	-	1	1	2	1	2	-	2	-	-
CO5	3	-	-	-	-	1	1	2	1	2	-	2	-	-

High-3; Medium-2;Low-1

Assessment pattern

	Assessment Component	**CO .No.**	**Marks**	**Total**
Continuous Comprehensive Evaluation	CCET 1	1,2	50	30
	CCET 2	3,4	50	
	Retest	1,2,3,4	50	
	CCET 3	5	50	
	Tutorial	1,2,3,4,5	30	10
End Semester Examination	ESE	1,2,3,4,5	100	60
Total				**100**

Course Code: 19ENHG2101	Course Title: COMMUNICATION SKILLS – I (Common to all B.E/B.Tech Programmes)		
Course Category: Humanities		**Course Level: Practice**	
L:T:P (Hours/Week) 2: 0: 2	**Credits:3**	**Total Contact Hours:60**	**Max. Marks:100**

Pre-requisites:

- The student should have undergone English as his/her first or second language in school.

Course Objectives:

The course is intended to:

1. Listen and understand monologues and dialogues of a native speaker on par with B1 of CEFR level.
2. Speak in simple sentences to convey their opinion and ideas on par with B1 of CEFR level.
3. Read and infer a given text on par with B1 of CEFR level.
4. Draft basic formal written communication on par with B1 of CEFR level.

UNIT I Listening 15 Hours

Importance of active listening –Physical condition needed for active listening-Identifying relevant points while taking notes.- Framing questions at different linguistic contexts - Listening for specific details of concrete monologues and dialogues –Listening to organize ideas - Developing ideas –Listening to compose paragraphs – Paraphrasing the aural input.

UNIT II Speaking 15 Hours

Importance of note making to practice speaking - Traditional note making, developing Mind map - Collecting points from various sources - Identifying relevant ideas needed for the speech -Using mind-map to organize thought processing - Prioritizing the ideas - Types of sentences -Frequently used words (Institution, home and leisure) - Mother Tongue Influence - Expressing the thoughts in simple sentences - Tenses & Voices (Active & Passive) - Postures, gestures and eye contact - Intonation and Sentence stress - Express one's thoughts coherently.

UNIT III Reading 15 Hours

Reading strategies - Skimming -Scanning - Interpretation of visual data - Factual texts on subjects of relevance - Inferring texts –Reading to write a review –Checking the accuracy of reading while presenting the interpreted data – Reading to comprehend

UNIT IV Writing 15 Hours

WritingSimple and short sentences - Writing E-mail, Memo, Note and Message - Letter Writing - Importance of punctuations -- Identifying the main points - Organising the main ideas - Writing a draft.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Listen actively and paraphrase simple messages and specific details of concrete monologues and dialogues.	Apply
CO2: Express one's views coherently in a simple manner.	Apply
CO3: Read and comprehend factual texts on subjects of relevance.	Understand
CO4: Write texts bearing direct meanings for different contexts maintaining an appropriate style.	Apply

Text Book(s):

T1. Whitby Norman, Business Benchmark Pre-intermediate to Intermediate Students' Book CUP Publications, 2nd Edition, 2014

T2. Wood Ian, Williams Anne, Cowper Anna, Pass Cambridge BEC Preliminary, Cengage Learning, 2nd Edition, 2015.

T3. Learners Book prepared by the Faculty members of Department of English.

Reference Book(s):

R1. BEC-Preliminary - Cambridge Handbook for Language Teachers, 2nd Edition, CUP 2000.

R2. Hewings Martin - Advanced Grammar in use - Upper-intermediate Proficiency, CUP, 3rd Edition, 2013.

Web Reference(s):

1. http://www.grammarinenglish.com
2. https://www.northshore.edu/support_centre /pdf/listen-notes.pdf
3. http://www.examenglish.com/BEC/BEC_Vantage.html

Course Articulation Matrix

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	PSO2
CO1	1	-	-	-	-	1	1	2	-	3	-	1	-	-
CO2	1	-	-	-	-	1	1	2	2	3	-	1	-	-
CO3	1	-	-	-	-	1	1	2	2	3	-	1	-	-
CO4	1	-	-	-	-	1	1	2	-	3	-	1	-	-

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	**CO .No.**	**Marks**	**Total**
Continuous Comprehensive Evaluation	CCET 1	1,2,3,4	50	30
	CCET 2	1,2,3,4	50	
	Retest	1,2,3,4	50	
	CCET 3	1,2,3,4	50	
	Tutorial	1,2	30	10
	Quiz			
	Assignment			
End Semester Examination	ESE	1,2,3,4	100	60
Total				**100**

Course Code: 19PHBC2101		Course Title: PHYSICS FOR MECHANICAL SCIENCES (Common to AU, ME, MC)	
Course Category: Basic Science		Course Level: Introductory	
L:T:P(Hours/Week) 3: 0: 2	Credits:4	Total Contact Hours:75	Max. Marks:100

Pre-requisite(s):

- Nil

Course Objective(s):

The course is intended to:

1. Determine the equilibrium condition of particles and rigid bodies.
2. Understand the motion of a particle.
3. Study the properties of acoustics and their applications.
4. Extend the knowledge of thermal properties to their applications.
5. Understand the basic principles of thermodynamics.

UNIT I Basics of Mechanics 9 Hours

Review of fundamental laws of mechanics – Physical quantities – scalars, vectors – Newton's law of mechanics, Gravitational law. Particles and rigid body, Concept of force and its effect on rigid body system of forces-Free body diagram-principle of transmissibility-equilibrium conditions-equilibrium of particles subjected to coplanar and non-coplanar force system – equilibrium of particles subjected to coplanar system of forces - Triangle law, Parallelogram law and Lami's theorem.

UNIT II Kinematics and Kinetics of Particles 9 Hours

Kinematic parameters – displacement, velocity, acceleration and time. Types of motion – uniform, non-uniform motion, motion of particles in a plane – Rectinlear and curvilinear motion of particles – normal and tangential component – motion of projectile – Relative motion – Dependent motion. Kinetics of particles – Force and acceleration - D'Alembert's principle – Work energy, and impulse momentum method.

UNIT III Physics of Sound 9 Hours

Classification of sound - decibel- Weber–Fechner law – Sabine's formula- derivation using growth and decay method – Absorption Coefficient and its determination – factors affecting acoustics of buildings and their remedies. Methods of sound absorptions: absorbing materials, paints - noise and its measurements, sound insulation and its measurements, impact of noise in machineries

UNIT IV Thermal Physics 9 Hours

Thermal conductivity, Specific heat capacity, Thermal shock resistance, Thermal stability, Thermal Expansion, Thermal insulation and Heat resistance.

Conduction – Co-efficient of the thermal conductivity – Cylindrical flow of heat – determination of thermal conductivity of bad conductor – Lee's disc method: theory and experiment – Conduction through compound media (series and parallel)

UNIT V Elements of Thermodynamics 9 Hours

Concept of temperature – heat – thermodynamics – work – heat in thermodynamics – comparison of heat and work – internal energy – first law of thermodynamics – applications of the first law– second law of thermodynamics – the Carnot cycle – heat engine – heat pump – refrigerators – third law of thermodynamics.

LIST OF EXPERIMENTS 30 Hours

1. Determination of Thermal Conductivity of the insulator – Lee's Disc.
2. Determination of velocity and compressibility of the given liquid – Ultrasonic Interferometer.
3. Determination of Young's modulus – Cantilever bending.
4. Determination of Rigidity modulus of the metallic wire – Torsional Pendulum.
5. Determination of Wavelength of laser and determination of particle size using laser.
6. Verify the triangular law of forces – Lami's theorem.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Use the laws of mechanics to determine the equilibrium condition of particles and rigid bodies.	Understand
CO2: Explain the motion of a particle.	Understand
CO3: Explain the properties of acoustics and their applications.	Understand
CO4: Explain the thermal properties of materials.	Understand
CO5: Explain the principles of thermodynamics.	Understand

Text Book(s):

T1. R. C. Hibbeller, “Engineering Mechanics: Combined Static and Dynamics”, Prentice Hall, 2010.

T2. V. Rajendran, “Engineering Physics”, Tata McGraw Hill Publishing Company limited. New Delhi, 2017.

T3. M.N.Avadhanulu and P.G.Kshirsagar, “Text Book of Engineering Physics”, S. Chand & Company Ltd., New Delhi, 2018.

Reference Book(s):

1. Balasubramaniam "Callister's Material Science and Engineering", John Wiley and Sons Inc., Second Edition, 2015.
2. Brijlal & N. Subramaniam, “Heat & Thermodynamics”, S.Chand & Co., 2008.
3. A.Marikani, “Engineering Physics”, PHI Learning Pvt. Ltd., 2013.

Web Reference(s):

1. http://www.physicsclassroom.com/class/thermal
2. http://nptel.ac.in/course.php?disciplineId=115

Course Articulation Matrix

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	PSO2
CO1	1	-	-	-	-	1	1	3	3	3	1	3	-	-
CO2	1	-	-	-	-	1	1	3	3	3	1	3	-	-
CO3	1	-	-	-	-	1	1	3	3	3	1	3	-	-
CO4	1	-	-	-	-	1	1	3	3	3	1	3	-	-
CO5	1	-	-	-	-	1	1	3	3	3	1	3	-	-

High-3; Medium-2;Low-1

Assessment pattern

	Component	CO .No.	Unit No.	Marks	Scaleto	Total
Continuous Comprehensive Evaluation	CCET 1	1,2	1,2	50	20	40
	CCET 2	3,4	3,4	50		
	Retest	1,2,3,4	1,2,3,4	50		
	CCET 3	5	5	50		
	Continuous Evaluation of Laboratory Experiments	1,2,3,4,5	1,2,3,4,5	20	20	
End Semester Examination	ESE	1,2,3,4,5	1,2,3,4,5	100	60	60
Total	100					

Course Code: 19CSSC2001	Course Title: C PROGRAMMING (Common to AU, ME, MC)		
Course Category: Engineering Science		Course Level: Introductory	
L:T:P(Hours/Week) 3: 0: 2	Credits:4	Total Contact Hours:75	Max. Marks:100

Pre-requisite(s):

- Nil

Course Objective(s):

The course is intended to:

1. Explain about computer organization and problem solving techniques.
2. Write programs using appropriate programming constructs.
3. Develop programs using arrays, functions & strings.
4. Implement programs using pointers, structures & unions.
5. Write programs using files & preprocessor directives.

UNIT I Introduction 7 Hours

Generation and Classification of Computers –Basic Organization of a Computer – Software development life cycle – Problem Solving Techniques, Algorithm, Pseudo code and Flow Chart.

UNIT II C Programming Basics 10 Hours

Introduction to C programming – Structure of a C program – Keywords – Identifiers-Constants– Variables –Data Types– Operators and Expressions –Formatted & Unformatted I/O functions– Decision statements –Loop control statements.

UNIT III Arrays, Functions & Strings 10 Hours

Arrays: Characteristics –One-dimensional and Two-dimensional arrays – Functions: Declaration & Definition of function –Built in function – User defined function –Types of functions –Call by value &reference– Strings: Formatting strings–String handling functions.

UNIT IV Pointers, Structures & Union 9 Hours

Pointers: Features and Types of pointers – Arithmetic operations with pointers–Pointers and Arrays – Structures: Features– Operations on Structures–Array of structures – Unions.

UNIT V Files & Pre-Processor Directives 9 Hours

Introduction to Files –Stream and File Types–File operations (Open, close, read, write) – Command line arguments–Pre-processor Directives: Macro Expansion, File Inclusion, Conditional Compilation.

LIST OF EXPERIMENTS **30 Hours**

1. Programs to process data types, operators and expression evaluation (any1).
    a. To find area of rectangle/circle/square.
    b. To find the simple interest and compound interest.
2. Programs using decision and looping statements(any 2).
    a. To find the maximum number among 3 given numbers.
    b. To check whether given year is leap year or not.
    c. To display the Fibonacci series.
    d. To find the factorial of a number.
3. Programs using Arrays.
    a. To search for particular number among N numbers(1D array).
    b. To compute matrix addition (2 D array).
4. Programs using Functions and Strings(any 2).
    a. To swap two numbers using call by reference.
    b. To find the cube of a number.
    c. To manipulate strings using string functions.
    d. To check whether the string is palindrome or not.
5. Programs using Pointer, Structure & Union
    a. To perform arithmetic operations using pointers.
    b. To display the information of N students using Structure.
    c. To display the employee details using Union.
6. Programs using Files (any 1)
    a. To read the contents of a text file
    b. To copy the contents from one file into another

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Explain about computer organization and problem solving techniques	Understand
CO2: Write programs for the given scenario using appropriate programming Constructs	Apply
CO3: Develop programs using arrays, functions & strings for the given Scenario	Apply
CO4: Implement programs for given application using pointers, structures & unions	Apply
CO5: Write programs using files & preprocessor directives for simple problems	Apply

Text Book(s):

T1. Ashok N.Kamthane, Amit.N.Kamthane, "Programming in C", 3rd Edition, Pearson Education, 2015.

Reference Book(s):

R1. Ajay Mittal, "Programming in C-A Practical Approach", 3rd Edition, Pearson Education, 2010.

R2. Yashavant P.Kanetkar, "Let Us C", 16th Edition, BPB Publications, 2018.

R3. Pradip Dey, Manas Ghosh, "Computer Fundamentals and Programming in C", 2nd Edition, Oxford University Press, 2013.

Web Reference(s):

1. **http://www.cprogramming.com/**
2. **http://www.c4learn.com/**

Course Articulation Matrix

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	PSO2
CO1	2	-	-	-	-	1	1	2	1	2	-	1	-	-
CO2	2	-	-	-	-	1	1	2	1	2	-	1	-	-
CO3	2	-	-	-	-	1	1	2	1	2	-	1	-	-
CO4	2	-	-	-	-	1	1	2	1	2	-	1	-	-
CO5	2	-	-	-	-	1	1	2	1	2	-	1	-	-

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	CO .No.	Marks	Total
Continuous Comprehensive Evaluation	CCET 1	1,2	50	20
	CCET 2	3,4	50	
	Retest	1,2,3,4	50	
	CCET 3	5	50	
	Continuous Evaluation of Laboratory Experiments	1,2,3,4,5	10	20
	Final Assessment of Laboratory Experiments	1,2,3,4,5	10	
End Semester Examination	ESE	1,2,3,4	100	60
Total				**100**

Course Code: 19MESC4001	Course Title: ENGINEERING DRAWING (Common to AU, ME, MC, CS, IT, EC & EI)		
Course Category: Engineering Science		**Course Level: Practice**	
L:T:P (Hours/Week) 1: 0: 3	**Credits:2.5**	**Total Contact Hours:60**	**Max. Marks:100**

Pre-requisites:

- NIL

Course Objectives:

The course is intended to:

1. Develop skills for communication of concepts and ideas.
2. Expose them to existing national standards related to technical drawings.

Unit I Orthographic Projection 12 Hours

Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning. Projection of points, Projection of straight lines located in the first quadrant. Determination of true lengths and true inclinations. Visualization principles –conversion of pictorial into orthographic views.

Unit II Projection of Solids 12 Hours

Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to one of the principal planes by rotating object method.

Unit III Projection of Sectioned Solids 12 Hours

Sectioning of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to one reference plane by cutting planes inclined to one reference plane and perpendicular to the other – Orthographic views of sections of simple solids.

Unit IV Development of Surfaces 12 Hours

Development of lateral surfaces of simple and truncated solids – Prisms, pyramids, cylinders and cones.

Unit V Isometric Projection 12 Hours

Principles of isometric projection – Isometric scale –Isometric projections of simple solids and truncated solids.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Sketch the orthographic projections of the given pictorial view of the object using first angle projection.	Apply
CO2: Sketch the projections of simple solids such as prism, pyramid, cylinder and cone using rotating object method.	Apply
CO3: Sketch the projections of simple sectioned solids with all necessary dimensions meeting the standards.	Apply
CO4: Sketch the lateral surface of simple solids using straight line and radial line development methods.	Apply
CO5: Sketch the isometric view of simple solids and truncated solids using principles of isometric projection.	Apply

Text Book(s):

T1. Cencil Jensen, Jay D.Helsel and Dennis R. Short, " Engineering Drawing and Design", Tata McGraw Hill India, New Delhi, 7th edition, 2017.

T2. Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, Gujarat, 53rd edition, 2015.

T3. K. V. Natrajan, "A Text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 48th edition, 2018.

Reference Book(s):

R1. BasantAgarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill India, New Delhi, 2nd edition, 2013.

R2. John K.C., "Engineering Graphics", PHI Learning, Delhi, 1st edition, 2009.

R3. Dhananjay A. Jolhe, "Engineering Drawing with an introduction to AutoCAD" Tata McGraw India, New Delhi, 3rd edition, 2008.

PUBLICATIONS OF BUREAU OF INDIAN STANDARDS

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

Web References:

1. **http://nptel.ac.in/courses/112103019/**
2. **https://en.wikipedia.org/wiki/Engineering_drawing**

Course Articulation Matrix

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	PSO2
CO1	1	1	2	1	-	-	-	-	1	-	-	-	-	-
CO2	1	1	2	1	-	-	-	-	1	-	-	-	-	-
CO3	1	1	2	1	-	-	-	-	1	-	-	-	-	-
CO4	1	1	2	1	-	-	-	-	1	-	-	-	-	-
CO5	1	1	2	1	-	-	-	-	1	-	-	-	-	-

High-3; Medium-2; Low-1

Assessment pattern

	Assessment component	**Marks**	**Total Marks**
Continuous comprehensive Evaluation	Each Lab Experiment	75	75
	Cycle Test 1	50	25
	Cycle Test 2	50	
	Total Marks		100

Course Code: 19PSHG3001	Course Title: WELLNESS FOR STUDENTS (Common to all B.E/B.Tech Programmes) (2019 Batch Only)		
Course Category: Humanities		**Course Level: Introductory**	
L:T:P (Hours/Week) 0: 0: 2	**Credits:1**	**Total Contact Hours:30**	**Max. Marks:100**

Pre-requisites:

- Nil

Course Objectives:

The course is intended to:

1. Articulate the importance of wellness for success in life.
2. Understand the dimensions of wellbeing and relevant practices
3. Guide in adopting such practices to improve wellness
4. Reflect the impact of changes sensed on personal and social effectiveness

UNIT I Wellness - Importance And Dimensions

Values and aspirations – goals – SMART Goals – means for achieving goals – job Vs career – success in life – attributes of successful persons. Maslow's Hierarchy of needs motivation - Concept of wellness – impact of absence of wellness - Wellness as important component to achieve success.

Wellbeing as per WHO - Dimensions of Wellbeing: Physical, Mental, Social, Spiritual – indicators and assessment methods – Guna – causes and impact - multiple dimensions of human structure (physical, astral, causal bodies) – human-panchabootha relationship.

UNIT II Practices for Physical Wellness through Yoga

Simplified Physical Exercises: Hand, Leg, Neuromuscular breathing, eye exercises, kapalabathy, makarasanam 1 & 2, body massage, 14-points acupressure – Suryanamaskar - relaxation. Simple asanas.

UNIT III Practices for Physical Wellness through Exercises

Fitness as a subset of Wellness – health related physical fitness - skill related physical fitness. Exercises related ailment and injuries - safety and precautions - first aid.

Fitness development: Muscular strength – exercises (calisthenics): pull-up, sit-up, push-up and weight training; Explosive power – exercises: vertical jump, long jump; Cardio respiratory endurance– exercises: walking, jogging, treadmill, stair climbing, bicycling, skipping; Flexibility – exercises: stretching.

Speed, agility, balance and coordination – exercises: sprint, cone drill, ladder drill, hurdle drill, ball throw - mental agility exercises.

UNIT IV Practices for Mental Wellness

Meditation: Mind and its functions - mind wave frequency - Agna, Thuriyam and Shanthi meditation – introspection: analysis of thoughts, moralization of desire, neutralization of anger and eradication of worries - simple mindfulness exercises.

UNIT V Practices for Social and Spiritual Wellness

Kayakalpa yoga - youthfulness and life force - cultural education – greatness of guru – universal compassion – fivefold culture. Greatness of friendship and social welfare – individual, family and world peace – blessings and benefits.

Food & sleep for wellness: balanced diet - good food habits for better health (anatomic therapy) – hazards of junk food - food and the gunas.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Explain the concept of wellness and its importance to be successful in career and life	Understand
CO2: Explain the dimensions of wellness and practices that can promote wellness	Understand
CO3: Demonstrate the practices that can promote wellness	Understand
CO4: Sense and improve the wellness periodically and its impact on personal effectiveness	Understand
CO5: Maintain harmony with self, family, peers, society and nature	Understand

Text Book(s):

T1. Reading material and workbook prepared by PS team of the college.

Reference Book(s):

R1. Vethathiri Maharishi Institute for Spiritual and Intuitional Education, Aliyar ,"Value education for harmonious life (Manavalakalai Yoga)", Vethathiri Publications, Erode, 1st Ed. 2010.

R2. Dr.R.Nagarathna, Dr.H.R.Nagendra, "Integrated approach of yoga therapy for positive health", Swami Vivekananda Yoga Prakashana, Bangalore, 2008.

R3. Tony Buzan, Harper Collins, The Power of Physical Intelligence (English).

Course offering:

Orientation programme (3 days)	CO1 and CO2
Student practice (weekly review classes)	CO3
Student journal writing (interim reviews)	CO4 and CO5

Evaluation:

Continuous assessment: 75 marks
Yoga:
Physical Exercises, KayaKalpa = 15 marks
Meditation = 15 marks
Assessment of student's workbook = 10 marks
Total = 40 marks
Sports:
Physical Exercises, KayaKalpa = 20 marks
Assessment of student's workbook = 15 marks
Total = 35 marks End Semester Examination (combined for yoga and sports):

Written test (MCQ and short answers) = 30 marks
Physical exercises = 50 marks
Viva-voce = 20 marks
Total = 100 marks

End semester mark out of 100 is reduced to 25 marks. The student should get a total of 50 marks put together for a pass.

Scheme of wellness measurement:

#	Wellbeing Dimensions	Sub-dimensions	Wt. in total score	Measurement	Sub-dim score
1	Physical Wellbeing (40%)	BMI	16	weight & height	16
		Flexibility	12	Sit & reach test	12
		Endurance (Energy)	12	12 min Cooper run test	12

2	Mental wellbeing (30%)	Attention/ Concentration	12	Stroop test	15
		Memory	9	Digit Forward and Backward Test.	15
3	Social wellbeing (20%)	Inter-personal	10	IDEA & General Health Questionnaire	10
		Emotional wellbeing	5	IDEA questionnaire	5
		Self concept	5	IDEA questionnaire	5
4	Spiritual Wellbeing (10%)	Guna	10	Guna Questionnaire	
		Total	100%		100

End of semester I

SEMESTER II

Course Code: 19MABC1201	Course Title: ORDINARY DIFFERENTIAL EQUATIONS AND COMPLEX VARIABLES (Common to AU, ME, MC, CE, EE, EC & EI)		
Course Category: Basic Science		**Course Level: Introductory**	
L:T:P (Hours/Week) 3: 1: 0	**Credits:4**	**Total Contact Hours:60**	**Max. Marks:100**

Pre-requisites:

- Matrices and Calculus

Course Objectives:

The course is intended to:

1. Explain the concepts of vector differentiation and integration.
2. Construct analytic functions.
3. Use the concept of complex integration to evaluate definite integrals.
4. Determine the solution of second and higher order ordinary differential equations.
5. Apply Laplace transform techniques to solve ordinary differential equations.

UNIT I Vector Calculus 9+3 Hours

Gradient, Divergence, Curl, Line integrals, Surface integrals, Volume integrals, Theorems of Green, Gauss and Stokes (without proof) , Simple applications involving cubes, spheres and rectangular parallelepipeds.

UNIT II Complex Variables (Differentiation) 9+3 Hours

Cauchy-Riemann equations – Analytic functions – Properties – Harmonic functions – Finding harmonic conjugate – Conformal mapping (w=z+a, w= az, w=1/z) – Mobius transformation and their properties.

UNIT III Complex Variables (Integration) 9+3 Hours

Contour integrals – Cauchy Integral formula (without proof) – Cauchy Integral theorem – Taylor's series – Singularities of analytic functions – Laurent's series–Residues – Cauchy

Residue theorem (without proof) – Evaluation of real definite integrals around unit circle and semi circle (Excluding poles on the real axis)

UNIT IV Ordinary Differential Equations of Higher Orders 9+3 Hours

Second and higher order linear differential equations with constant coefficients – Second order linear differential equations with variable coefficients (Cauchy - Euler equation–Legendre's equation) – Method of variation of parameters – Solution of first order simultaneous linear ordinary differential equations.

UNIT V Laplace Transform 9+3 Hours

Laplace Transform – Properties of Laplace Transform – Laplace transform of integrals – Laplace transform of periodic functions -Inverse Laplace transforms - Convolution theorem – Solution of ordinary differential equations by Laplace Transform method– Applications on engineering problems.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Explain the concepts of vector differentiation and integration.	Apply
CO2: Use the concept of complex variables to construct analytic functions	Apply
CO3: Use the concept of complex integration to evaluate definite integrals.	Apply
CO4: Determine the solution of second and higher order ordinary differential equations	Apply
CO5: Apply Laplace transform techniques to solve ordinary differential equations	Apply

Text Book(s):

T1. Erwin kreyzig, "Advanced Engineering Mathematics", 10th edition, John Wiley & Sons, 2015.

T2. Veerarajan T., "Engineering Mathematics for First Year" , Tata McGraw-Hill, New Delhi, 2011.

T3. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw-Hill, New Delhi, 1st edition, 2017.

Reference Book(s):

R1. G.B.Thomas and R.L Finney, "Calculus and Analytic Geometry", 9th edition, Pearson, Reprint, 2010.

R2. N.P.Bali and Manish Goyel, "A Text book of Engineering Mathematics", Laxmi Publication, 9th edition, 2010.

R3. B.S.Grewal, "Higher Engineering Mathematics", Khanna Publishers, 43rd edition, 2014.

Web Reference(s):

1. **https://onlinecourses.nptel.ac.in/noc16_ma05**
2. **https://nptel.ac.in/courses/122101003/2**

Course Articulation Matrix

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	PSO2
CO1	3	-	-	-	-	1	1	2	1	2	-	2	-	-
CO2	3	-	-	-	-	1	1	2	1	2	-	2	-	-
CO3	3	-	-	-	-	1	1	2	1	2	-	2	-	-
CO4	3	-	-	-	-	1	1	2	1	2	-	2	-	-
CO5	3	-	-	-	-	1	1	2	1	2	-	2	-	-

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	**CO .No.**	**Marks**	**Total**
Continuous Comprehensive Evaluation	CCET 1	1,2	50	30
	CCET 2	3,4	50	
	Retest	1,2,3,4	50	
	CCET 3	5	50	
	Tutorial	1,2,3,4,5	30	10
End Semester Examination	ESE	1,2,3,4,5	100	60
Total				**100**

Course Code: 19ENHG2201	Course Title: COMMUNICATION SKILLS - II (Common to all B.E/B.Tech Programmes)		
Course Category: Humanities		**Course Level: Practice**	
L:T:P (Hours/Week) 2: 0: 2	**Credits:3**	**Total Contact Hours:60**	**Max. Marks:100**

Pre-requisites:

- Communication Skills – I

Course Objectives:

The course is intended to:

1. Listen and understand monologues and dialogues of a native speaker on par with B2 of CEFR level.
2. Speak in simple sentences to convey their opinion and ideas on par with B2 of CEFR level.
3. Read and infer a given text on par with B2 of CEFR level.
4. Draft basic formal written communication on par with B2 of CEFR level.

UNIT I Listening 15 Hours

Importance and purpose of attentive listening - Importance and purpose of intensive listening -Body Language – active listening on complex and abstract themes- Correlating Ideas related to listening input – importance of empathetic- listening for main ideas – paraphrase – compound and complex sentences - Developing ideas - Compose paragraphs.

UNIT II Speaking 15 Hours

Jotting down ideas collected from listening to speak – organising the ideas – Expressing one's view coherently – Understanding grammatical elements (Noun – Pronoun Antecedent) – Expressing ideas assertively – Answering questions during presentations – Understanding the use of discourse markers – word stress and sentence stress – voice modulation and pauses – Highlighting significant points – interpretation of visual data – Using verbal cues - Preparing simple hand - outs.

UNIT III Reading 15 Hours

Reading strategies - Scanning – Inferring - Barriers to reading – sub vocalisation, Eye fixation, Regression – Speed Reading Techniques - read different texts and their context with speed – Note making – Reading a review – Paraphrasing - Read and comprehend.

UNIT IV Writing 15 Hours

Reported speech& Concord (Subject - verb Agreement) – structure of the report – Report writing- Proposal –Plagiarism –references –appendices – Techniques for report writing – Registers.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Listen actively and empathetically, and paraphrase discussions and presentations on complex and abstract themes and topics.	Apply
CO2: Express one's views coherently, fluently and confidently highlighting the significant points with supporting details.	Apply
CO3: Read and comprehend with speed, different texts and their contexts reasonably at moderate speed.	Understand
CO4: Write detailed reports on variety of subjects synthesizing information gathered during listening & reading citing appropriate references.	Apply
Text Book(s):	

T1. Whitby Norman, Business Benchmark Upper Intermediate Students' Book CUP Publications, 2nd Edition, 2014.

T2. Learners Book prepared by the Faculty members of Department of English.

Reference Book(s):

R1. Cambridge BEC Vantage - Practice Tests, Self-study Edition, Cambridge University Press, 2002.

R2. Hewings Martin - Advanced Grammar in use - Upper-intermediate Proficiency, CUP, Third Edition, 2013.

Web Reference(s):

1. **http://www.grammarinenglish.com**
2. **https://www.northshore.edu/support_centre /pdf/listen-notes.pdf**
3. **http://www.examenglish.com/BEC/BEC_Vantage.html**

Course Articulation Matrix

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	PSO2
CO1	2	-	-	-	-	-	-	-	2	3	-	-	-	-
CO2	2	-	-	-	-	-	-	1	2	3	-	-	-	-
CO3	1	-	-	-	-	-	-	1	-	3	-	-	-	-
CO4	2	-	-	-	-	-	-	1	-	3	-	-	-	-

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	CO .No.	Marks	Total
Continuous Comprehensive Evaluation	CCET 1	1,2,3,4	50	30
	CCET 2	1,2,3,4	50	
	Retest	1,2,3,4	50	
	CCET 3	1,2,3,4	50	
	Tutorial	1,2	30	10
	Quiz			
	Assignment			
End Semester Examination	ESE	1,2,3,4	100	60
Total				**100**

Course Code: 19CHBC2201		Course Title: CHEMISTRY FOR MECHANICAL SCIENCES (Common to AU, ME, MC)	
Course Category: Basic Science		Course Level: Introductory	
L:T:P (Hours/Week) 3: 0: 2	Credits:4	Total Contact Hours:75	Max. Marks:100

Pre-requisites:

- Nil

Course Objectives:

The course is intended to:

1.Calculate hardness of water based on water quality parameters.
2.Explain batteries based on their characteristics, construction, working principle and applications.
3.Explain the mechanism of corrosion and its control techniques.
4.Identify a suitable plastic for a specific engineering application.
5. Describe the characteristics of fuel and lubricants.

UNIT I Water Technology 9 Hours

Hardness (Definition, Types, Units) - problems - Estimation of Hardness (EDTA Method) - Water softening - Carbonate conditioning and Calgon conditioning - Demineralization (Ion-Exchange Method) - Water Quality Parameters - Municipal Water Treatment - Desalination - Reverse Osmosis. Effluent discharge standards for Sewage Treatment Plants (STP) - pH, TSS, BOD, COD, NH_4-N, N-total and Fecal Coliform - Construction and working of a typical **S**equential **B**atch **R**eactor STP.

UNIT II Electrochemistry and Batteries 9 Hours

Cells – Types of cells – Galvanic and electrolytic cells – emf and its measurement – Nernst equation - Batteries – Characteristics and Classifications of batteries, Construction, working and applications - Dry cells, Alkaline battery, Lead –Acid battery, Nickel-Cadmium battery, Lithium ion battery, Hydrogen - Oxygen Fuel Cell.

UNIT III Corrosion and Its Control 9 Hours

Corrosion – dry and wet corrosion – mechanism of electrochemical corrosion – galvanic corrosion and concentration cell corrosion - Factors influencing corrosion. Corrosion control methods – Cathodic protection methods, Metallic coating – Galvanizing - Tinning – Chrome plating - Electroless plating of plastics (Nickel plating) - Powder coating - Electrophoretic deposition.

UNIT IV Polymers, Plastics and Composites 9 Hours

Polymers – homo polymer and copolymer. Thermoplastics - thermosetting plastics - thermoplastic elastomers (TPE). Engineering plastics - PA, PC, PVC and Nylon 6, 6 – synthesis, properties and

applications. Polymer Additives and Reinforcements-Thermal and light stabilizers, antioxidants, and flame retardants - Polymer composites – FRP and ceramic matrix composites.

UNIT V Fuels and Lubricants 9 Hours

Automotive fuels - Petrol, Diesel, CNG, Blended fuels - composition, properties and uses. Gross calorific and Net calorific value. Knocking in petrol and diesel engines – octane number and cetane number. Lubricants - importance of lubrication - Classification of lubricants - properties of liquid lubricants and its significance - Total Acid number and Total Base Number. Greases – common grease types and properties. Components of grease - Base Oil, Additives and Thickener. NLGI consistency number.

LIST OF EXPERIMENTS

1. Estimation of Hardness of water by EDTA method.
2. Determination of corrosion rate by weight loss method.
3. Estimation of Fe^{2+} by potentiometric titration
4. Determination strength of acid by pH metry.
5. Conductometric titration of strong acid against strong base.
6. Determination of molecular weight of polymer by Viscometric method.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Calculate hardness of water based on water quality parameters associated with water conditioning methods.	Understand
CO2: Explain batteries based on their characteristics, construction, working principle and applications.	Understand
CO3: Explain the mechanism of corrosion and its control techniques.	Understand
CO4: Identify a suitable plastic for a specific engineering application.	Understand
CO5: Describe the characteristics of fuel and lubricants based on their composition and applications.	Understand

Text Book(s):

T1. Jain &Jain, "Engineering Chemistry" 17th edition, Dhanpat Rai Publishing Compan Ltd, New Delhi, 2018.

T2. Wiley Engineering Chemistry, 2nd edition, Wiley India Pvt Ltd, New Delhi. 2011.

Reference Book(s):

R1. Dara S.S.,and Umare S.S., "A Text book of Engineering Chemistry" ,S.Chand & Co Ltd,New Delhi, 2014.

R2. V.R.Gowariker ,N.V.Viswanathan and Jayadev Sreedhar,"Polymer Science," New Age International (P) Ltd, Chennai, 2006.

R3. Renu Bapna and Renu Gupta, "Engineering Chemistry" ,Macmillan India Publisher Ltd, 2010.

R4. Jeffery G.H.,BassettJ.,Mendham J.and Denny R.C.,Vogel's "Text Book of Quantitative Chemical Analysis" ,Oxford, ELBS ,London, 2012.

R5. Shoemaker D.P. and C.W.Garland.," Experiments in Physical Chemistry", Tata McGraw-Hill Pub.Co.,Ltd., London, 2009.

Web References:

1. **http://nptel.ac.in/courses/122101001/downloads/lec.23.pdf**
2. **http://nptel.ac.in/courses/118104004/**
3. **http://nptel.ac.in/courses/104105039/**

Course Articulation Matrix

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	PSO2
CO1	2	-	-	-	-	1	1	3	3	3	1	3	-	-
CO2	2	-	-	-	-	1	1	3	3	3	1	3	-	-
CO3	2	-	-	-	-	1	1	3	3	3	1	3	-	-
CO4	2	-	-	-	-	1	1	3	3	3	1	3	-	-
CO5	2	-	-	-	-	1	1	3	3	3	1	3	-	-
CO6														

High-3; Medium-2;Low-1

Assessment pattern

	Component	CO .No.	Marks	Total
Continuous Comprehensive Evaluation	CCET 1	1,2	50	20
	CCET 2	3,4	50	
	Retest	1,2,3,4	50	
	CCET 3	5	50	
	Continuous Evaluation of Laboratory Experiments	1,2,3,4,5	10	20
	Final Assessment of Laboratory Experiments	1,2,3,4,5	10	
End Semester Examination	ESE	1,2,3,4,5	100	60
Total				100

Course Code: 19MESC2001		Course Title: INTRODUCTION TO ENGINEERING (Common to AU, ME, MC, EE, EC & EI)	
Course Category: Engineering Science		Course Level: Introductory	
L:T:P (Hours/Week) 2: 0: 2	Credits: 3	Total Contact Hours:60	Max. Marks:100

Pre-requisites:

- Nil

Course Objectives:

The course is intended to:

1. Explain the career opportunities in engineering.
2. Explain how to acquire engineering competencies.
3. Explain how to remain, relevant and versatile as an engineer.
4. Observe engineering products and processes.
5. Take ownership for learning and development.
6. Identify and rectify unsafe conditions and acts.

UNIT I Careers Opportunities In Engineering 5 Hours

Technicians, engineers and scientists, history of engineering. 17 sustainable development goals set by UNO, concept of small e to big E. career choices for an engineer, types of industries, academia and research as career choices, entrepreneurship as a career choice, various departments in engineering industries, roles available in engineering industries. innate skills, learnt skills (competencies), graduate attributes, roles of engineers and the corresponding competencies, career opportunities in engineering in terms of roles & competencies

UNIT II Developing Specific Skills And Competencies 5 Hours

OBE Model, PEOs and POs, technical POs, professional POs, mapping with Graduate attributes, Classification of courses, resources available in the campus and e-resources, resources and facilities available to acquire specific competencies, on-campus and off-campus activities, the methods by which students can systematically involve in activities, significance of professional skill courses, plan for utilizing the resources and facilities to develop specific competencies.

UNIT III Staying Relevant Through Continuous Improvement /Environmental Versatility 7 Hours

Rate of change, technology life cycle (TLC), features of a dynamic and complex environment in which students operate or will operate, impact of globalization & technical advancements, importance of remaining, relevant and versatile in a dynamic and complex environment with the help of technology life cycle, activities/process to remain relevant and versatile, environmental scanning, Life- long learning.

UNIT IV Observe Every Product And Processes With An Engineering Perspective And Inquisitiveness 4 Hours

Product -Need, purpose - primary and secondary function, various stages of manufacturing and its processes. Product - assembly of several simple engineering devices/systems. Product-Parts, principles and laws (mechanical, electrical and electronics), functional relationship between the parts, role of programming in engineering products. Significance of materials and their advancements in improvements in product.

UNIT V Learning And Development Leveraging The Resources And Infrastructure 6 Hours

Process Of Learning, Situated Learning with Examples, Own Learning (Not Copying), Differences between Real Life and Simulated Environment, the Sprit Of Experimentation, Various Learning Enablers, Measure the performance against the plan.

UNIT VI Unsafe Conditions And Acts And Follows Environment Friendly Practices 3 Hours

Safety-definition, importance of personal safety. Statistics of road accidents. Unsafe condition and unsafe act- definition, cause and effects, identification of the unsafe conditions and acts in home/hostel, labs, class rooms, public places. Importance of environment friendly practices.

