HINDUSTHAN COLLEGE OF ENGINEERING AND TECHNOLOGY

(An Autonomous Institution, Affiliated to Anna University, Chennai
Approved by AICTE, New Delhi & Accredited by NAAC with 'A' Grade)
Coimbatore – 641 032

B.E. MECHANICAL ENGINEERING

HINDUSTHAN EDUCATIONAL AND CHARITABLE TRUST

HICET

Curriculum & Syllabus

2020-2021

CHOICE BASED CREDIT SYSTEM

VISION OF THE INSTITUTE

To become a premier institution by producing professionals with strong technical knowledge, innovative research skills and high ethical values.

MISSION OF THE INSTITUTE

- To provide academic excellence in technical education through novel teaching methods.
- To empower students with creative skills and leadership qualities.
- To produce dedicated professionals with social responsibility.

VISION OF THE DEPARTMENT

To provide quality technical education in Mechanical Engineering and build holistic professionals who can excel in the engineering establishments and serve for the country with ethical values.

MISSION OF THE DEPARTMENT

M1: To prepare graduates with good technical skills and knowledge.

M2: To prepare graduates with life-long learning skills to meet the requirements in the higher education and in society.

M3: To prepare graduates as successful entrepreneur with employment skills, ethics and human values.

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PROGRAMME EDUCATIONAL OBJECTIVES

PEO 1: Exhibit their sound theoretical, practical skills and knowledge for Successful employments, higher studies, research and entrepreneurial assignments.

PEO 2: Lifelong learning skills, professional ethics and good communication Capabilities along with entrepreneur skills and leadership, so that they can succeed in their life.

PEO 3: Become leaders and innovators by devising engineering solutions for social issues and problems, thus caring for the society.

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PROGRAMME OUTCOMES

Engineering Graduates will be able to:

PO 1. 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.

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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.

PROGRAMME SPECIFIC OUTCOMES

PSO 1: To design, analyze and apply knowledge in complex engineering problems with time effective software solutions.

PSO 2: To understand the relevance of engineering practices with society and environment and become an ethical team oriented effectively communicating individual with managerial skills and sustained learning ability.

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CURRICULUM

DETAILS OF CHANGES CARRIED OUT IN CURRICULUM & SYLLABUS

CBCS PATTERN

UNDER GRADUATE PROGRAMMES

DEPARTMENT OF MECHANICAL ENGINEERING (UG)

REGULATION 2016 & 2019
REGULATION 2019
For the students admitted during the academic year 2020-2021 and onwards

SEMESTER I

S.No.	Course Code	Course Title	Course Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	19HE1101	Technical English	HS	2	1	0	3	25	75	100
2	19MA1102	Calculus and Linear Algebra	BS	3	1	0	4	25	75	100
THEORY WITH LAB COMPONENT										
3	19PH1151	Applied Physics	BS	2	0	2	3	50	50	100
4	19CY1151	Engineering Chemistry	BS	2	0	2	3	50	50	100
5	19CS1151	Problem Solving and Python Programming	ES	2	0	2	3	50	50	100
6	19ME1152	Engineering Drawing	ES	1	0	4	3	50	50	100
PRACTICAL										
7	19HE1071	Value added course I: Language Competency Enhancement Course - I	HS	0	0	2	1	100	0	100
MANDATORY										
8	19MC1191	Induction Program	MC	0	0	0	0	0	0	0
9	19HE1072	Career Guidance – Level I	EEC	2	0	0	0	100	0	100
10	19HE1073	Entrepreneurship & Innovation	EEC	1	0	0	0	100	0	100
Total				**15**	**2**	**12**	**20**	**550**	**350**	**900**

SEMESTER II

S.No	Course Code	Name of the Course	Course Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	19HE2101	Business English for Engineers	HS	2	1	0	3	25	75	100
2	19MA2101	Differential Equations and Complex Variables	BS	3	1	0	4	25	75	100

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3	19EE2103	Basics of Electrical and Electronics Engineering	ES	3	0	0	3	25	75	100
4	19ME2101	Engineering Mechanics	ES	3	0	0	3	25	75	100
THEORY & LAB COMPONENT										
5	19PH2151	Material Science	BS	2	0	2	3	50	50	100
6	19CY2151	Environmental Studies	BS	2	0	2	3	50	50	100
PRACTICAL										
7	19ME2001	Engineering Practices Laboratory	ES	0	0	4	2	50	50	100
8	19HE2071	Language Competency Enhancement Course - II	HS	0	0	2	1	100	0	100
9	19HE2072	Career Guidance – Level II	EEC	2	0	0	0	100	0	100
Total				**17**	**2**	**10**	**22**	**450**	**450**	**900**

For the students admitted during the academic year 2019-2020 and onwards

SEMESTER III

S.No	Course Code	Name of the Course	Course Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	19MA3101	Fourier Series and Statistics	BS	3	1	0	4	25	75	100
2	19ME3201	Manufacturing Technology-I	PC	3	0	0	3	25	75	100
3	19ME3202	Engineering Thermodynamics	PC	3	0	0	3	25	75	100
4	19ME3203	Engineering Materials and Metallurgy	PC	3	0	0	3	25	75	100
THEORY & LAB COMPONENT										
5	19ME3251	Fluid Mechanics and Machinery	PC	3	0	2	4	50	50	100
PRACTICAL										
6	19ME3001	Manufacturing Technology Lab – I	PC	0	0	3	1.5	50	50	100
7	19ME3002	Computer Aided Drawing Lab	PC	0	0	3	1.5	50	50	100
MANDATORY										
8	19MC3191	Indian Constitution	MC	2	0	0	0	0	0	0
Total Credits				**17**	**1**	**8**	**20**	**250**	**450**	**700**

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SEMESTER IV

S.No	Course Code	Name of the Course	Course Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	19MA4101	Numerical Methods	BS	3	1	0	4	25	75	100
2	19ME4201	Manufacturing Technology – II	PC	3	0	0	3	25	75	100
3	19ME4202	Thermal Engineering	PC	3	0	0	3	25	75	100
4	19ME4203	Kinematics of Machinery	PC	3	1	0	4	25	75	100
THEORY & LAB COMPONENT										
5	19ME4251	Strength of Materials	PC	3	0	2	4	50	50	100
PRACTICAL										
6	19ME4001	Manufacturing Technology Lab–II	PC	0	0	3	1.5	50	50	100
7	19ME4002	Thermal Engineering Lab	PC	0	0	3	1.5	50	50	100
MANDATORY										
8	19MC4191	Value Education - Essence of Indian Traditional Knowledge	MC	2	0	0	0	0	0	0
Total Credits				**17**	**1**	**8**	**21**	**250**	**450**	**700**

For the students admitted during the academic year 2018-2019 and onwards

SEMESTER V

S.No	Course Code	Course Title	Course Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	16ME5201	CAD/CAM	PC	3	0	0	3	25	75	100
2	16ME5202	Heat and Mass Transfer	PC	3	0	0	3	25	75	100
3	16ME5203	Dynamics of Machines	PC	3	0	0	3	25	75	100
4	16ME5204	Design of Machine Elements	PC	3	0	0	3	25	75	100
5	16ME5205	Automobile Engineering	PC	3	0	0	3	25	75	100
6	16ME53XX	**Professional Elective – I**	PE	3	0	0	3	25	75	100
PRACTICAL										
7	16ME5001	CAD/CAM Laboratory	PC	0	0	4	2	50	50	100
8	16ME5002	Thermal Engineering Laboratory-II	PC	0	0	4	2	50	50	100
9	16ME5003	Dynamics Lab	PC	0	0	4	2	50	50	100
Total				**18**	**0**	**12**	**24**	**300**	**600**	**900**

SEMESTER VI

S.No	Coure Code	Course Title	Course Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	16ME6201	Finite Element Analysis	PC	3	0	0	3	25	75	100

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2	16ME6202	Metrology and Quality Control	PC	3	0	0	3	25	75	100
3	16ME6203	Hydraulic and Pneumatic Controls	PC	3	0	0	3	25	75	100
4	16ME6204	Design of Transmission Systems	PC	3	0	0	3	25	75	100
5	16ME63XX	**Professional Elective – II**	PE	3	0	0	3	25	75	100
6	16XX64XX	**Open Elective -I**	OE	3	0	0	3	25	75	100
PRACTICAL										
7	16ME6001	Simulation and Analysis Lab	PC	0	0	4	2	50	50	100
8	16ME6002	Metrology Lab	PC	0	0	4	2	50	50	100
9	16ME6003	Design and Fabrication Project	PC	0	0	4	2	50	50	100
Total Credits				**18**	**0**	**12**	**24**	**300**	**600**	**900**

LIST OF PROFESSIONAL ELECTIVES

S.No.	Course Code	Course Title	Course Category	L	T	P	C	CIA	ESE	TOTAL
ELECTIVE I										
1	16ME5301	Advanced Foundry Technology	PE	3	0	0	3	25	75	100
2	16ME5302	Metal Forming Processes	PE	3	0	0	3	25	75	100
3	16ME5303	Unconventional Machining Processes	PE	3	0	0	3	25	75	100
4	16ME5304	CNC Technology	PE	3	0	0	3	25	75	100
5	16ME5305	Advanced Welding Technology	PE	3	0	0	3	25	75	100
ELECTIVE II										
1	16ME6301	Refrigeration and Air Conditioning	PE	3	0	0	3	25	75	100
2	16ME6302	Advanced I.C. Engines	PE	3	0	0	3	25	75	100
3	16ME6303	Design of Heat Exchangers	PE	3	0	0	3	25	75	100
4	16ME6304	Gas Dynamics and Jet Propulsion	PE	3	0	0	3	25	75	100
5	16ME6305	Computational Fluid Dynamics	PE	3	0	0	3	25	75	100

LIST OF OPEN ELECTIVES

S.No.	Course Code	Course Title	Course Category	L	T	P	C	CIA	ESE	TOTAL
1	16ME6401	Rapid Prototyping and Lean Manufacturing	OE	3	0	0	3	25	75	100

For the students admitted during the academic year 2017-2018 and onwards

SEMESTER VII

S.No	Course Code	Course Title	Course Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	16ME7201	Entrepreneurship and Business Concepts	PC	3	0	0	3	25	75	100
2	16ME7202	Power Plant Engineering	PC	3	0	0	3	25	75	100
3	16ME7203	Principles of Management	PC	3	0	0	3	25	75	100