List of Experiments: 30 Hours

1. Career opportunities with roles and responsibilities.
2. Observe every product and processes with an engineering perspective and inquisitiveness.
    a. Primary and Secondary functions of products and their equivalents.
    b. Primary and Secondary functions of parts of the products, their manufacturing processes and materials.
    c. Structural and functional relations of the product.
3. Safe and unsafe acts and conditions in day-to-day life and professional practices.
4. Skills for Hobby project (At least TWO)
    a. Soldering and de-soldering practices.
    b. Circuit and component testing using multi-meter & CRO.
    c. Battery operated circuit connections and testing.
    d. Simple switching circuits using relays and transistors.

e. Adhesives used in part assembly.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1. Explain the career opportunities in engineering in terms of roles & competencies.	Understand
CO2. Explain how a student can acquire the competencies.	Understand
CO3. Explain how to remain, relevant and versatile in a dynamic and complex environment.	Understand
CO4. Observe every product and processes with an engineering perspective and inquisitiveness.	Apply
CO5. Choose to take ownership for his/her learning and development leveraging the resources and infrastructure.	Understand
CO6. Identify and rectify unsafe conditions and acts and follow environment friendly practices.	Understand

Text Book(s):

T1. Worksheets and Handouts prepared by MCET team.

Reference Book(s):

R1. L. A Bloomfield, "How things work: The physics of everyday life", WILYS 5th Edition, 2013

R2. C. Mason, "How things work," Usborne Publishing Ltd 2009.

R3. D.K. Publishing, "How things work encyclopedia", 2009.

R4. R. J. Segalat, "How things work", Edito-Service Vol.I-IV, 1990.

Web Reference(s):

1. **https://en.wikibooks.org/General_Engineering_Introduction/Engineering_Science**
2. **https://science.howstuffworks.com/engineering-channel.html**

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PS O1	PS O2
CO1	1	-	-	-	-	-	-	1	1	2	-	2	-	-
CO2	1	-	-	-	-	-	-	1	1	2	-	2	-	-
CO3	1	-	-	-	-	-	-	1	1	2	-	2	-	-
CO4	2	-	-	-	-	-	-	3	3	3	2	3	-	-
CO5	1	-	-	-	-	-	-	1	1	2	-	2	-	-

High-3; Medium-2; Low-1

Assessment pattern

Continuous Assessment	Assessment Component	CO. No.	Marks	Total
	CCET I	1,4	50	20
	CCET II	2,3	50	
	CCET III	5,6	50	
	Continuous Assessment – Practical	1,2,3,4,5,6	75	10
	Final Assessment – Practical	2,4	50	10
End Semester Examination	ESE	1,2,3,4,5	100	60
Total				100

Course Code: 19MESC2201	Course Title: ENGINEERING MATERIALS (Common to AU, ME, MC)		
Course Category: Engineering Science		Course Level: Introductory	
L:T:P(Hours/Week) 2: 0: 2	Credits:3	Total Contact Hours:60	Max. Marks:100

Pre-requisites:

- Nil

Course Objectives:

The course is intended to:

1. Calculate the crystal parameters.
2. Analyze the phase diagram.
3. Choose an appropriate ferrous and nonferrous alloy.
4. Select an appropriate powder metallurgy technique.
5. Select an appropriate heat treatment process.

UNIT I Crystal Physics 9 Hours

Introduction: Crystalline and Non crystalline materials. Single crystal , Polycrystalline materials Anisotrophic crystal parameters: Atomic radius, Number of atoms per unit cell, Coordination number, atomic packing factor for SC , BCC , FCC and HCP- Crystal planes: Miller indices, Braggs law . Interplanar distance- Polymorphism and allotrophy. Crystal imperfections: Point , line , surface and volume , grain boundary and its role in mechanical properties.

UNIT II Constitution of Alloys and Phase Diagrams 9 Hours

Constitution of alloys- Solid solutions- Substitutional and Interstitial. Phase diagrams- Interpretation of Phase diagram, Lever rule, Gibbs phase rule. cooling curve for pure metal, binary solid solution and binary eutectic system. Iron – Iron Carbide equilibrium diagram. Micro constituents in Fe3C diagram (Austenite, Ferrite, Cementite, Pearlite, Martensite, Bainite), Pearlite transformation.

UNIT III Ferrous and Nonferrous Alloy 9 Hours

Ferrous alloy: Effect of alloying elements on properties of steel (Mn, Si, Cr, Mg, V and W). Properties and applications of stainless steel and Tool steel.

Cast Iron-White, Malleable, Grey and Spheroidal Cast Iron-Properties and Applications

Non Ferrous alloy: Aluminium and its alloys, Copper and its alloys, Magnesium and its alloys, Titanium and its alloys, Nickel and its alloys- Composition, Properties and Applications.

Industrial standards for alloys and other materials - alloying elements and inclusion of ceramics materials.

UNIT IV Powder Metallurgy 9 Hours

Need of powder metallurgy products-Advantages and limitation of P/M-Stages in P/M-Need for additives in P/M-secondary process of P/M products-mechanical-physical-chemical methods of powder production-compaction and sintering techniques of P/M-particle size analysis

UNIT V Heat Treatment 9 Hours

Heat treatment process-purpose heat treatment – Process parameters. Bulk treatment: Annealing, Normalizing, Tempering, Quenching (Process parameter, application). Isothermal transformation Diagram (TTT Diagram). Cooling curves superimposed on TTT diagram.CCR. Harden ability- Definition. Method to determine Harden ability- Jominy end quench test.

Engineering Materials Lab 15 Hours

1. Determine the hardness of the given specimen.
2. Determine the toughness of the given specimen.
3. Draw the microstructure of cast iron, steel and aluminum using Metallurgical microscope.
4. Prepare a specimen using mounting press for metallographic examination.
5. Microstructure characterization of the polished specimen.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Explain the crystal parameters for different crystal structure and its influences on mechanical properties of bulk materials.	Understand
CO2: Analyze the phase diagram of an alloy by Gibbs phase rule and infer its property for a given composition.	Understand
CO3: Choose an appropriate Ferrous and Non ferrous nonferrous alloy for a suitable application.	Understand
CO4: Select an appropriate powder metallurgy technique, based on the functional requirement of the product.	Understand
CO5: Select an appropriate heat treatment process for the given ferrous alloy such as steel, cast iron for a suitable application.	Understand

Text Book(s):

T1. William D Callister “Material Science and Engineering”, John Wiley and Sons, 2014.

T2. Sidney H Avner “Introduction to Physical Metallurgy”, Tata McGRAW-Hill, 2017.

T3. Anup Goel, SS Sabharwal, “Engineering Materials and Metallurgy”, Technical Publication, 2014.

Reference Book(s):

R1. Raghavan.V “Materials Science and Engineering”, Prentice Hall of India Pvt., Ltd., 2015.

R2. Dieter G. E., “Mechanical Metallurgy”, McGraw Hill Book Company, 2013.

R3. Kenneth G. Budinski. “Engineering Materials”, Prentice Hall of India, New Delhi 2010.

R4. Y. Lakhtin, “Engineering Physical Metallurgy”, CBS Publisher, New Delhi, 2012.

Web Reference(s):

1. **http://nptel.ac.in/courses/113106032/**
2. **http://www.nptel.ac.in/courses/112108150/**
3. **https://en.wikipedia.org/wiki/Materials_science**

Course Articulation Matrix

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	PSO2
CO1	2	1	-	2	2	-	-	3	2	3	1	3	-	-
CO2	2	1	-	2	2	-	-	3	2	3	1	3	-	-
CO3	3	2	-	3	3	-	-	3	2	3	1	3	-	-
CO4	3	2	-	3	3	-	-	3	2	3	1	3	-	-
CO5	2	1	-	2	2	-	-	3	2	3	1	3	-	-

High-3; Medium-2;Low-1

Assessment pattern

	Assessment Component	CO .No.	Marks	Total
Continuous Comprehensive Evaluation	CCET 1	1,4	50	20
	CCET 2	2,3	50	
	Retest	1,2,3,4	50	
	CCET 3	5,6	50	
	Continuous Evaluation of Lab	1,2,3,4,5	20	20
End Semester Examination	ESE	1,2,3,4,5	100	60
Total				**100**

Course Code: 19MECC3201	Course Title : ENGINEERING PRACTICES LABORATORY (Common to AU, ME, MC)		
Course Category: Professional core		Course Level: Practice	
L:T:P (Hours/Week) 0: 0: 3	Credits:1.5	Total Contact Hours:45	Max. Marks:100

Pre-requisites:

- NIL

Course Objectives:

The course is intended to:

1. Draw the basic symbols of electrical and electronic components and identify the elements.
2. Execute soldering practice for electrical and electronic circuits.
3. Demonstrate the basic carpentry, fitting, plumbing, sheet metal and welding operations.

List of Experiments:

[A] Electrical & Electronics :

1) Symbols of electrical and electronic components and study of electrical drawing.

2) Insulation Testing using Megger.

3) Soldering practice of simple circuit and testing.

4) Fluorescent tube, staircase and house wiring.

5) Verification of Kirchhoff's current and voltage law.

[**B] Civil & Mechanical :**

1) Make a wooden Tee joint to the required dimension.
2) Make a "V" filling to the required dimension using fitting tools.
3) Make a tray in sheet metal to the required dimension.
4) Assemble the pipeline connections with different joining components for the given layout.
5) Weld a butt joint using welding process to the required dimension.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Draw the basic symbols of electrical and electronic components from a given circuit.	Apply
CO2: Connect the electrical and electronic components andother house holding items as per the given circuit.	Apply

CO3: Verify the Kirchhoff's laws as per the given circuit.	Apply
CO4: Make a wooden 'T' joint, metal 'V' joint, sheet metal 'TRAY', pipeline with various joining components and a permanent joint using various workshop tools as per the given dimensions.	Apply

Reference(s):

R1. Jeyachandran.K, Natarajan.S & Balasubramanian.S, "A Primer on Engineering Practices Laboratory", Anuradha Publications, TamilNadu (India), 2016.

R2. 19EPL21 - Engineering practices laboratory Manual.

Course Articulation Matrix

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	PSO2
CO1	2	1	2	2	-	-	-	-	2	2	-	-	-	-
CO2	2	1	2	2	-	-	-	-	2	2	-	-	-	-
CO3	2	1	2	2	-	-	-	-	2	2	-	-	-	-
CO4	2	1	2	2	-	-	-	-	2	2	-	-	-	-

High-3; Medium-2; Low-1

Assessment pattern

	Assessment component	**Marks**	**Total Marks**
Continuous comprehensive Evaluation	Each Lab Experiment	75	75
	Cycle Test 1	50	25
	Cycle Test 2	50	
	Total Marks		100

Course Code: 19PSHG3002		Course Title: PERSONAL EFFECTIVENESS (Common to all B.E/B.Tech Programmes) (2019 Batch only)	
Course Category: Humanities		**Course Level: Introductory**	
L:T:P (Hours/Week) 0: 0: 2	**Credits:1**	**Total Contact Hours:30**	**Max.Marks:100**

Pre-requisites:

- NIL

Course Objectives:

The course is intended to:

1. Set SMART goals for academic, career and life.
2. Identify strength, weaknesses and opportunities.
3. Plan for achieving the goals.
4. Apply time management techniques.
5. Create time and pursue activities of self interest.

UNIT I The Importance of Envisioning

Importance of positive self-perception – Principle of dual creation (Everything gets created twice – Envisioning) - Understanding Vision and mission statements - Writing personal mission statements – 'Focus' as a way of life of most successful people – Importance of goal setting –Importance of planning and working to time.

UNIT II Fundamental Principles of Goal Setting and Working to Time

Clarifying personal values, interests and orientations – Awareness of opportunities ahead – Personal SWOT analysis - Principles driving goal setting: Principle of response and stimuli, Circle of influence and circle of concern, What you see depends on the role you assume.

UNIT III Goal Setting and Action Orientation

Potential obstacles to setting and reaching your goals - Five steps to goals setting: SMART goals, Inclusive goals, Positive stretch, Pain vs gain, Gun-point commitment – Importance of action orientation - Converting goals to actionable tasks – Establishing road map – Using Gantt chart for planning and progress.

UNIT IV Time Management - Tools and Techniques

Pareto 80-20 principle of prioritization – Time quadrants as a way to prioritize weekly tasks – The glass jar principle - Handling time wasters – Assertiveness, the art of saying 'NO' – Managing procrastination.

UNIT V Putting into Practice

Practicals: Using the weekly journal – Executing and achieving short term goals – Periodic reviews.

Course Outcomes:

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

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Identify the strengths, weaknesses and opportunities.	Apply
CO2: Set well-articulated goals for academics, career, and personal aspirations.	Apply
CO3: Establish the road map to realize the goals	Apply
CO4: Apply time management techniques to complete planned tasks on time.	Apply
CO5: Create time and pursue activities of self-interest that add value.	Apply

Text book(s):

T1. Reading material, workbook and journal prepared by PS team of the college.

Reference(s):

R1. Stephen R Covey, "First things first", Simon & Schuster U.K, Aug 1997.

R2. Sean Covey, "Seven habits of highly effective teenagers", Simon & Schuster U.K, 2004.

Course offering:

Orientation programme (2 days)	CO1 and CO2
Student practice (weekly review classes)	CO3
Student journal writing (interim reviews)	CO4 and CO5

Course Code: 19PSHG6001		**Course Title: Wellness for Students** (Common to all B.E/B.Tech Programmes) (2020 Batch Only)	
Course Category: Humanities		**Course Level: Introductory**	
L:T:P (Hours/Week) 0: 0: 2	**Credits:1**	**Total Contact Hours:30**	**Max.Marks:100**

Course Objectives

The course is intended to

1. Set SMART goals for academic, career and life
2. Apply time management techniques
3. Articulate the importance of wellness for success in life.
4. Understand the dimensions of wellbeing and relevant practices

UNIT I GOAL SETTING

Understanding Vision and mission statements - Writing personal mission statements – 'Focus' as a way of life of most successful people. Clarifying personal values, interests and orientations – Awareness of opportunities ahead – Personal SWOT analysis - Principles driving goal setting: Principle of response and stimuli, Circle of influence and circle of concern, What you see depends on the role you assume. Potential obstacles to setting and reaching your goals - Five steps to goals setting: SMART goals, Inclusive goals, Positive stretch, Pain vs gain, Gun-point commitment.

UNIT II TIME MANAGEMENT - TOOLS AND TECHNIQUES

Importance of planning and working to time. Pareto 80-20 principle of prioritization – Time quadrants as a way to prioritize weekly tasks – The glass jar principle - Handling time wasters – Assertiveness, the art of saying 'NO' – Managing procrastination

UNIT III PRACTICES FOR PHYSICAL WELLNESS

Concept of wellness – impact of absence of wellness - Wellness as important component to achieve success. Wellbeing as per WHO - Dimensions of Wellbeing: Physical, Mental, Social, Spiritual – indicators and assessment methods

Simplified Physical Exercises. Fitness as a subset of Wellness – health related physical fitness - skill related physical fitness. Joint movements, Warm up exercises, simple asanas, WCSC simplified exercises.

UNIT IV PRACTICES FOR MENTAL WELLNESS:

Meditation: Mind and its functions - mind wave frequency – Simple basic meditation – WCSC meditation and introspection tables. Greatness of friendship and social welfare – individual, family and world peace – blessings and benefits.

Food & sleep for wellness: balanced diet - good food habits for better health (anatomic therapy) – hazards of junk food - food and the gunas.

UNIT V PUTTING INTO PRACTICE

Practicals: Using the weekly journal – Executing and achieving short term goals – Periodic reviews

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Set well-articulated goals for academics, career, and personal aspirations	Understand
CO2: Apply time management techniques to complete planned tasks on time	Understand
CO3: Explain the concept of wellness and its importance to be successful in career and life	Understand
CO4: Explain the dimensions of wellness and practices that can promote wellness	Understand
CO5: Demonstrate the practices that can promote wellness	Understand

Text books

T1: Reading material, workbook and journal prepared by PS team of the college.

Reference(s):

R1 Stephen R Covey, “First things first”, Simon & Schuster Uk, Aug 1997.

R2 Sean Covey, “Seven habits of highly effective teenagers”, Simon & Schuster Uk, 2004.

R3 Vethathiri Maharishi Institute for Spiritual and Intuitional Education, Aliyar, “Value education for harmonious life (Manavalakalai Yoga)”, Vethathiri Publications, Erode, I Ed. (2010).

Course offering: (Annual Pattern)

CO1, CO2 and CO5	Can be conducted in Odd semester
CO3, CO4 and CO5	Can be conducted in Even semester
Student journal writing (interim reviews)	CO1 to CO5

Evaluation:

Continuous assessment: 75 marks

Personal Effectiveness = 35 marks (Odd Sem)

Yoga and physical Exercise (Even Sem)

Physical Exercises = 20 marks

Meditation = 10 marks

Assessment of student's workbook = 10 marks

End Semester Examination (combined for yoga and sports):

Written test (MCQ and short answers)	= 30 marks
Physical exercises	= 50 marks
Viva-voce	= 20 marks
Total	= 100 marks

End semester mark out of 100 is reduced to 25 marks.

The student should get a total of 50 marks put together for a pass

Course Code: 19CHMG6201		Course Title: ENVIRONMENTAL SCIENCES (Common to all B.E/B.Tech Programmes)	
Course Category: Mandatory		Course Level: Introductory	
L:T:P (Hours/Week) 1: 0: 0	Credits: 0	Total Contact Hours:15	Max. Marks: 0

Pre-requisites:

- Nil

Course Objectives:

The course is intended to:

1. Create awareness for conservation and equitable use of natural resources.
2. Explain the measures of prevention of pollution and disaster management.
3. State the importance of environmental legislation in India.
4. Expose the general environmental issues relevant to human health.
5. Explain the innovative measures for day to day environmental issues.

UNIT I Natural Resoruces 2 Hours

Role of individual in conservation of natural resources; Equitable use of resources for sustainable lifestyles.

UNIT II Environmental Pollution And Disaster Management 2 Hours

Role of an individual in prevention of pollution; Disaster management : floods, earthquake, cyclone and landslides.

UNIT III Environmental Ethics And Legislations 2 Hours

Environmental ethics : Environment Protection Act; Air Act; Water Act ; Wildlife Protection Act; Forest Conservation Act; Issues involved in enforcement of environmental legislation.

UNIT IV Environmental Issues And Public Awarness 2 Hours

Public awareness - Environment and human health.

UNIT V Environmental Activities 7 Hours

(a) Awareness Activities:

i) Small group meetings about water management, promotion of recycle use, generation of less waste, avoiding electricity waste.

ii) Slogan making event.

iii) Poster making event.

(b) Actual Activities:

i) Plantation.

ii) Cleanliness drive.

iii) Drive for segregation of waste.

iv) To know about the different varieties of plants.

v) Shutting down the fans and ACs of the campus for an hour or so.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Create awareness for conservation and equitable use of natural resources.	Understand
CO2: Explain the measures of prevention of pollution and disaster management.	Understand
CO3: State the importance of environmental legislation in India.	Understand
CO4: Expose the general environmental issues relevant to human health.	Understand
CO5: Explain the innovative measures for day to day environmental issues.	Understand

Textbook(s):

T1. Benny Joseph, "Environmental Studies", Tata McGraw Hill, New Delhi, 2006.

T2. Mackenzie Davis and Susan Masten, "Principles of Environmental Engineering and science", Mc-Graw Hill, 3rd edition, 2014.

Reference(s):

R1. Trivedi R.K. "Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards", Vol. I and II, Enviro Media.

R2. Cunningham, W.P.Cooper., T.H. Gorhani, "Environmental Encyclopedia", Jaico Publishing House, Mumbai, 2001.

COURSE ARTICULATION MATRIX

CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1	1	-	-	-	-	1	1	1	1	1	-	-
CO2	2	1	1	-	-	-	-	1	1	1	1	1	-	-
CO3	2	1	1	-	-	-	-	1	1	1	1	1	-	-
CO4	2	1	1	-	-	-	-	1	1	1	1	1	-	-
CO5	2	1	1	-	-	-	-	1	1	1	1	1	-	-

ASSESSMENT PATTERN

- Attendance : 10 Marks
- Knowledge Test : 40 Marks
- Activity(ies) : 50 Marks

Total Marks : 100

RUBRICS FOR ATTENDANCE

Component	**Marks**	**Details**
Attendance	10	Minimum 80%, 1 mark for each 5% observed
Knowledge Test	40	40 objective type questions from Induction Program
Activity(ies)	50	Rubrics based assessment

NON-LETTER GRADES

Marks Scored	**Performance Level**
70 & above	Good
30 – 69	Average
< 30	Fair

End of semester II

SEMESTER III

Course Code:19MABC1302	Course Title: NUMERICAL METHODS AND LINEAR ALGEBRA (Common to EE,EC, EI and MC)		
Course Category: Basic Science		Course Level: Introductory	
L:T:P(Hours/Week) 3: 1: 0	Credits:4	Total Contact Hours: 60	Max Marks: 100

Pre-requisites:

- Matrices and Calculus
- Ordinary Differential Equation and Complex variables

Course Objectives:

The course is intended to:

1. Solve the system of linear equations, nonlinear equations & calculate the dominant Eigen value.
2. Determine the unknown values from the given set of data & Compute derivatives and integrals.
3. Solve first ordinary differential equation.
4. Apply the concept of vector spaces to electrical network problems
5. Apply the concept of Inner product spaces in Fourier approximation

Unit I Solution of System Of Linear Equations 9+3 Hours

Solution of system of linear equations– Direct methods: Gaussian elimination method – Indirect methods: Gauss Jacobi method, Gauss-Seidel method– sufficient conditions for convergence –Solution of nonlinear equations: Newton Raphsonmethod –Power method to find the dominant Eigen value and the corresponding Eigen vector.

Unit II Interpolation, Numerical Differentiation And Integration 9+3 Hours

Newton's forward, backward interpolation — Lagrange's interpolation. Numerical Differentiation and Integration — Trapezoidal rule — Simpson's 1/3 rule — Double integration using Trapezoidal rule.

Unit III Numerical Solution Of Ordinary Differential Equation 9+3 Hours

Numerical solution of first order ordinary differential equation-Single step method: Taylor's series- Euler's method - Runge-Kutta method of fourth order — Multi step method: Milne's and Adams – Bash forth predictor corrector methods for solving first order equations.

Unit IV Vector Spaces 9+3 Hours

System of linear equations -Vector spaces- Subspace of a vector space- basis and dimension of vector space - linear combination and spanning sets of vectors -linear independence and linear dependence of vectors-Row space, Column space and Null space- Rank and nullity of subspaces. Applications to linear equations: Simple electrical network problems to find loop current using Kirchhoff's voltage law.

Unit V Orthogonality And Inner Product Spaces 9+3 Hours

Inner product of vectors: length of a vector, distance between two vectors, and orthogonality of vectors- Orthogonal projection of a vector-Gram-Schmidt process to produce orthogonal and orthonormal basis - Inner product spaces- Fourier approximation of continuous functions using inner product spaces.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Solve the system of linear equations, nonlinear equations & Calculate the dominant Eigen value.	Apply
CO2: Determine the unknown values from the given set of data & Compute derivatives and integrals.	Apply
CO3: Solve first ordinary differential equation.	Apply
CO4: Apply the concept of vector spaces to electrical network problems.	Apply
CO5: Apply the concept of Inner product spaces in Fourier approximation	Apply

Text Book(s):

T1. Grewal, B.S. and Grewal, J. S., "Numerical Methods in Engineering and Science", Eleventh Edition, Khanna Publishers, New Delhi, 2013.

T2. David C Lay, "Linear Algebra and its Applications', Fifth Edition, Pearson Education, 2015.

Reference Book(s):

R1. Gerald, C. F. and Wheatley, P. O., "Applied Numerical Analysis", Sixth Edition, Pearson Education Asia, New Delhi, 2006.

R2. Jain M. K., lyengar, S. R. and Jain, R. K, "Numerical Methods for Scientific and Engineering Computation', New Age Publishers, 2012.

R3. Sastry.S.S "Introductory Methods of Numerical Analysis", 3 Edition, PHI, 2003.

Web Reference(s):

1. http://nptel.ac.in/courses/122104018/node2.html
2. http://nptel.ac.in/courses/111105038/

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO2
CO1	2	1	-	2	2	-	-	2	2	3	-	2	-	-
CO2	2	1	-	2	2	-	-	2	2	3	-	2	-	-
CO3	2	1	-	2	2	-	-	2	2	3	-	2	-	-
CO4	2	1	-	2	2	-	-	2	2	3	-	2	-	-
CO5	2	1	-	2	2	-	-	2	2	3	-	2	-	-

High-3; Medium-2; Low-1

Assessment pattern

<table>
<tr><th colspan="2" rowspan="8">Continuous Comprehensive Evaluation</th><th>Assessment Component</th><th>CO .No.</th><th>Marks</th><th>Total</th></tr>
<tr><td>CCET I</td><td>1,2</td><td>50</td><td rowspan="4">30</td></tr>
<tr><td>CCET II</td><td>3,4</td><td>50</td></tr>
<tr><td>Retest</td><td>1,2,3,4</td><td>50</td></tr>
<tr><td>CCET III</td><td>5</td><td>50</td></tr>
<tr><td>Tutorial</td><td>1,2,3,4,5</td><td rowspan="3">30</td><td rowspan="3">10</td></tr>
<tr><td>Quiz</td><td>1,2,3,4,5</td></tr>
<tr><td>Assignment</td><td>1,2,3,4,5</td></tr>
<tr><td colspan="2">End Semester Examination</td><td>ESE</td><td>1,2,3,4,5</td><td>100</td><td>60</td></tr>
<tr><td colspan="5">Total</td><td>100</td></tr>
</table>

Course Code:19MECC2301	Course Title: FLUID MECHANICS AND HYDRAULIC MACHINERY (Common to AU, ME & MC)		
Course Category: Professional Core		Course Level: Practice	
L:T:P(Hours/Week) 3: 0: 2	Credits: 4	Total Contact Hours: 75	Max Marks: 100

Pre-requisites:

- Physics for Mechanical Sciences

Course Objectives:

The course is intended to:

1. Apply mathematical knowledge to predict the properties and characteristics of a fluid.
2. Analyze and calculate major and minor losses associated with pipe flow.
3. Mathematically predict the nature of physical quantities.
4. Select a suitable hydraulic pump for the customer provided site conditions.
5. Select a suitable hydraulic turbine for the given rated parameters.

Unit I Fluid Properties and Flow Characteristics 9 Hours

Fluid: definition, classification of fluids, units and dimensions. Properties of fluids: density, specific weight, specific volume, specific gravity, viscosity, compressibility, vapor pressure, capillarity and surface tension.

Flow characteristics, Continuity equation and Bernoulli's equation in 1-D, Hydraulic and energy gradient. Application of Bernoulli's equation to flow through pipes, venturimeters, orificemeters and Pitot tube.

Unit II Flow Through Circular Conduits 9 Hours

Laminar and Turbulent flow though circular conduits, boundary layer concepts, boundary layer thickness. Darcy-Weisbach equation, Friction factor and Moody diagram, Minor and Major losses, Flow though pipes in series and in parallel.

Unit III Dimensional Analysis 9 Hours

Need for dimensional analysis, methods of dimensional analysis, Buckingham's π theorem. Similitude, types of similitude, Dimensionless parameters, application of dimensionless parameters, Model analysis

Unit IV Pumps 9 Hours

Centrifugal pump: working principle and working principle, velocity triangles, Euler pump equation, various efficiencies and performance curves.

Reciprocating pump: classification, working principle, indicator diagram, work saved by air vessels - performance curves.

Unit V Hydraulic Turbines **9 Hours**

Classification of turbines, heads and efficiencies, velocity triangles, Euler turbine equation. Pelton, Francis and Kaplan turbines, working principle and construction, work done by water on the runner, draft tube, performance curves, governing of turbines.

List of Experiments **30 Hours**

1. Determination of coefficient of discharge of given Orifice meter.
2. Determination of coefficient of discharge of given Venturimeter.
3. Determination of friction factor of given set of pipes.
4. Performance study of Centrifugal pumps
5. Performance study of reciprocating pumps.
6. Performance characteristics of a Pelton wheel.
7. Performance test on a Francis Turbine.
8. Performance test on a Kaplan Turbine

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Calculate the properties of real fluids such as water, oils and mercury.	Apply
CO2: Determine the flow properties of ideal fluid by applying the kinematic and dynamic principles.	Apply
CO3: Determine flow rates and head losses in real fluids under viscous and turbulent flows.	Apply
CO4: Evaluate the performance of impulse and reaction turbines under various loading and head conditions.	Apply
CO5: Evaluate the performance of rotary and reciprocating pumps under various head conditions.	Apply

Text Book(s):

T1. Bansal, R.K., "Fluid Mechanics and Hydraulics Machines", 5th edition, Laxmi Publications (P) Ltd., New Delhi, 2014.

T2. Vasandani, V.P., "Hydraulic Machines - Theory and Design", Khanna Publishers, 2014.

Reference Book(s):

R1.White, F.M., "Fluid Mechanics", Tata McGraw-Hill, 5th Edition, New Delhi, 2013

R2.Streeter, V.L., and Wylie, E.B., "Fluid Mechanics", McGraw-Hill, 2013.

R3.Kumar, K.L., "Engineering Fluid Mechanics", Eurasia Publishing House (P) Ltd., New Delhi (7^{th} edition), 2014.

Web Reference(s):

1. http://nptel.ac.in/courses/112107147/

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO2
CO1	2	1	-	2	2	-	-	1	2	2	-	1	-	-
CO2	2	1	-	2	2	-	-	1	2	2	-	1	-	-
CO3	2	1	-	2	2	-	-	1	2	2	-	1	-	-
CO4	2	1	-	2	2	-	-	1	2	2	-	1	-	-
CO5	2	1	-	2	2	-	-	1	2	2	-	1	-	-

High-3; Medium-2; Low-1

Assessment pattern:

	Assessment Component	**CO .No.**	**Marks**	**Total**
Continuous Comprehensive Evaluation	CCET 1	1,2	50	20
	CCET 2	3,4	50	
	Retest	1,2,3,4	50	
	CCET 3	5	50	
	Continuous Assessment – Practical	1,2,3,4,5	75	10
	Final Assessment – Practical	1,2,3,4,5	50	10
End Semester Examination	ESE	1,2,3,4,5	100	60
Total				**100**

Course Code:19MCSN1301	Course Title: BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING		
Course Category: Engineering Science		Course Level: Introductory	
L:T:P(Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours: 45	Max Marks: 100

Pre-requisites

- Physics for Mechanical Sciences

Course Objectives

The course is intended to:

1. Understand the Basic Electric circuit laws and Theorems.
2. Construct the single phase and three phase AC circuits and Loads
3. Explain the working principles of Electrical Machines
4. Outline the working principles of Special Electrical Machines
5. Illustrate the working principle of various electronic devices

Unit I DC Circuits 9 Hours

Basic circuit components – Ohms Law, Kirchoff's Law, Resistors in series and parallel circuits - – Mesh current and node voltage method of analysis for D.C circuits- Thevenin's Theorem, Norton's Theorem.

Unit II AC Circuits 9 Hours

Introduction to AC circuits – waveforms and RMS value – power and power factor,star delta conversion - single phase and three-phase balanced circuits – Three phase loads.

Unit III Electrical Machines 9 Hours

Principles of operation and characteristics of - DC Machines (Shunt motor, Shunt Generator), AC Machines - Induction motors (three phase and single phase), Transformers (single phase)

Unit IV Special Electrical Machines 9 Hours

Constructional feature, working principle, Phasor diagram, Performance and Application -Brushless D.C. machines, Stepper Motors, Universal Motor, AC Servo motor, DC Servomotor

Unit V Electronic Devices and Circuits 9 Hours

Types of Materials – Silicon & Germanium- N type and P type materials – PN Junction –Forward and Reverse Bias –Semiconductor Diodes –Bipolar Junction Transistor – Characteristics – Field Effect Transistors – Transistor Biasing

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Illustrate the Basic Electric circuit laws and Theorems.	Understand
CO2: Apply the electrical concepts for single phase and three phase circuits for balanced loads	Apply
CO3: Outline the working principles of Electrical Machines	Understand
CO4: Explain the working principles of Special Electrical Machines	Understand
CO5: Compare the working principle of various electronic devices	Understand

Text Book(s):

T1. William H. Hayt Jr, Jack E. Kemmerly and Steven M. Durbin, Engineering Circuits Analysis,Tata McGraw Hill publishers, 7th edition, New Delhi, 2007.

T2. D P Kothari and I.J Nagarath, "Electrical Machines "Basic Electrical and Electronics Engineering", McGraw Hill Education(India) Private Limited, Third Reprint ,2016

T3. Thereja .B.L., "Fundamentals of Electrical Engineering and Electronics", S. Chand & Co. Ltd., 2008

Reference Book(s):

R1. Del Toro, "Electrical Engineering Fundamentals", Pearson Education, New Delhi, 2007

R2. John Bird, "Electrical Circuit Theory and Technology", Elsevier, First Indian Edition, 2006

R3. Allan S Moris, "Measurement and Instrumentation Principles", Elsevier, First Indian Edition, 2006

R4. Charles K. Alexander, Mathew N.O. Sadik, "Fundamentals of Electric Circuits", Second Edition, McGraw Hill, 2007.

R5. A.E.Fitzgerald, David E Higginbotham and Arvin Grabel, "Basic Electrical Engineering", McGraw Hill Education(India) Private Limited, 2009

R6. N K De, Dipu Sarkar, "Basic Electrical Engineering", Universities Press (India)Private Limited 2016

Web Reference(s):

1. https://nptel.ac.in/courses/108108076/
2. https://nptel.ac.in/courses/108105053/

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO2
CO1	3	2	-	-	-	-	1	2	2	2	1	1	-	1
CO2	3	2	-	-	-	-	1	2	2	2	1	1	-	1
CO3	3	2	-	-	-	-	1	2	2	2	1	1	-	1
CO4	3	2	-	-	-	-	1	2	2	2	1	1	-	1
CO5	3	2	-	-	-	-	1	2	2	2	1	1	-	1

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	**CO .No.**	**Marks**	**Total**
Continuous Assessment	CCET 1	1,2	50	30
	CCET 2	3,4	50	
	Retest	1,2,3,4	50	
	CCET 3	5	50	
	Assignment	1,2,3,4,5	10	10
End Semester Examination	ESE	1,2,3,4,5	100	60
Total				**100**

Course Code:19MCCN1301	Course Title: SENSORS AND INSTRUMENTATION		
Course Category: Professional Core		Course Level: Introductory	
L:T:P(Hours/Week) 3: 0: 0	Credits: 3	Total Contact Hours: 45	Max Marks: 100

Pre-requisites:

- Physics for Mechanical Sciences

Course Objectives:

The course is intended to:

1. Classify the transducers and instruments based on their working principles, characteristics and order of the system.
2. Summarize the principle and application of resistance transducers.
3. Summarize the principle and application of variable inductance and capacitance transducers.
4. Illustrate the advanced types of transducers.
5. Explain the principle of signal conditioning and data acquisition

Unit I Measurement Systems 9 Hours

Generalized Measurement System – Performance Characteristics: Static and Dynamic Characteristics – Generalized Performance of Zero Order, First Order Systems – Classifications of Transducers.

Unit II Variable Resistance Transducers 9 Hours

Principle of operation, construction details, characteristics and application of potentiometer, strain gauge, resistance thermometer, Thermistor, hot-wire anemometer, piezo resistive sensor and humidity sensor.

Unit III Variable Inductance and Capacitance Transducers 9 Hours

Induction potentiometer – Variable reluctance transducers – Principle of operation, construction details, characteristics and application of LVDT –Capacitive transducer and types – Capacitor microphone.

Unit IV Special Transducers 9 Hours

Photo conductive cell, photo voltaic, Photo resistive, LDR – Fiber optic sensors –Piezoelectric – Tactile sensors, Acoustic Sensors – flow and level measurement, Radiation Sensors - Smart Sensors , MEMS & Nano Sensors

Unit V Signal Conditioning and Data Acquisition 9 Hours

Amplification, Filtering – Level conversion – Linearization - Buffering – Sample and Hold circuit – Quantization – Multiplexer / Demultiplexer – Analog to Digital converter – Digital to Analog converter-Data Acquisition -Data Logging.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1. Classify the transducers and instruments based on their working Principles, characteristics and order of the system.	Understand
CO2. Describe the working principle, Construction, Characteristics and Application of Resistance type transducers.	Understand
CO3. Describe the working principle, Construction, Characteristics and Application of capacitive and inductive type transducers	Understand
CO4. Explain the working principle, Construction and Application of advanced type of transducers.	Understand
CO5. Explain the DAQ systems with different sensors for real time applications.	Understand

Text Book(s):

T1. Ernest O Doebelin, "Measurement Systems – Applications and Design", Tata McGraw-Hill, 2009

T2. Sawney A K and PuneetSawney, "A Course in Mechanical Measurements and Instrumentation and Control", 12th edition, DhanpatRai& Co, New Delhi, 2013.

Reference Book(s):

R1. Patranabis D, "Sensors and Transducers", 2nd Edition, PHI, New Delhi, 2010.

R2. John Turner and Martyn Hill, "Instrumentation for Engineers and Scientists", Oxford Science Publications, 2009.

Web Reference(s):

1. https://nptel.ac.in/courses/108/108/108108147/
2. https://nptel.ac.in/courses/108/108/108108113/
3. https://nptel.ac.in/courses/108/105/108105064/

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PS O2
CO1	3	-	2	-	-	-	-	-	-	-	1	-	1	1
CO2	3	-	2	-	-	-	-	-	-	-	1	-	-	2
CO3	3	-	3	-	-	-	-	-	-	-	1	-	1	-
CO4	3	-	2	-	-	-	-	-	-	-	1	-	2	-
CO5	3	-	3	-	-	-	-	-	-	-	1	-	1	-

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	CO .No.	Marks	Total
Continuous Comprehensive Evaluation	CCET 1	1,2	50	30
	CCET 2	3,4	50	
	Retest	1,2,3,4	50	
	CCET 3	5	50	
	Tutorial	1,2,3,4,5	30	10
	Quiz	1,2,3,4,5		
	Assignment	1,2,3,4,5		
End Semester Examination	ESE	1,2,3,4,5	100	60
Total				**100**

Course Code:19MESC1301	Course Title: ENGINEERING MECHANICS (Common to AU, ME and MC)		
Course Category: Engineering Science		Course Level: Practice	
L:T:P(Hours/Week) 3: 1: 0	Credits:4	Total Contact Hours: 60	Max Marks: 100

Pre-requisites:

- Physics for Mechanical Sciences

Course Objectives:

The course is intended to:

1. Draw the free body diagram.
2. Determine the magnitude of unknown forces in a given system.
3. Determine the geometric properties of bodies.
4. Determine the degrees of freedom.
5. Determine the kinetic parameters of rigid bodies

Unit I Free body Diagram 12 Hours

Fundamental laws of mechanics (Review) – Free body diagram – Statics - Particles and Rigid body (Beams, Frames and Machines) – Types of forces – Action (Point, UDL, UVL and couples) – Reaction (Supports, Friction) – Dynamics – Particles and Rigid body – Linear and Circular planar motions.

Unit II Geometric Properties of Lamina and Bodies 12 Hours

Properties of surfaces – centroid of composite planes such as L, I and T – Moment of Inertia (MI) – Parallel and perpendicular axis theorem – MI of composite sections involving simple geometries such as rectangle, circle and triangle – Centre of gravity and mass moment of inertia of composite solids involving block, cylinder, cone and sphere.