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4	16ME73XX	**Professional Elective- III**	PE	3	0	0	3	25	75	100
5	16ME73XX	**Professional Elective -IV**	PE	3	0	0	3	25	75	100
6	16XX74XX	**Open Elective -II**	OE	3	0	0	3	25	75	100
PRACTICAL										
7	16ME7001	Comprehension Lab	PC	0	0	4	2	50	50	100
8	16ME7901	Project Work – Phase I	EEC	0	0	6	3	50	50	100
			Total	**18**	**0**	**10**	**23**	**250**	**550**	**800**

SEMESTER VIII

S.No	Course Code	Course Title	Course Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	16ME83XX	**Professional Elective -V**	PE	3	0	0	3	25	75	100
2	16ME83XX	**Professional Elective- VI**	PE	3	0	0	3	25	75	100
PRACTICAL										
3	16ME8902	Project Work – Phase II	EEC	0	0	24	6	100	100	200
			Total	**6**	**0**	**24**	**12**	**150**	**250**	**400**

LIST OF PROFESSIONAL ELECTIVES

S.No.	Course Code	Course Title	Course Category	L	T	P	C	CIA	ESE	TOTAL
ELECTIVE III										
1	16ME7301	Design of Jigs, Fixtures and Press Tools	PE	3	0	0	3	25	75	100
2	16ME7302	Design for Manufacture and Assembly	PE	3	0	0	3	25	75	100
3	16ME7303	Tool and Die Design	PE	3	0	0	3	25	75	100
4	16ME7304	Design of Material Handling Equipments	PE	3	0	0	3	25	75	100
5	16ME7305	Industrial Robotics and Expert Systems	PE	3	0	0	3	25	75	100
ELECTIVE IV										
1	16ME7306	Operations Research	PE	3	0	0	3	25	75	100
2	16ME7307	Industrial Engineering	PE	3	0	0	3	25	75	100
3	16ME7308	Production Planning and Control	PE	3	0	0	3	25	75	100
4	16ME7309	Total Quality Management	PE	3	0	0	3	25	75	100
5	16ME7310	Experimental Methods for Engineers	PE	3	0	0	3	25	75	100
ELECTIVE V										
1	16ME8301	Maintenance Engineering	PE	3	0	0	3	25	75	100
2	16ME8302	Industrial Safety Engineering	PE	3	0	0	3	25	75	100
3	16ME8303	Industrial Ergonomics	PE	3	0	0	3	25	75	100
4	16ME8304	Metrology and Non Destructive Testing	PE	3	0	0	3	25	75	100
5	16ME8305	Logistics and Supply Chain Management	PE	3	0	0	3	25	75	100

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ELECTIVE VI										
1	16ME8306	Two and Three Wheeler Vehicle Technology	PE	3	0	0	3	25	75	100
2	16ME8307	Manufacturing of Automotive Components	PE	3	0	0	3	25	75	100
3	16ME8308	Hybrid Vehicles	PE	3	0	0	3	25	75	100
4	16ME8309	Vehicle Maintenance	PE	3	0	0	3	25	75	100
5	16ME8310	Heating, Ventilation and Air Conditioning Systems	PE	3	0	0	3	25	75	100

LIST OF OPEN ELECTIVES

S.No.	Course Code	Course Title	Course Category	L	T	P	C	CIA	ESE	TOTAL
1	16ME7402	Renewable Energy Sources	OE	3	0	0	3	25	75	100

CREDIT DISTRIBUTION

R-2019

Semester	I	II	III	IV	V	VI	VII	VIII	Total
Credits	20	22	20	21	22	22	20	18	**165**

R-2016

Semester	I	II	III	IV	V	VI	VII	VIII	Total
Credits	27	25	27	25	24	24	23	12	**187**

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Principal

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COIMBATORE - 641 032.

SYLLABUS

Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19HE1101	TECHNICAL ENGLISH	2	1	0	3

(COMMON TO ALL BRANCHES)

Course Objective

- ✓ To facilitate students to communicate effectively with coherence.
- ✓ To train the learners in descriptive communication.
- ✓ To introduce professional communication.
- ✓ To enhance knowledge and to provide the information on corporate environment.
- ✓ To equip the trainers with the necessary skills on critical thinking.

Unit	Description	Instructional Hours
I	**Listening and Speaking** – Opening a conversation, maintaining coherence, turn taking, closing a conversation (excuse, general wishes, positive comments and thanks) **Reading** –Reading articles from newspaper, Reading comprehension **Writing** Chart analysis, process description, Writing instructions **Grammar and Vocabulary-** Tenses, Regular and irregular verb, technical vocabulary	9
II	**Listening and Speaking-** listening to product description, equipment & work place (purpose, appearance, function) **Reading-** Reading technical articles **Writing-** Letter phrases, writing personal letters, **Grammar and Vocabulary**-articles, Cause & effect, Prepositions.	9
III	**Listening and Speaking-** - listening to announcements **Reading-** Reading about technical inventions, research and development **Writing-** Letter inviting a candidate for interview, Job application and resume preparation **Grammar and Vocabulary-** Homophones and Homonyms.	9
IV	**Listening and Speaking-** - Practice telephone skills and telephone etiquette (listening and responding, asking questions).**Reading-** Reading short texts and memos **Writing-** invitation letters, accepting an invitation and declining an invitation **Grammar and Vocabulary-** Modal verbs, Collocation, Conditionals, Subject verb agreement and Pronoun-Antecedent agreement.	9
V	**Listening and Speaking-** listening to technical group discussions and participating in GDs **Reading-** reading biographical writing - **Writing-** Proposal writing, Writing definitions, **Grammar and Vocabulary-** Abbreviation and Acronym, Prefixes & suffixes, phrasal verbs.	9
	Total Instructional Hours	**45**

Course Outcome

CO1- Trained to maintain coherence and communicate effectively.

CO2- Practiced to create and interpret descriptive communication.

CO3- Introduced to gain information of the professional world.

CO4- acquired various types of communication and etiquette.

CO5- Taught to improve interpersonal and intrapersonal skills.

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TEXT BOOKS:

T1- Norman Whitby, "Business Benchmark-Pre-intermediate to Intermediate",Cambridge University Press, 2014

T2- Rizvi, Ashraf. M. Effective Technical Communication. Tata McGraw-Hill, 2005.

REFERENCE BOOKS:

R1 -Meenakshi Raman and Sangeetha Sharma. "Technical Communication- Principles and Practice", Oxford University Press, 2009.

R2 -Raymond Murphy, "English Grammar in Use"- 4th edition Cambridge University Press, 2004

R3 -Kamalesh Sadanan "A Foundation Course for the Speakers of Tamil -Part-I &II", Orient Blackswan, 2010.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19MA1102	CALCULUS AND LINEAR ALGEBRA	3	1	0	4

Course Objective

- ✓ Understand the concept of differentiation.
- ✓ Evaluate the functions of several variables which are needed in many branches of engineering.
- ✓ Understand the concept of double integrals.
- ✓ Understand the concept of triple integrals.
- ✓ Develop the skill to use matrix algebra techniques that is needed by engineers for practical applications.

Unit	Description	Instructional Hours
I	**DIFFERENTIAL CALCULUS** Rolle's Theorem – Lagrange's Mean Value Theorem- Maxima and Minima – Taylor's and Maclaurin's Theorem	12
II	**MULTIVARIABLE CALCULUS (DIFFERENTIATION)** Total derivatives - Jacobians – Maxima, M inima and Saddle points - Lagrange's method of undetermined multipliers – Gradient, divergence, curl and derivatives.	12
III	**DOUBLE INTEGRATION** Double integrals in Cartesian coordinates – Area enclosed by the plane curves (excluding surface area) – Green's Theorem (Simple Application) - Stoke's Theorem – Simple Application involving cubes and rectangular parellopiped.	12
IV	**TRIPLE INTEGRATION** Triple integrals in Cartesian co-ordinates – Volume of solids (Sphere, Ellipsoid, Tetrahedron) using Cartesian co-ordinates. Gauss Divergence Theorem – Simple Application involving cubes and rectangular parellopiped.	12
V	**MATRICES** Eigen values and Eigen vectors – Properties of Eigen values and Eigen vectors (without proof) -Cayley - Hamilton Theorem (excluding proof) - Reduction of a quadratic form to canonical form by orthogonal transformation.	12
	Total Instructional Hours	**60**

Course Outcome

CO1- Apply the concept of differentiation in any curve.

CO2- Identify the maximum and minimum values of surfaces.

CO3- Apply double integrals to compute area of plane curves.

CO4- Evaluation of triple integrals to compute volume of solids.

CO5- Calculate Eigen values and Eigen vectors for a matrix which are used to determine the natural frequencies (or Eigen frequencies) of vibration and the shapes of these vibrational modes.

TEXT BOOKS:

T1 - Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, Wiley India Private Ltd., New Delhi, 2018.

T2 - Veerarajan T, "Engineering Mathematics ", McGraw Hill Education(India) Pvt Ltd, New Delhi, 2016.

REFERENCE BOOKS :

R1- Erwin Kreyszig, "Calculus", 10th Edition, Wiley India Private Ltd., New Delhi, 2017.

R2 - Bali N.P & Manish Goyal, "A Text book of Engineering Mathematics", 8th Edition, Laxmi Pub. Pvt. Ltd. 2011.

R3 - Grewal B.S, "Higher Engineering Mathematics", 42nd Edition, Khanna Publications, Delhi, 2012.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19PH1151	APPLIED PHYSICS	2	0	2	3

Course Objective

- ✓ Enhance the fundamental knowledge in properties of matter
- ✓ Analysis the oscillatory motions of particles
- ✓ Extend the knowledge about wave optics
- ✓ Gain knowledge about laser and their applications
- ✓ Conversant with principles of optical fiber, types and applications of optical fiber

Unit	Description	Instructional Hours
	PROPERTIES OF MATTER	
I	Elasticity – Hooke's law – Stress-strain diagram - Poisson's ratio – Bending moment –Depression of a cantilever – Derivation of Young's modulus of the material of the beam by Uniform bending theory and experiment. Determination of Young's modulus by uniform bending method	9
II	**OSCILLATONS** Translation motion –Vibration motion – Simple Harmonic motion – Differential Equation of SHM and its solution – Damped harmonic oscillation - Torsion stress and deformations – Torsion pendulum: theory and experiment. Determination of Rigidity modulus – Torsion pendulum	9
III	**WAVE OPTICS** Conditions for sustained Interference – air wedge and it's applications - Diffraction of light – Fresnel and Fraunhofer diffraction at single slit –Diffraction grating – Rayleigh's criterion of resolution power - resolving power of grating. Determination of wavelength of mercury spectrum – spectrometer grating Determination of thickness of a thin wire – Air wedge method	9
IV	**LASER AND APPLICATIONS** Spontaneous emission and stimulated emission – Population inversion – Pumping methods – IV DerivationofEinstein'scoefficients(A&B)–Typeoflasers– Nd:YAGlaserandCO2laser- Laser Applications – Holography – Construction and reconstructionofimages. Determination of Wavelength and particle size using Laser	9
V	**FIBER OPTICS AND APPLICATIONS** Principle and propagation of light through optical fibers – Derivation of numerical aperture andacceptance angle – Classification of optical fibers (based on refractive index, modes and materials) – Fiber optical communication link – Fiber optic sensors – Temperature and displacement sensors	9
	Total Instructional Hours	**45**

Course Outcome

CO1- Illustrate the fundamental properties of matter.

CO2- Discuss the Oscillatory motions of particles.

CO3- Analyze the wavelength of different colors.

CO4- Understand the advanced technology of LASER in the field of Engineering.

CO5- Develop the technology of fiber optical communication in engineering field.

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TEXT BOOKS:

T1 - Rajendran V, Applied Physics, Tata McGraw Hill Publishing Company Limited, New Delhi, 2017.

T2- Gaur R.K. and Gupta S.L., Engineering Physics, 8th edition, DhanpatRaiPublications(P) Ltd., New Delhi,2015.

REFERENCE BOOKS:

R1 - Arthur Beiser "Concepts of Modern Physics" Tata McGraw Hill, New Delhi – 2015

R2 - M.N Avadhanulu and PG Kshirsagar "A Text Book of Engineering physics" S. Chand and Company ltd., New Delhi, 2016

R3 - Dr. G. Senthilkumar "Engineering Physics – I" VRB publishers Pvt Ltd., 2016

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Programme	Course Code	Name of the Course	L	T	P	C
BE/B.Tech	19CY1151	CHEMISTRY FOR ENGINEERS (COMMON TO ALL BRANCHES)	2	0	2	3

Course Objective

1. The boiler feed water requirements, related problems and water treatment techniques.
2. The principles of polymer chemistry and engineering applications of polymers and composites.
3. The principles of electrochemistry and with the mechanism of corrosion and its control.
4. The principles and generation of energy in batteries, nuclear reactors, solar cells, wind mills and fuel cells.
5. The important concepts of spectroscopy and its applications.

Unit	Description	Instructional Hours
I	**WATER TECHNOLOGY** Hard water and soft water- Disadvantages of hard water- Hardness: types of hardness, simple calculations, estimation of hardness of water – EDTA method – Boiler troubles - Conditioning methods of hard water – External conditioning - demineralization process - desalination: definition, reverse osmosis – Potable water treatment – breakpoint chlorination. **Estimation of total, permanent and temporary hardness of water by EDTA.**	6 +3=9
II	**POLYMER & COMPOSITES** Polymerization – types of polymerization – addition and condensation polymerization – mechanism of free radical addition polymerization – copolymers – plastics: classification – thermoplastics and thermosetting plastics, preparation, properties and uses of commercial plastics – PVC, Bakelite – moulding of plastics (extrusion and compression); Composites: definition, types of composites – polymer matrix composites (PMC) –FRP	6
III	**ELECTROCHEMISTRY AND CORROSION** Electrochemical cells – reversible and irreversible cells - EMF- Single electrode potential – Nernst equation (derivation only) – Conductometric titrations. Chemical corrosion – Pilling – Bedworth rule – electrochemical corrosion – different types –galvanic corrosion – differential aeration corrosion – corrosion control – sacrificial anode and impressed cathodic current methods - protective coatings – paints – constituents and functions. **Conductometric titration of strong acid vs strong base (HCl vs NaOH). Conductometric precipitation titration using $BaCl_2$ and Na_2SO_4. Estimation of Ferrous iron by Potentiometry.**	6+9 =15
IV	**ENERGY SOURCES AND STORAGE DEVICES** Introduction- nuclear energy- nuclear fission- controlled nuclear fission- nuclear fusion differences between nuclear fission and fusion- nuclear chain reactions- nuclear reactor power generator- classification of nuclear reactor- light water reactor- breeder reactor. Batteries and fuel cells: Types of batteries- alkaline battery- lead storage battery- lithium battery- fuel cell H_2 -O_2 fuel cell applications.	6
V	**ANALYTICAL TECHNIQUES** Beer-Lambert's law – UV-visible spectroscopy and IR spectroscopy – principle – instrumentation (block diagram only) – flame photometry – principle – instrumentation (block diagram only) – estimation of sodium by flame photometry – atomic absorption spectroscopy – principles – instrumentation (block diagram only) – estimation of nickel by atomic absorption spectroscopy. **Determination of iron content of the water sample using spectrophotometer.(1,10 phenanthroline / thiocyanate method).**	6+3
	Total Instructional Hours	**45**

Course Outcome

CO1: Differentiate hard and soft water and to solve the related problems on water purification and its significance in industries and daily life

CO2: Acquire the basic knowledge of polymers, composites and FRP and their significance.

CO3: Develop knowledge on the basic principles of electrochemistry and understand the causes of corrosion, its consequences to minimize corrosion to improve industrial design.

CO4: Develop knowledge about the renewable energy resources and batteries along with the need of new materials to improve energy storage capabilities.

CO5: Identify the structure and characteristics of unknown/new compound with the help of spectroscopy.

TEXT BOOKS

T1 - P.C.Jain and Monica Jain, "Engineering Chemistry" Dhanpat Rai Pub, Co., New Delhi (2018).

REFERENCE BOOKS

R1 - B.Sivasankar "Engineering Chemistry" Tata McGraw-Hill Pub.Co.Ltd, New Delhi (2012).
R2 - S.S.Dara "A Text book of Engineering Chemistry" S.Chand & Co. Ltd., New Delhi (2017).

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19CS1151	PROBLEM SOLVING AND PYTHON PROGRAMMING	2	0	2	3

Course Objective

- ✓ To know the basics of algorithmic problem solving.
- ✓ To read and write simple Python programs
- ✓ To develop Python programs with conditionals and loops and to define Python functions and call them
- ✓ To use Python data structures — lists, tuples, dictionaries
- ✓ To do input/output with files in Python

Unit	Description	Instructional Hours
I	**ALGORITHMIC PROBLEM SOLVING** Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation(pseudo I code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms(iteration,recursion).Illustrativeproblems:findminimuminalist,insertacardinalistof sorted cards, guess an integer number in a range, Towers of Hanoi..	9
II	**DATA, EXPRESSIONS, STATEMENTS** Python interpreter and interactive mode; values and types: int, float, boolean, string, and list; variables, II expressions, statements, tuple assignment, precedence ofoperators, comments; modules and functions, function definition and use, flow of execution, parameters and arguments. Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.	9
III	**CONTROL FLOW, FUNCTIONS** 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, sum an array of numbers, linear search, binary search.	9
IV	**LISTS, TUPLES, DICTIONARIES** Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; IV Tuples: tuple assignment, tuple as return value; Dictionaries:operationsandmethods; advanced list processing - list comprehension; Illustrative programs: selection sort, insertionsort, merge sort, histogram.	9
V	**FILES, MODULES, PACKAGES** Files and exception: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages. Illustrative programs: word count, copying file contents.	9
	Total Instructional Hours	**45**

Course Outcome

CO1- Develop algorithmic solutions to simplecomputational problems.

CO2- Read, write, execute by hand simple Python programs.

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CO3- Analyze the wavelength of different colors.

CO4- Understand the advanced technology of LASER in the field of Engineering.

CO5- Develop the technology of fiber optical communication in engineering field.

TEXT BOOKS:

T1: Guido van Rossum and Fred L. Drake Jr, An Introduction to Python – Revised and updated for Python 3.6.2, Shroff Publishers, First edition(2017).

T2:S. Annadurai, S.Shankar, I.Jasmine, M.Revathi, Fundamentals of Python Programming, Mc-Graw Hill Education (India) Private Ltd, 2019.

REFERENCE BOOKS:

R1: Charles Dierbach, —Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition,2013.

R2: Timothy A. Budd, —Exploring Python‖, Mc-Graw Hill Education (India) Private Ltd.,2015

R3: Robert Sedgewick ,KevinWayne, RobertDondero,—Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd.,2016

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19ME1152	ENGINEERING DRAWING	1	0	4	3

Course Objective

- ✓ To gain the knowledge of Engineer's language of expressing complete details about objects and construction of conics and special curves.
- ✓ To learn about the orthogonal projections of straight lines and planes.
- ✓ To aquire the knowledge of projections of simple solid objects in plan andelevation.
- ✓ To learn about the projection of sections of solids and development ofsurfaces.
- ✓ To study the isometric projections of different objects.

Unit	Description	Instructional Hours
I	**PLANE CURVES** Importance of engineering drawing; drafting instruments; drawing sheets – layout and folding; Lettering and dimensioning, BIS standards, scales. Geometrical constructions, Engineering Curves Conic sections – Construction of ellipse, parabola and hyperbola by eccentricity method. Construction of cycloids and involutes of square and circle – Drawing of tangents and normal to the above curves.	12
II	**PROJECTIONS OF POINTS, LINES AND PLANE SURFACES** Introduction to Orthographic projections- Projection of points. Projection of straight lines inclined to both the planes, Determination of true lengths and true inclinations by rotating line method. Projection of planes (polygonal and circular surfaces) inclined to both the planes by rotating object method (First angle projections only).	12
III	**PROJECTIONS OF SOLIDS** Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is perpendicular and inclined to one plane by rotating object method..	12
IV	**SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES** Sectioning of simple solids with their axis in vertical position when the cutting plane is inclined to one of the principal planes and perpendicular to the other – Obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids, cylinder and cone. Development of lateral surfaces of truncated solids.	12
V	**ISOMETRIC AND ORTHOGRAPHIC PROJECTIONS** Isometric views and projections simple and truncated solids such as - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions. Free hand sketching of multiple views from a pictorial drawing. Basics of drafting using AutoCAD software.	12
	Total Instructional Hours	**60**

Course Outcome

CO1- Understand and interpret the engineering drawings in order to visualize the objects and draw the conics and special curves.