Unit III Force Analysis of Beams, Frames and Machines 12 Hours

Governing equations of equilibrium – Equivalent force and couple moment – Types of beams – Determining reactions in statically determinate beams – Bending moment diagram and Shear force diagram of cantilever, simply supported beam and over hanging beams – Analysis of frames – Machines – Laws of dry friction – ladder, wedge and screw.

Unit IV Introduction to Mechanisms 12 Hours

Mechanism and structure – links – pairs – chains – four bar and slider crank mechanisms - degrees of freedom of linkages – Gruebler's criterion – Grashof's condition of rotatability - transmission angle and mechanical advantage – special lower pair mechanisms: peucelliar straight line mechanism, Ackermann steering mechanism, pantograph, Geneva mechanism.

Unit V Kinetics of Rigid Body 12 Hours

Dynamic equilibrium of rigid bodies – Planar kinetics of rigid body – Force and Acceleration, Work and energy, Impulse and momentum

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1. Develop the free body diagram of particles and rigid bodies such as beams, frames and machines under static and dynamic conditions.	Apply
CO2. Select reinforcement shapes/structures to modify centroids, centre of gravity and moment of inertia to meet the given requirements	Apply
CO3. Determine various forces on rigid bodies such as beams, frames and machines under static conditions.	Apply
CO4. Determine the degrees of freedom of given mechanism.	Apply
CO5. Calculate the kinetic parameters of rigid bodies for dynamic equilibrium.	Apply

Text Book(s):

T1. R C Hibbeler, "Engineering mechanics – Statics and Dynamics", Twelfth Edition, Pearson, New Delhi, 2009.

T2. F.P. Beer and Jr. E.R. Johnston, "Vector Mechanics for Engineers – Statics and Dynamics", TATA McGraw Hill publishing company, New Delhi, 2012

Reference Book(s):

R1. James L. Meriam and L. Glenn Kraige, "Engineering mechanics (Statics and Dynamics)" Eighth edition. John Wiley & Sons, 2016.

R2. Irving H. Shames, "Engineering mechanics – Statics and Dynamics", Fourth Edition, Pearson, New Delhi, 2005

Web Reference(s):

1. http://hyperphysics.phy-astr.gsu.edu/hbase/hframe.html
2. https://nptel.ac.in/courses/122104015/

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO2
CO1	2	1	-	2	2	-	-	2	2	3	-	2	1	-
CO2	2	1	-	2	2	-	-	2	2	3	-	2	1	-
CO3	2	1	-	2	2	-	-	2	2	3	-	2	1	-
CO4	2	1	-	2	2	-	-	2	2	3	-	2	1	-
CO5	2	1	-	2	2	-	-	2	2	3	-	2	1	-

High-3; Medium-2; Low-1

Assessment pattern:

	Assessment Component	CO. No.	Marks	Total
Continuous Assessment	CCET 1	1,2	50	30
	CCET 2	3,4	50	
	Retest	1,2,3,4	50	
	CCET 3	5	50	
	Tutorial	1,2,3,4,5	30	10
	Quiz	1,2,3,4,5		
	Assignment	1,2,3,4,5		
End Semester Examination	ESE	1,2,3,4,5	100	60
Total				**100**

Course Code:19MCCN3301	Course Title :COMPUTER AIDED MACHINE DRAWING LABORATORY FOR MECHATRONICS		
Course Category: Professional Core		Course Level: Practice	
L:T:P (Hours/Week) 0: 0: 3	Credits:1.5	Total Contact Hours:45	Max. Marks:100

Pre-requisites:

- Engineering Graphics

Course Objectives:

The course is intended to:

1. Explain drawing Standards, Limits, Fits and Tolerances
2. Develop part models and Draft
3. Prepare Assembly model and Assembly drawing

Unit I Drawing Standards 3 Hours

Code of practice for Engineering Drawing, BIS specifications – Welding symbols, riveted joints, keys, and fasteners – Reference to hand book for the selection of standard components such as bolts, nuts, screws, keys.

Unit II Fits and Tolerances 6 Hours

Limits, fits and tolerances-need, types, representation of tolerances on drawing, calculation of minimum and maximum clearances and allowances.
Geometric tolerance- types of form and position tolerances, symbols, method of indicating geometric tolerances on part drawings.

Unit III Computer Aided Assembly and Detailed Drawing Exercises 36 Hours

1. Part Modeling of Flange Coupling
2. Assembly modeling and drawing of Flange coupling
3. Part Modeling of Screw jack
4. Assembly modeling and drawing of Screw jack
5. Part Modeling of Plummer Block
6. Assembly drawing of Plummer Block
7. Part Modeling of Robot arm
8. Assembly drawing of Robot arm

Course Articulation Matrix

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
CO1	2	-	-	-	2	-	-	-	-	-	1	-	1	-
CO2	3	-	-	-	2	-	-	-	-	-	1	-	1	-
CO3	3	-	-	-	-	-	-	-	-	-	1	-	1	-

High-3; Medium-2; Low-1

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1. Explain drawing Standards, Limits, Fits and Tolerances	Understand
CO2. Develop part models and Draft as per the drawing standards.	Apply
CO3. Prepare assembly drawings of automobile components to understand the assembly process.	Apply

Reference(s):

R1. Gopalakrishna K.R., "Machine Drawing", 22nd Edition, Subhas Stores Books Corner, Bangalore, 2013.

R2. Bhatt, N.D., (1999), Machine Drawing, Published by R.C.Patel, Chartstar Book Stall, Anand, India.

Assessment pattern

	Assessment component	**CO. No.**	**Marks**	**Total Marks**
Continuous Assessment	Each Lab Experiment	1,2,3	75	75
	Cycle Test 1	1,2,3	50	25
	Cycle Test 2	1,2,3	50	
	Total			**100**

Course Code:19MCSN3301	Course Title: BASICS OF ELECTRICAL, ELECTRONICS AND INSTRUMENTATION LABORATORY		
Course Category: Engineering Science		Course Level: Practice	
L:T:P(Hours/Week) 0: 0: 3	Credits:1.5	Total Contact Hours: 45	Max Marks: 100

Pre-requisites:

- Physics for Mechanical Sciences

Course Objectives:

The course is intended to:

1. Demonstrate circuit laws and Theorems using simple Electric Circuits.
2. Design and test simple Electronic circuits using diodes and transistors
3. Determine the characteristics of different transducers

List of Experiments

1. Verification of Circuit Laws
2. Verification of Circuit Theorems
3. Diode based application circuits
4. Transistor based application circuits
5. Displacement measurement using potentiometer and LVDT and plotting the characteristic curves.
6. Characteristics and calibration of strain gauge and Load Cell
7. Temperature measurement using Thermocouple, Thermistor and RTD and comparing the characteristics.
8. Characteristics of Capacitive Transducer
9. Characteristics of Hall Effect Transducer
10. Design and testing of sample and hold circuit

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Demonstrate circuit laws and Theorems using simple Electric Circuits.	Understand

CO2: Design and test simple Electronic circuits using diodes and transistors	Apply
CO3: Determine the characteristics of different transducers	Apply

Course Articulation Matrix

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
CO1	2	-	-	-	2	-	-	-	-	-	1	-	1	-
CO2	3	-	-	-	2	-	-	-	-	-	1	-	1	-
CO3	3	-	-	-	-	-	-	-	-	-	1	-	1	-

High-3; Medium-2; Low-1

Assessment pattern

	Assessment component	**CO. No.**	**Marks**	**Total Marks**
Continuous Assessment	Each Lab Experiment	1,2,3	75	75
	Cycle Test 1	1,2	50	25
	Cycle Test 2	2,3	50	
	Total			**100**

End of semester III

SEMESTER IV

Course Code:19MABG1401	Course Title: PROBABILITY AND STATISTICS (Common to All Branches)		
Course Category: Basic Science		Course Level: Introductory	
L:T:P(Hours/Week) 3: 1: 0	Credits: 4	Total Contact Hours: 60	Max Marks: 100

Pre-requisites:

- Nil

Course Objectives:

The course is intended to:

1. Calculate expectations and variances of random variables
2. Apply the concepts of standard distributions to solve practical problems
3. Calculate the correlation and regression for two variables
4. Test the samples based on hypothesis
5. Apply the samples based on variance

Unit I Probability and Random Variables 9+3 Hours

Axioms of Probability- Conditional Probability- Total Probability -Baye's Theorem- Random Variables- Probability Mass Function- Probability Density Functions- Properties - Moments- Moment generating functions and their properties.

Unit II Standard Distributions 9+3 Hours

Binomial- Poisson- Uniform –Exponential- Normal Distributions and their properties-Functions of a random variable.

Unit III Two Dimensional Random Variables 9+3 Hours

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and regression – Transformation of random variables.

Unit IV Testing of Hypotheses 9+3 Hours

Sampling Distributions- Testing of hypotheses for mean, variance, proportions and differences using Normal, t, Chi-Square and F distributions – Tests for independence of attributes and Goodness of fit.

Unit V Design of Experiments 9+3 Hours

Analysis of Variance (ANOVA)- One way Classification – Completely Randomized Design(CRD) – Two way Classification – Randomized Block Design (RBD) – Latin square.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	

CO1: Calculate expectations and variances of random variables	Apply
CO2:Apply the concepts of standard distributions to solve practical problems	Apply
CO3:Calculate the correlation and regression for two variables	Apply
CO4:Test the samples based on hypothesis	Apply
CO5:Apply the samples based on variance	Apply

Text Book(s):

T1. Dr.J.Ravichandran, "Probability and Statistics for Engineers", 1st Edition, Wiley India Pvt.Ltd.,2010.

T2. Douglas C.Montgomery and George C. Runger, "Applied Statistics and Probability for Engineers", 6th Edition, Wiley India Pvt.Ltd.,2017.

T3. Veerarajan T, "Probability, Statistics and Random process", 4th Edition, Tata McGraw-Hill, New Delhi, 2013.

Reference Book(s):

R1. R.E. Walpole, R.H. Myers, S.L. Myers, and K Ye, "Probability and Statistics for Engineers and Scientists", 9th Edition Pearson Education, Asia, 2016.

R2. M.R. Spiegel,J. Schiller and R.A. Srinivasan, "Schaum's Outlines Probability and Statistics", 3rd Edition,Tata McGraw Hill edition, 2009.

R3. Morris DeGroot, Mark Schervish, "Probability and Statistics", Pearson Educational Ltd, 4th Edition, 2014.

Web Reference(s):

1. https://onlinecourses.nptel.ac.in/111105041/
2. https://nptel.ac.in/courses/111105090/
3. https://nptel.ac.in/courses/111104075/

Course Articulation Matrix

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

High-3; Medium-2; Low-1

Assessment pattern:

	Assessment Component	CO .No.	Marks	Total
Continuous Comprehensive Evaluation	CCET 1	1,2	50	30
	CCET 2	3,4	50	
	Retest	1,2,3,4	50	
	CCET 3	5	50	
	Tutorial	1,2,3,4,5	30	10
	Quiz	1,2,3,4,5		
	Assignment	1,2,3,4,5		
End Semester Examination	ESE	1,2,3,4,5	100	60
Total				**100**

Course Code:19MCCN1401	Course Title: THEORY OF MACHINES		
Course Category: Professional Core		Course Level: Introductory	
L:T:P(Hours/Week) 3: 1: 0	Credits: 4	Total Contact Hours: 60	Max Marks: 100

Pre-requisites:

- Physics for Mechanical Sciences
- Engineering Mechanics

Course Objectives:

The course is intended to:

1. Calculate kinematic parameters of simple mechanisms.
2. Perform static and dynamic force analysis and balancing of revolving and Reciprocating masses.
3. Calculate the kinematic parameters of spur gear and gear trains.
4. Analyze single degree of freedom free and forced vibration system.
5. Analyze natural frequency and mode shapes of the transverse and torsional vibration systems.

Unit I Mechanism analysis 9+3 Hours

Relative and absolute velocities and acceleration in linkages - Vector loop representation - position, velocity and acceleration analyses of four bar and slider crank mechanisms using graphical method. Instantaneous centres of rotation – Kennedy's theorem – procedure for locating instantaneous centres of four bar and slider crank mechanisms. Synthesis of four bar mechanisms.

Unit II Force analysis in Mechanisms 9+3 Hours

Static force analysis of four bar and slider crank mechanisms using analytical method – Force analysis in engines: gas forces – crank effort – bearing thrust.

Unit III Balancing of rotating and reciprocating masses 9+3 Hours

Static and dynamic balancing - balancing of rotating masses - balancing of single rotating mass by a single mass in the same plane. Balancing of single rotating mass by two masses in different plane and balancing of several rotating masses in the same plane, balancing of several masses in different planes - balancing of reciprocating masses-balancing of primary and secondary unbalanced forces of reciprocating masses. Partial balancing in locomotive engines – balancing of coupled locomotives.

Unit IV Kinematics of spur gear and gear trains 9+3 Hours

Types of gears – spur gear terminology – law of gearing - conjugate profile – cycloidal and involute tooth profile – length of path of contact – length of arc of contact – contact ratio – interference – number of teeth on pinion to avoid interference.

Classification of gear trains – calculation of velocity ratio of simple, compound and epicyclic (tabular column method) gear trains.

Unit V Longitudinal vibrations 9+3 Hours

Types of vibrations – basic elements of vibrating system – Degrees of Freedom – free longitudinal vibration of Single Degree of Freedom (SDOF) system: governing equation and natural frequency using equilibrium method and energy method – equivalent springs and dampers – free damped vibration of SDOF system: governing equation – under damped, critical damped and over damped systems – damping ratio – logarithmic decrement – force damped vibration – magnification factor – vibration isolation and transmissibility.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Calculate position, velocity and acceleration of four bar and slider crank mechanisms using algebraic method and graphical method.	Apply
CO2: Calculate the static and dynamic forces for equilibrium of the given a slider crank or a four bar mechanism	Apply
CO3: Perform static and dynamic balancing of revolving & reciprocating masses.	Apply
CO4: Calculate the kinematic parameters of spur gear and velocity ratio of simple, compound and epicyclic gear trains.	Apply
CO5: Analyze single degree of freedom longitudinally vibrating systems for free and forced vibrations with undamped and damped conditions.	Apply

Text Book(s):

T1 S.S. Rattan, "Theory of Machines", McGraw Hill Education, 4th Edition. 2017.

T2 Norton, R.L., "Kinematics and Dynamics of Machinery", Tata McGrawHill Education Pvt. Ltd., New Delhi, SI Edition 2014.

Reference Book(s):

R1. Gordon R. Pennock & Joseph E. Shigley John J. Uicker, "Theory Of Machine And Mechanisms Si Edition", Oxford University Press, 4th Edition 2014.

R2. Sadhu Singh, "Theory of Machines: Kinematics and Dynamics", Pearson Education India; 3rd Edition 2011.

R3. R.S. Khurmi, J.K. Gupta, "Theory of Machines", S.Chand, 14th Edition. 2005.

Web Reference(s):

1. https://nptel.ac.in/courses/112104121/
2. https://nptel.ac.in/courses/112101096/

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	2	2	-	-	1	2	2	-	1	1	1
CO2	2	1	-	2	2	-	-	1	2	2	-	1	1	1
CO3	2	1	-	2	2	-	-	1	2	2	-	1	1	1
CO4	2	1	-	2	2	-	-	1	2	2	-	1	1	1
CO5	2	1	-	2	2	-	-	1	2	2	-	1	1	1

High-3; Medium1-2; Low-1

Assessment pattern:

	Assessment Component	**CO .No.**	**Marks**	**Total**
Continuous Assessment	CCET 1	1,2	50	30
	CCET 2	3,4	50	
	Retest	1,2,3,4	50	
	CCET 3	5	50	
	Assignment	1,2,3,4,5	10	10
End Semester Examination	ESE	1,2,3,4,5	100	60
Total				**100**

Course Code:19MCCN2401	Course Title: ELECTRICAL DRIVES AND CONTROLS		
Course Category: Professional Core		Course Level: Practice	
L:T:P(Hours/Week) 3: 0: 2	Credits:4	Total Contact Hours: 75	Max Marks: 100

Pre-requisites:

- Basics of Electrical and Electronics Engineering

Course Objectives:

The course is intended to:

1. Summarize electrical drives and its control
2. Explain the characteristics of DC drives with different control techniques
3. Compare the characteristics of AC drives with different stator side control.
4. Explain the operating principle of special electrical drives
5. Choose an electrical drive for an applications

Unit I Introduction 9 Hours

Fundamentals of electric drives - characteristics of loads — different types of mechanical loads — four quadrant operation of electric drive- control circuit components: Fuses, circuit breakers, contactors, relays

Unit II Speed Control of DC Machines 9 Hours

Constructional features and working principle of a DC machine - Speed Torque characteristics of DC shunt & series motor — Methods of Speed control - Solid state DC drives: bridge rectifier fed DC drives, Chopper fed DC drives, Static Ward Leonard method.

Unit III Speed Control of AC Machines 9 Hours

Constructional details of induction motors — Types of rotors — Principle of operation —Slip - Speed torque Characteristics of Induction motors — speed control using: pole changing, stator frequency variation, stator voltage variation - basic inverter fed induction motor drive - variable voltage variable frequency drive.

Unit IV Special Electrical Drives & Controls 9 Hours

Stepper motor: Constructional and working — applications -BLDC motor : Constructional and working — applications — encoders - AC and DC Servo Motor : Constructional and working — applications.

Unit V Control and Selection of Electric Drives 9 Hours

Microcontroller, PLC & PC based control - Selection of an electric drive —IP classes -insulation testing and classes of electric motors - SF motors - continuous, intermittent and short time duty — Selection of drive for ne appliances, machine tools, automobile applications, locomotives and steel rolling mills.

List of Experiments **30 Hours**

1. Draw the load characteristics of DC shunt motor
2. Draw the load characteristics of DC series motor.
3. Draw the load characteristics of 3 phase Induction motor.
4. Draw the speed control curves of DC shunt motor
5. Draw the speed control curves of 3 phase Induction motor using VFD.
6. Draw the speed control curves of DC shunt motor using Bridge rectifier.
7. Demonstrate the position control of stepper motor.
8. Demonstrate insulation testing of motors using megger.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Demonstrate an electrical drives and its control to operate in different modes.	Understand
CO2:Compare the characteristics of DC drives with different control techniques such as field and armature control.	Understand
CO3:Illustrate the characteristics of AC drives with different stator side control.	Understand
CO4:Relate the operating principle of special electrical drives such as stepper, BLDC and servo drive.	Understand
CO5:Choose an electrical drive for applications such as residential and industrial.	Understand

Text Book(s):

T1.NE De and P.K Sen "Electric Drive&' Prentice Hall of India Private Ltd., 2012.

T2.VedamSubramaniam "Electric Drives" Tata McGraw HIN, New Delhi, 2010.

Reference Book(s):

R1. Bhattacharya Brinjinder Singh S.K, "Control of Electrical Machines" New Age International Publishers, 2006.

R2. Dubey.G.K., "Fundamental of Electrical Drives", Narosa publishing House, New Delhi 2013.

R3. Krishnan R, "Electric motor drives Modeling, analysis and control", Pearson Education, New Delhi, 2003.

Web Reference(s):

1. https://nptel.ac.in/courses/108108077/

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	2	2	-	-	-	-	-	1	1	1	2
CO2	2	1	-	2	2	-	-	-	-	-	1	1	1	2
CO3	2	1	-	2	2	-	-	-	-	-	1	1	1	2
CO4	2	1	-	2	2	-	-	-	-	-	1	1	1	2
CO5	2	1	-	2	2	-	-	-	-	-	1	1	1	2

High-3; Medium-2; Low-1

Assessment pattern:

	Assessment Component	**CO .No.**	**Marks**	**Total**
Continuous Assessment	CCET 1	1,2	50	20
	CCET 2	3,4	50	
	Retest	1,2,3,4	50	
	CCET 3	5	50	
	Continuous Assessment-Practical	1,2,3,4,5	75	10
	Final-Assessment-Practical	1,2,3,4,5	50	10
End Semester Examination	ESE	1,2,3,4,5	100	60
Total				**100**

Course Code:19MECC2401	**Course Title: STRENGTH OF MATERIALS** (Common to AU, ME & MC)
Course Category: Professional Core	**Course Level: Practice**

L:T:P(Hours/Week) 3: 0: 2	Credits:4	Total Contact Hours: 75	Max Marks: 100

Pre-requisites:

- Physics for Mechanical Sciences
- Engineering Mechanics

Course Objectives:

The course is intended to:

1. Characterize materials and determine the axial stresses and strains developed
2. Calculate the principal stresses and planes for 2-D state of stress in bars and thin walled pressure vessels.
3. Compute the stress distribution and slope-deflection in beams.
4. Calculate the shear stress distribution in solid and hollow shafts and design helical springs and leaf springs.
5. Compute the diameter of shafts subjected to combined bending, twisting and axial loads.

Unit I Deformation of Solids 9 Hours

Mechanical properties of metals - Rigid and deformable bodies. Stress and Strain - tensile, compressive and shear, stress-strain diagram - Hooke's law - Factor of Safety - Poisson's ratio - relationship between elastic constants. Deformation of simple and compound bars under axial load. Strain energy - resilience, proof resilience and modulus of resilience - Strain energy due to axial load. Stresses due to gradual load, sudden load and impact load. Thermal stresses.

Unit II Bi-axial State of Stress 9 Hours

Biaxial state of stresses – Principal planes and stresses – Maximum shear stress and planes of maximum shear stress - Mohr’s circle for biaxial stresses. Stresses in thin walled pressure vessels.

Unit III Flexure In Beams and Deflection of Beams 9 Hours

Theory of simple bending – Bending stress and Shear stress variation in beams of standard section like 'I', 'L' and 'T'. Evaluation of beam deflection and slope for cantilever and simply supported beams- Macaulay and Moment-area methods.

Unit IV Torsion of Shafts and Springs 9 Hours

Theory of torsion and assumptions - torsion equation- polar moment of inertia and polar modulus - Shear stress distribution in solid and hollow circular shafts. Helical compression springs - terminology, styles of end - stress and deflection equation. Multi-Leaf springs - terminology - stress and deflection equation - Nipping of leaf springs.

Unit V Theories of failure 9 Hours

Introduction to theories of failure - Maximum Principal Stress theory - Maximum Principal Strain theory - Maximum Strain Energy Theory - Maximum Distortion Energy theory - Maximum Shear Stress theory. Stresses in circular shaft with combined bending, axial loading and torsion. Equivalent bending moment and equivalent twisting moment.

List of Experiments: **30 Hours**

1. Conduct tensile test on Mild Steel rod.
2. Conduct shear test on Mild steel and Aluminum rods by Double shear.
3. Calculate the modulus of rigidity of mild steel rod by Torsion test.
4. Determine the Hardness Number of metals by Brinell and Rockwell Hardness tester.
5. Estimate the stiffness and modulus of rigidity of the helical spring by Compression test.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Characterize materials and determine the axial stresses and strains developed due to mechanical and thermal effects	Apply
CO2:Calculate the principal stresses and planes for 2-D state of stress in bars and thin walled pressure vessels using analytical and graphical methods.	Apply
CO3:Compute the stress distribution and slope-deflection in beams subjected to static loads.	Apply
CO4:Calculate the shear stress distribution in solid and hollow shafts subject to pure torsion and design helical springs and leaf springs subject to compressive loads.	Apply
CO5:Compute the diameter of shafts subjected to combined bending, twisting and axial loads using various theories of failure.	Apply

Text Book(s):

T1. Hibbeller RC, “Mechanics of Materials”, Prentice-Hall of India, New Delhi, 2013.

T2. James M Gere, “Mechanics of Materials”, Cengage Learning, India, 2012.

Reference Book(s):

R1. Rattan SS “Strength of Materials” Tata McGraw-Hill Education Pvt Ltd., New Delhi, 2011.

R2. Beer F. P. and Johnston R,” Mechanics of Materials”, McGraw-Hill Book Co, Third Edition, 2002.

Web Reference(s):

1. http://nptel.ac.in/courses/112107147/

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2

CO1	2	1	-	2	2	-	-	1	2	2	-	1	3	-
CO2	2	1	-	2	2	-	-	1	2	2	-	1	3	1
CO3	2	1	1	2	2	-	-	1	2	2	-	1	3	1
CO4	2	1	-	2	2	-	-	1	2	2	-	1	3	1
CO5	2	1	-	2	2	-	-	1	2	2	-	1	3	-

High-3; Medium-2;Low-1

Assessment pattern

	Assessment Component	**CO .No.**	**Marks**	**Total**
Continuous Comprehensive Evaluation	CCET 1	1,2	50	20
	CCET 2	3,4	50	
	Retest	1,2,3,4	50	
	CCET 3	5	50	
	Continuous Assessment – Practical	1,2,3,4,5	75	10
	Final Assessment – Practical	1,2,3,4,5	50	10
End Semester Examination	ESE	1,2,3,4,5	100	60
Total				**100**

Course Code:19MCCN3401	Course Title: THEORY OF MACHINES LABORATORY FOR MECHATRONICS		
Course Category: Engineering Science		Course Level: Practice	
L:T:P(Hours/Week) 0: 0: 3	Credits:1.5	Total Contact Hours: 45	Max Marks: 100

Pre-requisites:

- Engineering Mechanics
- Strength of Materials

Course Objectives:

The course is intended to:

1. Apply the concept of displacement, velocity and acceleration to analyze mechanisms
2. Construct characteristic curve for governor.
3. Manipulate the gyroscopic couple and moment of inertia for a given application.
4. Perform static and dynamic balancing of rotating and reciprocating masses.
5. Calculate natural frequency of forced and free vibrations.

List of Experiments:

1. Kinematics of 4 bar mechanisms Slider crank and Crank Rocker Mechanism - Determination of velocity and acceleration.

2.Kinematics of Universal Joints — Determination of velocity and acceleration

3.Kinematics of Gear Trains —Determination of velocity ratio and Torque

4.Governors - Determination of sensitivity, effort, etc. for Watt, Porter, Proell, Spring controlled Governors

5. Motorized Gyroscope-Verification of laws -Determination of gyroscopic couple.

6. Whirling of shaft-Determination of critical speed of shaft with concentrated loads.

7.Balancing of reciprocating masses and rotating masses

8. Determination of moment of inertia by oscillation method for connecting rod and flywheel.

9. Determination of transmissibility ratio - vibrating table.

10. Vibrating system — spring mass system —Determination of damping co-efficient of single degree of freedom system.

11. Determination of torsional frequencies for compound pendulum and flywheel system with lumped Moment of inertia

Course Outcomes	

At the end of this course, students will be able to:	**Cognitive Level**
CO:1 Demonstrate the concept of displacement, velocity and acceleration to analyze mechanisms.	Apply
CO:2 Determine characteristic curve for governor	Apply
CO:3 Demonstrate the gyroscopic couple and moment of inertia for a given application	Apply
CO:4 Examine static and dynamic balancing of rotating and reciprocating masses	Apply
CO:5 Illustrate natural frequency of forced and free vibrations	Apply

Reference(s):

R1. "Electrical Drives and Control Laboratory Manual" prepared by Department of Mechatronics Engineering.

Course Articulation Matrix

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**	**PSO2**
CO1	2	1	-	2	2	-	-	-	-	-	1	1	-	1
CO2	2	1	-	2	2	-	-	-	-	-	1	1	-	1
CO3	2	1	-	2	2	-	-	-	-	-	1	1	-	1
CO4	2	1	-	2	2	-	-	-	-	-	1	1	-	1
CO5	2	1	-	2	2	-	-	-	-	-	1	1	-	1

High-3; Medium-2; Low-1

Assessment pattern

	Assessment component	**CO. No.**	**Marks**	**Total Marks**
Continuous Assessment	Each Lab Experiment	1,2,3	75	75
	Cycle Test 1	1,2	50	25
	Cycle Test 2	2,3	50	
	Total			**100**

Course Code: 19PSHG6002	Course Title: UNIVERSAL HUMAN VALUES 2 :UNDERSTANDING HARMONY (Common to all B.E/B.Tech Programmes)		
Course Category: Humanities		**Course Level: Practice**	
L:T:P (Hours/Week) 2: 1: 0	**Credits:3**	**Total Contact Hours:45**	**Max. Marks:100**

Pre-requisites:

- 19SHMG6101- Induction Program (UHV1)

Course Objectives:

The course is intended to:

1. Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.
2. Strengthening of self-reflection
3. Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence
4. Development of commitment and courage to act

Unit I Introduction to Value Education 6+3 Hours

Need for the Value Education;. Self -exploration as the process for value education ; Continuous Happiness and Prosperity: A look at basic Human Aspirations; Right understanding: Relationship and Physical Facilities ; Happiness and Prosperity: current scenario ; Method to fulfill the Basic human aspirations

Unit II Harmony in Human Being 6+3 Hours

Human being as a co-existence of self (‘I’) and the material ‘Body’; needs of Self ('I') and 'Body'; The Body as an instrument of 'I' ; Harmony in the self(‘I’); Harmony of the self(‘I’) with body ;Sanyam and Swasthya; correct appraisal of Physical needs, meaning of Prosperity in detail. Programs to ensure Sanyam and Swasthya.

Unit III Harmony in the Family and Society 6+3 Hours

Harmony in the Family the basic unit of human interaction; Values in human to human relationship; Trust as the foundational values of relationship; Respect as the right evaluation ;Understanding harmony in the society (society being an extension of family); Vision for the universal human order

Unit IV Harmony in the Nature 6+3 Hours

Understanding the harmony in the Nature Interconnectedness, self-regulation and mutual fulfillment among the four orders of nature; Existence as Co-existence at all levels; Holistic perception of harmony in existence.

Unit V Harmony on Professional Ethics 6+3 Hours

Natural acceptance of human values ;Definitiveness of Ethical Human Conduct; Basic for Humanistic Education, Humanistic Constitution and Humanistic Universal Order; Competence in professional ethics ;Case study: holistic technologies, management models and production systems ;Strategy for transition towards value based life and profession

Course Outcomes	**Affective Level**
At the end of this course, students will be able to:	
CO1. Reflect on values, aspiration, relationships and hence identify strengths and weaknesses.	Responding
CO2. Appraise physical, mental and social well being of self and practice techniques to promote well being.	Responding
CO3. Value human relationships in family and society and maintain harmonious relationships.	Valuing
CO4. Respect nature and its existence for survival and sustainable of all life forms and hence practice conservation of nature	Valuing
CO5. Appreciate ethical behaviour as a result of value system in personal and professional situations	Receiving

Text Book(s):

T1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010.

Reference Book(s):

R1.Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.

R2.Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.

Web Reference(s):

1. https://aktu.ac.in/hvpe/ResourceVideo.aspx
2. http://hvpenotes.blogspot.com/
3. https://nptel.ac.in/courses/109/104/109104068/

Course Articulation Matrix

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

High-3; Medium-2; Low-1

Assessment Pattern

	Assessment Component	**CO .No.**	**Marks**	**Total**
Continuous Comprehensive Evaluation	Socially relevant project/Group Activities/ Assignments	1,2,3,4.5	20	75%
	Assessment by faculty mentor		10	
	Self-assessment		10	
	Assessment by peers		10	
End Semester Examination	Part A – Objective type – 20x 1 = 20 marks Part B – Short answer questions – 15x 2 = 30 marks Part C – Descriptive Types Questions (Either or Pattern) – 5 x 10 = 50 marks	1,2,3,4,5	100	25%
Total				**100%**

Course Code: 19MCPN6401	Course Title: MINI–PROJECT		
Course Category: Project		Course Level: Practice	
L:T:P (Hours/Week) 0: 0: 4	Credits:2	Total Contact Hours:60	Max. Marks:100

Pre-requisites:

- Nil

Course Objectives:

The course is intended to:

1. Take up any challenging practical problems and find solution by formulating proper methodology.
2. Work collaboratively on a team to successfully complete a design project
3. Effectively communicate the results of projects in a written and oral format

The object of Project I is to enable the student to take up investigative study in the broad field of Mechanical Engineering, either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department on an individual basis or two/three students in a group, under the guidance of a Supervisor. This is expected to provide a good initiation for the student(s) in R&D work. The assignment to normally include:

1. Survey and study of published literature on the assigned topic.
2. Working out a preliminary Approach to the Problem relating to the assigned topic.
3. Conducting preliminary Analysis/Modelling/Simulation/Experiment/Design/Feasibility.
4. Preparing a Written Report on the Study conducted for presentation to the Department.
5. Final Seminar, as oral Presentation before a departmental committee.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Take up any challenging practical problems and find solution by formulating proper methodology.	Understand
CO2: Work collaboratively on a team to successfully complete a design project	Understand
CO3: Effectively communicate the results of projects in a written and oral format	Understand

Course Code: 19MCPN6001	Course Title: INTERNSHIP OR SKILL DEVELOPMENT		
Course Category: Project		Course Level: Practice	
L:T:P (Hours/Week) 2 Weeks	Credits: 1	Total Contact Hours: Nil	Max. Marks:100

Pre-requisites:

- Nil

Course Objectives:

The course is intended to:

1. Understand industry-specific terminology and practices
2. Solve simple industrial problems
3. Work collaboratively on a team
4. Effectively communicate the activities of internship in a written and oral format

Minimum of two weeks in an Industry in the area of Mechanical Engineering. The summer internship should give exposure to the practical aspects of the discipline. In addition, the student may also work on a specified task or project which may be assigned to him/her. The outcome of the internship should be presented in the form of a report.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Understand industry-specific terminology and practices	Apply
CO2: Solve simple industrial problems	Understand
CO3: Work collaboratively on a team	Apply
CO4: Effectively communicate the activities of internship in a written and oral format	Understand

End of semester IV

SEMESTER V

Course Code: 19MCCN1501	Course Title: MICROPROCESSOR AND MICROCONTROLLER APPLICATIONS		
Course Category: Professional Core		Course Level: Mastery	
L:T:P (Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Prerequisites:

The student should have undergone the course(s):

1. Analog and Digital circuits

Course Objectives:

The course is intended to:

1. Distinguish the feature of the 8085 microprocessor, Hardware Architecture and PIN diagram.
2. Demonstrate programming proficiency using the various addressing modes and instructions of 8085 microprocessor
3. Distinguish the feature of the 8051 microcontroller, Hardware Architecture and PIN diagram.
4. Illustrate the interrupts handling and demonstrate peripherals applications in different IC and Know about A/D and D/A converters.
5. Apply the PIC programming concepts to interface the hardware units with Microprocessor and PIC Microcontroller.

UNIT I 8085 PROCESSOR 9 Hours

Hardware Architecture, Pin Diagram – Functional Building Blocks of Processor – Memory Organization – I/O Ports and Data Transfer Concepts–Interrupts.

UNIT II PROGRAMMING OF 8085 PROCESSOR 9 Hours

Instruction - Format and Addressing Modes – Assembly Language Format – Data Transfer, Data Manipulation & Control Instructions – Programming: Loop structure with Counting & Indexing – Look up table - Subroutine Instructions - Stack.

UNIT III 8051 MICRO CONTROLLER 9 Hours

Hardware Architecture, Pin Diagram – Memory Organization – I/O Ports and Data Transfer Concepts– Serial Communication – Interrupts.

UNIT IV PERIPHERAL INTERFACING 9 Hours

Introduction on Architecture, Configuration and Interfacing, with ICs: 8255, 8259, 8237, 8251, 8279, A/D and D/A Converters.

UNIT V PIC MICRO CONTROLLER PROGRAMMING AND APPLICATIONS 9 Hours

Introduction to PlC Microcontroller, Hardware Architecture , Pin Diagram, Key Board and Display Interface – Closed Loop Control of Servo motor- Stepper Motor Control –Washing Machine Control.

Course Outcomes

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Distinguish the feature of the 8085 microprocessor by indicating various functional blocks using hardware architecture and PIN diagram.	Understand
CO2: Demonstrate programming proficiency of 8085 microprocessor to develop assembly language programming using various addressing modes and Instructions.	Understand
CO3: Distinguish the feature of the 8051 microcontroller by indicating various functional blocks using hardware architecture and PIN diagram.	Understand
CO4: Illustrate the interrupts handling and demonstrate peripherals applications for various interfacing using different IC's.	Understand
CO5: Apply the PIC programming concepts to interface the hardware units with microprocessor and PIC Microcontroller.	Understand

Text Book(s):

T1. R.S. Gaonkar, ‘Microprocessor Architecture Programming and Application’, with 8085, Wiley Eastern Ltd., New Delhi, 2013.

T2. Muhammad Ali Mazidi& Janice GilliMazidi, R.D. Kinely ‘The 8051 Micro Controller and Embedded Systems’, PHI Pearson Education, 5th Indian reprint, 2003.

Reference Book(s):

R1. Krishna Kant, "Microprocessor and Microcontrollers", Eastern Company Edition, Prentice Hall of India, New Delhi, 2007.

R2. N. Senthil Kumar, M. Saravanan, S. Jeevananthan, 'Microprocessors and Microcontrollers', Oxford, 2013.

R3. Valder – Perez, "Microcontroller – Fundamentals and Applications with PIC", Yeesdee Publishers, Taylor & Francis, 2013.

Web Reference(s):

1. https://nptel.ac.in/courses/108107029/
2. https://www.Assignmentspoint.com/microprocessor

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	-	2	2	-	-	2	1	2	-	1	-	2
CO2	1	1	-	2	2	-	-	2	1	2	-	1	-	2
CO3	1	1	-	2	2	-	-	2	1	2	-	1	-	2
CO4	1	1	-	2	2	-	-	2	1	2	-	1	-	2
CO5	1	1	-	2	2	-	-	2	1	2	-	1	-	2

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	**CO. No.**	**Marks**	**Total**
Continuous Assessment	CCET I	1,2	50	30
	CCET II	3,4	50	
	Retest	1,2,3,4	50	
	CCET III	5	50	
	Assignment	1,2,3,4,5	30	10
End Semester Examination	ESE	1,2,3,4,5	100	60
Total				100

Course Code: 19MECC2501	Course Title: PROBLEM SOLVING USING PYTHON FOR MECHANICAL SCIENCES (Common to all ME,MC,AU Programmes)		
Course Category: Professional core		Course Level: Practice	
L:T:P (Hours/Week) 2: 0: 2	Credits:3	Total Contact Hours:60	Max. Marks:100

Pre-requisites:

- Nil

Course Objectives:

The course is intended to:

1. Develop algorithmic solutions to simple computational problems Read, write, execute by hand simple Python programs
2. Structure simple Python programs for solving problems.
3. Decompose a Python program into functions
4. Represent compound data using Python lists, tuples, dictionaries
5. Read and write data from/to files in Python Programs.

UNIT I ALGORITHMIC PROBLEM SOLVING 6 Hours

Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list.

UNIT II DATA, EXPRESSIONS, STATEMENTS 6 Hours

Python interpreter and interactive mode; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; modules and functions, function definition and use, flow of execution, parameters and arguments.

UNIT III CONTROL FLOW, FUNCTIONS 6 Hours

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation

UNIT IV LISTS, TUPLES, DICTIONARIES 6 Hours

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing – list comprehension; Illustrative programs: selection sort, , histogram.

UNIT V FILES, MODULES, PACKAGES 6 Hours

Files and exception: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages.