CO2- Draw the orthogonal projections of straight lines and planes.

CO3- Interpret the projections of simple solid objects in plan and elevation.

CO4- Draw the projections of section of solids and development of surfaces of solids.

CO5- Draw the isometric projections and the perspective views of different objects.

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TEXT BOOK:

T1. K.Venugopal, V.Prabu Raja, "Engineering Drawing, AutoCAD, Building Drawings", 5th edition New Age International Publishers, New delhi 2016.

T2. K.V.Natarajan, "A textbook of Engineering Graphics", Dhanlaksmi Publishers, Chennai 2016.

REFERENCES:

R1. Basant Agrawal and C.M.Agrawal, "Engineering Drawing", Tata McGraw Hill Publishing company Limited,New Delhi 2013.

R2. N.S. Parthasarathy, Vela Murali, "Engineering Drawing", Oxford University PRESS, India 2015

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19HE1071	LANGUAGE COMPETENCY ENHANCEMENT COURSE- I (COMMON TO ALL BRANCHES)	0	0	2	1

Course Objective

- ✓ To enhance student language competency
- ✓ To train the students in LSRW skills
- ✓ To develop student communication skills
- ✓ To empower the trainee in business writing skills.
- ✓ To train the students to react to different professional situations

Unit	Description	Instructional Hours
I	**Listening** Listening to technical group discussions and participating in GDs. listening to TED talks. Listen to Interviews & mock interview. Listening short texts and memos.	3
II	**Reading** Reading articles from newspaper, magazine. Reading comprehension. Reading about technical inventions, research and development. Reading short texts and memos.	3
III	**Writing** E-mail writing: Create and send email writing (to enquire about some details, to convey important message to all, to place an order, to share your joy and sad moment). Reply for an email writing.	3
IV	**Speaking** To present a seminar in a specific topic (what is important while choosing or deciding something to do). To respond or answer for general questions (answer for your personal details, about your family, education, your hobbies, your aim etc.,).	3
V	**Speaking** Participate in discussion or interactions (agree or disagree express your statement with a valid reason, involve in discussion to express your perspective on a particular topics).	3
	Total Instructional Hours	**15**

Course Outcome

CO1- Trained to maintain coherence and communicate effectively.
CO2- Practiced to create and interpret descriptive communication.
CO3- Introduced to gain information of the professional world.
CO4- acquired various types of communication and etiquette.
CO5- Taught to improve interpersonal and intrapersonal skills.

TEXT BOOKS:

T1- Norman Whitby, "Business Benchmark-Pre-intermediate to Intermediate", Cambridge University Press, 2016.

T2- Raymond Murphy, "Essential English Grammar", Cambridge University Press, 2019.

REFERENCE BOOKS :

R1- Meenakshi Raman and Sangeetha Sharma. "Technical Communication- Principles and Practice", Oxford University Press, 2009.

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19HE1072	CAREER GUIDANCE – LEVEL I Personality, Aptitude and Career Development	L T P C 2 0 0 0

Course Objectives

1. Introduce students to building blocks of Logical reasoning and Quantitative Aptitude
2. Train students on essential grammar for placements
3. Introduce students on scientific techniques to pick up skills
4. Provide an orientation for recruiter expectation in terms of non-verbal skills, and for how to build one's career with placements in mind

MODULE I LESSONS ON EXCELLENCE (01)

Skill introspection, Skill acquisition, consistent practice

MODULE II LOGICAL REASONING (07)

Thinking Skill

- Problem Solving
- Critical Thinking
- Lateral Thinking

Taught through thought-provoking word and rebus puzzles, and word-link builder questions

Coding & decoding, Series, Analogy, Odd man out and Visual reasoning

- Coding and Decoding
- Series
- Analogy
- Odd Man Out
- Visual Reasoning

Sudoku puzzles

Solving introductory to moderate level sudoku puzzles to boost logical thinking and comfort with numbers

Attention to detail

Picture and word driven Qs to develop attention to detail as a skill

MODULE III QUANTITATIVE APTITUDE (08)

Speed Maths

- Addition and Subtraction of bigger numbers
- Square and square roots
- Cubes and cube roots
- Vedic maths techniques
- Multiplication Shortcuts
- Multiplication of 3 and higher digit numbers
- Simplifications
- Comparing fractions
- Shortcuts to find HCF and LCM
- Divisibility tests shortcuts

Algebra and functions

MODULE IV RECRUITMENT ESSENTIALS (01)

Looking at an engineering career through the prism of an effective resume

- Importance of a resume - the footprint of a person's career achievements
- How a resume looks like?
- An effective resume vs. a poor resume: what skills you must build starting today and how?

Impression Management

Getting it right for the interview:

- Grooming, dressing
- Body Language and other non-verbal signs

Displaying the right behaviour

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MODULE V VERBAL ABILITY **(03)**

Essential grammar for placements:

- Nouns and Pronouns
- Verbs
- Subject-Verb Agreement
- Pronoun-Antecedent Agreement
- Punctuations

Verbal Reasoning

TOTAL: 20 HOURS

Course Outcome

Enable students to approach learning Aptitude with ease, and understand recruiter expectation.

Mode of Evaluation:

Assignments, 3 Assessments with End Semester (Computer Based Test)

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19HE1073	ENTREPRENEURSHIP & INNOVATION	L	T	P	C
		1	0	0	0

Course Objectives

1. To acquire the knowledge and skills needed to manage the development of innovation.
2. To recognize and evaluate potential opportunities to monetize these innovations.
3. To plan specific and detailed method to exploit these opportunities.
4. To acquire the resources necessary to implement these plans.
5. To make students understand organizational performance and its importance.

Module	Description	Instructional Hours
1.	Entrepreneurial Thinking	
2.	Innovation Management	
3.	Design Thinking	
4.	Opportunity Spotting / Opportunity Evaluation	
5.	Industry and Market Research	
6.	Innovation Strategy and Business Models	
7.	Financial Forecasting	
8.	Business Plans/ Business Model Canvas	
9.	Entrepreneurial Finance	
10.	Pitching to Resources Providers / Pitch Deck	
11.	Negotiating Deals	
12.	New Venture Creation	
13.	Lean Start-ups	
14.	Entrepreneurial Ecosystem	
15.	Velocity Venture	
	Total Instructional Hours	15

Course Outcomes

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

CO1: Understand the nature of business opportunities, resources, and industries in critical and creative aspects.

CO2: Understand the processes by which innovation is fostered, managed, and commercialized.

CO3: Remember effectively and efficiently the potential of new business opportunities.

CO4: Assess the market potential for a new venture, including customer need, competitors, and industry attractiveness.

CO5: Develop a business model for a new venture, including revenue. Margins, operations, working capital, and investment.

Text Books

T1 Arya Kumar "Entrepreneurship – Creating and leading an Entrepreneurial Organization", Pearson, Second Edition (2012).

T2 Emrah Yayici "Design Thinking Methodology", Artbiztech, First Edition(2016).

References

R1 Christopher Golis "Enterprise & Venture Capital", Allen & Unwin Publication, Fourth Edition (2007).

R2 Thomas Lock Wood & Edger Papke "Innovation by Design", Career Press.com, Second Edition (2017).

R3 Jonathan Wilson "Essentials of Business Research", Sage Publication, First Edition (2010).

Web Resources

W1 https://blof.forgeforward.in/tagged/startup-lessons

W2 https://blof.forgeforward.in/tagged/entrepreurship

W3 https://blof.forgeforward.in/tagged/minimum-viable-product

W4 https://blof.forgeforward.in/tagged/minimum-viable-product

W5 https://blof.forgeforward.in/tagged/innovation

W6 https://www.youtube.com/watch?v=8vEyL7uKXs&list=PLmP9QrmTNPqBEvKbMSXvwlwn7fdnXe6Lw

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19HE2101	**BUSINESS ENGLISH FOR ENGINEERS (COMMON TO ALL BRANCHES)**	2	1	0	3

Course Objective

- ✓ To introduce to business communication.
- ✓ To train the students to react to different professional situations.
- ✓ To make the learner familiar with the managerial skills
- ✓ To empower the trainee in business writing skills.
- ✓ To learn to interpret and expertise different content.

Unit	Description	Instructional Hours
I	**Listening and Speaking** – listening and discussing about programme and conference arrangement **Reading** –reading auto biographies of successful personalities **Writing** Formal & informal email writing, Recommendations **Grammar and Vocabulary-** Business vocabulary, Adjectives & adverbs	9
II	**Listening and Speaking-** listening to TED talks **Reading-** Making and interpretation of posters **Writing-** Business letters: letters giving good and bad news, Thank you letter, Congratulating someone on a success" **Grammar and Vocabulary-** Active & passive voice, Spotting errors (Tenses, Preposition, Articles)	9
III	**Listening and Speaking-**travel arrangements and experience **Reading-** travel reviews **Writing-** Business letters (Placing an order, making clarification & complaint letters). **Grammar and Vocabulary-** Direct and Indirect speech,	9
IV	**Listening and Speaking-** Role play - **Reading-** Sequencing of sentence **Writing-** Business report writing (marketing, investigating) **Grammar and Vocabulary-** Connectors,Gerund & infinitive	9
V	**Listening and Speaking-** Listen to Interviews & mock interview **Reading-** Reading short stories, reading profile of a company - **Writing-** Descriptive writing (describing one'sown experience) **Grammar and Vocabulary-** Editing a passage(punctuation, spelling & number rules)	9
	Total Instructional Hours	**45**

Course Outcome

CO1- Introduced to different modes and types of business communication.
CO2- Practiced to face and react to various professional situations efficiently.
CO3- learnt to practice managerial skills.
CO4- Familiarized with proper guidance to business writing.
CO5- Trained to analyze and respond to different types of communication.

TEXT BOOKS:

T1 - Norman Whitby, "Business Benchmark-Pre-intermediate to Intermediate",Cambridge University Press, 2014.

T2- Ian Wood and Anne Willams. "Pass Cambridge BEC Preliminary", Cengage Learning press 2013.

REFERENCE BOOKS :

R1 - Michael Mc Carthy, "Grammar for Business", Cambridge University Press, 2009

R2- Bill Mascull, "Business Vocabulary in use: Advanced 2nd Edition", Cambridge University press, 2009.

R3- Frederick T. Wood, "Remedial English Grammar For Foreign Students", Macmillan publishers, 1986.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19MA2101	DIFFERENTIAL EQUATIONS AND COMPLEX VARIABLES (AERO, AUTO, MCT, MECH, CIVIL, FT & AGRI)	3	1	0	4

Course Objectives

1. Describe some methods to solve different types of first order differential equations.
2. Solve ordinary differential equations of certain types using Wronskian technique.
3. Use the effective mathematical tools for the solutions of partial differential equations.
4. Describe the construction of analytic functions and conformal mapping.
5. Illustrate Cauchy' s integral theorem and calculus of residues

Unit	Description	Hours
I	**FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS** Equations of the first order and of the first degree – Homogeneous equations – Exact differential equations – Linear equations – Equations reducible to the linear form – Benoulli's equation .	12
II	**ORDINARY DIFFERENTIAL EQUATIONS OF HIGHER ORDER** Second order linear differential equations with constant and variable co-efficients – Cauchy – Euler equations – Cauchy – Legendre equation – Method of variation of paramers.	12
III	**PARTIAL DIFFERENTIAL EQUATIONS** Formation of partial differential equations by the elmination of arbitrary constants and arbitrary functions – Solution of standard types of first order partial differential equations of the form f(p,q)=0, Clairaut's type : z = px+qy +f(p,q) – Lagrange's linear equation.	12
IV	**COMPLEX DIFFERENTIATION** Functions of complex variables – Analytic functions – Cauchy's – Riemann's equations and sufficient conditions (excluding proof) – Construction of analytic functions – Milne –Thomson's method – Conformal mapping w = A+z , Az, 1/z and bilinear transformations.	12
V	**COMPLEX INTEGRATION** Cauchy's integral theorem – Cauchy's integral formula –Taylor's and Laurent's series (statement only) –Residues - Cauchy's Residue theorem.	12
	Total Instructional Hours	**45+15**

Course Outcomes

CO1: Apply few methods to solve different types of first order differential equations.
CO2: Develop sound knowledge of techniques in solving ordinary differential equations.
CO3 Solve Partial Differential Equations using various methods.
CO4: Infer the knowledge of construction of analytic functions and conformal mapping.
CO5: Evaluate real and complex integrals over suitable closed paths or contours.

TEXT BOOKS:

T1- Ravish R Singh, Mukul Bhatt, "Engineeing Mathematics", McGraw Hill education (India) Private Ltd.,Chennai,2017.
T2- Veerarajan T, "Engineering Mathematics", McGraw Hill Education(India) Pvt Ltd, New Delhi, 2016

REFERENCE BOOKS :

R1 - Bali N.P & Manish Goyal, "A Text book of Engineering Mathematics", 8th Edition, Laxmi Pub. Pvt. Ltd. 2011.
R2 - Grewal B.S, "Higher Engineering Mathematics", 42nd Edition, Khanna Publications, Delhi, 2012.
R3- Peter V. O'Neil, "Advanced Engineering Mathematics", 7th Edition, Cengage learning,2012.
R4 - Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley and Sons, 2006.
R5 - Wylie & Barett, "Advanced Engineering Mathematics", McGraw Hill Education, 6th edition, 2003.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19EE2103	BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING	3	0	0	3

Course Objectives

1. To understand the basic laws and apply them in Electrical circuits and understand different measuring instruments.
2. To impart knowledge on construction and working of DC and AC machines
3. To create awareness on the methods for electrical safety, load protection basics.
4. To provide knowledge on the fundamentals of semiconductor devices and their applications.
5. To impart knowledge on digital electronics and its principles.

Unit	Description	Instructional Hours
I	**UNIT I: ELECTRICAL CIRCUITS AND MEASUREMENTS** Ohm's Law – Kirchoff's Laws – Steady State Solution of DC Circuits – Introduction to AC Circuits – Waveforms and RMS Value – Power and Power factor – Single Phase circuits - Three Phase Balanced Circuits. Operating Principles of Moving Coil and Moving Iron Instruments - Ammeters and Voltmeters, Dynamometer type Watt meters and Energy meters.	9
II	**UNIT II : ELECTRICAL MACHINES** Construction, Principle of Operation of DC Generators - EMF Equation - Construction, Principle of Operation of DC shunt and series Motors, Single Phase Transformer - EMF Equation, Single phase capacitor start - capacitor run – Construction, Principle of Operation of Three Phase Induction Motor – Applications - (Qualitative Approach only).	9
III	**UNIT III : ELECTRICAL WIRING AND SAFETY** Wiring types and applications: Service mains, meter board and distribution board - Brief discussion on concealed conduit wiring. One way and two way control. Elementary discussion on Circuit protective devices: fuse and Miniature Circuit Breaker (MCB's). Electric shock, precautions against shock, Objectives for Neutral and Earthing, types of earthing; pipe and plate earthing, Residual current circuit breaker.	9
IV	**UNIT IV : SEMICONDUCTOR DEVICES AND APPLICATIONS** Characteristics of PN Junction Diode – Zener Diode and its Characteristics – Zener Effect – Half wave and Full wave Rectifiers – Voltage Regulation. Bipolar Junction Transistor (BJT) – CB, CE, CC Configurations and Characteristics – FET – Characteristics.	9
V	**UNIT V : DIGITAL ELECTRONICS** Binary Number System – Logic Gates – Boolean Algebra – Half and Full Adders – Flip-Flops (RS, JK, T & D), A/D and D/A Conversion (Dual Slope, SAR, Binary-weighted and R-2R).	9
	Total Instructional Hours	**45**

Course Outcomes

CO1	Apply the KVL and KCL in Electrical circuits.
CO2	Explain the constructional features of AC and DC machines.
CO3	Develop awareness on the methods for electrical safety, load protection basics.
CO4	Identify electronics components and use of them to design circuits.
CO5	Develop Combinational and Sequential logic circuits.

TEXT BOOKS:

T1 Muthusubramanian R, Salivahanan S and Muraleedharan K A, "Basic Electrical, Electronics and Computer Engineering", Tata McGraw Hill, Eighteenth Reprint, 2014.

T2 Mittle N., "Basic Electrical Engineering", Tata McGraw Hill Edition, New Delhi, 1990.

REFERENCE BOOKS:

R1 Premkumar N, "Basic Electrical and Electronics Engineering", Anuradha Publishers, 2018.

R2 Mehta V K, "Principles of Electronics", S.Chand& Company Ltd, 1994.

R3 Nagsarkar T K and Sukhija M S, "Basics of Electrical Engineering", Oxford press 2005.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19ME2101	ENGINEERING MECHANICS	3	0	0	3

COURSE OBJECTIVES:

1. To understand basic concepts and force systems in a real world environment.
2. To understand the static equilibrium of particles and rigid bodies both in two dimensions.
3. To understand the moment of surfaces and solids.
4. To understand the effect of static friction on equilibrium.
5. To understand the dynamic equilibrium equation.

Unit	Description	Instructional Hours
I	**STATICS OF PARTICLES** Introduction to engineering mechanics - Classifications, force vector, Law of mechanics, System of forces, transmissibility, Force on a particle – resultant of two forces and several concurrent forces – resolution of a force – equilibrium of a particle — forces in space – equilibrium of a particle in space.	9
II	**EQUILIBRIUM OF RIGID BODIES** Free body diagram, moment of a force – varignon's theorem – moment of a couple – resolution of a force and a couple. Support reactions of the beam.	9
III	**CENTROID, CENTRE OF GRAVITY AND MOMENT OF INERTIA** Centroids of simple plane areas, composite areas, determination of moment of inertia of composite plane figures, polar moment of inertia-radius of gyration – mass moment of inertia of simple solids.	9
IV	**FRICTION** Laws of dry friction – angles of friction- angle of repose-coefficient of static and kinetic friction – – Friction in inclined plane, Ladder friction, Screw friction– rolling resistance – belt friction.	9
V	**DYNAMICS OF PARTICLES** Rectilinear and Curvilinear motion, -Newton's II law – D'Alembert's principle- Energy - potential energy kinetic energy-conservation of energy-work done by a force - work energy method, Impulse momentum method, Impact of bodies, Translation and rotation of the particles.	9
	Total Instructional Hours	45

Course Outcomes **Upon completion of the course students can be able to**

CO1: Define and illustrate the basic concepts of force system.
CO2: Identify the resultant force and couple, support reactions of the beam.
CO3: Calculate the Centre of gravity and moment of inertia of an object.
CO4: Examine the friction force of particles and objects for Impending Motion.
CO5: Determine the Displacement, velocity and acceleration of particles and objects

TEXT BOOKS:

T1. F.P.Beer, and Jr. E.R.Johnston., "Vector Mechanics for Engineers (In SI Units): Statics and Dynamics", 11th Edition, Tata McGraw-Hill Publishing company, New Delhi (2018).
T2. NH.Dubey, "Engineering Mechanics", Tata Mcraw Hill, New Delhi, 2016.