List of Experiments Periods:30

1. Program to calculate the linear stress, strain, Young's modulus & other elastic moduli and strain energy of the bar of user specified dimensions and load.
2. Program to calculate the Thermal efficiency of Otto Engine & COP of the heat engine for the user specified inputs.
3. Program to calculate the diameter of the shaft for the user specified inputs.
4. Program to find the dimensions of a Flexible Flange Coupling
5. Program to plot the equation of the motion of a simple pendulum

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Develop algorithmic solutions to simple computational problems Read, write, execute by hand simple Python programs	Understand
CO2: Structure simple Python programs for solving problems.	Understand
CO3: Decompose a Python program into functions	Understand
CO4: Represent compound data using Python lists, tuples, dictionaries	Understand
CO5: Read and write data from/to files in Python Programs.	Understand

Text Book(s):

T1. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist‘‘, 2nd edition, Updated for Python 3, Shroff/O‘Reilly Publishers, 2016 (http://greenteapress.com/wp/thinkpython/)

T2. Guido van Rossum and Fred L. Drake Jr, ―An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011.

Reference Book(s):

R1. John V Guttag, ―Introduction to Computation and Programming Using Python‘‘, Revised and expanded Edition, MIT Press , 2013

R2. Robert Sedgewick, Kevin Wayne, Robert Dondero, ―Introduction to Programming inPython: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.

Web Reference(s):

1. https://nptel.ac.in/courses/106/106/106106182/

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	-	2	2	-	-	2	1	3	-	1	-	-
CO2	1	1	-	2	2	-	-	2	1	3	-	1	-	-
CO3	1	1	-	2	2	-	-	2	1	3	-	1	-	-
CO4	1	1	-	2	2	-	-	2	1	3	-	1	-	-
CO5	1	1	-	2	2	-	-	2	1	3	-	1	-	-

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	**CO. No.**	**Marks**	**Total**
Continuous Assessment	CCET I	1,2	50	20
	CCET II	3,4	50	
	Retest	1,2,3,4	50	
	CCET III	5	50	
	Continuous Assessment – Practical	1,2,3,4,5	75	10
	Final Assessment – Practical	1,2,3,4,5	50	10
End Semester Examination	ESE	1,2,3,4,5	100	60
Total				100

Course Code: 19MCCN1502	Course Title: CONTROL SYSTEMS FOR MECHATRONICS		
Course Category: Professional core		Course Level: Mastery	
L:T:P (Hours/Week) 3: 1: 0	Credits:4	Total Contact Hours:60	Max. Marks:100

Prerequisites:

The student should have undergone the course(s):

1. Engineering Mathematics – I & II

Course Objectives:

The course is intended to:

1. Model electrical and mechanical systems using transfer function.
2. Determine the time response and time domain specifications of first order and second order systems.
3. Analyse the given first order and second order system with their frequency domain specifications.
4. Analyse the stability of the given system.
5. Design compensator using bode plot technique

UNIT I CONTROL SYSTEM MODELING 9+3 Hours

Basic Elements of Control System – Open loop and Closed loop systems - Transfer function, Modelling of Electrical systems, Mechanical systems: Translational and rotational systems- Transfer function of armature and field controlled DC motor- Block diagram reduction Techniques – Signal flow graph.

UNIT II TIME RESPONSE ANALYSIS 9+3 Hours

Standard test signals - Time response of first order systems - Impulse and Step Response analysis of second order systems – Time Domain specifications - Steady state errors and error constants – Effects of P, PI, PD and PID Controllers on the system's response.

UNIT III FREQUENCY RESPONSE ANALYSIS 9+3 Hours

Frequency Response – Bode Plot: Gain margin, Phase margin, gain & phase crossover frequency-Polar Plot: Gain margin, Phase margin, Frequency Domain specifications from the plots – correlation between time domain and frequency domain specifications.

UNIT IV STABILITY ANALYSIS 9+3 Hours

Stability, Routh-Hurwitz Criterion, Concept of Root Locus Technique, Construction of Root Locus, Effects of adding poles and zeros – Nyquist Stability Criterion.

UNIT V COMPENSATOR DESIGN 9+3 Hours

Performance criteria – Lag, lead and lag-lead networks – Compensator design using bode plots. Compensator Design using simulation.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Model electrical and mechanical systems using transfer function..	Apply
CO2: Determine the time response and time domain specifications of first order and second order systems.	Apply
CO3: Analyse the given first order and second order system with their frequency domain specifications.	Apply
CO4: Analyse the stability of the given system.	Apply
CO5: Design compensator using bode plot technique	Apply

Text Book(s):

T1. J. Nagrath and M. Gopal, 'Control Systems Engineering', New Age International Publishers, 6th Edition, 2017

T2. Benjamin C. Kuo, 'Automatic Control systems', Pearson Education, New Delhi, 10th Edition, 2017.

Reference Book(s):

R1. Norman S. Nise, 'Control Systems Engineering', John Wiley, New Delhi, Sixth Edition, 2011.

R2. Samarajit Ghosh, 'Control systems Theory and Applications ', Pearson Education, New Delhi, Second Edition 2012.

R3. M. Gopal, 'Control Systems, Principles and Design', Tata McGraw Hill, New Delhi, 4th Edition 2012.

R4. K. Ogata, 'Modern Control Engineering', Pearson Education India, New Delhi, 5th Edition 2015.

R5. Richard C. Dorf and Robert H. Bishop, "Modern Control Systems ", Pearson Prentice Hall, 13th Edition 2016.

Web Reference(s):

1. http://nptel.ac.in/courses/108101037/1
2. https://www.Assignmentspoint.com/control_systems/control_systems

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	-	2	2	-	-	2	1	2	-	1	2	2
CO2	1	1	-	2	2	-	-	2	1	2	-	1	2	2
CO3	1	1	-	2	2	-	-	2	1	2	-	1	2	2
CO4	1	1	-	2	2	-	-	2	1	2	-	1	2	2
CO5	1	1	-	2	2	-	-	2	1	2	-	1	2	2

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	**CO. No.**	**Marks**	**Total**
Continuous Assessment	CCET I	1,2	50	30
	CCET II	3,4	50	
	Retest	1,2,3,4	50	
	CCET III	5	50	
	Assignment	1,2,3,4,5	30	10
End Semester Examination	ESE	1,2,3,4,5	100	60
Total				100

Course Code: 19MECC1501	Course Title: MECHANICAL DESIGN (Common to all ME, MC Programmes)		
Course Category: Professional Core		Course Level: Mastery	
L:T:P(Hours/Week) 3: 1: 0	Credits:4	Total Contact Hours: 60	Max Marks:100

Pre-requisites:

The student should have undergone the course(s):

- Strength of Materials

Course Objectives:

The course is intended to:

1. Design the machine elements subjected to static loads.
2. Design the machine elements against fluctuating and impact loads
3. Calculate the design parameters for power transmitting element.
4. Determine the design parameters of helical and leaf spring.
5. Design/Select a suitable bearing.

UNIT I DESIGN FOR STATIC LOAD OR STEADY STRESSES 9+3 Hours

Design Processes and its types, factor of safety - selection. Preferred numbers, Selection of materials and its properties, Fits and Tolerances - eccentric loading-stress due to eccentric loading, curved beams - problems.

UNIT II DESIGN FOR FLUCTUATING AND IMPACT LOADS 9+3 Hours

Fatigue, types, Endurance limit, modifying factors, relation between endurance limit, ultimate tensile strength and yield strength, problems on different fatigue loading conditions. Stress concentration, stress concentration factor, causes of stress concentration, method of reducing stress concentration, stress concentration factor for different material configuration. Notch sensitivity, factors affecting of notch sensitivity. Impact loading, shock loading, simple problems.

UNIT III DESIGN OF SHAFTS, KEYS, AND COUPLINGS 9+3 Hours

Difference between shaft, axle and spindle, Shaft materials, criteria of shaft design, different transmitting elements on a shaft, shaft design against static loading for given application. Shaft design for fatigue loading. Keys, types of keys, stresses developed in the key. Spline, stresses in spline shaft, design of shunk key and spline. Couplings, types of coupling, design of coupling based on given speed and load conditions, Design of flexible coupling based on given speed and load conditions.

UNIT IV DESIGN OF SPRINGS 9+3 Hours

Springs, types of springs, applications, spring terminology. Stresses in helical springs, Design of helical and concentric spring for given loading. Leaf springs, NIP in leaf springs Design of leaf spring for given application.

UNIT V DESIGN OF BEARING 9+3 Hours

Bearings, bearing types, Parts of the bearing, rolling contact bearing, its applications. Load carrying capacity, equivalent load, Life of bearing, Load life relationship, Problems. Selection of ball bearings from manufacturing catalogue. Sliding contact bearings, types and Nomenclature. Hydrodynamic bearing, load carrying capacity, lubrication, selection of lubricant, equivalent load, minimum oil film thickness- length to diameter ratio- bearing pressure, radial clearance. Mckees equation, Somerfield equations - Bearing characteristic number problems.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Design the machine elements subjected to simple and combined static loads.	Apply
CO2: Design the machine elements against fluctuating loads and impact loads	Apply
CO3: Calculate the design parameters for power transmitting element such as shaft, key, and coupling.	Apply
CO4: Determine the design parameters of helical and leaf spring for given application.	Apply
CO5: Design/Select a suitable bearing for the given application.	Apply

Text Book(s):

T1. V.B. Bhandari. "Design of Machine Elements" Tata McGraw Hills Education, 3rd edition, 2014.

T2. Shigley J.E and Mischke C.R., "Mechanical Engineering Design", Sixth Edition, Tata McGraw Hill, 2012

Reference Book(s):

R1. P. C Sharma and A. K Agarwal. “Machine Design” (SI units). S.K. Kataria& Sons, Reprint 2013.

R2. Ugural A.C, “Mechanical Design – An Integral Approach”, McGraw-Hill Book Co., 2010.

Web Reference(s):

1.https://nptel.ac.in/courses/112/105/112105125/

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	1	1	-	-	2	-	3	-	2	2	-
CO2	2	1	1	1	1	-	-	2	-	3	-	2	2	-
CO3	2	1	1	1	1	-	-	2	-	3	-	2	2	-
CO4	2	1	1	1	1	-	-	2	-	3	-	2	2	-
CO5	2	1	1	1	1	-	-	2	-	3	-	2	2	-

High-3; Medium-2; Low-

Assessment pattern

	Assessment Component	**CO .No.**	**Marks**	**Total**
Continuous Comprehensive Evaluation	CCET 1	1,2	50	30
	CCET 2	3,4	50	
	Retest	1,2,3,4	50	
	CCET 3	5	50	
	Assignment	1,2,3,4,5	30	10
End Semester Examination	ESE	1,2,3,4,5	100	60
Total				**100**

Course Code: 19MCCN3501	Course Title: MICROPROCESSOR AND MICROCONTROLLER LABORATORY		
Course Category: Professional Core		Course Level: Practical	
L:T:P(Hours/Week) 0: 0: 3	Credits:1.5	Total Contact Hours: 45	Max Marks:100

Prerequisites:

The student should have undergone the course(s):

1. Analog and Digital circuits

Course Objectives:

The course is intended to:

1. Develop a simple arithmetic and control instructions of 8085 Microprocessor.
2. Develop for interfacing A/D and D/A converter and traffic light controller.
3. Build a program for the simulator and emulator for I/O Serial communication.
4. Explain the basic instruction set of 8051 Microcontroller.
5. Apply the concepts of programming on real-time applications

LIST OF EXPERIMENTS **45 Hours**

1. Simple arithmetic operations: Addition / Subtraction / Multiplication / Division.
2. Programming with control instructions:
   (i) Ascending / Descending order, Maximum / Minimum of numbers.
3. Interface Experiments: with 8085
   (i) A/D Interfacing
   (ii) D/A Interfacing
4. Traffic light controller.
5. I/O Port / Serial communication
6. Programming Practices with Simulators/Emulators/open source
7. Read a key, interface and display
8. Demonstration of basic instructions with 8051 Microcontroller execution, including:
   (i) Conditional jumps, looping
   (ii) Calling subroutines
9. Programming I/O Port 8051
   (i) Interfacing with A/D & D/A
10. Mini project development with processors.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Explain simple program for arithmetic operations using assembly language	Apply
CO2: Develop a program and interface A/D and D/A converters and traffic light controllers.	Apply
CO3: Develop an interface using emulator for serial communication	Apply
CO4: Program 8051 Microcontroller using program control instructions such as Conditional jumps, looping and Calling subroutines.	Apply
CO5: Select the hardware interface for microcontroller-based systems	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	2	2	-	-	-	2	2	-	1	-	-
CO2	2	1	-	2	2	-	-	-	2	2	-	1	-	-
CO3	2	1	-	2	2	-	-	-	2	2	-	1	-	-
CO4	2	1	-	2	2	-	-	-	2	2	-	1	-	-
CO5	2	1	-	2	2	-	-	-	2	2	-	1	-	-

High-3; Medium-2; Low-1

Assessment pattern

	Assessment component	Marks	Total Marks
Continuous comprehensive Evaluation	Each Lab Experiment	75	100
	Cycle Test 1	25	
	Cycle Test 2	25	

Course Code: 19PSHG6501	Course Title: EMPLOYABILITY SKILLS 1: TEAMNESS AND INTERPERSONAL SKILLS		
Course Category: Humanities	Course Level: Introductory		
L: T:P (Hours/Week): 0:0:2	Credit :1	Total Contact Hours: 30	Total Marks: 100

Pre-requisites:

- **NIL**

Course objectives:

The course is intended to

1. Demonstrate effective communicative attributes and facilitate presentation and public speaking skills
2. Identify and explore the true self and handle negatives
3. Develop interpersonal skills and to groom as a professional
4. Educate the importance of Nonverbal skill set to attain perfection
5. Build teamness and its ethics to facilitate corporate working

UNIT I : EFFECTIVE COMMUNICATION & PRESENTATION SKILLS 6 Hours

Barriers of Communication -Fear Of English -Handling Social Factors -Handling Psychological Factors -Handling Practical Problems -Do's&Don't's-**Effective Presentation** - Presentation - Importance of Presentation Slide orientation – Introduction in a presentation - Styles of a slide - Slide Templates- Font ,color, Background -Graph Diagrammatic representation - Delivery of presentation - Body Language &Gestures - Verbal Attributes - Communication -Handling stammers and breaks - Handling fear of stage - Maintaining Confidence - Content delivery methods- Do's and Don'ts in a presentation- Tips to handle it- Effective Conclusion

UNIT II: POSITIVE ATTTITUDE &HANDLING REJECTIONS 6 Hours

A,B,C's Of Attitude -Influencing Factors -Individual Factors -Character Comparison - Strategies to Handle ourselves-Benefits of Positive Attitude - Do's&Don't's - **Handling Rejections**---- Identifying Negativities -Nuances of handling it -Necessary changes -To do List -Creating One's self -Self Qualifiers

UNIT III: INTERPERSONAL SKILLS 6 Hours

Life skills -Core IP Skills -Importance of IPSkills -Tips to improve IP Skills-Necessity of IP Skills

UNIT IV : BODY LANGUAGE, DRESSING &GROOMING 6 Hours

Unconscious Physical moments - Metrics of Body Language - Good Posture -Head Motion - Facial Expression - Eye contact –Gestures -Dressing -Grooming & Outlook - Necessity of good Body Language

UNIT V : TEAM ETHICS **6 Hours**

Team Ethics-Necessity of Team Work- Teams Everywhere - Benefits of team culture -Reason for team failure -Conflicts -Handling Conflicts -Being a team player -Work difference from college

COURSE OUTCOMES:

Course Outcomes	**Cognitive Level**
CO1: Demonstrate effective communicative attributes as part of their skills and facilitate presentation & public speaking skills	Apply
CO2: Identify and explore the true self and handle negatives	Apply
CO3: Develop interpersonal skills and to groom as a professional	Apply
CO4: Explain the importance of Nonverbal skill set to attain perfection	Understand
CO5: Build teamness and its ethics to facilitate corporate working	Apply

Text Book(s):

T1. John C Maxwell, " The 17 Indisputable Laws of Teamwork: Embrace Them and Empower Your Team", Harper Collins Leadership Publishers, 2013

Reference Book(s):

R1. Patrick Lencioni, " The Five Dysfunctions of a Team: A Leadership Fable" Jossey Bass Publishers, 2006

R2. Malcolm Gladwell, "Talking to Strangers: What We Should Know about the People We Don’t Know" Penguin Publishers, 2019

R3. Harvey Segler, " Body Language: Discovering & Understanding the Psychological secrets behind reading & Benefiting from Body Language” Kindle Edition, 2016

Course Articulation Matrix

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
CO1	-	-	-	-	-	-	-	-	-	3	-	1	-	-
CO2	-	-	-	-	-	-	-	-	2	-	-	1	-	-
CO3	-	-	-	-	-	-	-	-	2	-	1	1	-	-
CO4	-	-	-	-	-	-	-	-	-	1	-	1	-	-
CO5	-	-	-	-	-	-	-	2	1	-	-	1	-	-

High -3, Medium – 2, Low-1

Assessment Details

Mode of Delivery:

1. Continuous learning and reviews guided by faculty

2. Guided Learning Workshop

Assessment	Details	Weight (%)	Remarks
Continuous Assessment	Diagnostic assessment of a student's communication skills, cognitive abilities, and behavioural traits during the course	25	Continuous
	MCQs/Diagnostic tests and Viva-voce	25	Two per semester - After CCET1 and after CCET2
Final Assessment	MCQs/Diagnostic tests and Viva-voce	50	End of Semester

End of semester V

SEMESTER-VI

Course Code: 19MCCN2601	Course Title: FLUID POWER SYSTEMS		
Course Category: Professional Core	Course Level: Practice		
L: T:P (Hours/Week): 3:0:2	Credit :4	Total Contact Hours: 60	Total Marks: 100

Prerequisites:

The student should have undergone the courses:

- Fluid Mechanics and Hydraulic Machinery

Course Objectives:

The course is intended to:

1. Explain the fluid power systems.
2. Explain construction and working of hydraulic components.
3. Develop a hydraulic circuit.
4. Explain construction and working of pneumatic components.
5. Develop a pneumatic circuit.

UNIT I FLUID POWER SYSTEM AND FUNDAMENTALS 6 Hours

Introduction to Fluid power - Types of fluid power systems - Hydraulic system components - Pneumatic system components - Application of Pascal's Law in hydraulics-Advantages of fluid power system -Applications of Fluid power system -Properties of hydraulic fluids - Types of fluids.

UNIT II HYDRAULIC SYSTEM AND COMPONENTS 6 Hours

Pumping theory - Pump classification - Construction and working of gear pumps, Vane pumps, Piston pumps - Construction and working of linear actuators - Special cylinder - Rotary actuator – Construction and operation of direction control valves (DCV), Pressure control valve, Flow control valve – Construction and operation of accumulators, Intensifiers..

UNIT III HYDRAULIC CIRCUITS 6 Hours

Hydraulic symbols - Hydraulic circuits for linear actuators - Hydraulic circuits using different actuating devices - Speed control circuits - Sequencing circuit - Synchronizing circuit - Regenerative circuit - Accumulator circuit – Application of intensifier - Hydraulic circuit for Milling operation, Grinding Machine - Hydraulic braking in Automobile.

UNIT IV PNEUMATIC SYSTEM AND COMPONENTS 6 Hours

Properties of air – Compressor - Types of compressor - Construction and operation of air filter, air regulator, air lubricator - Pneumatic linear actuator - Rotary actuator - Constriction and working of pneumatic direction control valve – Flow control valve - Pneumatic symbols.

UNIT V PNEUMATIC CIRCUITS 6 Hours

Pneumatic circuits for single acting cylinder, Double acting cylinder - Pneumatic circuits using manual, mechanical, electrical actuating devices - Cascade method for sequencing: two and three Cylinders - Step counter method- Hydro-Pneumatic circuit - Material handling system circuit - Multiple operation Machining.

List of Experiments Periods: 30

1. Develop a hydraulic circuit for the Mechanical actuation of hydraulic cylinder using trainer kit.
2. Develop a hydraulic circuit for Speed regulation of double-acting cylinder trainer kit. (Meter in &Meter out).
3. Develop a Pneumatic circuit for single acting Cylinder and double acting Cylinder using trainer kit.
4. Develop a Pneumatic circuit for sequential circuit using Electro pneumatic trainer kit.
5. Develop a Cascading operation of a double acting cylinder with pneumatic sensors.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Explain the construction and working of hydraulic system components.	Understand
CO2: Develop a hydraulic circuit for milling, grinding and automobile braking application.	Understand
CO3: Explain the construction and working of pneumatic system components.	Understand
CO4: Develop a pneumatic circuit for material handling and machining application.	Understand
CO5: Explain the construction and working of hydraulic system components.	Understand

Text Book(s):

T1. Esposito Anthony, “Fluid Power with Applications”, Pearson Education Inc., New York, 2008.

T2. Majumdar, S.R., “Oil Hydraulic Systems – Principles and Maintenance”, Tata McGraw-Hill, New Delhi, 2006.

Reference Book(s):

R1. Srinivasan.R, “Hydraulic and Pneumatic controls”, Vijay Nicole, 2006.

R2. Andrew Parr, “Hydraulics and Pneumatics, A technician's and engineer's guide”, Third Edition, Butterworth-Heinemann, 2011.

R3. Majumdar, S.R., “Pneumatic Systems – Principles and Maintenance”, Tata McGraw-Hill, New Delhi, 2006

Web Reference(s):

1. http://www.nptel.ac.in/courses/112106175/
2. http://nptel.ac.in/courses/112105046/

Course Articulation Matrix

CO	PO1	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
CO1	2	1	-	2	2	-	-	2	1	2	-	1	1	-
CO2	2	1	-	2	2	-	-	2	1	2	-	1	1	-
CO3	2	1	-	2	2	-	-	2	1	2	-	1	1	-
CO4	2	1	-	2	2	-	-	2	1	2	-	1	1	-
CO5	1	1	-	1	1	-	-	2	1	2	-	1	1	-

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	**CO. No.**	**Marks**	**Total**
Continuous Assessment	CCET I	1,2	50	20
	CCET II	3,4	50	
	Retest	1,2,3,4	50	
	CCET III	5	50	
	Continuous Assessment – Practical	1,2,3,4,5	75	10
	Final Assessment – Practical	1,2,3,4,5	50	10
End Semester Examination	ESE	1,2,3,4,5	100	60
Total				100

Course Code: 19MCCN2602	MANUFACTURING TECHNOLOGY		
Course Category: Professional Core	Course Level: Practice		
L: T:P (Hours/Week): 3:0:2	Credit :4	Total Contact Hours: 60	Total Marks: 100

Prerequisites:

The student should have undergone the course(s):

1. Material Science
2. Engineering Metrology and Measurements

Course Objectives:

The course is intended to:

1. Explain the basic principles involved in metal cutting process.
2. Select appropriate metal cutting processes to manufacture a cylindrical part.
3. Select appropriate metal cutting operations to manufacture a prismatic a part.
4. Select appropriate metal finishing processes for the given design requirement.
5. Select various Unconventional Machining processes.

UNIT I THEORY OF METAL CUTTING 6 Hours

Metal removal processes, Orthogonal cutting, Oblique cutting, Cutting tools, Tool geometry of single point cutting tool, Types of chips, Cutting tool – Characteristics, materials, Mechanics of orthogonal cutting, Machinability, Tool life using Taylors equation, Types of tool wear, Cutting fluids – Functions, types.

UNIT II MACHINING CYLIDRICAL FEATURES 6 Hours

LATHE: Centre lathe - Constructional Features, Parts, Operations performed, Attachments / Accessories, Process parameters, Capstan lathe and Turret lathe, Types of automatic lathes, Turret indexing mechanism, Bar feeding mechanism, semi-automatic and automatic lathes, Tooling layout.

DRILLING: Constructional features of drilling machine, upright drilling machine, radial drilling machine, Operations, Process parameters.

UNIT III MACHINING PRISMATIC COMPONENTS WITH MILLING MACHINES 6 Hours

Milling machines - Types, Constructional features. Milling cutter - Types, nomenclature. Up milling & Down milling, Operations performed in milling machine, Process parameters.

UNIT IV METAL FINISHING PROCESSES 6 Hours

Grinding: Types of grinding machines, Types of grinding wheels, Grinding wheel designation, Classification of grinding machines and grinding wheels, Constructional features of cylindrical grinding machines, Surface grinding machines, Process parameters. Honing, Types of honing, Lapping, Types of lapping (Equalising, form), Types of lapping machines, Burnishing, Polishing and Buffing. – Process and Application

UNIT V UNCONVENTIONAL MACHINING PROCESS 6 Hours

Ultrasonic Machining process, abrasive jet machining process, water jet machining process, Electric discharge machining(EDM) – wire cut EDM, chemical machining process, electro chemical machining, electron beam machining, laser beam machining-principles, working process , applications, merits and demerits.

List of Experiments **Periods: 30**

1. Exercise on turning of shaft.
2. Exercise on Shaping- Male dove tail part.
3. Exercise on Drilling, Reaming and Tapping.
4. Exercise on Spur Gear Cutting.
5. Exercise on Machining of bolt in capstan lathe.

Course Outcomes	
At the end of the course students will be able to:	
CO1: Explain the basic principles involved in manufacturing a part by metal cutting process.	Understand
CO2: Select appropriate metal cutting processes to manufacture a cylindrical part which involve Lathe, Automat and Drilling machines.	Understand
CO3: Select appropriate metal cutting operations to manufacture a prismatic a part which involve Milling machines.	Understand
CO4: Select appropriate metal finishing processes which involve grinding, honing, burnishing and lapping for the given design requirement.	Understand
CO5: Compare various energy based unconventional machining processes.	Understand

Text Book(s):

T1. Rao P N, “Manufacturing Technology, Vol 2, Metal Cutting and Machine Tools”, , Tata McGraw Hill, New Delhi, 3rd Edition, 2013.

T2. Serope Kalpakjian, Steven Schmid, "Manufacturing Engineering and Technology", Addison Wesley Publishing Company, 7th edition, 2013.

T3. Vijay.K.Jain "Advanced Machining Processes" Allied Publishers Pvt.ltd, New Delhi, 2014.

Reference Book(s):

R1. Rajput R K, "A Text Book of Manufacturing Technology (Manufacturing Process)", Laxmi Publications (P) Ltd., New Delhi, Reprint 2015.

R2. Sharma P C, "A Text book of Production Engineering", S.Chand & Co Ltd., 8th Edition Revised, 2017.

Web Reference(s):

1. http://nptel.ac.in/courses/112105126/

Course Articulation Matrix

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	PSO1	PSO2
CO1	1	1	1	1	1	-	-	2	1	2	-	1	-	-
CO2	1	1	1	1	1	-	-	2	1	2	-	1	-	-
CO3	1	1	1	1	1	-	-	2	1	2	-	1	-	-
CO4	1	1	1	1	1	-	-	2	1	2	-	1	-	-
CO5	1	1	1	1	1	-	-	2	1	2	-	1	-	-

1. High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	**CO. No.**	**Marks**	**Total**
Continuous Assessment	CCET I	1,2	50	20
	CCET II	3,4	50	
	Retest	1,2,3,4	50	
	CCET III	5	50	
	Continuous Assessment – Practical	1,2,3,4,5	75	10
	Final Assessment – Practical	1,2,3,4,5	50	10
End Semester Examination	ESE	1,2,3,4,5	100	60
Total				100

Course Code: 19MECC1602	Course Title: DATA SCIENCE FOR ENGINEERS (Common to MC,ME,AU Programmes)		
Course Category: Professional Core		Course Level: Mastery	
L:T:P (Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Prerequisites:

The student should have undergone the course(s):

- Problem solving using PYTHON

Course Objective:

The course is intended to:

1. Understand the importance of data science and Python in Engineering
2. Develop algorithmic solutions to simple computationalproblems
3. Apply basic statistic tools and techniques
4. Perform data analytics process using python
5. Analyze relevant data using basic statistic tools and techniques

UNIT I INTRODUCTION TO DATA SCIENCE AND PYTHON 9 Hours

Data, types of data, data sets, data frames, Importance of data applications, Introduction to data science, data science in various fields, anaconda, IDE, Jupyter Notebooks, Microsoft visual studio code, Python-Introduction, Application and Installation procedures. Creation of root path, conda activation, Import sample excel sheet and access using Jupyter Note book. Keys steps of the data analysis process.

UNIT II BASICS OF PYTHON PROGRAMMING 9 Hours

Ipython, Introduction to NumPy, NumPy Basics: Arrays and Vectorized Computation, Getting started with Pandas, data manipulation with pandas,Perform the entire data analysis process on a dataset, Visualization with Matplotlib, Learn to use NumPy and Pandas to wrangle, explore, analyze, and visualize data

UNIT III ROLE OF STATISTICS AND PROBABILITY IN DATA SCIENCE 9 Hours

Central tendency and dispersion, Introduction to probability, Probability distributions, Random variables and expectation, sampling and sampling distribution, Distribution of Sample Means, population, and variance, confidence interval estimation, Hypothesis and Hypothesis testing, Errors, Two sample T test, F test, ANOVA, Pearson correlation, Goodness of Fit, Simple Linear Regression, Multiple Regression, Logistic Regression

UNIT IV DATA ANALYTICS USING PYTHON 9 Hours

Data Loading, Storage, and File Formats, Data Cleaning and Preparation, Data Wrangling, Gathering Data, Assessing Data, Cleaning Data, Join, Combine, and Reshape, Plotting and Visualization, Data Aggregation and Group Operations, Data assembly and Missing data handling, Time Series, Machine Learning.

UNIT V DATA ANALYSIS PROCESS 9 Hours

Linear Algebra for Data Science, Introduction to Vectors and Matrices using Python, Python demo for distributions and statistics analysis using python, use Seaborn for statistical plots, Use SciKit-Learn for Machine Learning Tasks, Data Visualization in Data Analysis and Data Presentation.

Course Outcomes **At the end of this course, students will be able to:**	**Cognitive Level**
CO1: Understand the importance of data science and Python in Engineering.	Understand
CO2: Develop algorithmic solutions to simple computational problems	Understand
CO3: Apply basic statistic tools and techniques	Understand
CO4: Perform data analytics process using python	Understand
CO5: Analyze relevant data using basic statistic tools and techniques	Understand

Text Book(s):

T1. Jake VanderPlas (2017) “Python Data Science Handbook: Essential Tools for Working with Data” O'Reilly Media, Inc

T2. Daniel Y. Chen, (2018) “Pandas for Everyone: Python Data Analysis” addison wesley

T3. McKinney, W. (2012). Python for data analysis: Data wrangling with Pandas, NumPy, and IPython. " O'Reilly Media, Inc.".

T4. .Douglas C. Montgomery, George C. Runger (2002). Applied Statistics & Probability for Engineering. “John Wiley & Sons, Inc”

T5.

Reference Book(s):

R1. Swaroop, C. H. (2003). A Byte of Python. Python Assignment.

R2. Anirban DasGupta – 2011 Probability for Statistics and Machine Learning" Springer link

R3. Anderson Sweeney Williams (2011). Statistics for Business and Economics. "Cengage Learning".

Web Reference(s):

1. https://jakevdp.github.io/PythonDataScienceHandbook/index.html
2. https://towardsdatascience.com/

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	1	1	1	-	-	2	1	2	-	1	1	-
CO2	1	1	1	1	1	-	-	2	1	2	-	1	1	-
CO3	1	1	1	1	1	-	-	2	1	2	-	1	1	-
CO4	1	1	1	1	1	-	-	2	1	2	-	1	1	-
CO5	1	1	1	1	1	-	-	2	1	2	-	1	1	-

High-3; Medium-2;Low-1

Assessment pattern

	Assessment Component	**CO .No.**	**Marks**	**Total**
Continuous Comprehensive Evaluation	CCET 1	1,2	50	30
	CCET 2	3,4	50	
	Retest	1,2,3,4	50	
	CCET 3	5	50	
	Assignment	1,2,3,4,5	30	10
End Semester Examination	ESE	1,2,3,4,5	100	60
Total				**100**

Course Code: 19PSHG6601	Course Title: EMPLOYABILITY SKILLS 2: CAMPUS TO CORPORATE (Common to all B.E/B.Tech Programmes)		
Course Category: Humanities	Course Level: Introductory		
L: T:P (Hours/Week): 0:0:2	Credit :1	Total Contact Hours: 30	Total Marks: 100

Pre-requisites:

- NIL

Course objectives:

The course is intended to:

1. Understand emotions and necessity to handle it to evolve as an effective social animal
2. Build effective resumes to project the positives to be employable
3. Facilitate working in a collaborative work environment and to engage in healthy agreements for building person's professional facet
4. Formulate the growth attribute to outperform, initiate and grow in professional arena
5. Explain time management and impart leadership skills.

UNIT I: EMOTIONAL INTELLIGENCE 6 Hours

Nature of Emotions - Importance of EI -EQ vs IQ -Behavioral difference between EQ & IQ - Acquiring Emotional Intelligence -Benefits of high EI -Steps to develop EI -Role of EI in Interviews

UNIT II: RESUME PREPARATION 6 Hours

Importance of Resume - Good Resume -Planning Resume -Organizing Resume -Spell check - Benefits of good resume -Resume Writing

UNIT III: GROUP DISCUSSION 6 Hours

Purpose of GD -Prerequisites of GD-Benefits of GD-Features of GD-Do's & Don'ts in GD-Accept Criticism &Feedback-Accepting Suggestions-GD Phrases-Effective Introduction& Conclusion-Preferred Etiquette of GD.

UNIT IV: INTERVIEW ETIQUETTE(NETIQUETTE) 6 Hours

Definition of Interview-Types of Interview -Prior interview-Know the Company -Employer's perspective in interview- Non Verbal etiquette-Dressing -Verbal Communication in Interview-Facing Rejection in Interview-Do's & Don'ts in an Interview-Common Interview Questions - Handling Stress Questions - Handling Telephonic Interviews.

UNIT V: LEADERSHIP SKILLS& TIME MANAGEMENT 6 Hours

Leadership -Leadership Traits -Leadership styles -Types of Leaders -Qualities of a leader - Developing Perspectives

Time Management -Necessity of Time Management- Types of time -Estimation of time - Process of Time management -Efficient utilization of Time -Time wasting culprits - Tips to manage time -Goal setting in Time Management

COURSE OUTCOME:

Course Outcomes	**Cognitive Level**
CO1: Understand the emotions and necessity to handle them	Understand
CO2: Build effective resumes to project the positives to be employable	Apply
CO3: Facilitate collaborative work environment and to engage in healthy agreements for building person's professional facet	Understand
CO4: Formulate the growth attribute to outperform, initiate and grow in professional arena	Apply
CO5: Explain time management and impart leadership skills	Understand

Text Book(s):

T1. Thea Kelley, "Get That Job! The Quick and Complete Guide to a Winning Interview " Plover crest Press, 2017

Reference Book(s):

R1. Daniel Goleman, " Emotional Intelligence Reader's Guide", BANTAM PUBLISHERS, 1997

R2. Daniel Goleman, Richard Boyatzis & Annie McKee, " Primal Leadership: Unleashing the Power of Emotional Intelligence" Harvard Business Review Press; Anniversary edition, 2013

R3. Stephen R Covey, " The 7 Habits of Highly Effective People: Powerful Lessons in Personal Change" Simon & Schuster; Anniversary edition, 2013

Course Articulation Matrix

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	P10	P11	P12	PSO 1	PSO 2
CO1	-	-	-	-	-	-	-	1	-	1	-	1	-	-
CO2	-	-	-	-	-	-	-	-	-	2	-	1	-	-
CO3	-	-	-	-	-	-	-	-	1	1	-	1	-	-
CO4	-	-	-	-	-	-	-	-	1	-	-	1	-	-
CO5	-	-	-	-	-	-	-	1	-	-	1	1	-	-

High -3, Medium – 2, Low-1

Assessment Details

Mode of Delivery:

1. Continuous learning and reviews guided by faculty

2. Guided Learning Workshop

Assessment	Details	Weight (%)	Remarks
Continuous Assessment	Diagnostic assessment of a student's communication skills, cognitive abilities, and behavioural traits during the course	25	Continuous
	MCQs/Diagnostic tests and Viva-voce	25	Two per semester - After CCET1 and after CCET2
Final Assessment	MCQs/Diagnostic tests and Viva-voce	50	End of Semester

Course Code: 19MCPN6601	Course Title: INNOVATIVE & CREATIVE PROJECT		
Course Category: Project		Course Level: Practice	
L:T:P (Hours/Week) 0: 0: 4	Credits:2	Total Contact Hours:60	Max. Marks:100

Pre-requisites:

- Nil

Course Objectives:

The course is intended to:

1. Take up any challenging practical problems and find solution by formulating proper methodology.
2. Work collaboratively on a team to successfully complete a design project
3. Effectively communicate the results of projects in a written and oral format

The objective of Project I is to enable the student to take up investigative study in the broad field of Mechanical Engineering, either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department on an individual basis or two/three students in a group, under the guidance of a Supervisor. This is expected to provide a good initiation for the student(s) in R&D work. The assignment to normally include:

1. Survey and study of published literature on the assigned topic.
2. Working out a preliminary Approach to the Problem relating to the assigned topic.
3. Conducting preliminary Analysis/Modelling/Simulation/Experiment/Design/Feasibility.
4. Preparing a Written Report on the Study conducted for presentation to the Department.
5. Final Seminar, as oral Presentation before a departmental committee.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1:Take up any challenging practical problems and find solution by formulating proper methodology.	Understand
CO2: Work collaboratively on a team to successfully complete a design project	Understand
CO3: Effectively communicate the results of projects in a written and oral format	Understand

Course Code: 19MCPN6002		Course Title: INTERNSHIP OR SKILL DEVELOPMENT	
Course Category: Project		Course Level: Practice	
L:T:P (Hours/Week) 2 Weeks	Credits: 1	Total Contact Hours: Nil	Max. Marks:100

Pre-requisites:

- Nil

Course Objectives:

The course is intended to:

1. Understand industry-specific terminology and practices
2. Solve simple industrial problems
3. Work collaboratively on a team
4. Effectively communicate the activities of internship in a written and oral format

Minimum of two weeks in an Industry in the area of Mechanical Engineering. The summer internship should give exposure to the practical aspects of the discipline. In addition, the student may also work on a specified task or project which may be assigned to him/her. The outcome of the internship should be presented in the form of a report.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO5: Understand industry-specific terminology and practices	Apply
CO6: Solve simple industrial problems	Understand
CO7: Work collaboratively on a team	Apply
CO8: Effectively communicate the activities of internship in a written and oral format	Understand

End of semester VI

SEMESTER VII

Course Code:19MCCN1701	Course Title: ROBOTICS AND MACHINE VISION SYSTEM		
Course Category: Professional Core		Course Level: Mastery	
L:T:P(Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max Marks:100

Prerequisites:

The student should have undergone the course(s):

1. Sensors and signal processing
2. Basics of computer programming
3. Hydraulics and Pneumatics
4. Theory of machines

Course Objectives:

The course is intended to:

1. Make use of different configurations of robot system for the industrial problems
2. To select the appropriate robot end effector based on the type of materials to be handled
3. Apply the knowledge of mechanics in robot movements
4. Develop a robot programming for required applications
5. Utilize machine vision systems in robotics applications

UNIT I BASICS OF ROBOTICS 8 Hours

Brief History, Laws of robots, Types of robots, Overview of robot system and subsystems, resolution, repeatability and accuracy, Degrees of freedom of robots, Robot configurations and concept of workspace, Drive mechanisms and transmission. Present status and future of robots.

UNIT II ROBOT END EFFECTORS 6 Hours

Introduction, need of End effectors, types – Design of finger gripper- Different types of grippers – Mechanical, vacuum, Magnetic and other methods of gripping, actuation methods for mechanical gripper, gripper force analysis, selection of grippers, tools as an end effector

UNIT III ROBOT KINEMATICS 12 Hours

Rotation and Translation of Homogeneous coordinates multiple transformations. Transformation Matrices, Forward and Inverse kinematics of robots, Degrees of freedom (2,

3, 4, 5, and 6 DOF), Denavit-Hartenberg convention, kinematic solution for articulated robot. Degeneracy and dexterity. Basics of Trajectory planning, Joint space trajectory planning, Cartesian Space trajectories.

UNIT IV ROBOT PROGRAMMING AND APPLICATIONS 10 Hours

Methods of robot programming – manual and textual programming, robot control system, Robot work cell, Point to point programming and continues path programming. Application of robots in material handling, entertainment, medical and security fields

UNIT V MACHINE VISION AND APPLICATIONS 9 Hours

Active vision system, Machine vision components, hardware's, Image acquisition. Industrial machine vision, structure of industrial machine vision, generic standards, data reduction, segmentation, feature extraction, object recognition, application of machine vision such as in inspection and identification.

COURSE OUTCOMES:

At the end of this course, students will be able to:	**Cognitive Level**
CO1: Explain the different configurations of robot system in appropriate places	Understand
CO2: Select suitable robot end effector.	Understand
CO3: Apply the knowledge of mechanics and identifying path of robots.	Understand
CO4: Construct robot programming to meet desired applications	Understand
CO5: Use the machine vision system in robots	Understand

Text Book(s):

T1. Mikell P Groover, Nicholas G Odrey, Mitchel Weiss, Roger N Nagel, Ashish Dutta, "Industrial Robotics, Technology programming and Applications", McGraw Hill, 2012.

T2. Craig. J. J. "Introduction to Robotics- mechanics and control", Addison- Wesley, 1999.

Reference Book(s):

R1. S.R. Deb, "Robotics Technology and flexible automation", Tata McGraw-Hill Education., 2009.

R2. Richard D. Klafter, Thomas .A, ChriElewski, Michael Negin, "Robotics Engineering an Integrated Approach", PHI Learning, 2009.

R3. Rafael C. Gonzalez, Richard E. Woods, "Digital Image Processing using MATLAB", Main purpose-Practical

Web Reference(s):

1. https://nptel.ac.in/courses/112/105/112105249/
2. https://nptel.ac.in/courses/112101099/
3. https://nptel.ac.in/courses/112108093/

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	-	1	1	-	-	2	1	2	-	1	-	2
CO2	1	1	-	1	1	-	-	2	1	2	-	1	-	2
CO3	1	1	-	1	1	-	-	2	1	2	-	1	-	2
CO4	1	1	-	1	1	-	-	2	1	2	-	1	-	2
CO5	1	1	-	1	1	-	-	2	1	2	-	1	-	2

High-3; Medium-2;Low-1

Assessment pattern

	Assessment Component	**CO .No.**	**Marks**	**Total**
Continuous Comprehensive Evaluation	CCET 1	1,2	50	30
	CCET 2	3,4	50	
	Retest	1,2,3,4	50	
	CCET 3	5	50	
	Assignment	1,2,3,4,5	30	10
End Semester Examination	ESE	1,2,3,4,5	100	60
Total				**100**

Course Code:19MCCN1702	**Course Title: CAD/CAM/CIM**
Course Category: Professional Core	**Course Level: Mastery**

L:T:P(Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max Marks:100

Prerequisites:

The student should have undergone the course(s):

1. Manufacturing Technology

Course Objectives:

The course is intended to:

1. Explain the computer aided design principles.
2. Distinguish different CNC machines.
3. Explain the different part program of CNC Lathe and CNC Machining centre.
4. Defining manufacturing planning and control.
5. Explains process planning and product planning.

UNIT I COMPUTER AIDED DESIGN **9 Hours**

Introduction to CAD -Types of CAD system – 2D&3D Transformations – translation - scaling- rotation – Geometry Modelling techniques - Wireframe modelling - surface modelling - solid modelling - Boundary Representation – CSG – Comparison – Graphics Standard – GKS - IGES.

UNIT II DESIGN FEATURES OF CNC MACHINES **9 Hours**

Working principles of - CNC turning centre- machining centre-pneumatic and hydraulic control system - Open loop and closed loop systems-microprocessor based CNC systems - Selection of CNC machine tools – structure - drive kinematics - gear box - main drive - selection of timing belts and pulleys - spindle bearings arrangement - Re-circulating ball screws - linear motion guide ways - tool magazines – ATC – APC - chip conveyors tool turrets - spindle encoder.

UNIT III PART PROGRAMMING **9 Hours**

CNC turning centre programming - G and M functions-tool offset information - tool nose radius compensation - long turning cycle - facing cycle - threading cycle - peck drilling cycle - part programming examples. CNC Milling Programming - Co-ordinate systems - cutter diameter compensation - fixed cycles - drilling cycle - tapping cycle - boring cycle - part programming examples.

UNIT IV COMPUTER INTEGRATED MANUFACTURING **9 Hours**

Brief introduction to Manufacturing Planning, Manufacturing control Introduction to CAD/CAM – Concurrent Engineering - CIM concepts – Computerized elements of CIM system –Types of production - Manufacturing models and Metrics – Mathematical models of Production Performance – Simple problems – Manufacturing Control – Simple Problems – Basic Elements of an Automated system – Levels of Automation – Lean Production and Just-In Time Production.

UNIT V PRODUCTION PLANNING AND CONTROL AND COMPUTERISED PROCESS PLANNING **9 Hours**

Process planning – Computer Aided Process Planning (CAPP) – Logical steps in Computer Aided Process Planning – Aggregate Production Planning and the Master Production Schedule – Material Requirement planning – Capacity Planning- Control Systems-Shop Floor Control Inventory Control – Brief on Manufacturing Resource Planning-II (MRP-II) & Enterprise Resource Planning (ERP) - Simple Problems.

COURSE OUTCOMES:

At the end of this course, students will be able to:	**Cognitive Level**
CO1: Explain the computer aided design principles such as transformations, geometry modelling technique and graphics standard.	Understand
CO2: Explain the construction and features of CNC machines.	Understand
CO3: Develop a part program to produce a component by CNC lathe and Machining centre.	Understand
CO4: Categorizing CIM concepts.	Understand
CO5: Explains process planning and product planning for different manufacturing process.	Understand

Text Book(s):

T1. Mikell.P. Groover "Automation, Production Systems and Computer Integrated Manufacturing"4th Edition, Pearson India Pvt. ltd, 2016.

T2. Radhakrishnan P, SubramanyanS. and Raju V., "CAD/CAM/CIM", 4th Edition, New Age International (P) Ltd, New Delhi, 2018.

Reference Book(s):

R1. Kant Vajpayee. S., "Principles of Computer Integrated Manufacturing", Prentice Hall of India, 2010.

R2. Yorem Koren, “Computer Control of Manufacturing System”, McGraw Hill, 2017.

Web Reference(s):

1. https://nptel.ac.in/courses/112102101

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	-	1	1	-	-	2	1	2	-	1	2	-
CO2	1	1	-	1	1	-	-	2	1	2	-	1	2	-
CO3	1	1	-	1	1	-	-	2	1	2	-	1	2	-
CO4	1	1	-	1	1	-	-	2	1	2	-	1	2	-
CO5	1	1	-	1	1	-	-	2	1	2	-	1	2	-

High-3; Medium-2;Low-1

Assessment pattern

	Assessment Component	**CO .No.**	**Marks**	**Total**
Continuous Comprehensive Evaluation	CCET 1	1,2	50	30
	CCET 2	3,4	50	
	Retest	1,2,3,4	50	
	CCET 3	5	50	
	Assignment	1,2,3,4,5	30	10
End Semester Examination	ESE	1,2,3,4,5	100	60
Total				**100**

Course Code:19MECC1701	Course Title: ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING (Common to AU, ME, MC Programmes)		
Course Category: Professional Core		Course Level: Mastery	
L:T:P (Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Prerequisites:

- Nil

Course Objective:

The course is intended to:

1. Explain the basics of Artificial Intelligence and applications.
2. Explain search methods to achieve a goal.
3. Explain first-order logic to represent knowledge.
4. Explain the basics of machine learning and applications.
5. Explain the various machine learning techniques.

UNIT I ARTIFICIAL INTELLIGENCE – INTRODUCTION 9 Hours

AI - definition. Foundations of AI - History, trends and future. Intelligent Agents - agents and environments, the concept of rationality, the nature of environments, the structure of agents and types-case studies of Artificial Intelligence.

UNIT II PROBLEM SOLVING BY SEARCH 9 Hours

Problem solving agents, searching for solutions- Infrastructure for search algorithms, measuring problem-solving performance. Uninformed search strategies- Breadth-first search, Depth-first search, Iterative deepening search, Uniform-cost search, Bidirectional search, Comparing uninformed search strategies. Heuristic functions, Informed (heuristic) search strategies- Best first search.

UNIT III KNOWLEDGE REPRESENTATION 9 Hours

Introduction to Knowledge Representation- Hypothesis, Reasoning, Representing Knowledge, Syntax and semantics of Knowledge Representation language, Propositional- Logic. First-order logic: syntax and semantics of first-order logic, knowledge engineering in first-order logic, inference in first-order logic.

UNIT IV INTRODUCTION TO MACHINE LEARNING 9 Hours

Introduction: Basic definitions, types of learning, hypothesis, space and inductive bias, evaluation, cross-validation- Linear regression- R programming, Decision trees, over fitting- Instance based learning, Feature reduction, Collaborative filtering based recommendation- Probability and Bayes learning.

UNIT V MACHINE LEARNING TECHNIQUES 9Hours

Introduction: Neural network - Perceptron, multilayer network, back propagation. Introduction to deep neural network- Computational learning theory, PCA learning model, Ensemble learning- Clustering: k-means, adaptive hierarchical clustering.-case studies on Machine Learning.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1. Explain the basic concept, and application of Artificial Intelligence.	Understand
CO2. Explain uninformed and informed search methods for problem solving.	Understand
CO3. Explain knowledge representation using first order logic.	Understand
CO4. Explain the basic concept, and application of Machine Learning.	Understand
CO5. Explain the classification and clustering techniques for decision making.	Understand

Text Book(s):

T1. Stuart J. Russell and Peter Norvig, "Artificial Intelligence- A Modern Approach", Fourth Edition, Pearson Series, 2021.

T2. Tom M. Mitchell, "Machine Learning", McGraw hill, 2013.

Reference Book(s):

R1. George Lugar, .Al-Structures and Strategies for and Strategies for Complex Problem solving, Sixth Edition, 2009, Pearson Educations.

R2. E. Rich and K. Knight, "Artificial intelligence", McGraw Hill, 3rd ed., 2017.

R3. Robin R Murphy, Introduction to AI Robotics PHI Publication, 2nd edition,2019.

R4. Nils.J. Nilsson, "Principles of AI", Narosa Publ. House, 2000.

Course Articulation Matrix

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	PS O1	PS O2
CO1	1	1	-	1	1	-	-	2	1	2	-	1	1	-
CO2	1	1	-	1	1	-	-	2	1	2	-	1	1	-
CO3	1	1	-	1	1	-	-	2	1	2	-	1	1	-
CO4	1	1	-	1	1	-	-	2	1	2	-	1	1	-
CO5	1	1	-	1	1	-	-	2	1	2	-	1	1	-

High-3; Medium-2;Low-1

Assessment pattern

	Assessment Component	**CO. No.**	**Marks**	**Total**
Continuous Assessment	CCET I	1,2	50	30
	CCET II	3,4	50	
	CCET III	5	50	
	Tutorials / Quiz / Assignments	1,2,3,4,5	30	10
End Semester Examination	ESE	1,2,3,4,5	100	60
			Total	100

Course Code: 19MCCN3701	Course Title: CAM/CAE LABORATORY		
Course Category: Professional Core		Course Level: Practice	
L:T:P (Hours/Week) 0: 0: 3	Credits: 1.5	Total Contact Hours:45	Max. Marks:100

Prerequisites:

The student should have undergone the course(s):

1. Manufacturing Technology
2. CAD/CAM/CIM
3. Strength of Materials

Course Objectives:

The course is intended to:

1. Explain G codes and M codes used in CNC Machines for programming.
2. Develop the programming skills and create a component for required drawing.
3. Simulate the manual part programme for CNC turning centre using software.
4. Learn and simulate finite element simulation software to solve simple problems in structural Element,

LIST OF EXPERIMENTS 45 Hours

1. Write part program for simple facing and turning operation and simulate by using software.
2. Write part program for step turning operation and simulate by using software.
3. Write part program for taper turning operation and simulate by using software.
4. Write part program for multiple facing operation and simulate by using software.
5. Write part program for multiple turning operation and simulate by using software.
6. Stress analysis of beams (Cantilever, Simply supported, Fixed ends)
7. Stress analysis of a plate with a circular hole.
8. Stress analysis of rectangular L bracket
9. Stress analysis of an Axi-symmetric component
10. Mode frequency analysis of beams(Cantilever, Simply supported, Fixed ends)

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Interpret G codes and M codes used in CNC Machines for programming.	Understand
CO2: Develop the CNC program and create a component for required drawing.	Apply
CO3: Develop the manual part programme simulation for CNC turning centre using software.	Apply
CO4: Apply finite element simulation software to solve simple problems in structural Element,	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	-	1	1	-	-	2	1	2	-	1	-	-
CO2	1	1	-	1	1	-	-	2	1	2	-	1	-	-
CO3	1	1	-	1	1	-	-	2	1	2	-	1	-	-
CO4	1	1	-	1	1	-	-	2	1	2	-	1	-	-
CO5	1	1	-	1	1	-	-	2	1	2	-	1	-	-

High-3; Medium-2;Low-1

Assessment pattern

	Assessment Component	Marks	Total
Continuous Comprehensive Evaluation	Each Lab Experiment	**75**	100
	Cycle Test 1	**25**	
	Cycle Test 2	**25**	

Course Code: 19MCCN3702	Course Title: ROBOTICS AND CONTROL LABORATORY		
Course Category: Professional Core		Course Level: Practice	
L:T:P (Hours/Week) 0: 0: 3	Credits: 1.5	Total Contact Hours:45	Max. Marks:100

Prerequisites:

The student should have undergone the course(s):

1. Sensors and signal processing
2. Basics of computer programming
3. Hydraulics and Pneumatics
4. Theory of machines

Course Objectives:

The course is intended to:

1. Make use of different configurations of robot system for the industrial problems.
2. Select the appropriate robot end effector based on the type of materials to be handled.
3. Verify different types of simulations for robot applications.
4. Develop a robot program for point to point applications.
5. Develop a robot program for continuous part applications.

LIST OF EXPERIMENTS **45 Hours**

1. Determination of maximum and minimum position of links.
2. Verification of transformation (Position and orientation) with respect to gripper and world coordinate system
3. Estimation of accuracy, repeatability and resolution.
4. Study and selection of Gripper
5. Robot programming for pick and place
6. Robot programming for welding
7. Construction of different configurations of robot using RoboAnalyzer
8. Determination of DH parameters
9. Robot programming for writing practice
10. Robot programming for Drawing practice

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Explain the different configurations of robot system in appropriate places	Understand
CO2: Select suitable robot end effector.	Apply
CO3: Construct robot programming to meet desired applications.	Apply
CO4: Develop program for different point to point applications	Apply
CO5: Develop program for continuous part applications	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	-	1	1	-	-	2	1	2	-	1	-	-
CO2	1	1	-	1	1	-	-	2	1	2	-	1	-	-
CO3	1	1	-	1	1	-	-	2	1	2	-	1	-	-
CO4	1	1	-	1	1	-	-	2	1	2	-	1	-	-
CO5	1	1	-	1	1	-	-	2	1	2	-	1	-	-

High-3; Medium-2;Low-1

Assessment pattern

	Assessment Component	Marks	Total
Continuous Comprehensive Evaluation	Each Lab Experiment	75	100
	Cycle Test 1	25	
	Cycle Test 2	25	

End of semester VII

SEMESTER VIII

Course Code: 19MCPN6801	Course Title: PROJECT		
Course Category: Project		Course Level: Practice	
L:T:P (Hours/Week) 0: 0: 16	Credits:8	Total Contact Hours:240	Max. Marks:200

Pre-requisites:

- Nil

Course Objectives:

The course is intended to:

1. Take up any challenging practical problems and find solution by formulating proper methodology.
2. Work collaboratively on a team to successfully complete a design project
3. Effectively communicate the results of projects in a written and oral format

The objective of Project I is to enable the student to take up investigative study in the broad field of Mechanical Engineering, either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department on an individual basis or two/three students in a group, under the guidance of a Supervisor. This is expected to provide a good initiation for the student(s) in R&D work. The assignment to normally include:

1. Survey and study of published literature on the assigned topic.
2. Working out a preliminary Approach to the Problem relating to the assigned topic.
3. Conducting preliminary Analysis/Modelling/Simulation/Experiment/Design/Feasibility.
4. Preparing a Written Report on the Study conducted for presentation to the Department.
5. Final Seminar, as oral Presentation before a departmental committee.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1:Take up any challenging practical problems and find solution by formulating proper methodology.	Understand
CO2: Work collaboratively on a team to successfully complete a design project	Understand
CO3: Effectively communicate the results of projects in a written and oral format	Understand

Course Code: 19MCPN6003	Course Title: INTERNSHIP OR SKILL DEVELOPMENT		
Course Category: Project		Course Level: Practice	
L:T:P (Hours/Week) 8/16 Weeks	Credits: 4	Total Contact Hours: Nil	Max. Marks:100

Pre-requisites:

- Nil

Course Objectives:

The course is intended to:

1. Understand industry-specific terminology and practices
2. Solve simple industrial problems
3. Work collaboratively on a team
4. Effectively communicate the activities of internship in a written and oral format

Minimum of 8/16 weeks in an Industry in the area of Mechanical Engineering. The summer internship should give exposure to the practical aspects of the discipline. In addition, the student may also work on a specified task or project which may be assigned to him/her. The outcome of the internship should be presented in the form of a report.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Understand industry-specific terminology and practices	Understand
CO2: Solve simple industrial problems	Understand
CO3: Work collaboratively on a team	Understand
CO4: Effectively communicate the activities of internship in a written and oral format	Understand

End of Semester VIII

Professional Electives

Course Code:19MCEN1001	Course Title: FINITE ELEMENT METHODS		
Course Category: Professional Elective		Course Level: Mastery	
L:T:P(Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max Marks:100

Pre-requisites:

The student should have undergone the course(s):

- Fluid Mechanics and Hydraulic Machinery
- Strength of Materials
- Applied Thermodynamics

Course Objectives:

The course is intended to:

1. Convert physical problems into mathematical model
2. Solve the one dimensional structural problems
3. Solve the 2D vector variable problems
4. Solve the 1D and 2D scalar variable problems
5. Determine the shape function, Jacobean matrix, element stiffness matrix for 2D Quadrilateral element

UNIT I FINITE ELEMENT FORMULATION 9 Hours

Finite element methods - general applicability of the methods, general finite element procedure, discretization of the domain, degree of freedom, basic element shapes and nodes, numbering of element and nodes, displacement models, local, global coordinates, Spring element - derivation of element stiffness matrices, global stiffness matrix and force vector using minimum potential energy, solution of numerical problems.

UNIT II ONE DIMENSIONAL VECTOR VARIABLE PROBLEMS 9 Hours

Finite element modeling – Natural Coordinates and shape functions - linear bar element, - total potential energy approach - element stiffness matrix and force vector – global stiffness matrix and force vector - boundary condition – problems- quadratic element, Beam Element - development of shape function - element equations , element stiffness matrix and force vector – global stiffness matrix and force vector – boundary condition- problems.

UNIT III TWO DIMENSIONAL VECTOR VARIABLE PROBLEMS 9 Hours USING CONSTANT STRAIN TRIANGLES

Finite element modeling – constant strain triangular element – Iso-parametric representation – Potential Energy approach - Element stiffness matrix and force vector – global stiffness matrix and force vector –Boundary condition – Problems,

UNIT IV HEAT TRANSFER / SCALAR VARIABLE PROBLEM 1 D & 2D 9 Hours

Scalar variable problems- steady state heat transfer- 1D,2D conduction & convection – Global stiffness matrix and global thermal load vector - Boundary condition – Problems.

UNIT V TWO DIMENSIONAL VECTOR VARIABLE PROBLEM USING QUADRILATERAL ELEMENTS 9 Hours

Iso parametric elements – the four node quadrilateral- derivation of shape function, element stiffness matrix, element force vector- global stiffness matrix and force vector- Boundary condition-problems.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Convert physical problems into mathematical model using finite element procedure and solve simple problem using spring element	Apply
CO2: Solve the one dimensional structural problems such as bar, truss and beam using natural co ordinate system.	Apply
CO3: Solve the 2D vector variable problems by applying plane stress, strain and axi-symmetric conditions using CST element.	Apply
CO4: Solve the 1D and 2D scalar variable problems such as conduction and convection.	Apply
CO5: Determine the shape function, Jacobean matrix, and element stiffness matrix for 2D Quadrilateral element and find out the coordinates of a point in a element by applying interpolation technique.	Apply

Text Book(s):

T1. Chandrupatla & Belagundu, “Introduction to Finite Elements in Engineering”, Prentice-Hall of India, 3rd Edition, Eastern Economy Editions, 2011.

T2. Logan D.L., “A first course in Finite Element Method”, Thomson Asia Pvt. Ltd., 2002

Reference Book(s):

R1. David V.Hutton, “Fundamentals of Finite Element Analysis”, Tata McGraw-Hill Edition, 2005.

R2. J.N.Reddy, “An Introduction to the Finite Element Method”, McGraw-Hill International Editions (Engineering Mechanics Series), 2005.

Web Reference(s):

1. http://textofvideo.nptel.iitm.ac.in/105106051/lec1.pdf

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	2	2	-	-	2	2	3	-	2	-	-
CO2	2	1	-	2	2	-	-	2	2	3	-	2	-	-
CO3	2	1	-	2	2	-	-	2	2	3	-	2	-	-
CO4	2	1	-	2	2	-	-	2	2	3	-	2	-	-
CO5	2	1	-	2	2	-	-	2	2	3	-	2	-	-

High-3; Medium-2; Low-1

Assessment pattern:

	Assessment Component	CO .No.	Marks	Total
Continuous Comprehensive Evaluation	CCET 1	1,2	50	30
	CCET 2	3,4	50	
	Retest	1,2,3,4	50	
	CCET 3	5	50	
	Assignment/Quiz/Assignment	1,2,3,4,5	30	10
End Semester Examination	ESE	1,2,3,4,5	100	60
Total				100

Course Code : 19MCEN1002	Course Title: DESIGN OF MECHATRONIC SYSTEMS	
Course level : Mastery	L : T : P: C	3 : 0 : 0 : 3
Course Category: Professional Elective	Total Contact hours:	45 Hrs

Prerequisites:

The student should have undergone the course(s):

1. Virtual Instrumentation
2. Hydraulic and Pneumatic systems

Course Objectives:

The course is intended to:

1. Explain with the basics of design of Mechatronic systems and advanced approaches
2. Explain the concepts of system modelling , validation and application
3. Model the Mechatronic systems in Labview and Vim-Sim Environments.
4. Apply the design concepts and simulation in realtime examples in simulation environment.
5. Explain the Micro Mechatronic system design concepts for Mechatronics application.

UNIT I INTRODUCTION TO MECHATRONIC SYSTEMS 9 Hours

Key elements – Mechatronics Design process – Design Parameters – Traditional and Mechatronics Designs – Advanced Approaches in Mechatronics - Industrial Design and Ergonomics, Safety.

UNIT II SYSTEM MODELLING 9 Hours

Introduction - Model Categories - Fields of Application - Model Development - Model Verification-Model Validation - Model Simulation - Design of Mixed Systems - Electro Mechanics Design - Model Transformation- Domain-Independent Description Forms - Simulator Coupling.

UNIT III REAL TIME INTERFACING 9 Hours

Introduction - Selection of Interfacing Standards Elements of Data Acquisition and Control Systems- Over View of I/O Process, General purpose I/O card and its installation, Data conversion process, Application Software- Lab view Environment and its applications, Vim-Sim Environment and its Applications - Man machine interface.

UNIT IV CASE STUDIES ON MECHATRONIC SYSTEMS 9 Hours

Introduction –Fuzzy based Washing machine – pH control system – Autofocus Camera, exposure control–Motion control using D.C Motor and Solenoids – Engine management systems.– Controlling temperature of a hot/cold reservoir using PID Controller - Control of

pick and place robot – Part identification and tracking using RFID – Online surface measurement using image processing

UNIT V MICRO MECHATRONIC SYSTEM 9 Hours

Introduction- System principle - Component design – System design – Scaling laws – Micro actuation Micro robot – Micro pump – Applications of micro mechatronic components.

Course Outcomes	**Cognitive Level**
At the end of the course students will be able to:	
CO1: Explain the key elements of Mechatronic systems.	Understand
CO2: Model any Electro mechanical systems.	Understand
CO3: Build the controller and Data Acquisition system concepts in simulation using Labview and Vim-Sim platform.	Understand
CO4: Choose a Mechatronic system for real time problems.	Understand
CO5: Explain the Micro Mechatronic systems components for Mechatronic application.	Understand

Text Book(s):

T1. Devdas shetty, Richard A. Kolk, “Mechatronics System Design”, 2nd Edition, Cengage Learning 2011.

T2. Georg pelz, "Mechatronic Systems: Modeling and simulation" with HDL’s, John wiley and sons Ltd, 2003.

Reference Book(s):

R1. Bishop, Robert H, "Mechatronics Hand book", CRC Press, 2002.

R2. Bradley, D. Dawson, N.C. Burd and A.J. Loader, "Mechatronics: Electronics in Products and Processes", CRC Press 1991, First Indian print 2010.

R3. De Silva, "Mechatronics: A Foundation Course", Taylor & Francis, Indian Reprint, 2013

Web Reference(s):

1. https://ocw.tudelft.nl/courses/mechatronic-system-design/
2. http://www.tesla-institute.com/index.php/mechatronic-articles/95-mechatronics-desig

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	2	2	-	-	2	1	2	-	1	-	-
CO2	2	1	-	2	2	-	-	2	1	2	-	1	-	-
CO3	2	1	-	2	2	-	-	2	1	2	-	1	-	-
CO4	2	1	-	2	2	-	-	2	1	2	-	1	-	-
CO5	1	1	-	1	1	-	-	2	1	2	-	1	-	-

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	**CO .No.**	**Marks**	**Total**
Continuous Comprehensive Evaluation	CCET 1	1,2	50	30
	CCET 2	3,4	50	
	Retest	1,2,3,4	50	
	CCET 3	5	50	
	Assignment	1,2,3,4,5	30	10
End Semester Examination	ESE	1,2,3,4,5	100	60
Total				**100**

Course Code :19MCEN1003	Course Title: PRODUCT DESIGN AND DEVELOPMENT	
Course level : Mastery	L : T : P: C	3 : 0 : 0 : 3
Course Category: Professional Elective	Total Contact hours:	45 Hrs

Prerequisites:

The student should have undergone the course(s):

1. CAD/ CAM/ CIM

Course Objectives

The course is intended to:

1. Explain the basic concepts of product design and product features.
2. Select the suitable concept.
3. Define the basic concepts of product architecture.
4. Identify the Requirements of Industrial design.
5. Compare the design with product development.

UNIT I INTRODUCTION 9 Hours

Need for IPPD-Strategic importance of Product development - integration of customer, designer, material supplier and process planner, Competitor and customer – behavior analysis. Understanding customer-promoting customer understanding-involve customer in development and managing requirements -Organization process management and improvement

UNIT II CONCEPT GENERATION AND SELECTION 9 Hours

Plan and establish product specifications. Task - Structured approaches - clarification -search-externally and internally-Explore systematically - reflect on the solutions and processes - concept selection - methodology - benefits. Implications - Product change -variety - component standardization - product performance - manufacturability – Concept Testing Methodologies.

UNIT III PRODUCT ARCHITECTURE 9 Hours

Product development management - establishing the architecture - creation - clustering - geometric layout development - Fundamental and incidental interactions - related system level design issues - secondary systems -architecture of the chunks - creating detailed interface specifications-Portfolio Architecture.

UNIT IV INDUSTRIAL DESIGN 9 Hours

Integrate process design - Managing costs - Robust design - Integrating CAE, CAD, CAM tools – Simulating product performance and manufacturing processes electronically -Need for

industrial design-impact – design process - investigation of customer needs -conceptualization -refinement -management of the industrial design process -technology driven products - user - driven products - assessing the quality of industrial design.

UNIT V DESIGN FOR MANUFACTURING AND PRODUCT DEVELOPMENT 9 Hours

Definition - Estimation of Manufacturing cost-reducing the component costs and assembly costs – Minimize system complexity - Prototype basics - Principles of prototyping -Planning for prototypes - Economic Analysis - Understanding and representing tasks baseline project planning - accelerating the project-project execution.

Course Outcomes	**Cognitive Level**
At the end of the course students will be able to:	
CO1: Construct product development process.	Understand
CO2: Select suitable concept and testing methodologies.	Apply
CO3: Demonstrate the fundamental architecture of product.	Understand
CO4: Choose the requirements of industrial product design	Apply
CO5: Apply the design knowledge on manufacturing in product development.	Apply

Text Book(s):

T1. Kari T. Ulrich and Steven D. Eppinger, "Product Design and Development", McGraw-Hill, Fifth edition, 2016.

Reference Book(s):

R1. Integrated Product Development/Concurrent Engg. Kemnneth Crow, DRMAssociates, 6/3,ViaOlivera, Palos Verdes, CA 90274(310) 377-569,Workshop Book

R2. Effective Product Design and Development, Stephen Rosenthal, Business One Orwin, Homewood, 1992.

Web Reference(s):

1. https://nptel.ac.in/courses/112107217/
2. https://www.alskar.com/product-design-and-development.html

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	2	2	-	-	2	1	2	-	1	-	-
CO2	2	1	-	2	2	-	-	2	1	2	-	1	-	-
CO3	2	1	-	2	2	-	-	2	1	2	-	1	-	-
CO4	2	1	-	2	2	-	-	2	1	2	-	1	-	-
CO5	1	1	-	1	1	-	-	2	1	2	-	1	-	-

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	**CO .No.**	**Marks**	**Total**
Continuous Comprehensive Evaluation	CCET 1	1,2	50	30
	CCET 2	3,4	50	
	Retest	1,2,3,4	50	
	CCET 3	5	50	
	Tutorial	1,2,3,4,5	30	10
End Semester Examination	ESE	1,2,3,4,5	100	60
Total				**100**

Course Code:19MEEC1001	Course Title: PRODUCT LIFE CYCLE MANAGEMENT (Common to AU, MC & ME)		
Course Category: Professional Elective		Course Level: Mastery	
L:T:P (Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Pre-requisites:

- Nil

Course Objectives:

The course is intended to:

1. To explain the fundamentals of PLM
2. To provide an in-depth understanding of business processes in the PLM.
3. To explain the management concept for product development in PLM.
4. To explain the importance of Digital Manufacturing in PLM.
5. To explain the use case scenarios through various customer case studies.

UNIT I BUSINESS STRATEGY IN THE PLM 9 Hours

Definition, PLM Lifecycle Model, Threads of PLM, Need for PLM, Opportunities and Benefits of PLM, Views, Components and Phases of PLM, PLM feasibility Study, PLM Visioning, Strategy, Impact of strategy, Implementing a PLM strategy, PLM Initiatives to Support Corporate Objectives, Infrastructure Assessment, Assessment of Current Systems and Applications.

UNITII BUSINESS PROCESSES IN THE PLM 9 Hours

Characteristics of PLM, Environment Driving PLM, PLM Elements, Drivers of PLM, Conceptualization, Design, Development, Validation, Production, Support of PLM.

Engineering Vaulting, Product Reuse, Smart Parts, Engineering Change Management, Workflow Management.

UNIT III PRODUCT DEVELOPMENT CONCEPTS IN THE PLM 9 Hours

Bill of Materials (E-BOM, M-BOM, S-BOM) and Process Consistency, Product Structure, Configuring BOM, Simulation Process Management, Variant Management, Digital Mock-Up and Prototype Development, Design for Environment, Virtual Testing and Validation, Marketing Collateral.

UNIT IV DIGITAL MANUFACTURING IN THE PLM 9 Hours

Digital Manufacturing, Benefits of Digital Manufacturing, Manufacturing the First-One, Ramp Up, Virtual Learning Curve, Manufacturing the Rest, Production Planning.

UNIT V CUSTOMER USE CASES OF THE PLM 9 Hours

Impact and Challenges faced while implementing a successful PLM strategy -Rolls Royce, Nissan Motor, Sunseeker International and Xtrac

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Understand PLM strategy based on the business needs	Understand
CO2: Explain various business processes in the PLM	Understand
CO3: Understand the product development concepts involved in the PLM	Understand
CO4: Explain the use of Digital Manufacturing environment in the PLM.	Understand
CO5: Understand the various customer use cases of the PLM	Understand

Text Book(s):

T1. John Stark, "Product Lifecycle Management: Volume 1: 21st Century Paradigm for Product Realisation", Springer International Publishing Switzerland, 3rd edition, 2015.

T2. Grieves Michael, "Product Lifecycle Management- Driving the Next Generation of Lean Thinking", McGraw-Hill, 2010.

T3. Wang, Lihui; Nee, Andrew Y.C. (Eds.) Collaborative Design and Planning for Digital Manufacturing, Springer, 2009.

Reference(s):

R1. Elangovan, U., "Product Lifecycle Management (PLM)". Boca Raton, CRC Press, 2020.

R2. Fabio Giudice, Guido La Rosa, Product Design for the environment-A life cycle approach, Taylor & Francis 2006.

R3. Antti Saaksvuori, " Product Life Cycle Management" - Anselmi Immonen, Springer, 1st Edition, 2003.

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	1	1	1	-	-	2	1	2	-	1	1	1
CO2	1	1	1	1	1	-	-	2	1	2	-	1	1	1
CO3	1	1	1	1	1	-	-	2	1	2	-	1	1	1
CO4	1	1	1	1	1	-	-	2	1	2	-	1	1	1
CO5	1	1	1	1	1	-	-	2	1	2	-	1	1	1

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	CO .No.	Marks	Total
Continuous Comprehensive Evaluation	CCET 1	1,2	50	30
	CCET 2	3,4	50	
	Retest	1,2,3,4	50	
	CCET 3	5	50	
	Assignment	1,2,3,4,5	30	10
End Semester Examination	ESE	1,2,3,4,5	100	60
Total				100

Course Code:19MEEC1002	Course Title: DESIGN FOR MANUFACTURE, ASSEMBLY AND ENVIRONMENT (Common to AU, ME & MC)		
Course Category: Professional Elective		**Course Level: Mastery**	
L:T:P (Hours/Week) 3: 0: 0	**Credits:3**	**Total Contact Hours: 45**	**Max. Marks:100**

Prerequisites:

The student should have undergone the course(s):

- Machine Design

Course Objectives:

The course is intended to:

1. Explain the design principles for manufacturability
2. Describe the factors influencing form design
3. Explain the machining consideration while design
4. Optimize the given casting part.
5. Explain the environmental consideration in design.

UNIT I INTRODUCTION 9 Hours

General design principles for manufacturability - strength and mechanical factors, mechanisms selection, evaluation method, Process capability - Feature tolerances - Geometric tolerances - Assembly limits -Datum features - Tolerance stacks, GD & T

UNIT II FORM DESIGN OF CASTINGS, FORGINGS AND WELDMENTS 9 Hours

Working principle, Material, Manufacture, Design- Possible solutions – Materials choice - Influence of materials on form design - form design of welded members, forgings and castings.

UNIT III COMPONENT DESIGN - MACHINING CONSIDERATION 9 Hours

Design features to facilitate machining - drills - milling cutters - keyways - Doweling procedures, counter sunk screws - Reduction of machined area- simplification by separation - simplification by amalgamation - Design for machinability - Design for economy - Design for clampability - Design for accessibility - Design for assembly.

UNIT IV COMPONENT DESIGN – CASTING CONSIDERATION 9 Hours

Redesign of castings based on Parting line considerations - Minimizing core requirements, machined holes, redesign of cast members to obviate cores. Identification of uneconomical design - Modifying the design - group technology - Computer Applications for DFMA

UNIT V DESIGN FOR THE ENVIRONMENT AND DFMA TOOLS 9 Hours

Introduction – Environmental objectives – Global issues – Regional and local issues – Basic DFE methods – Design guide lines – Example application – Lifecycle assessment – Basic method – AT&T's environmentally responsible product assessment - Weighted sum assessment method – Lifecycle assessment method – Techniques to reduce environmental impact – Design to minimize material usage – Design for disassembly – Design for recyclability – Design for remanufacture – Design for energy efficiency – Design to regulations and standards.

Course Outcomes		Cognitive Level
At the end of this course, students will be able to:		
CO1	Explain the design principles for manufacturability considering strength, process capability and tolerances.	Understand
CO2	Describe the factors influencing form design of castings, forgings and welding.	Understand
CO3	Explain the machining consideration while design such as machinability, economy, clampability, accessibility and assembly.	Understand
CO4	Optimize the given casting part by applying design principles.	Understand
CO5	Explain the environmental consideration in design while using DFMA tools.	Understand

Text Book(s):

T1. Geoffrey Boothroyd, Peter Dewhurst, Winston A. Knight , "Product Design for Manufacture and Assembly", Third Edition, CRC Press, 2010

T2. Boothroyd, G, "Design for Assembly, Automation and Product Design"., Marcel Dekker, New York 2005

Reference Book(s):

R1. Harry Peck , "Designing for Manufacture", Pitman Publishing, 1973

R2. Dickson, John. R, and Corroda Poly, "Engineering Design and Design for Manufacture and Structural Approach", Field Stone Publisher, USA, 1999

R3. Fixel, J. "Design for the Environment" McGraw hill., 2011

Web Reference(s):

1. http://www.nptel.ac.in/courses/112101005/

2. https://ocw.mit.edu/courses/mechanical-engineering/2-008-design-and-manufacturing-ii-spring-2004/lecture-notes/

Course Articulation Matrix

CO	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO1	PSO2
CO1	1	1	1	1	1	-	-	2	1	2	-	1	-	1
CO2	1	1	1	1	1	-	-	2	1	2	-	1	-	1
CO3	1	1	1	1	1	-	-	2	1	2	-	1	-	1
CO4	1	1	1	1	1	-	-	2	1	2	-	1	-	1
CO5	1	1	1	1	1	-	-	2	1	2	-	1	-	1

- **High-3; Medium-2; Low-1**

Assessment pattern

	Assessment Component	**CO .No.**	**Marks**	**Total**
Continuous Comprehensive Evaluation	CCET 1	1,2	50	30
	CCET 2	3,4	50	
	Retest	1,2,3,4	50	
	CCET 3	5	50	
	Assignment	1,2,3,4,5	30	10
End Semester Examination	ESE	1,2,3,4,5	100	60
Total				**100**

Course Code:19MEEC1003	Course Title: VIBRATION AND NOISE ENGINEERING (Common to ME & MC)		
Course Category: Professional Elective		Course Level: Mastery	
L:T:P (Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours: 45	Max. Marks:100

Prerequisites:

The student should have undergone the courses:

- Theory of Machines

Course Objectives:

The course is intended to:

1. Calculate the natural frequency of the given systems.
2. Calculate natural frequency of continuous system using approximate methods.
3. Identify the required vibration measuring instruments.
4. Calculate the basic noise parameters from the given condition.
5. Analyze the industrial noise and apply the control techniques.