REFERENCE BOOKS:

1. R.C.Hibbeller, and Ashok Gupta, "Engineering Mechanics: Statics and Dynamics", 11th Edition, Pearson Education 2010.
2. S.S.Bhavikatti, and K.G.Rajashekarappa, "Engineering Mechanics", New Age International (P) Limited Publishers, 2015.
3. P. Jaget Babu, "Engineering Mechanics", Pearson Education, India Ltd, 2016.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19PH2151	MATERIALS SCIENCE (COMMON TO ALL BRANCHES)	2	0	2	3

The student should be able to

Course Objective

1. Acquire fundamental knowledge of semiconducting materials which is related to the engineeringprogram
2. Extend the knowledge about the magneticmaterials
3. Explore the behavior of super conductingmaterials
4. Gain knowledge about Crystal systems
5. Understand the importance of ultrasonic waves

Unit	Description	Instructional Hours
I	**SEMICONDUCTING MATERIALS** Introduction – Intrinsic semiconductor – Compound and elemental semiconductor - direct and indirect band gap of semiconductors. Carrier concentration derivation – Fermi level – Variation of Fermi level with temperature – electrical conductivity – band gap determination. Optical properties of semiconductor – Light through optical fiber(Qualitative). Determination of band gap of a semiconductor Determination of acceptance angle and numerical aperature in an optical fiber	6 3 3
II	**MAGNETIC MATERIALS** Origin of magnetic moment – Bohr magneton – comparison of Dia, Para and Ferro magnetism – Domain theory – Hysteresis – soft and hard magnetic materials – anti ferromagnetic materials – Ferrites and its applications. B – H curve by Magnetic hysteresis experiment	6 3
III	**SUPERCONDUCTING MATERIALS** Superconductivity : properties(Messiner effect, effect of magnetic field, effect of current and isotope effects) – Type I and Type II superconductors – High Tc superconductors – Applications of superconductors –Cryotron and magnetic levitation.	6
IV	**CRYSTAL PHYSICS** Crystal systems - Bravais lattice - Lattice planes - Miller indices - Interplanar spacing in cubic lattice - Atomic radius, Coordination number and Packing factor for SC, BCC and FCC crystal structures.	6
V	**ULTRASONICS** Production – Magnetostrictive generator – Piezoelectric generator – Determination of velocity using acoustic grating – Cavitations – Viscous force – co-efficient of viscosity. Industrial applications – Drilling and welding – Non destructive testing – Ultrasonic pulse echosystem. Determination of velocity of sound and compressibility of liquid – Ultrasonic wave Determination of Coefficient of viscosity of a liquid –Poiseuille's method	6 3 3
	Total Instructional Hours	**45**

After completion of the course the learner will be able to

Course Outcome

CO1: Understand the purpose of acceptor or donor levels and the band gap of a semiconductor
CO2: Interpret the basic idea behind the process of magnetism and its applications in everyday
CO3: Discuss the behavior of super conducting materials
CO4: Illustrate the types and importance of crystal systems
CO5: Evaluate the production of ultrasonics and its applications in NDT

TEXT BOOKS:

T1 - Rajendran V, Applied Physics, Tata McGraw Hill Publishing Company Limited, New Delhi, 2017.
T2- Gaur R.K. and Gupta S.L., Engineering Physics, 8th edition, Dhanpat Rai Publications (P) Ltd., New Delhi, 2015.

REFERENCE BOOKS:

R1 - Arthur Beiser "Concepts of Modern Physics" Tata McGraw Hill, New Delhi – 2015
R2 - M.N Avadhanulu and PG Kshirsagar "A Text Book of Engineering physics" S. Chand and Company ltd., New Delhi 2016
R3 - Dr. G. Senthilkumar "Engineering Physics – II" VRB publishers Pvt Ltd., 2016

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19CY2151	ENVIRONMENTAL STUDIES (COMMON TO ALL BRANCHES)	2	0	2	3

Course Objective

The student should be conversant with

1. The natural resources, exploitation and its conservation
2. The importance of environmental education, ecosystem and biodiversity.
3. The knowledge about environmental pollution – sources, effects and control measures of environmental pollution.
4. Scientific, technological, economic and political solutions to environmental problems.
5. An awareness of the national and international concern for environment and its protection.

Unit	Description	Instructional Hours
I	**NATURAL RESOURCES** Renewable and Non renewable resources - Forest resources: Use and over-exploitation, deforestation, timber extraction, mining, dams and their effects on forests and tribal people - Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture – Energy resources: Renewable and non renewable energy sources – Solar energy and wind energy - role of an individual in conservation of naturalresources.	6
II	**ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY** Importance of environment – need for public awareness - concept of an ecosystem – structure and function of an ecosystem - energy flow in the ecosystem – ecological succession processes – Introduction, types, characteristic features, structure and function of the forest and ponds ecosystem – Introduction to biodiversity definition: types and value of biodiversity – hot-spots of biodiversity – threats to biodiversity– endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity.	6
III	**ENVIRONMENTALPOLLUTION** Definition – causes, effects and control measures of: Air pollution- Water pollution – Water quality parameters- Soil pollution - Noise pollution- Nuclear hazards – role of an individual in prevention of pollution. **Determination of Dissolved Oxygen in sewage water by Winkler's method. Estimation of alkalinity of water sample by indicator method. Determination of chloride content of water sample by argentometric method.**	6+9=15
IV	**SOCIAL ISSUES AND THE ENVIRONMENT** From unsustainable to sustainable development – urban problems related to energy- environmental ethics: Issues and possible solutions – 12 Principles of green chemistry- Municipal solid waste management. Global issues – Climatic change, acid rain, greenhouse effect and ozone layer depletion – Disaster Management – Tsunami and cyclones. **Determination of pH in beverages.**	6+3=9
V	**HUMAN POPULATION AND THE ENVIRONMENT** Population growth, variation among nations – population explosion – family welfare programme – environment and human health – effect of heavy metals – human rights – value education – HIV / AIDS – women and child welfare –Environmental impact analysis (EIA)- GIS-remote sensing-role of information technology in environment and human health. **Estimation of heavy metal ion (copper). in effluents by EDTA**	6+3=9
	Total Instructional Hours	**45**

Course Outcome

After the completion of the course, the learner will be able to

CO1: Develop an understanding of different natural resources including renewable resources.
CO2: Realise the importance of ecosystem and biodiversity for maintaining ecological balance.
CO3: Understand the causes of environmental pollution and hazards due to manmade activities.
CO4: Demonstrate an appreciation for need for sustainable development and understand the various social issues and solutions to solve the issues.
CO5: Gain knowledge about the importance of women and child education and know about the existing technology to protect environment

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TEXT BOOKS:

T1- Anubha Kaushik and C. P. Kaushik, "Perspectives in Environmental studies", Sixth edition, New Age International Publishers, New Delhi, 2019.

T2 – S.Annadurai and P.N. Magudeswaran, "Environmental studies", Cengage Learning India Pvt.Ltd, Delhi, 2

REFERENCES:

R1 – Erach Bharucha, "Textbook of environmental studies" University Press (I) Pvt.ltd, Hyderabad, 2015

R2 - G.Tyler Miller, Jr and Scott E. Spoolman"Environmental Science" Thirteenth Edition, Cengage Learning, 2010.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19ME2001	ENGINEERING PRACTICES LABORATORY	0	0	4	2

OBJECTIVES:

To provide exposure to the students with hands on experience on various basic engineering practices in Civil, Mechanical and Electrical Engineering.

GROUP A (CIVIL & MECHANICAL)

S.No Description of the Experiments

CIVIL AND MECHANICAL ENGINEERING PRACTICES

1. Preparation of Single pipe line and Double pipe line connection by using valves, taps, couplings, unions, reducers and elbows.
2. Arrangement of bricks using English bond for 1brick thick wall and 11/2 brick thick wall for right angle corner junction.
3. Arrangement of bricks using English bond for 1brick thick wall and 11/2 brick thick wall for T junction.
4. Preparation of arc welding of Butt joints, Lap joints and Tee joints.
5. Practice on sheet metal Models– Trays and funnels
6. Hands-on-exercise in wood work, joints by sawing, planning and cutting.
7. Practice on simple step turning, taper turning and drilling.
8. Demonstration on Smithy operation.
9. Demonstration on Foundry operation.
10. Demonstration on Power tools.

GROUP B
(ELECTRICAL)

S.No Description of the

Experiments ELECTRICAL

ENGINEERINGPRACTICES

1. Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2. Fluorescent lamp wiring.
3. Stair case wiring.
4. Measurement of Electrical quantities – voltage, current, power & power factor in single phasecircuits.
5. Measurement of energy using single phase energy meter.
6. Soldering practice using general purpose PCB.
7. Measurement of Time, Frequency and Peak Value of an Alternating Quantity using CRO and Function Generator.
8. Study of Energy Efficient Equipment's and Measuring Instruments.

Total Practical Hours 45

COURSE OUTCOME:

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

- Fabricate wooden components and pipe connections including plumbing works.
- Fabricate simple weld joints.
- Fabricate different electrical wiring circuits and understand the AC Circuits.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19HE2071	LANGUAGE COMPETENCY ENHANCEMENT COURSE- II (COMMON TO ALL BRANCHES)	0	0	2	1

Course Objective

- ✓ To introduce to business communication.
- ✓ To train the students to react to different professional situations.
- ✓ To make the learner familiar with the managerial skills
- ✓ To empower the trainee in business writing skills.
- ✓ To learn to interpret and expertise different content.

Unit	Description	Instructional Hours
I	**Listening and Speaking** – listening and discussing about programme and conference arrangement **Reading** –reading auto biographies of successful personalities **Writing** Formal & informal email writing, Recommendations **Grammar and Vocabulary-** Business vocabulary, Adjectives & adverbs.	3
II	**Listening and Speaking-** listening to TED talks **Reading-** Making and interpretation of posters **Writing-** Business letters: letters giving good and bad news, Thank you letter, Congratulating someone on a success" **Grammar and Vocabulary-** Active & passive voice, Spotting errors (Tenses, Preposition, Articles).	3
III	**Listening and Speaking-**travel arrangements and experience **Reading-** travel reviews **Writing-** Business letters (Placing an order, making clarification & complaint letters). **Grammar and Vocabulary-** Direct and Indirect speech.	3
IV	**Listening and Speaking-** Role play - **Reading-** Sequencing of sentence **Writing-** Business report writing (marketing, investigating) **Grammar and Vocabulary-** Connectors, Gerund & infinitive.	3
V	**Listening and Speaking-** Listen to Interviews & mock interview **Reading-** Reading short stories, reading profile of a company - **Writing-** Descriptive writing (describing one's own experience) **Grammar and Vocabulary-** Editing a passage(punctuation, spelling & number rules).	3
	Total Instructional Hours	**15**

Course Outcome

CO1- Introduced to different modes and types of business communication.
CO2- Practiced to face and react to various professional situations efficiently.
CO3- learnt to practice managerial skills.
CO4- Familiarized with proper guidance to business writing.
CO5- Trained to analyze and respond to different types of communication.