UNIT I BASICS OF VIBRATION 9 Hours

Introduction, classification of vibration: free and forced vibration, linear and non-linear vibration, response of damped and undamped systems under harmonic force, Free and forced vibration of multi-degree of freedom systems.

UNIT II VIBRATION OF CONTINUOUS SYSTEMS 9 Hours

Vibration of continuous systems: exact methods, boundary value problem, Eigen value problem, axial vibration of rods, transverse vibration of beams, response of system by modal analysis, General elastic waves, approximate methods to analyse system, different methods like Rayleigh's energy method, Rayleigh-Ritz method, Dunkerley's method.

UNIT III VIBRATION ANALYSIS AND CONTROL TECHNIQUES 9 Hours

Vibration isolation, tuned absorbers, untuned viscous dampers, damping treatments, application dynamic forces generated by IC engines, engine isolation, crank shaft damping, Experimental Methods in Vibration Analysis.-Vibration Measuring Instruments - Selection of Sensors-Accelerometer Mountings. –Vibration Exciters-Mechanical, Hydraulic, Electromagnetic And Electrodynamics –Frequency Measuring Instruments.

UNIT IV BASICS OF NOISE 9 Hours

Introduction, amplitude, frequency, wavelength and sound pressure level, addition, subtraction and averaging decibel levels, noise level, legislation, measurement and analysis of noise, measurement environment and equipment, frequency analysis, tracking analysis, sound quality analysis.

UNIT V INDUSTRIAL NOISE AND CONTROL 9 Hours

Noise Characteristics of engines, engine overall noise levels, assessment of combustion noise, assessment of mechanical noise, engine radiated noise, intake and exhaust noise, engine accessory contributed noise, transmission noise. Introduction to -Methods for control of engine noise, combustion noise, mechanical noise, predictive analysis, palliative treatments and enclosures, automotive noise control principles.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Calculate the natural frequency of the given systems.	Apply
CO2: Calculate natural frequency of continuous system using approximate methods like Rayleigh's energy method, Rayleigh-Ritz method and Dunkerleys method.	Apply
CO3: Identify the required measuring instruments for vibration analysis in engine system.	Apply
CO4: Calculate the basic noise parameters from the given condition.	Apply
CO5: Analyze the industrial noise and apply the control techniques in automobile.	Apply

Text Book(s):

T1. Ambekar A.G. “Mechanical Vibrations and Noise Engineering” Prentice Hall of India Pvt. Ltd, 2008

T2. SingiresuS.Rao - “Mechanical Vibrations” - Pearson Education, ISBM –81-297-0179-0 - 2010.

Reference Book(s):

R1. Rao V. Dukkipati&Srinivas J. “Mechanical Vibrations” - Prentice Hall of India Pvt. Ltd, 2008.

R2. KewalPujara “Vibrations and Noise for Engineers, DhanpatRai& Sons, 1992.

R3. W. T. Thomson, “Theory of Vibrations with applications”,CBS Publishers,2002

R4. Rao, J.S., & Gupta, K. “Ind. Course on Theory and Practice Mechanical Vibration”, New Age International (P) Ltd., 1999.

R5. Ramamurti. V, “Mechanical Vibration Practice with Basic Theory”, Narosa, New Delhi, 2000.

Web Reference(s):

1. http://nptel.ac.in/courses/112107088/
2. http://nptel.ac.in/courses/112104040/
3. http://www.journals.elsevier.com/journal-of-sound-and-vibration/most-downloaded-articles/
4. http://www.kineticsnoise.com/industrial/

Course Articulation Matrix

CO	PO1	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
CO1	2	1	1	1	1	-	-	2	1	2	-	1	1	-
CO2	2	1	1	1	1	-	-	2	1	2	-	1	1	-
CO3	2	1	1	1	1	-	-	2	1	2	-	1	1	-
CO4	2	1	1	1	1	-	-	2	1	2	-	1	1	-
CO5	1	1	1	1	1	-	-	2	1	2	-	1	1	-

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	**CO .No.**	**Marks**	**Total**
Continuous Comprehensive Evaluation	CCET 1	1,2	50	30
	CCET 2	3,4	50	
	Retest	1,2,3,4	50	
	CCET 3	5	50	
	Assignment	1,2,3,4,5	30	10
End Semester Examination	ESE	1,2,3,4,5	100	60
Total				**100**

Course Code:19MEEC1004	Course Title: COMPUTATIONAL FLUID DYNAMICS (Common to ME & MC)		
Course Category: Professional Elective		Course Level: Mastery	
L:T:P (Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours: 45	Max. Marks:100

Prerequisites:

The student should have undergone the course(s):

- Fluid Mechanics & Hydraulic Machinery
- Heat and Mass Transfer

Course Objectives:

The course is intended to:

1. Explain the governing equations and partial differential equation
2. Discretize governing equations using finite difference method.
3. Discretize governing equations using finite volume method.
4. Solve incompressible viscous flow problems.
5. Discuss basics of turbulence.

UNIT I GOVERNING EQUATIONS 9 Hours

Introduction to fluid mechanics – Reynolds Transport Theorem- Continuity Equation – Momentum Equation - Energy Equation – Classification of PDE's – Initial and Boundary conditions.

UNIT II FINITE DIFFERENCE METHOD 9 Hours

Taylors Series – Forward, Backward and Central differencing schemes – FDM Formulation – Explicit scheme – FTCS and Dufort-Frankel method – Implicit scheme- Laasonen and Crank Nicolson method –1D Heat conduction –Problems - Errors (Qualitative).

UNIT III FINITE VOLUME METHOD 9 Hours

Introduction – 1D Steady state diffusion – 2D Steady state diffusion - 1D Steady state convection-diffusion - Central differencing schemes –UPWIND Scheme – Problems

UNIT IV VISCOUS FLOW 9 Hours

Incompressible flow using MAC and Simple algorithm - Stream function and Vorticity formulation for viscous incompressible flow. Two dimensional incompressible viscous flow.

UNIT V TURBULENCE AND ITS MODELLING 9 Hours

Introduction to turbulence- Turbulence models- One equation model - Mixing length model – Two equation model – K-Ɛ Model – Implementation of boundary condition in practical applications

Course Outcomes		Cognitive Level
At the end of this course, students will be able to:		
CO1	Explain the governing equations, classification of partial differential equation, initial and boundary conditions.	Apply
CO2	Discretize governing equations using finite difference method.	Apply
CO3	Discretize governing equations using finite volume method.	Apply
CO4	Solve incompressible viscous flow problems using MAC and SIMPLE algorithms.	Apply
CO5	Discuss basics of turbulence, its modeling and boundary conditions in real life problems	Apply

Text Book(s):

T1. Anderson D.A., Tannehil J.C, Pletcher R.H, "Computational Fluid Mechanics & Heat Transfer", CRC Press; 3rd edition, 2012.

T2. Versteeg H.K, Malalasekara W, "An Introduction to Computational Fluid Dynamics: The Finite Volume Method", Second Edition, Pearson Publishers, 2008.

Reference Book(s):

R1. Klaus A. Hofmann, Steve T. Chiang, "Computational Fluid Dynamics", Fourth Edition, Engineering Education System, 2000.

R2. John D. Anderson, "Computational Fluid Dynamics: The Basics with Applications", First Edition, McGraw-Hill Education, 2012

R3. Murlidhar.K.,Sunderrajan.T, "Computational Fluid Mechanics and Heat Transfer", Narosa Publishing House, 2008.

Web Reference(s):

1. http://nptel.ac.in/courses/112105045/
2. http://www.cfd-online.com/

Course Articulation Matrix

CO	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO1	PSO2
CO1	2	1	1	1	1	-	-	2	1	2	-	1	2	-
CO2	2	1	1	1	1	-	-	2	1	2	-	1	2	-
CO3	2	1	1	1	1	-	-	2	1	2	-	1	2	-
CO4	2	1	1	1	1	-	-	2	1	2	-	1	2	-
CO5	1	1	1	1	1	-	-	2	1	2	-	1	2	-

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	**CO .No.**	**Marks**	**Total**
Continuous Comprehensive Evaluation	CCET 1	1,2	50	30
	CCET 2	3,4	50	
	Retest	1,2,3,4	50	
	CCET 3	5	50	
	Assignment	1,2,3,4,5	30	10
End Semester Examination	ESE	1,2,3,4,5	100	60
Total				**100**

Course Code:19MEEC1005	Course Title: DESIGN OF TRANSMISSION SYSTEM (Common to ME & MC)		
Course Category: Professional Elective		Course Level: Mastery	
L:T:P (Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours: 45	Max. Marks:100

Prerequisites:

The student should have undergone the course(s):

- Theory of Machines

Course Objectives:

The course is intended to

1. Design a suitable flexible element
2. Design a spur gear and helical gear drives
3. Design bevel and worm gear drives
4. Design a multi stage sliding mesh gear box
5. Design single, multi plate clutch and brakes

UNIT I SELECTION OF FLEXIBLE ELEMENT DRIVES 9 Hours

Mechanical drives-types of drives -power and motion transmission drives-stepped and steeples transmission-speed ratio-under direct and over drives and its applications-reversible and irreversible drives and its applications-belt drives and its applications-Select suitable flat belt and V-belt drives and pulleys for industrial applications-chain drives-hoisting and hauling chains -Conveyor Chains -Power transmitting chains-block chain- roller chain-silent chain-select suitable roller chains and sprockets for industrial applications

UNIT II DESIGN OF SPUR GEAR AND HELICAL GEAR DRIVES 9 Hours

Toothed gearing and its applications- gear tooth terminology- failures in gears- gear materials-law of gearing- tooth forces and stresses- Design of spur gear for given situations, helical gear - Tooth terminology - equivalent number of teeth – Design of Helical Gear drives for given situations, Cross helical: Terminology (Qualitative Treatment only)

UNIT III DESIGN OF BEVEL AND WORM GEAR DRIVES 9 Hours

Types of bevel gear - Tooth terminology - equivalent number of teeth gear, Design the bevel gear, Materials- Worm Gear terminology , Types of worm gears - equivalent number of teeth, gear Materials, Thermal capacity, Efficiency - Tooth forces and stresses of worm gears, Design of worm gear drives.

UNIT IV DESIGN OF SLIDING MESH GEAR BOX 9 Hours

Preferred numbers- Geometric progression- standard step ratio- kinematic layout- ray diagram- Design 3, 6, 9 and 12 sliding mesh speed gear box.

UNIT V DESIGN OF CLUTCHES AND BRAKES 9 Hours

Needs and role of clutch- types of clutch-positive clutch- square jaw clutch- spiral jaw clutch- friction clutch- types of friction clutch-plate clutches- cone clutch- centrifugal clutch- Design of plate clutches- needs and role of brakes- types of brakes -single block or shoe brake- pivoted block or shoe brake- double block or shoe brake- simple band brake- differential band brake- band and block brake- internal expanding brake- Design of shoe brake, band and block brake, internal expanding brake, Disc Brake.

NOTE: (Use of approved Data Book is permitted in the End semester examination)

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Design suitable flexible element drives such as flat belt, V-belt and chain drives for power transmitting applications.	Apply
CO2: Design spur gear and helical gear drives considering the tooth bending and surface strength for given application.	Apply
CO3: Design and analyze bevel and worm gear drives for strength and surface durability.	Apply
CO4: Design single/multi stage sliding mesh gear box having maximum of 12 speeds and calculate the output speeds for machine tool applications.	Apply
CO5: Design single, multi plate clutch and brakes such as shoe brake, band brake, block brake, disc brake and internal expanding type brakes for given applications.	Apply

Text Book(s):

T1. Shigley J.E and Mischke C.R, **"**Mechanical Engineering Design" 9th Edition, Tata McGraw-Hill,2011.

T2. Bhandari V.B, **"**Design of Machine Elements" 3rdEdition,Tata McGraw-Hill, 2010.

Reference Book(s):

R1. Prabhu. T.J., "Design of Transmission Elements", Mani Offset, Chennai, 2000.

R2. GitinMaitra, L. Prasad "Hand book of Mechanical Design", 2nd Edition, Tata McGraw-Hill, 2001.

R3. Sundararajamoorthy T.V, Shanmugam N, "Machine Design", Anuradha Publications, Chennai, 2003.

Web Reference(s):

1. http://nptel.ac.in/courses/112106137/
2. http://nptel.ac.in/courses/112102014/38
3. http://dunloptransmissions.com/
4. http://www.renold.in/Products/TransmissionChainSprockets/TransmissionChainIndexPage.asp
5. http://khkgears.net/gear-knowledge/

Course Articulation Matrix

CO	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO1	PSO2
CO1	2	1	1	1	1	-	-	2	2	3	-	2	-	-
CO2	2	1	1	1	1	-	-	2	2	3	-	2	-	-
CO3	2	1	1	1	1	-	-	2	2	3	-	2	-	-
CO4	2	1	1	1	1	-	-	2	2	3	-	2	-	-
CO5	2	1	1	1	1	-	-	2	2	3	-	2	-	-

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	**CO .No.**	**Marks**	**Total**
Continuous Comprehensive Evaluation	CCET 1	1,2	50	30
	CCET 2	3,4	50	
	Retest	1,2,3,4	50	
	CCET 3	5	50	
	Assignment	1,2,3,4,5	30	10
End Semester Examination	ESE	1,2,3,4,5	100	60
Total				**100**

Course Code:19MEEC1006	Course Title: AUTOMOTIVE ENGINE AND ITS SYSTEMS (Common to ME & MC)		
Course Category: Professional Elective		**Course Level: Mastery**	
L:T:P (Hours/Week) 3: 0: 0	**Credits:3**	**Total Contact Hours: 45**	**Max. Marks:100**

Prerequisites:

The student should have undergone the course(s):

- Thermal Engineering

Course Objectives:

The course is intended to:

1. Explain the construction details of the power train.
2. Describe the combustion and emission characteristics of IC engines.
3. Describe the functions of various engine subsystems.
4. Interpret the performance characteristics of the vehicle.
5. Examine various advanced engines and alternate fuels.

UNIT I INTRODUCTION TO POWER TRAIN 9 Hours

Power train – Types – Engine (SI and CI) – Torque converter – Valve train layout & crank train layout- valve timing and timing chain layout – Piston components – importance of B/S and L/r – Crank offset.

UNIT II COMBUSTION AND EMISSION IN IC ENGINES 9 Hours

Chemistry of combustion, Stoichiometric equations of combustion – Introduction to SI and CI combustion – Engine knocking – Combustion chamber and its types –Combustion chamber design – Temperature – Fuel (include load /speed) – Fuel properties/characteristics (temperatures, Octane, Cetane no. etc) – Emission norms (Indian, European – US emission norms – Emission testing and certification) – Fuel Norms(BS1, BS2) – Environmental effects of Emissions – Emission relation with AFR – After treatment devices (include SAI,2WC), Chemical reactions involved in after treatment.

\UNIT III ENGINE SUBSYSTEMS 9 Hours

Energy balance and cooling load estimation – Typical operating temperatures of engine parts – Types of cooling system – Cooling system design (Air cooled and water cooled) – Schematic

layout of Cooling system for a two wheeler engine – Engine friction – Lubrication requirements of engine – Functions of Lubricating oil – Parts to be lubricated and not to be lubricated – Schematic layout of lubricating system – Oil filtering – Lubricating oils, types and properties – Functions of induction system – Schematic layout (2W and 4W) – Air Filtering and its importance – Exhaust and after treatment – Functions of exhaust system – Muffler layout – Schematic layout of exhaust system (2W and 4W)

UNIT IV PERFORMANCE CHARACTERISTICS 9 Hours

Volumetric efficiency – Factors affecting volumetric efficiency, ram effect, engine tuning, Fuel control systems (Carburetor, Fuel Injection) – Meeting demands of Vehicle (drivability, emissions and fuel economy) by controlling air and fuel – sensors – Vehicle performance characteristics, Road resistance, Wheel force in different gears, predict acceleration from engine performance graph – Various relations between AFR, Ignition timing and injection timing – Emission, performance (fuel consumption) – Sensors and devices used for performance and emission measurements.

UNIT V ADVANCED ENGINE CONCEPTS 9 Hours

Engines (Wankel, six stroke, lean burn, GDI, HCCI etc.) Hybrid vehicles – VVT, Turbo/super charging – Benefits of different engine concepts – Alternate fuels, compare performance – Fuel economy & emission with fuels (alcohol, vegetable oils, LPG, CNG etc.) – Limiting factors and practical problems.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Explain the construction details of the power train such as Valve & crank train layout used in four stroke IC engines.	Understand
CO2: Describe the combustion characteristics such as chemistry, knocking, temperature & fuel and emission characteristics such as norms, environmental effects, after treatment devices of four stroke IC engines.	Understand
CO3: Describe the functions of various engine subsystems such as cooling system, induction system and exhaust system of an automobiles.	Understand
CO4: Interpret the performance characteristics like volumetric efficiency, ram effect, engine tuning, Fuel control systems of the vehicle considering the relationship between volumetric efficiency of engine and emission norms.	Understand

CO5: Examine various advanced engines like Wankel, lean burn, GDI, HCCI and alternate fuels like alcohol, vegetable oils, LPG, CNG used in automobiles.	Understand

Text Book(s):

T1. Edward F. Obert, "Internal Combustion Engines and Air Pollution" First Edition, Addison-Wesley Educational Publishers, Incorporated, reprint, 2012.

T2. V. Ganesan, "Internal Combustion Engines" McGraw-Hill, reprint 2012.

Reference Book(s):

R1. John B. Heywood, "Internal Combustion Engine Fundamentals", McGraw-Hill, reprint 2012.

R2. Richard Stone, "Introduction to Internal Combustion Engines", Third edition, Society of Automotive Engineers, Incorporated 1999.

Web Reference(s):

1. https://en.wikibooks.org/wiki/Automotive_Systems
2. https://bajatutor.net/online-baja-crash-course-for-atv-enthusiasts/

Course Articulation Matrix

CO	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO1	PSO2
CO1	1	1	1	1	1	-	-	2	1	2	-	1	-	-
CO2	1	1	1	1	1	-	-	2	1	2	-	1	-	-
CO3	1	1	1	1	1	-	-	2	1	2	-	1	-	-
CO4	1	1	1	1	1	-	-	2	1	2	-	1	-	-
CO5	1	1	1	1	1	-	-	2	1	2	-	1	-	-

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	CO .No.	Marks	Total
Continuous Comprehensive Evaluation	CCET 1	1,2	50	30
	CCET 2	3,4	50	
	Retest	1,2,3,4	50	
	CCET 3	5	50	
	Assignment	1,2,3,4,5	30	10
End Semester Examination	ESE	1,2,3,4,5	100	60
Total				**100**

Course Code:19MCEN1004	Course Title: DESIGN FOR ROBOTIC WELDING		
Course Category: Professional Elective		Course Level: Mastery	
L:T:P (Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours: 45	Max. Marks:100

Prerequisites:

The student should have undergone the courses:

- Engineering Metrology and Measurements
- Engineering Materials

Course Objectives:

The course is intended to:

1. Choose a suitable welding process.
2. Identify the potential failure modes of a weld joint.
3. Explain the types of fixtures used in welding processes.
4. Design a suitable welding fixture.
5. Explain inspection, maintenance and calibration procedure.

UNIT I INTRODUCTION 9 Hours

Fundamentals of welding Process - Arc welding processes - Principle and operation - Advantages and limitations of welding processes - Power sources of arc welding process and their influence on the process behavior - MIG / MAG Welding - Metal transfer in MIG welding processes-Process requirements of GMAW process - Impact of Process parameters - Defects of GMAW, Causes and their remedies - Resistance Welding Processes - Various types of Resistance welding process and its applications - Process requirements of Resistance Welding process - Impact of Process parameters – Resistance welding defects, causes and their remedies.

UNIT II DESIGN OF WELD JOINTS 9 Hours

Types of Weld Joints and their applications - Styles and practices of Edge preparation - Representation of Weld symbols - Loads acting on the Weld Joints - Calculation of Stresses in Weld Joints - Determination of Weld size for Fatigue Applications -Effect of Temperature on Metallurgical properties - Causes of Distortion - Causes for Residual Stresses - Quality

requirement for Welders - Qualification Tests for welder - Optimization of Weld Process - Estimation of Welding Costs for a given application.

UNIT III INTRODUCTION TO WELDING FIXTURES 9 Hours

Fixtures and its types - Datum and its importance of the Part - Location and its importance of the Part - Orientation and its importance of the Part - Resting & Clamping and its importance of the Part - Elements of the welding fixture - Different fixture accessories used for welding fixture assembly - Different types of welding fixtures for Resistance welding Process- Different types of welding fixtures for Arc welding Process. [SMAW&MIG].

UNIT IV DESIGN OF FIXTURES FOR WELD PARTS 9 Hours

Critical & Major dimension of the fixture part - Datum and its classifications - Location, orientation & clamping for the weld part - Design of fixture elements for the given weld joint - Design of FMEA for the pre designed concept fixture -Welding distortion control by using fixture clamping - Design of welding fixture drawing for a given part.

UNIT V INSPECTION AND VALIDATION OF WELDING FIXTURES 9 Hours

Inspection procedure for welding fixtures - Critical fit function of fixture hold part – Need of tolerance in fixture assembly-Possible failure modes while inspection of fixtures –Need of Fixture Maintenance and Calibration-Fixture maintenance procedure - Different fixture maintenance tools - Fixture calibration procedure.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Choose suitable welding processes.	Understand
CO2: Identify the potential failure modes of a weld joint.	Understand
CO3: Explain the types of Fixtures used in welding process.	Understand
CO4: Design the welding fixtures for the given weld parts.	Understand
CO5: Explain the inspection, maintenance and calibration procedure of welding fixtures.	Understand

Text Book(s):

T1. O.P Khanna "A Textbook of Welding Technology", Dhanpat Rai & Sons, Twentieth Reprint, 2011.

T2. Omer. W.Blodgett, James F. Lincoln, "Design of Welded Structures,rc Welding Foundation", 1st Edition 1996.

T3. Prakash Hiralal Joshi, "Welding and Assembly Fixtures", McGraw-Hill Professional, 2010.

Reference Book(s):

R1. S.J Maddox, "Fatigue Strength of Welded Structures", Woodhead Publishing, 1991.

R2. T.R Gurney, Tim Gurney, "Fatigue Strength of Transverse Fillet Welded Joints: A Study of the Influence of Joint Geometry", Woodhead Publishing, 1991.

Web Reference(s):

1. https://ocw.mit.edu/courses/materials-science-and-engineering/3-37-welding-and-joining-processes-fall-2002/lecture-notes/
2. http://www.esabna.com/euweb/awtc/lesson1_1.htm

Course Articulation Matrix

CO	PO1	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
CO1	2	1	-	2	2	-	-	2	1	2	-	1	-	-
CO2	2	1	-	2	2	-	-	2	1	2	-	1	-	-
CO3	2	1	-	2	2	-	-	2	1	2	-	1	-	-
CO4	2	1	-	2	2	-	-	2	1	2	-	1	-	-
CO5	1	1	-	1	1	-	-	2	1	2	-	1	-	-

High-3; Medium-2; Low-

Assessment pattern

	Assessment Component	CO .No.	Marks	Total
Continuous Comprehensive Evaluation	CCET 1	1,2	50	30
	CCET 2	3,4	50	
	Retest	1,2,3,4	50	
	CCET 3	5	50	
	Assignment	1,2,3,4,5	30	10
End Semester Examination	ESE	1,2,3,4,5	100	60
Total				**100**

Course Code:19MEEC1008	Course Title: COMPOSITE MATERIALS (Common to AU, ME & MC)		
Course Category: Professional Elective		Course Level: Mastery	
L:T:P (Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours: 45	Max. Marks:100

Prerequisites:

The student should have undergone the courses:

- Material Science
- Strength of Materials

Course Objectives:

The course is intended to:

1. Explain the properties of matrices and reinforcements
2. Explain the various types of composite materials
3. Explain the fabrication and testing of composites.
4. Explain the mechanics and lamination theory of fiber reinforced composites
5. Explain the load bearing behaviour of composite and composite structures

UNIT I MATRICES AND REINFORCEMENTS 9 Hours

Definition – Functions of a Matrix, desired Properties of a Matrix, Classifications of Matrix - Polymer Matrix (Thermosets and Thermoplastics), Metal matrix, Ceramic matrix, Carbon Matrix, Glass Matrix etc.: Role and selection of reinforcement materials, Classifications of Reinforcements/Fibers - Glass fibers, Carbon fibers, Aramid fibers , Metal fibers, Alumina fibers, Boron Fibers, Silicon carbide fibers etc., Mechanical properties of fibres.

UNIT II TYPES OF COMPOSITES 9 Hours

Various types of composites: Classification based on Matrix Material: Organic Matrix composites, Polymer matrix composites (PMC), Carbon matrix Composites or Carbon-Carbon Composites, Metal matrix composites (MMC), Ceramic matrix composites (CMC); Classification based on reinforcements: Fiber Reinforced Composites, Fiber Reinforced Polymer (FRP) Composites, Laminar Composites, Particulate Composites, Comparison with Metals, Advantages & limitations of Composites

UNIT III FABRICATION AND TESTING OF COMPOSITES 9 Hours

Fabrication methods: hand layup, Autoclave, filament welding, compression molding, resin-transplant method, pultrusion, pre-peg layer. Mechanical testing of composites - tensile testing, Compressive testing, Flexural testing, Shear testing and Impact testing.

UNIT IV MECHANICS AND LAMINATION THEORY OF COMPOSITES9Hrs

Rule of mixture -volume and mass fractions – density - void content, Evaluation of four elastic moduli based on strength of materials approach and Semi - Empirical model - Longitudinal Young's modulus-transverse Young's modulus – major Poisson's ratio-In- plane shear modulus, Ultimate strengths of a unidirectional lamina. Characteristics of Fiber-reinforced lamina – laminates – lamination theory, Inter laminar stresses.

UNIT V COMPOSITE STRUCTURES 9 Hours

Fatigue – S-N curves – Fatigue behaviors of CMCs – Fatigue of particle and whisker reinforced composites. Introduction to structures - selection of material, manufacturing and laminate configuration -design of joints - bonded joints - bolted joints - bonded and bolted.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Explain the properties of matrices and reinforcements	Understand
CO2: Explain the various types of composite materials	Understand
CO3: Explain the fabrication and testing of composites.	Understand
CO4: Explain the mechanics and lamination theory of fiber reinforced composites.	Understand
CO5: Explain the load bearing behavior of composite and composite Structures	Understand

Text Book(s):

T1. Krishnan K.Chawla, "Composite Materials Science and Engineering", Springer-Verlag New York, 3rd Edition, 2012.

T2. Mallick, P.K., "Fiber Reinforced Composites: Materials, Manufacturing and Design",Manee Dekker Inc, 2007.

Reference Book(s):

R1. Agarwal, B.D., and Broutman L.J., "Analysis and Performance of Fiber Composites",John Wiley and Sons, New York, 2012.

R2. Gibson, R.F., "Principles of Composite Material Mechanics", McGraw-Hill, 2011.

R3. Srinivasan K , "Composite Material" NarosaPublication , 2009.

Web Reference(s):

1. http://nptel.ac.in/courses/101104010/
2. http://nptel.ac.in/courses/Webcourse-contents/IISc BANG/Composite%20Materials/New_index1.html

Course Articulation Matrix

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
CO1	1	1	1	1	1	-	-	2	1	2	-	1	-	-
CO2	1	1	1	1	1	-	-	2	1	2	-	1	-	-
CO3	1	1	1	1	1	-	-	2	1	2	-	1	-	-
CO4	1	1	1	1	1	-	-	2	1	2	-	1	-	-
CO5	1	1	1	1	1	-	-	2	1	2	-	1	-	-

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	**CO .No.**	**Marks**	**Total**
Continuous Comprehensive Evaluation	CCET 1	1,2	50	30
	CCET 2	3,4	50	
	Retest	1,2,3,4	50	
	CCET 3	5	50	
	Assignment	1,2,3,4,5	30	10
End Semester Examination	ESE	1,2,3,4,5	100	60
Total				**100**

Course Code:19MEEC1009	Course Title: ADDITIVE MANUFACTURING (Common to AU, ME & MC)		
Course Category: Professional Elective		Course Level: Mastery	
L:T:P (Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Pre-requisites:

- Manufacturing Processes

Course Objectives:

The course is intended to:

1. Apply the concept of design and process optimization.
2. Select suitable materials for additive manufacturing.
3. Explain the concept of photo polymerization and extrusion process system.
4. Explain the concept of Powder bed fusion and direct energy system.
5. Apply the architecture of IoT in additive manufacturing.

UNIT I DESIGN FOR ADDITIVE MANUFACTURING 9 Hours

Introduction of AM – Basic principle-Generic AM process – DFAM concepts and objectives-AM unique capabilities –Exploring design freedoms – Design tools for AM- Guidelines for process selection.

UNIT II MATERIALS FOR ADDITIVE MANUFACTURING 9 Hours

Classification of polymer and metallic materials –Properties of AM materials – Application of AM material – Atomic structure and bonding-ceramics – polymer- powdered materials-composites- Multiple materials in AM – Multiple – discrete – porous – blended.

UNIT III PHOTOPOLYMERIZATION PROCESSES AND EXTRUSION BASED SYSTEM 9 Hours

Photopolymerization materials – Reaction Rates – Vector scan SL - SL Resin Curing Process - SL Scan Patterns - Vector Scan Microstereolithography - Mask Projection Photopolymerization Technologies and Processes - Two-Photon SL - Extrusion-Based Systems – Basic Principles - Plotting and Path Control - Fused Deposition Modeling – Materials – Limitation – Bio extrusion - FDM of Ceramics.

UNIT IV POWDER BED FUSION AND DIRECT ENERGY SYSTEM 9 Hours

SLS process - Powder Fusion Mechanisms - Powder Handling – Process parameters – Materials – Application – SLM Process – Process parameters – Materials – Application –

DMLS process – Process parameters – materials – application – EBM process – process parameters – materials – application – LENS process – process parameters – materials – application.

UNIT V ARTIFICIAL INTELLIGENT ADDITIVE MANUFACTURING 9 Hours

Overview of AI – Types of intelligent agents – AI model – AI enabled AM - AM-based product development - Intelligent agents for product design - Intelligent agents for process design - Intelligent agents for production - Global methods - Framework of smart AM - Artificial Intelligence Applications in 3D Printing.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Apply the concept of design and process optimization for Additive manufacturing	Apply
CO2: Select suitable materials in additive manufacturing for various applications.	Apply
CO3: Explain the concept of photo polymerization and extrusion process system	Understand
CO4: Explain the concept of Powder bed fusion and direct energy system.	Understand
CO5: Apply the architecture of IoT in various additive manufacturing process and application	Apply

Text Book(s):

T1 . Ian Gibson, David W.Rosen, Brent Stucker, "Additive Manufacturing Technologies", Springer, 3rd edition, 2020.

T2 . Patri.K.Venuvinod and Weiyin Ma. "Rapid Prototyping" Springer science+ business Media, LLC, 2004.

Reference(s):

R1 . Andreas Gebhardt, Hanser "Rapid Prototyping", Gardener Publications, 2003

R2 .LiouW.Liou, Frank W.Liou, "Rapid Prototyping and Engineering applications: A tool box for prototype development", CRC Press, 2007.

R3 . Chua C.K. Leong K.F., and Lim C.S., "Rapid prototyping: Principles and application", Second edition, World Scientific Publishers, 2010

Web reference(s):

1. https://nptel.ac.in/courses/112/104/112104265/

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	1	1	-	-	2	1	2	-	1	1	-
CO2	2	1	1	1	1	-	-	2	1	2	-	1	1	-
CO3	1	1	1	1	1	-	-	2	1	2	-	1	1	-
CO4	1	1	1	1	1	-	-	2	1	2	-	1	1	-
CO5	2	1	1	1	1	-	-	2	1	2	-	1	1	-

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	**CO .No.**	**Marks**	**Total**
Continuous Comprehensive Evaluation	**CCET 1**	**1,2**	**50**	**30**
	CCET 2	**3,4**	**50**	
	Retest	**1,2,3,4**	**50**	
	CCET 3	**5**	**50**	
	Assignment	**1,2,3,4,5**	**30**	**10**
End Semester Examination	**ESE**	**1,2,3,4,5**	**100**	**60**
Total				**100**

Course Code: 19AUEC1001	Course Title: UNCONVENTIONAL MACHINING PROCESSES (Common to AU & MC)		
Course Category: Professional Elective		**Course Level: Mastery**	
L:T:P (Hours/Week) 3: 0: 0	**Credits:3**	**Total Contact Hours: 45**	**Max. Marks:100**

Prerequisites:

The student should have undergone the course(s):

- Nil

Course Objective:

The course is intended to:

1. Explain the Classification of UCM
2. Describe the mechanical energy based UCM
3. Explain electrical energy based unconventional machining processes
4. Explain Chemical & Electro chemical energy based UCM
5. Describe Thermal energy based unconventional UCM

UNIT I INTRODUCTION 9 Hours

Need for unconventional machining process-Advantages of UCM - Disadvantages of UCM - Comparison of conventional and unconventional machining processes - Process parameters - Processes based on type of energy required to shape the material- Processes based on mechanism of material removal- Processes based on transfer media- Processes based on source of energy

UNIT II MECHANICAL ENERGY BASED UCM PROCESSES 9 Hours

Principle of Mechanical energy based UCM Processes - Mechanical energy based unconventional machining processes: Ultrasonic machining process, Abrasive Jet machining process, Water Jet Machining process - Principle, Working of various elements, Mechanism of metal removal, Applications, Advantages and Disadvantages. Comparison of Mechanical energy based unconventional machining processes

UNIT III ELECTRICAL ENERGY BASED UCM PROCESSES 9 Hours

Principle of Electrical energy based UCM Processes - Electrical energy based unconventional machining processes: Electric Discharge machining - Principle, Layout of EDM process,

Functions and types of dielectric fluid, Properties of different tool materials, Working of R-C (Relaxation) circuit, R-C-L circuit, rotary pulse generator circuit, controlled pulse generator circuit, Process parameters in EDM Process, Mechanism of metal removal, Applications, Advantages and Disadvantages. Wire cut EDM (WCEDM) process: Layout, Construction and working of various elements, Applications, Advantages and Disadvantages.Drilling and Die sinking by EDM process. Comparison of Electrical energy based unconventional machining processes

UNIT IV CHEMICAL & ELECTRO CHEMICAL ENERGY BASED UCM PROCESSES 9 Hours

Principle of Chemical & Electro chemical energy based UCM Processes - Chemical & Electro chemical energy based unconventional machining processes: Chemical machining, Electro chemical machining, Electro chemical grinding, Electro chemical honing processes - Principle, Working of various elements, Mechanism of metal removal, Applications, Advantages and Disadvantages. Comparison of Chemical & Electro chemical energy based unconventional machining processes

UNIT V THERMAL ENERGY BASED UCM PROCESSES 9 Hours

Principle of Thermal energy based UCM Processes - Thermal energy based unconventional machining processes: Electron Beam machining (EBM), Laser Beam machining (LBM), Plasma Arc machining (PAM) processes - Principle, Working of various elements, Mechanism of metal removal, Applications, Advantages and Disadvantages. Comparison of Thermal energy based unconventional machining processes.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1 Explain the various methods of Unconventional Machining Processes based on type of energy required, mechanism of material removal, transfer media and source of energy.	Understand
CO2 Select mechanical energy based unconventional machining processes such as Ultrasonic machining process, Abrasive Jet machining process and water jet machining process based on machining requirements for a product.	Apply
CO3 Choose Electrical energy based unconventional machining processes such as EDM based on machining requirements for a product.	Analyse
CO4 Select Chemical & Electro chemical energy based unconventional machining processes such as Chemical machining, Electro chemical machining and Electro chemical grinding based on machining requirements for a product..	Apply
CO5 Choose Thermal energy based unconventional machining processes such as Electron Beam machining (EBM), Laser Beam machining (LBM), Plasma Arc machining (PAM) processes for special applications.	Analyse

Text Book(s):

T1. Vijay.K. Jain "Advanced Machining Processes" Allied Publishers Pvt. Ltd., New Delhi, 2007

T2. Pandey P.C. and Shan H.S. "Modern Machining Processes" Tata McGraw-Hill, New Delhi, 2007.

Reference Book(s):

R1. Paul De Garmo, J.T.Black, and Ronald.A.Kohser, "Material and Processes in manufacturing" Prentice Hall of India Pvt. Ltd., New Delhi ,8th Edition, 2001.

R2. Ghosh and Malik, "Manufacturing Science", 1st ed., EWP Private Ltd., 2008.

Web Reference(s):

1. https://en.wikipedia.org/wiki/Machining
2. https://en.wikipedia.org/wiki/Laser_beam_machining
3. https://en.wikipedia.org/wiki/Electrical_discharge_machining
4. http://mechteacher.com/manufacturing-technology/
5. http://www.engineershandbook.com/MfgMethods/nontraditionalmachining

Course Articulation Matrix

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
CO1	1	1	1	1	1	-	-	2	1	2	-	1	1	1
CO2	2	1	1	1	1	-	-	2	1	2	-	1	1	1
CO3	3	2	1	2	2	-	-	2	1	2	-	1	1	1
CO4	2	1	1	1	1	-	-	2	1	2	-	1	1	1
CO5	3	2	1	2	2	-	-	2	1	2	-	1	1	1

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	**CO .No.**	**Marks**	**Total**
Continuous Comprehensive Evaluation	CCET 1	1,2	50	30
	CCET 2	3,4	50	
	Retest	1,2,3,4	50	
	CCET 3	5	50	
	Assignment	1,2,3,4,5	30	10
End Semester Examination	ESE	1,2,3,4,5	100	60
Total				**100**

Course Code:19MEEC1010	Course Title: FLEXIBLE MANUFACTURING SYSTEMS (Common to ME & MC)		
Course Category: Professional Elective		Course Level: Mastery	
L:T:P (Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours: 45	Max. Marks:100

Prerequisites:

The student should have undergone the course:

- Manufacturing Technology.

Course Objectives:

The course is intended to:

1. Classify and distinguish FMS and other manufacturing systems
2. Explain processing stations and material handling systems used in FMS environments.
3. Understand tool management and analyze the production management problems in planning, loading, scheduling, routing and breakdown in a typical FMS.
4. Understand the concepts of group technology in FMS.
5. Design and analyze FMS using simulation and analytical techniques

UNIT I UNDERSTANDING AND CLASSIFICATION OF FMS 9Hours

Evolution of Manufacturing Systems, Definition, objective and Need, Components, Merits, Demerits and Applications Flexibility in Pull and Push type Classification of FMS Layout - Layouts and their Salient features, Single line, dual line, loop, ladder, robot centre type etc

UNIT II PROCESSING STATIONS AND MATERIAL HANDLING SYSTEM 9Hrs

Processing stations: Salient features Machining Centers, Turning centre, Coordinate measuring machine (CMM), Washing/ Deburring station. Material Handling System: An introduction, Conveyor, Robots, Automated Guided Vehicle (AGV), Automated Storage Retrieval System (ASRS)

UNIT III MANAGEMENT TECHNOLOGY 9 Hours

Tool Management, tool magazine, Tool preset, identification, Tool monitoring and fault detection, routing, Production Planning and Control, Scheduling and loading of FMS

UNIT IV GROUP TECHNOLOGY 9 Hours

Introduction, Definition, Reasons for Adopting Group Technology, Benefits of Group Technology Affecting Many Areas of a Company, Obstacles to Application of GT

UNIT V DESIGN OF FMS 9 Hours

Performance Evaluation of FMS, Analytical model and Simulation model of FMS, Application of simulation – model of FMS– simulation software – limitation – manufacturing data systems – data flow – FMS database systems – planning for FMS database

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Classify and distinguish FMS and other manufacturing systems	Understand
CO2: Explain processing stations and material handling systems used in FMS environments	Understand
CO3: Understand tool management and analyze the production management problems in planning, loading, scheduling, routing and breakdown in a typical FMS	Understand
CO4: Understand the concepts of group technology in FMS	Understand
CO5: Design and analyze FMS using simulation and analytical techniques	Apply

Text Book(s):

T1. Jha, N.K. "Handbook of flexible manufacturing systems", Academic Press Inc., 1991

T2. Groover, M.P "Automation, Production Systems and Computer Integrated Manufacturing", Prentice Hall of India Pvt.Ltd. New Delhi 2009.