TEXT BOOKS:

T1 - Norman Whitby, "Business Benchmark-Pre-intermediate to Intermediate",Cambridge University Press, 2016.

T2- Ian Wood and Anne Willams. "Pass Cambridge BEC Preliminary", Cengage Learning press 2015.

REFERENCE BOOKS :

R1 - Michael Mc Carthy, "Grammar for Business", Cambridge University Press, 2009.

R2- Bill Mascull, "Business Vocabulary in use: Advanced 2nd Edition", Cambridge University Press, 2009.

R3- Frederick T. Wood, "Remedial English Grammar For Foreign Students", Macmillan publishers, 2001.

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19HE2072	CAREER GUIDANCE – LEVEL II Personality, Aptitude and Career Development	L	T	P	C
		2	0	0	0

Course Objectives

1 Solve Logical Reasoning questions of easy to intermediate level
2 Solve Quantitative Aptitude questions of easy to intermediate level
3 Solve Verbal Ability questions of easy to intermediate level

MODULE I LOGICAL REASONING **(05)**

Word group categorization questions
Puzzle type class involving students grouping words into right group orders of logical sense
Cryptarithmetic
Data arrangements and Blood relations

- Linear Arrangement
- Circular Arrangement
- Multi-dimensional Arrangement

Blood Relations

MODULE II QUANTITATIVE APTITUDE **(08)**

Ratio and Proportion

- Ratio
- Proportion
- Variation
- Simple equations
- Problems on Ages
- Mixtures and alligations

Percentages, Simple and Compound Interest

- Percentages as Fractions and Decimals
- Percentage Increase / Decrease
- Simple Interest
- Compound Interest
- Relation Between Simple and Compound Interest

Number System

- Number system
- Power cycle
- Remainder cycle
- Factors, Multiples

HCF and LCM

MODULE III VERBALABILITY **(07)**

Essential grammar for placements

- Prepositions
- Adjectives and Adverbs
- Tenses
- Forms and Speech and Voice
- Idioms and Phrasal Verbs
- Collocations, Gerund and Infinitives

Reading Comprehension for placements

- Types of questions
- Comprehension strategies
- Practice exercises

Articles, Prepositions and Interrogatives

- Definite and Indefinite Articles
- Omission of Articles
- Prepositions
- Compound Prepositions and Prepositional Phrases
- Interrogatives

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Vocabulary for placements

- Exposure to solving questions of
- Synonyms
- Antonyms
- Analogy
- Confusing words
- Spelling correctness

TOTAL: 20 HOURS

Course Outcome:
Enable students to approach learning Aptitude with ease, and understand recruiter expectation

Mode of Evaluation: Assignments, 3 Assessments with End Semester (Computer Based Test)

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SYLLABUS

Programme	Name of the Course	L	T	P	C
B.E.	19MA3101 FOURIER SERIES AND STATISTICS (AERO, AUTO, MECH, and MCT)	3	1	0	4

Course Objective

1. Analyze Fourier series which is central to many applications inengineering.
2. Solve boundary value problems by applying Fourier series.
3. Demonstrate knowledge of large-sample statistical properties.
4. Apply basic concepts of statistical methods for testing the hypothesis.
5. Analyze design of experiment techniques to solve various engineeringproblem.

Unit	Description	Instructional Hours
I	**FOURIER SERIES** Dirichlet's conditions- General Fourier Series – Odd and Even Functions – Half range sine and cosine series – Change of Interval - Parseval's Identity - Harmonic analysis.	12
II	**BOUNDARY VALUE PROBLEMS** Classification and solution of one dimensional wave equation – one dimensional heat equation - Fourier series solution in Cartesian coordinates.	12
III	**TESTS BASED ON LARGE SAMPLES** Large sample tests based on Normal distribution –Test of significance for single proportion- Test of significance for difference of proportions - Test of significance for single means-Test of significance for difference of means.	12
IV	**TESTS BASED ON SMALL SAMPLES** Tests based on t (for single mean and difference of means) - F distribution for testing difference of variance, Chi – Square test for Contingency table (Test for Independency) – Goodness of fit.	12
V	**ANOVA** Introduction, assumptions of analysis of variance - Completely randomized design– Randomized block design – Latin square design.	12
	Total	60

Course Outcome

CO1: Understand the mathematical principles of Fourier series which would provide them the ability to formulate and solve some of the physical problems of engineering.
CO2: Apply the concept of application of Fourier series in solving the heat and wave equations.
CO3: Understand the mix proportioning techniques for field applications.
CO4: Understand the concepts of statistical methods for testing the hypothesis.
CO5: Apply design of experiment techniques to solve various engineering problem.

TEXT BOOKS:

T1 - Veerarajan. T.,"Transforms and Partial Differential Equations", Tata McGraw Hill Education Pvt. Ltd.Reprint, New Delhi, 2016.
T2 - Gupta, S.C., & Kapoor, V.K., Fundamentals of Mathematical Statistics, Sultan Chand & Sons, Reprint 2019.

REFERENCE BOOKS :

R1 - C.Ray Wylie " Advanced Engineering Mathematics" Louis C. Barret, 6th Edition, McGraw Hill Education India Private Limited, New Delhi 2003.
R2 - Kandasamy P., Thilagavathy K. and Gunavathy K.,"Engineering Mathematics Volume III", S.Chand & Company Ltd., New Delhi, 2015.
R3 - Walpole. R.E., Myers. R.H., Myers. S.L., and Ye. K., "Probability and Statistics for Engineers and Scientists", 9th Edition, Pearson Education, Asia, 2018.

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Programme	Name of the Course	L	T	P	C
B.E.	19ME3201 MANUFACTURING TECHNOLOGY – I	3	0	0	3

Course Objective

1. To learn the concepts of some basic manufacturing processes and fabrication techniques
2. To know the manufacturing of metal components in different methods such as metal casting.
3. To gain the metal joining, metal forming techniques.
4. To acquire knowledge in the bulk forming process such as forging androlling.
5. To learn the manufacturing of plastic components.

Unit	Description	Instructional Hours
I	**METAL CASTING PROCESSES** Sand Casting: Sand Mould – Type of patterns - Pattern Materials – Pattern allowances –Moulding sand Properties and testing – Cores –Types and applications – Moulding machines– Types and applications; Melting furnaces: Blast and Cupola Furnaces; Special casting processes : Shell - investment – Pressure die casting - Centrifugal Casting - Continuous casting process – Stir casting; Casting Defects.	9
II	**JOINING PROCESSES** Operating principle, basic equipment, merits and applications of: Fusion welding processes: Gas welding - Types – Flame characteristics; Manual metal arc welding – Gas Tungsten arc welding- Gas metal arc welding – Submerged arc welding – Electro slag welding; Operating principle and applications of: Resistance welding - Plasma arc welding – Thermit welding – Electron beam welding – Friction welding and Friction Stir Welding; Brazing and soldering; Weld defects: types, causes and cure.	9
III	**METAL FORMING PROCESSES** Hot working and cold working of metals – Forging processes – Open and closed die forging – forging operations. Rolling of metals– Types of Rolling mills – Flat strip rolling – shape rolling operations – Defects in rolled parts. Tube drawing – Principles of Extrusion – Types – Hot and Cold extrusion Principle of rod and wire drawing.	9
IV	**SHEET METAL FORMING PROCESS** Sheet metal characteristics – shearing, bending and drawing operations – Stretch forming operations – Formability of sheet metal –Special forming processes; Hydro forming –Rubber pad forming – Metal spinning– Explosive forming- Magnetic pulse forming- Peen forming- Super plastic forming – Micro forming.	9
V	**MANUFACTURE OF PLASTIC COMPONENTS** Types and characteristics of plastics –Thermoplastics and Thermosetting plastics – working principles and typical applications of Injection moulding, Plunger and screw machines – Compression moulding, Transfer Moulding – Blow moulding –Rotational moulding – Film blowing – Extrusion – Thermoforming – Bonding of Thermoplastics -industrial applications of plastics..	9
	Total Instructional Hours	45

Course Outcome

Upon completion of this course, the students will be able to, CO1:
Identify the suitable casting process for the given component.
CO2: Identify the suitable welding process and integrate the basic knowledge from material science
CO3: Compare the functions and applications of metal forming process
CO4: Develop basic calculation to fabricate sheet metal components.
CO5: Understand plastic component manufacturing.

TEXT BOOKS:

T1 - Hajra Choudhary S.K and Hajra Choudhury. AK, "Elements of workshop Technology", volume I and II, Media promoters and Publishers pvt, Mumbai, 2013.
T2 - Rao, P.N. "Manufacturing Technology Foundry, Forming and Welding", 2nd Ed, TMH-2015.

REFERENCES:

R1 - Sharma, P.C., "A Text book of production Technology", S.Chand and Co. Ltd., 2019.
R2 - Paul Degarma E, Black J.T and Ronald A. Kosher, "Materials and Processes, in Manufacturing" 8th Ed, Prentice – Hall of India, 2017.
R3 - Gowri.S, Hariharan.P, SureshBabu.A, "Manufacturing Technology I", Pearson Education, 2014.

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Programme		Name of the Course	L	T	P	C
B.E.	19ME3202	ENGINEERINGTHERMODYNAMICS	3	1	0	3

Course Objective

1. To learn the fundamentals of thermodynamics and energy conversion.
2. To gain knowledge on energy degradation in thermodynamicsystems.
3. To impart knowledge on behavior of pure substances and working principle of steam power cycles.
4. To learn the thermodynamic relations.
5. To study the properties of atmospheric air.