Reference Book(s):

R1. Reza A Maleki "Flexible Manufacturing system" Prentice Hall of Inc New Jersey, 1991.

R2. John E Lenz "Flexible Manufacturing" Marcel Dekker Inc New York, 1989.

Web Reference(s):

1. https://nptel.ac.in/courses/112107143/36
2. https://nptel.ac.in/courses/112104228/31

Course Articulation Matrix

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	PS O1	PSO 2
CO1	1	1	1	1	1	-	-	2	1	2	-	1	1	-
CO2	1	1	1	1	1	-	-	2	1	2	-	1	1	-
CO3	1	1	1	1	1	-	-	2	1	2	-	1	1	-
CO4	1	1	1	1	1	-	-	2	1	2	-	1	1	-
CO5	2	1	1	1	1	-	-	2	1	2	-	1	1	-

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	CO .No.	Marks	Total
Continuous Comprehensive Evaluation	CCET 1	1,2	50	30
	CCET 2	3,4	50	
	Retest	1,2,3,4	50	
	CCET 3	5	50	
	Assignment	1,2,3,4,5	30	10
End Semester Examination	ESE	1,2,3,4,5	100	60
Total				**100**

Course Code:19MEEC1011	Course Title: NON-DESTRUCTIVE TESTING METHODS (Common to AU, ME & MC)		
Course Category: Professional Elective		Course Level: Mastery	
L:T:P (Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours: 45	Max. Marks:100

Prerequisites:

The student should have undergone the course(s):

- NIL

Course Objectives:

The course is intended to:

1. Explain the testing procedure for Visual Inspection and Eddy Current Testing Method.
2. Explain testing procedure for Magnetic Particle Testing Method.
3. Explain testing procedure for Liquid Penetrant Testing Method.
4. Plan inspection sequence for Ultrasonic Testing Method.
5. Plan inspection sequence for Radiographic Testing Method.

UNIT I VISUAL INSPECTION AND EDDY CURRENT TESTING METHOD 9 Hrs

Scope and advantages of NDT-Compare NDT with DT-Principle of Visual Inspection theory-Optical aids used for Visual Inspection-Microscope, Boroscope, Endoscope, Flexiscope, Telescope and Hollography- Principles of Eddy Current Theory-surface mounted coils-Encircling coils-types of Probes-Eddy current sensing Probes-Flux leakage sensing Probes-Eddy Current Techniques, Advanced Eddy Current Techniques-applications, Limitations and standards.

UNIT II MAGNETIC PARTICLE TESTING METHOD 9 Hours

Basic Principle of magnetic particle testing(MPT)-induced magnetic fields-circular and longitudinal fields-Hysteresis curve-magnetic flux strips and coils-residual fields and demagnetization-MPT techniques-magnetization using a permanent magnet, magnetization using a Electro magnet, contact current flow method, wet and dry particle inspection methods, remote magnetic particle inspection, probe power inspection, light weight UV lamps inspection, semi automatic inspection, applications and limitations of MPT.

UNIT III LIQUID PENETRANT TESTING METHOD 9 Hours

Physical properties of liquid penetrant-penetrant testing materials-penetrants, cleaners, emlusifiers developers, lint free cloth-Basic Principle, applications and limitations of liquid

penetrant testing(LPT)-different LPT methods-Post-Emulsification Fluorescent penetrant process, Reverse Fluorescent Dye penetrant process, Visible Dye penetrant process, Water-Emulsification visible Dye penetrant process, solvent clean visible Dye penetrant process.

UNIT IV ULTRASONIC TESTING METHOD 9 Hours

Basic properties of sound beam-sound waves-velocity of ultrasonic waves, Acoustic Impedance behaviour of ultrasonic waves-ultrasonic transducers-characteristics of ultrasonic beam, Flaw sensitivity, Beam divergence, Attenuation-Principle of ultrasonic testing methods, applications and limitations-Ultrasonic testing method-normal incident pulse echo inspection method, normal incident through transmission testing method, angle beam pulse echo inspection method.

UNIT V RADIOGRAPHIC TESTING METHOD 9 Hours

Basic Principle of Radiography-Electromagnetic radiation sources-X ray source, Gamma ray source-properties of X and Gamma rays-Radiographic Imaging-Geometrical factors-radiographic film-film density-Radiographic sensitivity- Penetrameter-Radiographic Inspection Techniques-single wall single image technique, wall penetration technique, Latitude technique-Applications and Limitations of Radiographic Inspection Techniques.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Explain the testing procedure for Visual Inspection and Eddy Current Testing Method in Quality Assurance.	Understand
CO2: Explain testing procedure for Magnetic Particle Testing Method for Quality Assurance.	Understand
CO3: Explain testing procedure for Liquid Reentrant Testing Method for Quality Assurance.	Understand
CO4: Plan inspection sequence for Ultrasonic Testing Method for Quality Assurance.	Understand
CO5: Plan inspection sequence for Radiographic Testing Method for Quality Assurance.	Understand

Text Book(s):

T1. Baldev Raj, T.Jayakumar, M.Thavasimuthu,“Practical Non-Destructive Testing”, Narosa Publishing House, 2009.

T2. J Prasad, C G K Nair, “Non-Destructive Testing and Evaluation of Materials”, Tata McGraw-HillEducation Private Limited, 2003.

Reference Book(s):

R1. Ravi Prakash, "Non-Destructive Testing Techniques", 1st revised edition, New Age International Publishers, 2010.

R2. American Metals Society, "Non-Destructive Examination and Quality Control", Metals Hand Book, Vol.17, 9th Edition, Metals Park, 1989.

R3. Paul Mix, "Introduction to Non-destructive testing: a training guide", Wiley, 2nd Edition,New Jersey,2005.

Web Reference(s):

1. https://www.nde-ed.org/index_flash.htm
2. http:// http://117.55.241.6/library/E-Books/NDT%20Notes.pdf
3. http:// www.slideshare.net/ndtindia123/introduction-uses-of-non-destructive-testing-24377016
4. http:// www.eis.hu.edu.jo/ACUploads/10526/Ultrasonic%20Testing.pdf
5. http://www.hse.gov.uk/comah/sragtech/ndt2.pdf

Course Articulation Matrix

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
CO1	1	1	1	1	1	-	-	2	1	2	-	1	-	-
CO2	1	1	1	1	1	-	-	2	1	2	-	1	-	-
CO3	1	1	1	1	1	-	-	2	1	2	-	1	-	-
CO4	1	1	1	1	1	-	-	2	1	2	-	1	-	-
CO5	1	1	1	1	1	-	-	2	1	2	-	1	-	-

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	CO .No.	Marks	Total
Continuous Comprehensive Evaluation	CCET 1	1,2	50	30
	CCET 2	3,4	50	
	Retest	1,2,3,4	50	
	CCET 3	5	50	
	Assignment	1,2,3,4,5	30	10
End Semester Examination	ESE	1,2,3,4,5	100	60
Total				**100**

Course Code:19MCEN1006	Course Title: INDUSTRIAL ENGINEERING FOR MECHATRONICS		
Course Category: Professional Elective		Course Level: Mastery	
L:T:P (Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours: 45	Max. Marks:100

Pre-requisites:

The student should have undergone the course(s):

- Manufacturing Processes

Course Objectives:

The course is intended to:

1. Explain the concept of industrial engineering
2. Explain appropriate work and method study
3. Identify the suitable forecasting techniques
4. Explain the concept of ergonomics
5. Explain the importance of property rights and Industrial legislation

UNIT I INTRODUCTION 10 Hours

INDUSTRIAL ENGINEERING: Meaning, Definition, Objective, Need, Scope, Evolution and developments. Concept of quality and cost, Logistics, Production planning and inventory control, Operations research, Quality control PRODUCTIVITY: Definition of productivity, individual enterprises, task of management Productivity of materials, land, building, machine and power. Measurement of productivity, factors affecting the productivity, productivity improvement programs, wages and incentives (simple numerical problems). PRODUCT DESIGN AND DEVELOPMENT: Principles of good product design, tolerance design; quality and cost considerations; product life cycle; standardization, simplification, diversification, value engineering and analysis, concurrent engineering.

UNIT II WORK AND METHOD STUDY 10 Hours

WORK STUDY: Definition, objective and scope of work study. Human factors in work study. Work study and management, work study and supervision, work study and worker. Taylor's scientific management, Gilbreths's contributions; productivity – concepts and measurements METHOD STUDY: Definition, objective and scope of method study, activity recording and exam aids. Charts to record moments in shop operation – process charts, flow process charts,

travel chart and multiple activity charts. principles of motion economy; work measurement – stop watch time study, work sampling, standard data, PMTS; ergonomics; job evaluation, merit rating, incentive schemes, and wage administration; business process reengineering.

UNIT III PRODUCTION PLANNING AND INVENTORY CONTROL 9 Hours

Forecasting techniques – causal and time series models, moving average, exponential smoothing, trend and seasonality; aggregate production planning; master production scheduling; MRP and MRP-II; order control and flow control; routing, scheduling and priority dispatching; push and pull production systems, concept of JIT manufacturing system; logistics, distribution, and supply chain management; Inventory – functions, costs, classifications, deterministic and probabilistic inventory models, quantity discount; perpetual and periodic inventory control systems..

UNIT IV ERGONOMICS 9 Hours

Introduction, areas of study under ergonomics, system approach to ergonomics model, man-machine system. Components of man-machine system and their functions – work capabilities of industrial worker, study of development of stress in human body and their consequences. Computer based ergonomics. DESIGN OF MAN-MACHINE SYSTEM: Fatigue in industrial workers, Quantitative qualitative representation and alphanumeric displays, Controls and their design criteria, control types, relation between controls and displays, layouts of panels and machines. Design of work places, influence of climate on human efficiency. Influence of noise, vibration and light.

UNIT V PROPERTY RIGHTS AND INDUSTRIAL LEGISLATION 7 Hours

Definition of intellectual property, importance of IPR; TRIPS and its implications, patent, copyright, industrial design and trademark. Need for Industrial legislation, Factories act 1948, Industrial dispute act 1947, The Indian trade unions act 1926, Industrial employment act 1946, Payment of wage act 1936, Workmen compensation act 1923, Payment of bonus act 1965, Employees provident fund scheme 1952 – Group Discussion.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Explain concept of industrial Engineering to take the right decisions to optimize resources utilization by improving productivity	Understand

CO2: Explain the work study to eliminate unproductive activities and method study to use the Charts to record the Activities of the people, materials and Equipment for minimizing the waste and implement the best method.	Understand
CO3: Identify the suitable forecasting techniques to improve the processes and find the Standard Time for given applications	Understand
CO4: Explain the concept of ergonomics to design the Man – Machine System to improve Human Efficiency and reduce the effort of the workers for a given resources	Understand
CO5: Explain the importance of property rights and Industrial legislation for the betterment of employees	Understand

Text Book(s):

T1. Khan, M.I, "Industrial Engineering", New Age International, 2nd Edition, 2009.

T2. "Work study", ILO, Second Edition, Oxford and IBH Publishin, 2010

T3. Kapoor N.D, "Handbook of Industrial Law", sultan Chand & sons, 14th revised edition 2013.

Reference Book(s):

R1. "Human Factors in Engineering Design" - S Sanders and E J McCormick, 7th Edition,2016

R2. Industrial Engineering and Production management", Martand Telsang, S. Chand Publisher, 2006

R3. Paul Kales, " Reliability for Technology Engineering and Management", Prentice Hall, New Jersey, 1998

Web Reference(s):

1. https://nptel.ac.in/courses/112/107/112107143/
2. https://nptel.ac.in/courses/112/107/112107292/

Course Articulation Matrix

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
CO1	2	1	-	2	2	-	-	2	1	2	-	1	-	-
CO2	2	1	-	2	2	-	-	2	1	2	-	1	-	-
CO3	2	1	-	2	2	-	-	2	1	2	-	1	-	-
CO4	2	1	-	2	2	-	-	2	1	2	-	1	-	-
CO5	1	1	-	1	1	-	-	2	1	2	-	1	-	-

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	**CO .No.**	**Marks**	**Total**
Continuous Comprehensive Evaluation	CCET 1	1,2	50	30
	CCET 2	3,4	50	
	Retest	1,2,3,4	50	
	CCET 3	5	50	
	Assignment	1,2,3,4,5	30	10
End Semester Examination	ESE	1,2,3,4,5	100	60
Total				**100**

Course Code:19MEEC1015	Course Title: PRINCIPLES OF MANAGEMENT (Common to ME & MC)		
Course Category: Professional Elective		Course Level: Mastery	
L:T:P (Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours: 45	Max. Marks:100

Prerequisites:

The student should have undergone the course(s):

- Nil

Course Objectives:

The course is intended to:

1. Describe the role of managers
2. Explain the significance of planning, decision making and strategies for international business
3. Explain the significance of organizing the tasks
4. Explain the motivational theories
5. Explain the control techniques

UNIT I OVERVIEW OF MANAGEMENT 9 Hours

Organization – Management – Role of managers – Evolution of Management thought – Organization and the environmental factors – Managing globally – Strategies for International Business.

UNIT II PLANNING 9 Hours

Nature and Purpose planning – Planning process – Types of plans – Objectives – Managing by objective (MBO) Strategies – Types of strategies – Policies – Decision Making – Types of decision –Decision Making Process - Rational Decision Making Process – Decision Making under different conditions.

UNIT III ORGANISING 9 Hours

Nature and purpose of organizing – Organization structure – Formal and informal groups / organization – Line and Staff authority – Departmentation – Span of Control – Centralization and Decentralization – Delegation of authority – Staffing – Selection and Recruitment – Orientation Career Development – Career stages – Training – Performance Appraisal.

UNIT IV DIRECTING 9 Hours

Creativity and Innovation – Motivation and Satisfaction – Motivation Theories Leadership – Leadership theories – Communication – Hurdles to effective communication – Organization Culture – Elements and types of culture – Managing cultural diversity

UNIT V CONTROLLING 9 Hours

Process of controlling – Types of control – Budgetary and non-budgetary control techniques – Managing Productivity – Cost Control – Purchase Control – Maintenance Control – Quality Control – Planning operations.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Describe the role of managers with reference to an organization context and business.	Understand
CO2: Explain the significance of planning, decision making and strategies for international business to accomplish the organizational goal.	Understand
CO3: Explain the significance of organizing the tasks to accomplish the organizational goal.	Understand
CO4: Explain the motivational theories to increase the productivity and retention rate of employees.	Understand
CO5: Explain the control techniques such as budgetary, maintenance, quality to accomplish the organizational goal.	Understand

Text Book(s):

T1. Stephen P. Robbins and Mary Coulter, "Management", Prentice Hall of India, 8th edition, 2009.

T2. Charles W.L Hill, Steven L McShane, "Principles of Management", Mcgraw Hill Education, 2007.

Reference Book(s):

R1. Hellriegel, Slocum & Jackson, "Management – A Competency Based Approach", Thomson South Western, 10th edition, 2007.

R2. Harold Koontz, Heinz Weihrich and mark V Cannice, "Management – A global & Entrepreneurial Perspective", Tata McGraw Hill, 12th edition, 2007.

R3. Andrew J. Dubrin, "Essentials of Management", Thomson Southwestern, 7th edition,

Web Reference(s):

1. http://www.managementstudyguide.com/all-subjects.htm

Course Articulation Matrix

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
CO1	1	1	1	1	1	-	-	2	1	2	-	1	-	-
CO2	1	1	1	1	1	-	-	2	1	2	-	1	-	-
CO3	1	1	1	1	1	-	-	2	1	2	-	1	-	-
CO4	1	1	1	1	1	-	-	2	1	2	-	1	-	-
CO5	1	1	1	1	1	-	-	2	1	2	-	1	-	-

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	**CO .No.**	**Marks**	**Total**
Continuous Comprehensive Evaluation	CCET 1	1,2	50	30
	CCET 2	3,4	50	
	Retest	1,2,3,4	50	
	CCET 3	5	50	
	Assignment	1,2,3,4,5	30	10
End Semester Examination	ESE	1,2,3,4,5	100	60
Total				**100**

Course Code:19MEEC1016	Course Title: QUALITY ENGINEERING (Common to AU, ME & MC)		
Course Category: Professional Elective		Course Level: Mastery	
L:T:P (Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours: 45	Max. Marks:100

Prerequisites:

The student should have undergone the course(s):

- Engineering Materials.

Course Objectives:

The course is intended to:

1. Explain the need of quality and customer satisfaction.
2. Explain the basics of Quality cost with classification
3. Explain the concept of total quality management relevant to both manufacturing and service industry.
4. Explain the various tools used in Quality Engineering and Management.
5. Explain the steps used for Designing for Quality.

UNIT I INTRODUCTION 9 Hours

Introduction – Need for quality – Evolution of quality – Different Definitions and Dimensions of Quality– Concepts of Product and Service Quality– Contributions of Deming, Juran and Crosby – Barriers to Quality – Quality statements – Customer focus – Customer orientation, Customer satisfaction, Customer complaints, and Customer retention – Costs of Poor quality.

UNIT II QUALITY COSTS 9 Hours

Basic Concept Quality Costs: Fitness for Use, Quality Characteristics, Parameters of Fitness for use-Quality functions, Concept of Quality assurance and Quality control, Quality costs concept, Quality cost categories, Examples of Quality cost studies, Securing the Cost figures, Pareto Analysis, Cost reduction Programs and economics of quality.

UNIT III TOTAL QUALITY MANAGEMENT 9 Hours

Total quality Management- Basic concepts of TQM, historical review, leadership, concepts, role of senior management, quality statements, plans for process parameters, Modern Quality Management Techniques-Benchmarking, QFD, Taguchi quality loss function TPM,Lean

Manufacturing continuous improvement techniques, JIT systems, Cause and effect diagrams, Scatter diagram, Run charts, Affinity diagrams, Inter-relationship diagram, Process decision program charts, PDCA Concept

UNIT IV QUALITY ENGINEERING AND MANAGEMENT TOOL 9 Hours

Quality Engineering and Management Tools, Techniques &Standards: 7 QC tools,7 New Quality Management Tools, 5S Technique, Kaizen, Poka-Yoke, SMED, Quality Circle, Cost of Quality Technique, Introduction to Quality Management Standards – ISO 9000, IATF 16949, ISO 14001, ISO 45001, ISO 50001 (Concept, Scope, Implementation Requirements & Barriers, and Benefits), Introduction to National and International Quality Awards.

UNIT V DESIGNING FOR QUALITY 9 Hours

Introduction to Concurrent Engineering, Quality Function Deployment (QFD) and Failure Mode and Effect Analysis (FMEA) – Concept, Methodology and Application (with case studies). Six Sigma - Basic Concept, Principle, Methodology, Implementation, Scope, Advantages and Limitations – DOE

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Explain the need of quality and customer satisfaction.	Understand
CO2: Explain the basics of Quality cost with classification	Understand
CO3: Explain the concept of total quality management relevant to both manufacturing and service industry.	Understand
CO4: Explain the various tools used in Quality Engineering and Management.	Understand
CO5: Explain the steps used for Designing for Quality	Understand

Text Book(s):

T1. Quality Assurance and Total Quality Management (ISO 9000, QS 9000 ISO 14000) by K C Jain and A K Chitale, Khanna Publishers.

T2. Total Quality Management by Dale H. Besterfield, Carol Besterfield-Michna, Glen H. Besterfield and Mary Besterfield-Sacre, Pearson Education .

T3. Quality Management by Kanishka Bedi .

Reference Book(s):

R1. Quality planning and Analysis, Juran and Gryna, TMH, New Delhi

R2. Quality Control & Application by B. L. Hanson & P. M. Ghare, Prentice Hall of India

Web Reference(s):

1. http://www.nptel.ac.in
2. http://www.ocw.mit.edu

Course Articulation Matrix

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
CO1	1	1	1	1	1	-	-	2	1	2	-	1	-	-
CO2	1	1	1	1	1	-	-	2	1	2	-	1	-	-
CO3	1	1	1	1	1	-	-	2	1	2	-	1	-	-
CO4	1	1	1	1	1	-	-	2	1	2	-	1	-	-
CO5	1	1	1	1	1	-	-	2	1	2	-	1	-	-

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	**CO .No.**	**Marks**	**Total**
Continuous Comprehensive Evaluation	CCET 1	1,2	50	30
	CCET 2	3,4	50	
	Retest	1,2,3,4	50	
	CCET 3	5	50	
	Assignment	1,2,3,4,5	30	10
End Semester Examination	ESE	1,2,3,4,5	100	60
Total				**100**

Course Code:19MEEC1017	Course Title: INDUSTRIAL SAFETY MANAGEMENT (Common to AU, ME & MC)		
Course Category: Professional Elective		Course Level: Mastery	
L:T:P (Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours: 45	Max. Marks:100

Prerequisites:

The student should have undergone the course(s):

- Engineering Materials

Course Objectives:

The course is intended to:

1. Explain the importance of safety management
2. Explain the measurement and monitoring techniques
3. Explain the roles and responsibilities of Safety department
4. Describe the importance of Industrial safety acts
5. Explain the classes of fires and controlling techniques.

UNIT I INTRODUCTION TO SAFETY MANAGEMENT 9 Hours

Principles of Safety Management ,Need of safety in organisation, Occupational Health & hygiene, modern safety concept-Safe operating procedure (SOP's), Safety permits, Social and physiological effects, Behavioural based safety- aim, benefits, law and rules, Accident - Near Miss, injury, Cost of accident, Unsafe act , Unsafe condition, Environmental safety - air pollution, water pollution ,industrial noise & vibration control ,physical hazards - chemical hazards , biological hazards, electrical hazards.

UNIT II SAFETY PERFORMANCE MONITORING 9 Hours

Incident Recall Technique (IRT), disaster control, job safety analysis, safety survey, safety inspection, safety sampling, Components of safety audit, types of audit, audit methodology, permanent total disabilities, permanent partial disabilities, temporary total disabilities - Concept of an accident, reportable and non-reportable accidents, unsafe act and condition – principles of accident prevention incident rate, accident rate, safety “t” score, safety activity rate Records of accidents, accident reports.

UNIT III SAFETY ORGANISATION 9 Hours

Role and responsibilities of management and line staffs Supervisors and Employees, Safety committee, Motivation, budgeting for safety, safety policy, Safety Education and Training,

Importance of training-identification of training needs- Training methods –programme, seminars, conferences, role of government agencies and private consulting agencies in safety training – creating awareness, awards, celebrations, safety posters, safety displays, safety pledge, safety incentive scheme, safety campaign – Domestic Safety and Training, Personal Protective Equipment (PPE) - Requirements of PPE, Selection and Usage of PPE, Importance of IS Standard, Types of PPE

UNIT IV INDUSTRIAL ACTS 9 Hours

Indian Factories act 1948, Tamilnadu Factories rule 1950 – Environmental protection act 1986- Indian electricity act 1910, Indian electricity rule 1956 – Indian boiler act 1923 – Workmen's compensation act 1923 – Explosive act1983 - Noise pollution rules 2000

UNIT V DISASTER MANAGEMENT AND EMERGENCY PREPAREDNESS 9Hrs

Fire properties of solid, liquid and gases - fire spread - toxicity of products of Combustion - sources of ignition – fire triangle – principles of fire extinguishing – active and passive fire protection systems – various classes of fires – a, b, c, d, e – fire extinguishing agents - fire stoppers, Emergency preparedness and responsibilities, On site and off site emergency plan, Mock drill Bhopal Gas tragedy - faulty handling of equipment's, failure of hoist, crane.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Explain the importance of safety management to control the accidents, pollution and hazards.	Understand
CO2: Explain the measurement and monitoring techniques to report the safety performance.	Understand
CO3: Explain the roles and responsibilities of Safety department in an organization to eliminate the unsafe act and conditions.	Understand
CO4: Describe the importance of Industrial safety acts related to safety environment pollution in India.	Understand
CO5: Explain the classes of fires and controlling techniques and plan for an onsite and offsite emergency.	Understand

Text Book(s):

T1. Deshmukh .L.M "Industrial Safety Management" McGraw-Hill 2006.

T2. C.RayAsfahl "Industrial Safety and Health management" Pearson Prentice Hall,2003

Reference Book(s):

R1. John V. Grimaldi and Rollin H. Simonds, "Safety Management", All India Travellers bookseller, New Delhi-1989.

R2. Heinrich H.W. "Industrial Accident Prevention" McGraw-Hill Company, New York, 1980

R3. Subramanian.V., "The Factories Act 1948 with Tamilnadu factories rules 1950", Madras Book Agency, 21st ed., Chennai, 2000.

Web Reference(s):

1. http://www.icebookshop.com
2. http://nptel.ac.in/courses/112107143/40

Course Articulation Matrix

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
CO1	1	1	1	1	1	-	-	2	1	2	-	1	1	1
CO2	1	1	1	1	1	-	-	2	1	2	-	1	1	1
CO3	1	1	1	1	1	-	-	2	1	2	-	1	1	1
CO4	1	1	1	1	1	-	-	2	1	2	-	1	1	1
CO5	1	1	1	1	1	-	-	2	1	2	-	1	1	1

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	**CO .No.**	**Marks**	**Total**
Continuous Comprehensive Evaluation	CCET 1	1,2	50	30
	CCET 2	3,4	50	
	Retest	1,2,3,4	50	
	CCET 3	5	50	
	Assignment	1,2,3,4,5	30	10
End Semester Examination	ESE	1,2,3,4,5	100	60
Total				**100**

Course Code:19MEEC1018	Course Title: AUTOMOBILE ENGINEERING (Common to ME & MC)		
Course Category: Professional Elective		Course Level: Mastery	
L:T:P (Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours: 45	Max. Marks:100

Pre-requisites:

The student should have undergone the course(s):

- Basics of Electrical and Electronics Engineering

Course Objectives:

The course is intended to:

1. Explain the vehicle structure and components.
2. Explain the IC Engines and lubricating systems.
3. Explain the construction and working principle of Transmission system.
4. Explain the construction and working principle of steering, braking and suspension system.
5. Explain electrical system, accessories and emission norms.

UNIT I VEHICLE STRUCTURE AND ENGINES 9 Hours

Types of automobiles , vehicle construction and different layouts chassis, frame and body, resistances to vehicle motion and need for a gearbox, Introduction to IC Engines-types, working principles, components of engines-their forms functions and materials.

UNIT II FUELS AND LUBRICATION SYSTEM 9 Hours

Petrol fuel feed system: Feed pump – mechanical, electrical type – Carburetors – fixed venturi type (carter), variable venturi type (SU), multiple barrel type (Solex, Mikuni), carburetors for two wheelers -Petrol injection – Multi Point Fuel Injection (MPFI), VVT (petrol engines),Turbo chargers, Diesel fuel system: Jerk type fuel injection pump–Methods of fuel injection–common rail, distributor types-Nozzles–Cold starting aids, Cooling system: Direct and indirect cooling, Lubricating system: Mist, wet and dry sump.

UNIT III TRANSMISSION SYSTEMS 9 Hours

Clutch-types and construction , gear boxes- manual and automatic, gear shift mechanisms, Over drive, transfer box, fluid flywheel –torque converter, propeller shaft, slip joints, universal joints ,Differential, and rear axle, Hotchkiss Drive and Torque Tube Drive

UNIT IV STEERING, BRAKES AND SUSPENSION SYSTEMS 9 Hours

Steering geometry and types of steering gear box-Power Steering, Types of Front Axle, Types of Suspension Systems , Pneumatic and Hydraulic Braking Systems, Antilock Braking System and Traction Control.

UNIT V ELECTRICAL SYSTEMS, ACCESSORIES AND EMISSION NORMS 9 Hours

Ignition system- coil ignition and magneto ignition system – Spark plug, Battery –Construction and maintenance, Starter motor – types, alternator, distributor, generator, cut out relay, panel board instruments and: Power operated windows-Vehicle Air conditioning- Air bags- Air pollution control-Catalytic converter working principle-Emission norms- Bharat and Euro emission Standards

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Explain the vehicle structure chassis layouts and different types of IC Engines	Understand
CO2: Describe the fuels and lubrication system used in SI & IC engines. viz carburetors, APFI, VVT, Turbo charger, CRDI, Lubrication system viz mist, wet and dry sump system	Understand
CO3: Explain the construction and working principle of various components of a Transmission system viz gear box,, clutch, torque converter, fluid flywheel, differential etc.	Understand
CO4: Describe the construction and working principle of steering and suspension system of a Automotive vehicle	Understand
CO5: Explain the electrical system and its accessories viz battery, starter motor, panel board, power operated windows, air bags and the emission norms.	Understand

Text Book(s):

T1. Kirpal Singh, “Automobile Engineering Vol. 1 &Vol 2”, Standard Publishers, 7th Edition, 2012.

T2. Sethi H.M, “Automobile Technology”, Tata McGraw-Hill, 2003.

Reference Book(s):

R1. Jain, K.K., and Asthana .R.B, “Automobile Engineering” Tata McGraw Hill Publishers, New Delhi, 2002.

R2. Srinivasan.S, “Automotive Mechanics” 2nd edition, Tata McGraw-Hill, 2003.

Web Reference(s):

1. https://en.wikipedia.org/wiki/Automotive_engineering

2. http://auto.howstuffworks.com/

Course Articulation Matrix

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
CO1	1	1	1	1	1	-	-	2	1	2	-	1	-	1
CO2	1	1	1	1	1	-	-	2	1	2	-	1	-	1
CO3	1	1	1	1	1	-	-	2	1	2	-	1	-	1
CO4	1	1	1	1	1	-	-	2	1	2	-	1	-	1
CO5	1	1	1	1	1	-	-	2	1	2	-	1	-	1

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	**CO .No.**	**Marks**	**Total**
Continuous Comprehensive Evaluation	CCET 1	1,2	50	30
	CCET 2	3,4	50	
	Retest	1,2,3,4	50	
	CCET 3	5	50	
	Assignment	1,2,3,4,5	30	10
End Semester Examination	ESE	1,2,3,4,5	100	60
Total				**100**

Course Code :19MCEN1007	Course Title: DISASTER MANAGEMENT	
Course level : Mastery	L : T : P: C	3 : 0 : 0 : 3
Course Category: Professional Elective	Total Contact hours:	45 Hrs

Prerequisites:

The student should have undergone the course(s):

1. Environmental science and Engineering

Course Objectives:

The course is intended to:

1. Define relationship between vulnerability, disasters, disaster prevention and risk reduction
2. Define the approaches of Disaster Risk Reduction (DRR).
3. Develop awareness of institutional processes in the country
4. Develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity.
5. Identify the different disaster management techniques.

UNIT I INTRODUCTION TO DISASTERS **9 Hours**

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Disasters: Types of disasters – Earthquake, Landslide, Flood, Drought, Fire etc – Classification, Causes, Impacts including social, economic, political, environmental, health, psychosocial, etc.- Differential impacts- in terms of caste, class, gender, age, location, disability – Global trends in disasters: urban disasters, pandemics, complex emergencies, Climate change- Dos and Don'ts during various types of Disasters.

UNIT II APPROACHES TO DISASTER RISK REDUCTION (DRR) **9 Hours**

Disaster cycle – Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre, and other stakeholders- Institutional Processes and Framework at State and Central Level- State Disaster Management Authority(SDMA) – Early Warning System – Advisories from Appropriate Agencies

UNIT III INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT **9 Hours**

Factors affecting Vulnerabilities, differential impacts, impact of Development projects such as dams, embankments, changes in Land-use etc.- Climate Change Adaptation- IPCC Scenario

and Scenarios in the context of India – Relevance of indigenous knowledge, appropriate technology and local resources.

UNIT IV DISASTER RISK MANAGEMENT IN INDIA **9 Hours**

Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, Disaster Management Act and Policy – Other related policies, plans, programmes and legislation – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment.

UNIT V DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES AND FIELD WORKS **9 Hours**

Landslide Hazard Zonation: Case Studies, Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.

Course Outcomes	**Cognitive Level**
At the end of the course students will be able to	
CO1: Compare the types of disasters, causes and their impact on environment and society.	Understand
CO2: Explain vulnerability and various methods of risk reduction measures as well as mitigation.	Understand
CO3: Identify the hazard and vulnerability profile of India, Scenarios in the Indian context.	Understand
CO4: Classify Disaster damage assessment and management.	Understand
CO5: Select a suitable disaster management techniques.	Understand

Text Book(s):

T1. Tushar Bhattacharya, "Disaster Science and Management", McGraw Hill India Education Pvt. Ltd., 2012.

T2. Gupta Anil K, Sreeja S. Nair. Environmental Knowledge for Disaster Risk Management, NIDM, New Delhi, 2011.

T3. Kapur Anu Vulnerable India: A Geographical Study of Disasters, IIAS and Sage Publishers, New Delhi, 2010.

Reference Book(s):

R1. Govt. of India: Disaster Management Act, Government of India, New Delhi, 2005.

R2. Government of India, National Disaster Management Policy, 2009.

Web Reference(s):

1. https://nptel.ac.in/courses/105104183/7

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	2	2	-	-	2	-	2	-	1	-	-
CO2	2	-	-	2	2	-	-	2	-	2	-	1	-	-
CO3	2	-	-	2	2	-	-	2	-	2	-	1	-	-
CO4	2	-	-	2	2	-	-	2	-	2	-	1	-	-
CO5	2	-	-	2	2	-	-	2	-	2	-	1	-	-

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	**CO .No.**	**Marks**	**Total**
Continuous Comprehensive Evaluation	CCET 1	1,2	50	30
	CCET 2	3,4	50	
	Retest	1,2,3,4	50	
	CCET 3	5	50	
	Assignment	1,2,3,4,5	30	10
End Semester Examination	ESE	1,2,3,4,5	100	60
Total				**100**

Course Code : 19MCEN1008	Course Title: MAINTENANCE ENGINEERING	
Course level : Mastery	L : T : P: C	3 : 0 : 0 : 3
Course Category: Professional Elective	Total Contact hours:	45 Hrs

Prerequisites:
The student should have undergone the course(s):

1. Design of Machine Elements

Course Objectives:
The course is intended to:

1. Define the principles, functions and practices adapted in industry for the successful management of maintenance activities.
2. Explain the different maintenance categories like Preventive maintenance, condition monitoring and repair of machine elements.
3. Illustrate some of the simple instruments used for condition monitoring in industry.
4. Identify fault location and methods for Machine elements
5. Identify the repair methods for Material handling equipments

UNIT I PRINCIPLES AND PRACTICES OF MAINTENANCE PLANNING **9 Hours**

Scope and advantages of NDT-Compare NDT with DT-Principle of Visual Inspection theory- Optical aids used for Visual Inspection-Microscope, Boroscope, Endoscope, Flexiscope, Telescope and Holography- Principles of Eddy Current Theory-surface mounted coils-Encircling coils-types of Probes-Eddy current sensing Probes-Flux leakage sensing Probes-Eddy Current Techniques, Advanced Eddy Current Techniques-applications, Limitations and standards.

UNIT II MAINTENANCE POLICIES – PREVENTIVE MAINTENANCE **9 Hours**

Maintenance categories – Comparative merits of each category – Preventive maintenance, maintenance schedules, repair cycle - Principles and methods of lubrication – TPM.

UNIT III CONDITION MONITORING **9 Hours**

Condition Monitoring – Cost comparison with and without CM – On-load testing and offload testing – Methods and instruments for CM – Temperature sensitive tapes – Pistol thermometers – wear-debris analysis**.**

UNIT IV REPAIR METHODS FOR BASIC MACHINE ELEMENTS 9 Hours

Repair methods for beds, slide ways, spindles, gears, lead screws and bearings – Failure analysis – Failures and their development – Logical fault location methods – Sequential fault location.

UNIT V REPAIR METHODS FOR MATERIAL HANDLING EQUIPMENT 9 Hours

Repair methods for Material handling equipment - Equipment records –Job order systems - Use of computers in maintenance.

Course Outcomes **At the end of the course students will be able to**	**Cognitive Level**
CO1: Select the maintenance function and different practices in industries	Understand
CO2: Explain the maintenance categories on Preventive maintenance.	Understand
CO3: Identify the maintenance categories on monitoring and condition of the system.	Understand
CO4: Explain the repair methods for basic machine elements.	Understand
CO5: Select the repair methods for Job Order systems.	Understand

Text Book(s):

T1. Srivastava S.K., "Industrial Maintenance Management", S. Chand and Co., 1981

T2. Venkataraman .K "Maintenance Engineering and Management", PHI Learning, Pvt. Ltd., 2007.

Reference Book(s):

R1. Bhattacharya S.N., "Installation, Servicing and Maintenance", S. Chand and Co., 1995

R2. White E.N., "Maintenance Planning", I Documentation, Gower Press, 1979.

R3. Garg M.R., "Industrial Maintenance", S. Chand and Co., 1986.

Web Reference(s):

1. https://nptel.ac.in/courses/112107238/1
2. https://nptel.ac.in/courses/112105232/2

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	2	2	-	-	2	-	2	-	1	-	-
CO2	2	-	-	2	2	-	-	2	-	2	-	1	-	-
CO3	2	-	-	2	2	-	-	2	-	2	-	1	-	-
CO4	2	-	-	2	2	-	-	2	-	2	-	1	-	-
CO5	2	-	-	2	2	-	-	2	-	2	-	1	-	-

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	**CO .No.**	**Marks**	**Total**
Continuous Comprehensive Evaluation	**CCET 1**	1,2	50	30
	CCET 2	3,4	50	
	Retest	1,2,3,4	50	
	CCET 3	5	50	
	Assignment	1,2,3,4,5	30	10
End Semester Examination	**ESE**	1,2,3,4,5	100	60
Total				**100**

Course Code:19MCEN1010	Course Title: AUTOMOTIVE ELECTRONICS		
Course Category: Professional Elective		Course Level: Mastery	
L:T:P (Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours: 45	Max. Marks:100

Prerequisites:
The student should have undergone the course(s):

1. Sensors and Signal Processing
2. Electric and Electronic circuits

Course Objectives:
The course is intended to:

1. Explain the importance of emission standards in automobiles.
2. Understand the electronic fuel injection/ignition components and their function.
3. Classify sensors, appropriate actuators and equipments for measuring mechanical quantities and temperature.
4. Illustrate electronic engine control systems used in Engine Management Systems.
5. Choose the chassis and vehicle safety system.

UNIT I INTRODUCTION **8 Hours**

Evolution of electronics in automobiles – emission laws – introduction to Euro I, Euro II, Euro III, Euro IV, Euro V standards – Equivalent Bharat Standards. Charging systems: Working and design of charging circuit diagram – Alternators – Requirements of starting system - Starter motors and starter circuits.

UNIT II IGNITION AND INJECTION SYSTEMS **10 Hrs**

Ignition systems: Ignition fundamentals - Electronic ignition systems - Programmed Ignition – Distribution less ignition - Direct ignition – Spark Plugs. Electronic fuel Control: Basics of combustion – Engine fuelling and exhaust emissions – Electronic control of carburetion – Petrol fuel injection – Diesel fuel injection.

UNIT III SENSOR AND ACTUATORS IN AUTOMOTIVES **7 Hours**

Working principle and characteristics of Airflow rate, Engine crankshaft angular position, Hall effect, Throttle angle, temperature, exhaust gas oxygen sensors – study of fuel injector, exhaust gas recirculation actuators, stepper motor actuator, and vacuum operated actuator.

UNIT IV ENGINE CONTROL SYSTEMS **10 Hrs**

Control modes for fuel control-engine control subsystems – ignition control methodologies – different ECU's used in the engine management – block diagram of the engine management system. In vehicle networks: CAN standard, format of CAN standard – diagnostics systems in modern automobiles.

UNIT V CHASSIS AND SAFETY SYSTEMS 10 Hrs

Traction control system – Cruise control system – electronic control of automatic transmission – antilock braking system – electronic suspension system – working of airbag and role of MEMS in airbag systems – centralized door locking system – climate control of cars.

Course Outcomes **At the end of the course students will be able to**	**Cognitive Level**
CO1: Explain the basics of electronics, emission controls and its Importance in automobiles.	Understand
CO2: Classify types of Ignition and Injection systems	Understand
CO3: Understand various sensors and actuators used in automobiles for improving fuel economy and emission control.	Understand
CO4: Choose suitable Ignition control methods using various Electronic Control Units	Understand
CO5: Select Electronic control of an automatic transmission system	Understand

Text Book(s):

T1. Ribbens, "Understanding Automotive Electronics", 8th Edition, Elsevier, Indian Reprint, 2013

Reference Book(s):

R1. Barry Hollembeak, “Automotive Electricity, Electronics & Computer Controls”, Delmar Publishers, 2001.

R2. Richard K. Dupuy “Fuel System and Emission controls”, Check Chart Publication, 2000.

R3. Ronald. K. Jurgon, “Automotive Electronics Handbook”, McGraw-Hill, 1999.

R4. Tom Denton, “Automobile Electrical and Electronics Systems”, Edward Arnold Publishers, 2000.

Web Reference(s):

1. https://nptel.ac.in/courses/108103009/
2. https://tifac.org.in//index.php/8-publication/151-automotive-electronics?showall=1

Course Articulation Matrix

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	PSO1	PSO2
CO1	2	1	-	2	2	-	-	2	1	2	-	1	-	-
CO2	2	1	-	2	2	-	-	2	1	2	-	1	-	-
CO3	2	1	-	2	2	-	-	2	1	2	-	1	-	-
CO4	2	1	-	2	2	-	-	2	1	2	-	1	-	-
CO5	1	1	-	1	1	-	-	2	1	2	-	1	-	-

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	**CO .No.**	**Marks**	**Total**
Continuous Comprehensive Evaluation	CCET 1	1,2	50	30
	CCET 2	3,4	50	
	Retest	1,2,3,4	50	
	CCET 3	5	50	
	Assignment	1,2,3,4,5	30	10
End Semester Examination	ESE	1,2,3,4,5	100	60
Total				**100**

Course Code:19MEEC1019	Course Title: INDUSTRIAL IOT (Common to AU, ME & MC)		
Course Category: Professional Elective		Course Level: Mastery	
L:T:P (Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Pre-requisites:

- Nil

Course Objectives:

The course is intended to:

1. Explain the basic concepts of IIoT.
2. Explain the various Architectures of IIoT.
3. Explain the sensors available in IIoT based on application requirement.
4. Explain the basics of Big Data and IoT Analytics.
5. Explain the various applications of IoT .

UNIT I INTRODUCTION 9 Hours

Introduction to IoT, IoT Vs. IIoT, History of IIoT, Components of IIoT -Sensors, Interface, Networks, Industry 4.0: Globalization and Emerging Issues, The Fourth Revolution, LEAN Production Systems, Smart and Connected Business Perspective, Smart Factories, Role of IIoT in Manufacturing Processes, Sustainability through Business excellence tools Challenges & Benefits in implementing IIoT.

UNIT II ARCHITECTURES 9 Hours

Overview of IOT components, various architectures of IOT and IIOT, Advantages & Disadvantages, IIOT System components: Sensors, Gateways, Routers, Modem, Cloud brokers, servers and its integration, WSN, WSN network design for IoT, IIoT Business Model and Reference Architectures, Industrial IoT-Sensing,IIoT-Processing and Communication,IIoT Networking.

UNIT III SENSOR AND INTERFACING 9 Hours

Introduction to sensors, Transducers, Classification, Roles of sensors in IIOT, Various types of sensors, special requirements for IIOT sensors, Role of actuators, types of actuators. Hardwire the sensors with different protocols such as HART, MODBUS-Serial & Parallel, Ethernet and BACNet.

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UNIT IV BIG DATA AND IOT ANALYTICS 9 Hours

Big Data, Characteristics of Big Data, Types of Big Data, Analysing of Data, Applications, Big Data tools, Introduction to Machine Learning and Data Science ,R and Julia Programming, IOT Analytics, Role of Analytics in IOT, Data visualization Techniques.

UNIT V IoT APPLICATIONS 9 Hours

Internet of Things Applications : City Automation, Automotive Applications, Home Automation, Smart Cards, Plant Automation, Real life examples of IIoT in Manufacturing Sector, Industrial IoT- Application Domains: Oil, chemical and pharmaceutical industry, Applications of UAVs in Industries.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Explain the basic concepts of IIoT.	Understand
CO2: Explain the various Architectures of IIoT.	Understand
CO3: Explain the sensors available in IIoT based on application requirement.	Understand
CO4: Explain the basics of Big Data and IoT Analytics.	Understand
CO5: Explain the various applications of IoT.	Understand

Text Book(s):

T1. Sudip Misra, Chandana Roy, Anandarup Mukherjee "Introduction to Industrial Internet of Things and Industry 4.0" CRC Press,1st edition 2020.

T2. Adrian McEwen, Hakim Cassimally "Designing the Internet of Things", John Wiley & Sons, 2014.

T3. Perry Lea, "Internet of Things for Architects: Architecting IoT solutions by implementing sensors, communication infrastructure, edge computing, analytics, and security", Packt Publishing Ltd., 2018.

T4. Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on Approach)", 1st Edition, VPT, 2014.

Reference Book(s):

R1. Qusay F. Hassan, "Internet of Things A to Z: Technologies and Applications", John Wiley & Sons,2018.

R2. Joe Biron and Jonathan Follett "Foundational Elements of an IoT Solution: The Edge, The Cloud, and Application Development", Cisco Press, First Edition, 2017.

Web Reference(s):

1. https://onlinecourses.nptel.ac.in/noc20_cs69/preview

Course Articulation Matrix

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
CO1	1	1	1	1	1	-	-	2	1	2	-	1	1	1
CO2	1	1	1	1	1	-	-	2	1	2	-	1	1	1
CO3	1	1	1	1	1	-	-	2	1	2	-	1	1	1
CO4	1	1	1	1	1	-	-	2	1	2	-	1	1	1
CO5	1	1	1	1	1	-	-	2	1	2	-	1	1	1

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	**CO .No.**	**Marks**	**Total**
Continuous Comprehensive Evaluation	CCET 1	1,2	50	30
	CCET 2	3,4	50	
	Retest	1,2,3,4	50	
	CCET 3	5	50	
	Assignment	1,2,3,4,5	30	10
End Semester Examination	ESE	1,2,3,4,5	100	60
Total				**100**

Course Code : 19MCEN1011	Course Title: MICRO ELECTRO MECHANICAL SYSTEMS	
Course level : Mastery	L : T : P: C	3 : 0 : 0 : 3
Course Category: Professional Elective	Total Contact hours:	45 Hrs

Prerequisites:
The student should have undergone the course(s):

1. Manufacturing Technology
2. Additive Manufacturing

Course Objectives:
The course is intended to:

1. Identify semiconductors and solid mechanics to fabricate MEMS devices.
2. List various sensors and actuators in MEMS.
3. Explain Micro fabrication techniques.
4. Explain the different manufacturing system of MEMS.
5. Apply MEMS concepts in various disciplines and its applications.

UNIT I INTRODUCTION **9 Hours**

Overview-Microsystems and microelectronics -definition-MEMS materials-scaling laws-scaling in geometry-scaling in rigid body dynamics- scaling in electrostatic forces- scaling in electricity scaling in fluid mechanics- scaling in heat transfer.

UNIT II MICRO SENSORS AND ACTUATORS **9 Hours**

Working principle of Microsystems - micro actuation techniques - micro sensors-types - Microactuators – types – micropump – micromotors – micro – valves – microgrippers –micro accelerometers.

UNIT III FABRICATION PROCESS **9 Hours**

Substrates-single crystal silicon wafer formation-Photolithography-Ion implantation-Diffusion – Oxidation-CVD-Physical vapor deposition-Deposition by epitaxy-etching process.

UNIT IV MICRO SYSTEM MANUFACTURING **9 Hours**

Bulk Micro manufacturing- surface micro machining –LIGA-SLIGA-Micro system packaging materials- die level-device level-system level-packaging techniques-die preparation-surface bonding-wire bonding-sealing.

UNIT V MICRO SYSTEM DESIGN **9 Hours**

Design considerations-process design-mask layout design- mechanical design-applications of micro system in -automotive industry-bio medical –aero space-telecommunications.

Course Outcomes	

At the end of the course students will be able to	Cognitive Level
CO1: Explain semiconductors and solid mechanics to fabricate MEMS devices.	Understand
CO2: Analyze the use of various sensors and actuators in MEMS.	Understand
CO3: Select the Micro fabrication techniques.	Understand
CO4: Explain the different manufacturing system for MEMS	Understand
CO5: Develop a Microsystem layout in automotive, Bio-medical, aerospace and Telecommunication.	Understand

Text Book(s):

T1. Tai-Ran Hsu, "MEMS and Microsystems: Design and Manufacture", Tata McGraw-Hill, First edition, 2017.

Reference Book(s):

R1. Mohamed Gad-el-Hak, "The MEMS Hand book", Third Volume, CRC press.2005.

R2. Julian W. Gardner, Vijay K. Varadan, Osama O. AwadelKarim, "Microsensors, MEMS, and Smart Devices", John Wiley & Sons Ltd, 2001.

R3. Sergej Fatikow, Ulrich Rembold, "Microsystem Technology and Microrobotics", Springer-Verlag Berlin Heidelberg.Newyork, 1997

R4. Francis E.H Tay and W.O Choong, Microfludics and BioMEMS Applications, Springer, 2002.

Web Reference(s):

1. https://nptel.ac.in/courses/117105082/
2. https://www.lboro.ac.uk/microsites/mechman/research/ipm-ktn/pdf/Technology_review/an-introduction-to-mems.pdf

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	2	2	-	-	2	-	2	-	1	-	-
CO2	2	-	-	2	2	-	-	2	-	2	-	1	-	-
CO3	2	-	-	2	2	-	-	2	-	2	-	1	-	-
CO4	2	-	-	2	2	-	-	2	-	2	-	1	-	-
CO5	2	-	-	2	2	-	-	2	-	2	-	1	-	-

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	CO .No.	Marks	Total
Continuous Comprehensive Evaluation	CCET 1	1,2	50	30
	CCET 2	3,4	50	
	Retest	1,2,3,4	50	
	CCET 3	5	50	
	Assignment	1,2,3,4,5	30	10
End Semester Examination	ESE	1,2,3,4,5	100	60
Total				**100**

Course Code:19MCEN1012	Course Title: HYBRID ELECTRIC VEHICLES		
Course Category: Professional Elective		Course Level: Mastery	
L:T:P (Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours: 45	Max. Marks:100

Prerequisites:
The student should have undergone the course(s):

1. Electrical Drives and Control

Course Objectives:
The course is intended to:

1. Explain the basics of electric vehicles
2. Illustrate the concepts of hybrid vehicles.
3. Analyze the different electric propulsion methods.
4. Identify the different control methods
5. Choose the energy storage mediums.

UNIT I ELECTRIC VEHICLES 9 Hours

Electric vehicle layout, performance of electric vehicles – traction motor characteristics, tractive effort, transmission requirements, vehicle performance, energy consumption, advantage and limitations, specifications, system components, electronic control system, safety and challenges in electric vehicles.

UNIT II HYBRID VEHICLES 9 Hours

Concepts of hybrid electric drive train, types, architecture of series and parallel hybrid electric drive train, merits and demerits, hybrid electric drive train design, mild and full hybrids, plug-in hybrid electric vehicles and range extended hybrid electric vehicles.

UNIT III ELECTRIC PROPULSION SYSTEMS 9 Hours

DC motors, AC motors, permanent magnet motors, brushless DC and reluctance motors, characteristics and regenerative braking.

UNIT IV MOTOR CONTROLLERS AND CONTROL SYSTEMS 9 Hours

Control system principles, speed and torque control –DC motors and AC motors.

UNIT V ENERGY STORAGE DEVICES 9 Hours

Electromechanical batteries- types of batteries –lead acid batteries, nickel based batteries, lithium based batteries, electrochemical reactions, thermodynamic voltage, specific energy, specific power, energy efficiency and ultra-capacitors.

Course Outcomes	Cognitive Level

At the end of the course students will be able to	
CO1: Explain working of different configurations of electric vehicles.	Understand
CO2: Explain hybrid vehicle configuration and its components, performance analysis.	Understand
CO3: Analyze the electric drive systems.	Understand
CO4: Build a control system to control speed and torque.	Understand
CO5: Select different types of batteries for energy storage.	Understand

Text Book(s):

T1. Jack Erjavec and Jeff Arias, "Hybrid, Electric and Fuel Cell Vehicles", Second edition Cengage Learning, 2012.

T2. Iqbal Husain, "Electric and Hybrid Vehicles: Design Fundamentals, Second edition, CRC Press, New York, 2010.

Reference Book(s):

R1. Seref Soylu "Electric Vehicles - The Benefits and Barriers", InTech Publishers, Croatia, 2011.

R2. Jack Erjavec and Jeff Arias, "Alternative Fuel Technology – Electric, Hybrid and Fuel Cell Vehicles", Cengage Learning Pvt. Ltd., New Delhi, 2007.

R3. Mehrdad Ehsani, Yimin Gao, sebastien E. Gay and Ali Emadi, "Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design", CRC Press, 2009.

Web Reference(s):

1. https://nptel.ac.in/courses/108103009/

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	2	2	-	-	2	1	2	-	1	-	-
CO2	2	1	-	2	2	-	-	2	1	2	-	1	-	-
CO3	2	1	-	2	2	-	-	2	1	2	-	1	-	-
CO4	2	1	-	2	2	-	-	2	1	2	-	1	-	-
CO5	1	1	-	1	1	-	-	2	1	2	-	1	-	-

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	CO .No.	Marks	Total
Continuous Comprehensive Evaluation	CCET 1	1,2	50	30
	CCET 2	3,4	50	
	Retest	1,2,3,4	50	
	CCET 3	5	50	
	Assignment	1,2,3,4,5	30	10
End Semester Examination	ESE	1,2,3,4,5	100	60
Total				**100**

Course Code:19MCEN1013	Course Title: DIGITAL CONTROL ENGINEERING		
Course Category: Professional Elective		Course Level: Mastery	
L:T:P (Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours: 45	Max. Marks:100

Prerequisites:
The student should have undergone the course(s):

1. Engineering Mathematics I & II
2. Control systems

Course Objectives:
The course is intended to:

1. Explain the basics of digital control system and sampling.
2. Explain the digital control algorithm.
3. Develop a basic knowledge of representing the system in state variable form.
4. Outline the concept of stability of the discrete data systems and analysis.
5. Model digital control systems using various techniques.

UNIT I INTRODUCTION **9 Hours**

Digital control systems – basic concepts of sampled data control systems – principle of sampling,– Sample and Hold circuits – Practical aspects of choice of sampling rate –Basic discrete time signals.

UNIT II MODELS OF DIGITAL CONTROL DEVICES AND SYSTEMS **9 Hours**

Z domain description of sampled continuous time plants – models of A/D and D/A converters – Z Domain description of systems with dead time – Implementation of digital controllers – Digital PID controllers –Position, velocity algorithms – Tuning – Zeigler – Nichols tuning method.

UNIT III DISCRETE STATE-VARIABLE TECHNIQUE **9 Hours**

State space representation of discrete time systems – Solution of discrete time state space equation – State transition matrix – Decomposition techniques

UNIT IV STABILITY ANALYSIS **9 Hours**

Mapping between S plane and Z plane– Jury's stability test – Bilinear transformation and extended Routh array– Root Locus Method –Liapunov Stability Analysis of discrete time systems.

UNIT V DESIGN OF DIGITAL CONTROL SYSTEM **9 Hours**

Z plane specifications of control system design – Digital compensator design – Frequency response method – State feedback – Pole placement design.

Course Outcomes	**Cognitive Level**
At the end of the course students will be able to	**Understand**
CO1: Analyze the discrete data systems and choosing sampling rate for different systems	Understand
CO2: Explain the digital control algorithm.	Understand
CO3: Model the system in discrete state space, solution of state transition matrix.	Understand
CO4: Analyze the stability of the discrete data system and analysis using various methods.	Understand
CO5: Develop controllers using different techniques and digital compensator design.	Understand

Text Book(s):

T1. M. Gopal "Digital Control and State Variable methods", Tata McGraw-Hill Publishing Company Ltd., New Delhi, India, 2003.

Reference Book(s):

R1. B. C. Kuo, "Digital Control Systems", Oxford University Press, Second edition, Indian Edition, 2007.

R2. K. Ogata "Discrete Time Control Systems", Prentice Hall International, New Jersey, USA, 2002.

R3. C.H. Houpis and C.B Lamont., "Digital Control Systems", Tata Mc Graw Hill, 1999.

R4. G. F. Franklin, J. D. Powell and M. L. Workman, Digital Control of Dynamic Systems", Addison-Wesley; Third edition, 1997, Pearson Education, Asia, Third edition, 2000.

Web Reference(s):

1. https://nptel.ac.in/courses/108103008/4
2. http://ctms.engin.umich.edu/CTMS/index.php?example=Introduction&section=ControlDigital

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	2	2	-	-	2	-	2	-	1	-	-
CO2	2	-	-	2	2	-	-	2	-	2	-	1	-	-
CO3	2	-	-	2	2	-	-	2	-	2	-	1	-	-
CO4	2	-	-	2	2	-	-	2	-	2	-	1	-	-
CO5	2	-	-	2	2	-	-	2	-	2	-	1	-	-

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	**CO .No.**	**Marks**	**Total**
Continuous Comprehensive Evaluation	CCET 1	1,2	50	30
	CCET 2	3,4	50	
	Retest	1,2,3,4	50	
	CCET 3	5	50	
	Assignment	1,2,3,4,5	30	10
End Semester Examination	ESE	1,2,3,4,5	100	60
Total				**100**

Course Code:19MCEN1014	Course Title: POWER ELECTRONICS		
Course Category: Professional Elective		Course Level: Mastery	
L:T:P (Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours: 45	Max. Marks:100

Prerequisites:

The student should have undergone the course(s):

1. Analog and Digital circuits

Course Objectives

The course is intended to:

1. Explain various power switching devices.
2. Compute the performance parameters.
3. Identify a DC-DC converter.
4. Explain the operation of inverters and harmonic reduction.
5. Explain the operation of AC voltage controller and cyclo converter

UNIT I POWER SWITCHES 9 Hours

Power Diode: reverse recovery characteristics, types

SCR: Two transistor model, turn-on methods, commutation techniques, dynamic behavior, types, series and parallel connection, UJT trigger circuit, protection circuits: over voltage and over current and snubber circuits, losses and cooling

TRIAC & GTO: Construction, dynamic behavior and driver circuit

MOSFET& IGBT: Construction, dynamic behavior and driver circuit

UNIT II CONTROLLED RECTIFIERS 9 Hours

Controlled Rectifiers: 1 pulse, 2 pulse, 3 pulse and 6 pulse converters with R and RL loads, dual converter, performance parameters, estimation of average load voltage and effect of source impedance.

UNIT III DC-DC CONVERTERS 9 Hours

Choppers: Principle of step-up and step-down operation, Time ratio control and current limit control, types, forced commutation techniques (voltage, current and load).

Switching regulators: Operation of Buck, Boost and Buck-boost regulators**.**

UNIT IV INVERTERS 9 Hours

Inverter: single-phase half and full bridge, three-phase six step VSI and CSI**,** Control: voltage control of single phase inverter, output AC voltage control and harmonic reduction.

UNIT V AC CONVERTERS 9 Hours

AC voltage controller: types of control - on-off, phase angle control and sequence control, Single phase: With R and RL loads, Three phase: Star and Delta connected loads.

Cycloconverter: single phase and three phase cyclo converters

Course Outcomes	**Cognitive Level**
At the end of the course students will be able to	Understand
CO1: Explain the operation of various power switching devices and their dynamic characteristics.	Understand
CO2: Compute the performance parameters of controlled rectifiers.	Understand
CO3: Identify a DC-DC converter for a given application.	Understand
CO4: Explain the modulation techniques of PWM inverter and harmonic reduction methods.	Understand
CO5: Describe the operation of AC voltage controller and cycloconverter.	Understand

Text Book(s):

T1. Muhammad H. Rashid, "Power Electronics: Circuits, Devices and Applications", Pearson Education, Third Edition (reprint), 2011.

T2. P. S. Bimbhra, “Power Electronics”, Khanna Publishers, Third Edition, 2004.

Reference Book(s):

R1. Ned Mohan, T.M. Undeland, W.P. Robbins, "Power Electronics: Converters, Applications and Design", John Wiley and Sons, Third Edition (reprint), 2009..

R2. Joseph Vithayathil, “Power Electronics: Principles and Applications”,Tata McGraw-Hill, New Delhi,2010.

R3. M.D. Singh and K.B. Khanchandani, ‘Power Electronics’, Tata McGraw Hills Publishing Company Limited, Second Edition, 2006.

R4. Philip T. Krein, ‘Elements of Power Electronics’, Oxford University Press, First Edition, 2012.

R5. Cyril W Lander: Power Electronics, Third Edition, McGraw Hills International Editions, 1993.

Web Reference(s):

1. http://nptel.ac.in/courses/108101038/1
2. http://www.nptelvideos.in/2012/11/industrial-drives-power-electronics.html
3. http://cusp.umn.edu/power_electronics.php
4. http://ecee.colorado.edu/copec/book/slides/slidedir.html

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	2	2	-	-	2	-	2	-	1	-	-
CO2	2	-	-	2	2	-	-	2	-	2	-	1	-	-
CO3	2	-	-	2	2	-	-	2	-	2	-	1	-	-
CO4	2	-	-	2	2	-	-	2	-	2	-	1	-	-
CO5	2	-	-	2	2	-	-	2	-	2	-	1	-	-

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	**CO .No.**	**Marks**	**Total**
Continuous Comprehensive Evaluation	CCET 1	1,2	50	30
	CCET 2	3,4	50	
	Retest	1,2,3,4	50	
	CCET 3	5	50	
	Assignment	1,2,3,4,5	30	10
End Semester Examination	ESE	1,2,3,4,5	100	60
Total				**100**

Course Code:19MCEN1015	Course Title: VIRTUAL INSTRUMENTATION		
Course Category: Professional Elective		Course Level: Mastery	
L:T:P (Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours: 45	Max. Marks:100

Prerequisites:

The student should have undergone the course(s):

1. Sensors and Signal processing
2. C programming

Course Objectives:

The course is intended to:

1. Summarizing the need for Virtual Instrumentation
2. Create and modify the virtual instruments with program control structures of LabVIEW.
3. Choose the appropriate functions for handling Arrays, Strings and File I/O tasks.
4. Illustrate different communication Interfaces for Virtual Instrumentation.
5. Build a vision system for an automated inspection.

UNIT I GRAPHICAL SYSTEM DESIGN 9 Hours

Graphical System Design Model – Virtual Instrumentation – Virtual Instrument and Traditional Instrument – Hardware and software in virtual instrumentation – Virtual instrumentation for test, control and Design – Conventional and Graphical programming.

UNIT II CONTROL DESIGN 9 Hours

Front Panel and Block Diagram – Tools, Controls and Functions palette. Modular programming – SubVI. Structures – FOR, WHILE Loops, Case, Sequence, event structures, Formula node.

UNIT III ALGORITHM DEVELOPEMENT 9 Hours

Data types, Arrays, Clusters, Strings, File I/O, Time and Dialog controls, Waveform chart, Graph, XY Graph and operations, Web Publishing tool.

UNIT IV DATA ACQUISITION SYSTEM 9 Hours

Instrument control: GPIB – VISA – Instrument drivers – Serial Port communication. Data Acquisition: Review of Transducers and signal conditioning, DAQ hardware – AI, AO, DIO. DAQ Assistant and configuration.

UNIT V LABVIEW APPLICATIONS 9 Hours

Vision Builder for Automated Inspection-Checking for the Presence of a Part-Inspecting Objects for Correct Measurements-Inspecting an Object that Spans Two Image Frames-Branching and Decision Making.

Course Outcomes	**Cognitive Level**
At the end of the course students will be able to	Understand
CO1: Illustarte the advantages of the Virtual Instrumentation.	Understand
CO2: Apply program control structures in LabVIEW.	Understand
CO3: Identify appropriate tools for arrays, strings and File I/O tasks.	Understand
CO4: Select data acquisition system interfaces based on the requirement	Understand
CO5: Construct vision inspection system for automated inspection of objects.	Understand

Text Book(s):

T1. Jovitha Jerome, 'Virtual Instrumentation using LABVIEW' PHI Learning Private Limited, New Delhi, Second Printing, 2011

T2. Gary W Johnson, Richard Jennings, 'LABVIEW Graphical Programming' Fourth Edition, McGraw Hill, 2006

Reference Book(s):

R1. Sanjay Gupta, Joseph John, 'Virtual Instrumentation using LabVIEW' Tata McGraw Hill, 5th Reprint, 2010.

R2. Robert H Bishop. 'Learning with LabVIEW 2009' Pearson Education, 2010.

R3. Salivaganan. S and Arivazhagan.S., "Digital circuits and design" Fourth Edition 2012.

R4. Donald G.Givone, "Digital principles and Design", Tata McGraw Hill 2002.

Web Reference(s):

1. http://www.ni.com/getting-started/labview-basics/environment
2. http://www.ni.com/getting-started/set-up-hardware/
3. http://www.ni.com/getting-started/set-up-hardware/data-acquisition/sensors
4. http://www.ni.com/pdf/manuals/373379h.pdf

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	2	2	-	-	2	2	2	-	1	-	-
CO2	2	-	-	2	2	-	-	2	2	2	-	1	-	-
CO3	2	-	-	2	2	-	-	2	2	2	-	1	-	-
CO4	2	-	-	2	2	-	-	2	2	2	-	1	-	-
CO5	2	-	-	2	2	-	-	2	2	2	-	1	-	-

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	**CO .No.**	**Marks**	**Total**
Continuous Comprehensive Evaluation	CCET 1	1,2	50	30
	CCET 2	3,4	50	
	Retest	1,2,3,4	50	
	CCET 3	5	50	
	Assignment	1,2,3,4,5	30	10
End Semester Examination	ESE	1,2,3,4,5	100	60
Total				**100**

Course Code:19MCEN1016	Course Title: ANALOG AND DIGITAL CIRCUITS		
Course Category: Professional Elective		Course Level: Mastery	
L:T:P (Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours: 45	Max. Marks:100

Prerequisites:

The student should have undergone the course(s):

1. Electric and Electronic Circuits

Course Objectives:

The course is intended to:

1. Explain the concepts of operational amplifier.
2. Classify the different types of operational amplifier.
3. Understand the various number systems and codes.
4. Implement the various combinational and sequential circuits.
5. Explain the basics about synchronous and Asynchronous circuits

UNIT I OPAMP AND ITS CHARACTERISTICS 9 Hours

Basics of BJT Differential amplifier-Internal stages of opamp-Ideal opamp characteristics and its equivalent circuits-DC characteristics- AC characteristics-Concept of frequency compensation and slew rate.

UNIT II APPLICATION OF OPAMP 9 Hours

Sign Changer, Scale Changer, Voltage Follower, V-to-I and I-to-V converters, adder, subtractor, Instrumentation amplifier, Integrator, Differentiator, Comparators, Schmitt trigger.

UNIT III MINIMIZATION TECHNIQUES AND LOGIC GATES 9 Hours

Number systems, Basic digital circuits: Logic circuits - universal building block construction using logic gates - Boolean Algebra- Simplification of Boolean functions - special forms of Boolean functions min term (SOP) max term (POS) - K Map representation of logic functions - simplification of logic functions using K Map – Don't care conditions - Five variable K maps.

UNIT IV COMBINATIONAL AND SEQUENTIAL CIRCUITS 10Hours

Combinational Circuits: Half And Full Adders-Half And Full Subtractors -4 bit Adder & Subtractor – Multiplexer, De-multiplexer – Encoder, Decoder - Code Converters – BCD Adder

Sequential Circuits: SR Latch - Flip-Flops: SR, JK, T, D - Level Triggering, Edge Triggering- Register: Shift Registers – 4 bit binary Counters.

UNIT V SYNCHRONOUS AND ASYNCHRONOUS SEQUENTIAL CIRCUITS **8 Hours**

Design of synchronous and asynchronous sequential circuits - parity checker - sequence detector - Race conditions and Cycles – Hazards.

Course Outcomes	**Cognitive Level**
At the end of the course students will be able to	Understand
CO1: Analyze the characteristics of operational amplifier in terms of AC & DC parameters.	Understand
CO2: Examine the various applications of operational amplifier.	Understand
CO3: Examine the structure of various number systems and its application in digital logic design.	Understand
CO4: Create a gate-level implementation of a combinational and sequential logic function.	Understand
CO5: Differentiate synchronous and asynchronous circuits in a logic design.	Understand

Text Book(s):

T1. Roy Choudhary.D.,SheilB.Jani,"Linear Integrated Circuits",IIedition.New Age,2003.

T2. M. Morris Mano, Michel D. Ciletti, Digital Design, Pearson Education, New Delhi,

Reference Book(s):

R1. Ramakant A. Gayakward,"Op-amps and Linear Integrated Circuits", IV edition, Pearson Education,2003.

R2. Anil.K.Maini,"DigitalElectronis",First Edition, wiley India Pvt,Ltd.,2011

R3. Salivaganan. S and Arivazhagan.S., "Digital circuits and design" Fourth Edition 2012.

R4. Donald G.Givone, "Digital principles and Design", Tata McGraw Hill 2002.

Web Reference(s):

1. http://nptel.ac.in/courses/117106086/1
2. http://nptel.ac.in/courses/117106114/
3. http://nptel.ac.in/courses/117107094/

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	2	2	-	-	2	2	2	-	1	-	-
CO2	2	-	-	2	2	-	-	2	2	2	-	1	-	-
CO3	2	-	-	2	2	-	-	2	2	2	-	1	-	-
CO4	2	-	-	2	2	-	-	2	2	2	-	1	-	-
CO5	2	-	-	2	2	-	-	2	2	2	-	1	-	-

High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	**CO .No.**	**Marks**	**Total**
Continuous Comprehensive Evaluation	CCET 1	1,2	50	30
	CCET 2	3,4	50	
	Retest	1,2,3,4	50	
	CCET 3	5	50	
	Assignment	1,2,3,4,5	30	10
End Semester Examination	ESE	1,2,3,4,5	100	60
Total				**100**

Course Code:19MCEN1017	Course Title: INDUSTRIAL AUTOMATION		
Course Category: Professional Elective		Course Level: Mastery	
L:T:P (Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours: 45	Max. Marks:100

Prerequisites:

The student should have undergone the course(s):

1. Analog and Digital circuits.

Course Objectives:

The course is intended to:

1. Explain the building blocks of Programmable Logic Controllers.
2. Illustrate the types of PLC programming languages.
3. Apply the concept of timer in programmable logic controllers.
4. Apply the concept of counter in programmable logic controllers.
5. Explain the Interface of the peripheral devices with Programmable logic controllers.

UNIT I BASICS OF PLC 9 Hours

Introduction of PLC – PLC vs. Computers – PLC size and application - H/W Components of PLC-I/O Modules – Sourcing and Sinking – CPU – Memory – Communication Interface –Types of Addressing

UNIT II PLC PROGRAMMING 9 Hours

Relay ladder logic – Symbols of I/O types – Digital Logic – The Binary Concept. Relay Ladder programming vs. PLC ladder Programming. Program Scan – Types of PLC Programming - exercises on LD, ST and FBD.

UNIT III PROGRAMMING TIMERS 9 Hours

Introduction to Time delay – Mechanical timing relay –Timer instructions – ON Delay – OFF Delay – Real time Clock – Practices on Real time Applications using ON delay and OFF delay timers.

UNIT IV PROGRAMMING COUNTERS 9 Hours

Introduction to Counters – Types of counters - UP counter, Down counter and UP down Counters – Incremental Encoder applications - Program Control Instruction.

UNIT V PLC INTERFACING 9 Hours

Interfacing of PLC with Sensorics –Speed measurement and Distance measurement - Interfacing of PLC with Pneumatic System -control of linear actuators.

Course Outcomes	**Cognitive Level**
At the end of the course students will be able to:	
CO1: Illustrate the architecture of PLC	Understand
CO2: Explain the types of I/O's and understanding the difference between various PLC programming	Understand
CO3: Compare with different PLC timer concepts.	Apply
CO4: Compare with different PLC counter concepts.	Apply
CO5: Program PLC with interfacing concepts.	Understand

Text Book(s):

T1. Frank D. Petruzella, 'Programmable Logic Controllers', Fourth edition, Tata McGraw Hill, 2010.

T2. John W. Webb, Ronald A. Reis 'Programmable Logic Controllers and Applications', PHI Learning, Fifth Edition, 2009.

Reference Book(s):

R1. T. Hughes, 'Programmable Logic Controllers', ISA press, 4th edition, 2008.

R2. W.Bolton, "Programmable Logic Controllers" Newness (an imprint of Butterworth-Heinemann Ltd)Fifth Edition, 2009.

Web Reference(s):

1. https://nptel.ac.in/courses/112102011/1
2. https://nptel.ac.in/courses/108106022/8
3. https://nptel.ac.in/courses/112104040/29
4. https://www.Assignmentspoint.com/simulation_with_logo_soft/index.asp

Course Articulation Matrix

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO1 2	PSO1	PSO2
CO1	2	1	-	2	2	-	-	2	1	2	-	1	-	-
CO2	2	1	-	2	2	-	-	2	1	2	-	1	-	-
CO3	2	1	-	2	2	-	-	2	1	2	-	1	-	-
CO4	2	1	-	2	2	-	-	2	1	2	-	1	-	-
CO5	1	1	-	1	1	-	-	2	1	2	-	1	-	-

1. High-3; Medium-2; Low-1

Assessment pattern

	Assessment Component	**CO .No.**	**Marks**	**Total**
Continuous Comprehensive Evaluation	CCET 1	1,2	50	30
	CCET 2	3,4	50	
	Retest	1,2,3,4	50	
	CCET 3	5	50	
	Assignment	1,2,3,4,5	30	10
End Semester Examination	ESE	1,2,3,4,5	100	60
Total				**100**

Course Code: 19MEEC1023	Course Title: MODEL BASED SYSTEMS ENGINEERING		
Course Category: Professional Elective		Course Level: Introductory	
L:T:P(Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours: 45	Max Marks:100

Prerequisites

The student should have undergone the courses:

- Nil

Course Objective

The course is intended to

1. Explain the basis of system modeling
2. Explain the system specification
3. Develop a system architecture
4. Develop a handoff to downstream engineering
5. Demonstration of meeting needs

UNIT I BASICS OF SYSTEMS MODELING 9 Hours

Concept Generation and Selection-Product Architecture - Design for Manufacturing and Product Development– Managing backlog - Managing risk- Product roadmap- Release plan – Iteration plan – Estimating effort – Work item prioritization- Organizing your models.

UNIT II SYSTEM SPECIFICATION 9 Hours

Functional analysis with scenarios, activities, state machine and user stories- Model based safety and threat analysis- specific logical system interfaces – Creating the logical data schema- Technological forecasting.

UNIT III DEVELOPING SYSTEM ARCHITECTURES 9 Hours

General architectural guidelines – Architectural merging – Pattern driven architecture – Subsystem and component architecture – Architectural allocation - Creating subsystem interfaces.

UNIT IV HANDOFF TO DOWNSTREAM ENGINEERING 9 Hours

Preparation for handoff – Federating models for handoff – Logical to physical interfaces – Deployment architecture – Allocation to engineering facets – Interdisciplinary interfaces.

UNIT V VERIFICATION AND VALIDATION 9 Hours

Demonstration of meeting needs- Model simulation – Model based testing – Computable constraint modeling – Traceability – Effective reviews – Test driven models.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Explain the purpose, inputs & preconditions and outputs & post conditions of model based systems engineering	Understand
CO2: Explain the purpose, inputs & preconditions and outputs & post conditions of functional analysis and threat analysis	Understand
CO3: Explain the purpose, inputs & preconditions and outputs & post conditions of critical views of architecture	Understand
CO4: Explain the purpose, inputs & preconditions and outputs & post conditions of activities regarding the handoff to downstream engineering.	Understand
CO5: Explain the purpose, inputs & preconditions and outputs & post conditions of verification and validation.	Understand

Text Book(s):

T1. Bruce Powel Douglass, ”Agile Model-Based Systems Engineering Cookbook” ,Packt Publishing Ltd, UK, 1st edition, 2021.

T2. Tim Weikiens, Jesko G Lamm, Stephan Roth, Markus Walker ,”Model-Base Systems Architecture ” , John Wiley & Sons, Inc., Hoboken, New Jersey, 1st edition, 2016.

Reference(s):

R1. John Holt,” Systems Engineering Demystified” ,Packt Publishing Ltd, UK, 1st edition, 2021.Andrew P Sage and James E Armstrong,” Introduction to Systems Engineering”, John Wiley & Sons, Inc., Hoboken, New Jersey, 1st edition, 2017

Course Articulation Matrix

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO1 2	PSO1	PSO2
CO1	2	1	-	2	2	-	-	2	1	2	-	1	-	-
CO2	2	1	-	2	2	-	-	2	1	2	-	1	-	-
CO3	2	1	-	2	2	-	-	2	1	2	-	1	-	-
CO4	2	1	-	2	2	-	-	2	1	2	-	1	-	-
CO5	1	1	-	1	1	-	-	2	1	2	-	1	-	-

1. **High-3; Medium-2; Low-1**

Assessment pattern

	Assessment Component	**CO .No.**	**Marks**	**Total**
Continuous Comprehensive Evaluation	CCET 1	1,2	50	30
	CCET 2	3,4	50	
	Retest	1,2,3,4	50	
	CCET 3	5	50	
	Assignment	1,2,3,4,5	30	10
End Semester Examination	ESE	1,2,3,4,5	100	60
Total				**100**