Unit	Description	Instructional Hours
I	**FIRST LAW OF THERMODYNAMICS** Basic concepts: concept of continuum, microscopic and macroscopic approach, path and point functions, properties, thermodynamic system, equilibrium, state, path and process. Quasi-static, reversible and irreversible processes. Heat and work transfer: definition and comparison, sign convention. Zeroth law of thermodynamics: thermal equilibrium. First law of thermodynamics: application to closed and open systems.	9
II	**SECOND LAW OF THERMODYNAMICS** Heat Reservoirs: source and sink. Heat Engine, Refrigerator, and Heat pump. Statements and its corollaries. Carnot cycle, Clausius inequality. Concept of entropy: T-s diagram, Tds Equations, entropy change of pure substance, ideal gases, different processes, principle of increase in entropy and availability concepts.	9
III	**PROPERTIES OF PURE SUBSTANCE AND STEAM POWER CYCLES** Steam: formation and its thermodynamic properties, p-v, p-T, T-v, T-s, h-s diagrams. p-v-T surface. Use of steam tables and Mollier Chart. Estimation of steam properties and dryness fraction. Steam power cycles: Rankine cycle, Reheat and Regenerative cycles.	9
IV	**THERMODYNAMIC RELATIONS AND GASES** Maxwell relations, Tds Equations, Difference and ratio of heat capacities, Energy equation, Joule-Thomson Coefficient, Clausius Clapeyron equation. Properties of Ideal and real gases: equations of state, Vander Waals equation for ideal and real gases, reduced properties, compressibility factor, generalised compressibility chart and its usage. Gas mixtures: mole and mass fractions, gas laws, gas constant.	9
V	**PSYCHROMETRY** Psychrometric properties, Property calculations of air vapour mixtures using psychrometric chart and expressions. Psychrometric process: sensible heating and cooling, humidification, dehumidification, adiabatic saturation, adiabatic mixing of two streams.	9
	Total Instructional Hours	45

Course Outcome

Upon completion of this course, the students will be able to:
CO1: Understand the thermodynamic principles and its applications.
CO2: Quantify the energy conversion in various thermal systems.
CO3: Identify the losses and inefficient components in the thermodynamic system.
CO4: Apply the thermodynamic principles for predicting the properties of steam, gas and gas mixtures.
CO5: Apply the psychrometric principles for design of air conditioning systems.

TEXT BOOK:

T1 - Nag.P.K, "Engineering Thermodynamics", 5th Edition, Tata McGraw-Hill, New Delhi, 2017.
T2 - Cengel. Y. and Boles.M, "Thermodynamics - An Engineering Approach", 8 th Edition, Tata McGraw Hill, 2010.

REFERENCES:

R1- Natarajan E., "Engineering Thermodynamics: Fundamentals and Applications", Anuragam Publications, 2012.
R2 - Holman.J.P., "Thermodynamics", 3rd Edition. McGraw-Hill, 2014.

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Programme	Name of the Course	L	T	P	C
B.E.	19ME3203 ENGINEERING MATERIALS AND METALLURGY	3	0	0	3

Course Objective

1. To learn material classification and their atomic structure.
2. To study mechanical behavior of materials, Phase diagrams and its importance.
3. To understand heat treatment and surface treatments of metals.
4. To study the stress-strain behavior of various materials, fracture types.
5. To learn the properties of nonferrous alloys, polymers and ceramics.

Unit	Description	Instructional Hours
I	**BASIC CONCEPTS** Introduction to Materials Science, Defects-Point, Line, Area, Volume-Slip planes and slip systems, Schmidt's rule, Polymorphism and allotropy -Solidification–Nucleation and Growth mechanism, Cooling curve of pure metal and alloy	9
II	**PHASE DIAGRAMS AND PHASE TRANSFORMATION** Gibbs's Phase rule, Solubility and Solid Solutions -Isomorphous alloy system -Binary Eutectic alloy system (Lead-Tin System), Eutectoid and Peritectic system, Iron-Iron carbide equilibrium diagram, Phase Transformation-Temperature-Time-Transformation (TTT) and Continuous Cooling Transformation (CCT) Diagrams -Steels, Cast Irons and Stainless steels –types and applications –Effects of alloying elements.	9
III	**HEAT TREATMENT & SURFACE TREATMENTS** Heat Treatment –Annealing and its types, Normalizing, Aus-tempering, Mar-tempering, Quenching, Hardenability -Surface hardening processes –Flame and induction hardening, Carburizing, Nitriding and Carbonitriding—Basic concepts of wear and corrosion & their types.	9
IV	**MECHANICAL PROPERTIES AND MATERIALS** Sress-strain behavior of ferrous & non-ferrous metals, polymer and ceramics - Hardness, Fracture of metals -Ductile Fracture, Brittle Fracture, Fatigue –Endurance limit of ferrous and non-ferrous metals – Fatigue, Creep and rupture–mechanism of creep –stages of creep.	9
V	**NON FERROUS ALLOYS & COMPOSITE MATERIALS** Non Ferrous Alloys of Aluminum, Magnesium, Copper –Microstructure and mechanical property , Composites- Classification, properties and applications, Ceramics –Alumina, Zirconium, Silicon Carbide, Sialons -Processing, properties and applications of ceramics, Glasses –properties and applications.	9
	Total Instructional Hours	45

Course Outcome

Upon completion of this course, the students will be able to:
CO1: Understand the atomic structure & classification of engineering materials
CO2: Predict the alloy components and its composition variation with respect to temperature changes.
CO3: Select suitable materials and heat treatment methods for various industrial applications.
CO4: Gain knowledge on testing different types of materials and their applications.
CO5: Explain the properties of non-ferrous alloys, polymers and ceramics.

TEXT BOOKS:

T1 - Callister.W.D., Jr., (2010), Materials Science and Engineering: An Introduction, 8th ed., Wiley & Sons.
T2 -William F. Smith and Javad Hashemi (2014), Foundations of Materials Science and Engineering 4th edition.Mc Graw Hill

REFERENCE BOOKS:

R1 - Anderson.C, K.D. Leaver, P. Leavers and R.D. Rawlings, (2013), Materials Science for Engineers, 5th edition, Tata McGraw Hill Publishers.
R2 -Sydney H Avner, (2015) "Introduction to Physical Metallurgy, Tata McGraw Hill Publishing Company Limited.
R3 - Krishnan K. Chawla, (2017) Composite materials, Science and Engineering 2nd edition, Springer.

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PROGRAMME	NAME OF THE COURSE	L	T	P	C
B.E.	19ME3251 FLUID MECHANICS AND MACHINERY	3	0	2	4

Course Objective

1. To study the fluid laws, properties and measurements.
2. To expose various fluid flow measuring devices and calculate the flow losses in pipes.
3. To learn the concept of dimensional analysis
4. To gain the knowledge on working principles and performance curves of fluid pumps
5. To impart knowledge on various hydraulic turbines and performance curves...

Unit	Description	Instructional Hours
I	**INTRODUCTION TO FLUID AND FLUID FLOW** Fluid Properties - density, specific weight, specific volume, specific gravity, viscosity, compressibility, capillary, surface tension and buoyancy – pressure measurements- manometers, Continuity equation, theory of various types of flow - laminar, turbulent, unsteady, steady, non-uniform and uniform flows. Stream line, streak line and path.	9
II	**FLUID DYNAMICS AND FLOW THORUGH PIPE** Navier Stokes equation – derivation and problems, derivation of Euler's equation and Bernoulli's energy equation, Pipes in series and parallel. Reynolds number, Darcy-Weisbach equation, use of Moody diagram, minor losses-sudden expansion, sudden contraction and losses in pipe fittings..	9
III	**FLOW MEASUREMENT AND DIMENSIONAL ANALYSIS** Orificemeter, Venturimeter, Pitot tubes, Rotameter, dimensional analysis- Buckingham's theorem, Reynolds, Froude, Weber, Euler and Mach number and their applications. Calculation of discharge using Venturimeter & Orificemeter	9+5
IV	**HYDRAULIC PUMPS** Classifications of pumps –Centrifugal pumps– work done by the impeller -Head and efficiencies performance curves-velocity triangles – cavitation-priming- Reciprocating pump-slip, Indicator diagram, efficiency. Performance curves- theory of Air vessel. Experimentation on centrifugal pump and reciprocating pump.	9+5
V	**HYDRAULIC TURBINES** Classification of turbines – heads and efficiencies – velocity triangles. Theory of axial, radial and mixed flow turbines. Pelton wheel, Francis turbine and Kaplan turbines- work done by water on the runner. Specific speed– performance curves. Experimentation on Pelton wheel and Francis turbine.	9+5
	Total Instructional Hours	**60**

Course Outcome

At the end of the course The Students will be able to,
CO1: Apply the properties of fluids and flow characteristics.
CO2: Apply the momentum principle and losses in pipes in solving real life problems.
CO3: Perform the Dimensional and Model analysis.
CO4: Design suitable types of pumps for various applications.
CO5: Analyze the performance of various hydraulic turbines.

TEXT BOOKS:

T1- Rajput, R.K., "Fluid Mechanics and Hydraulic Machines,"S.Chand Publishers 2013.
T2 - Streeter, V.L., and Wylie, E.B., "Fluid Mechanics", McGraw-Hill Education, 2010.

REFERENCE BOOKS:

R1- Ramamrutham.S and Narayanan.R. "Fluid Hydraulics and Fluid Machines", Dhanpat Rai Publishing House (P) Ltd, New Delhi, 2012.
R2- Kumar K. L., "Engineering Fluid Mechanics", Eurasia Publishing House(p) Ltd., New Delhi 2014.
R3- White, F.M., "Fluid Mechanics", Tata Mcgraw-Hill, New Delhi, 2013.
R4- P.M.Modi & S.M.Seth, "Hydraulics and fluid mechanics including hydraulic machines", Standard book house, 2015.

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Programme	Name of the Course	L	T	P	C
B.E.	19ME3001 MANUFACTURING TECHNOLOGY LAB – I	0	0	4	2

Course Objective

- To Study and practice the various operations that can be performed on the lathe, drilling and grinding machines etc. and equip with the practical knowledge required in the core industries.

S.No	Description of the Experiments	Hrs
	LIST OF EXPERIMENTS	
1	Machining of Step Turning using a Lathe.	
2	Machining of Knurling & Grooving using a Lathe.	
3	Machining of Taper Turning using a Lathe.	
4	Machining of Boring using a Lathe.	
5	Machining of Internal Thread Cutting using a Lathe.	
6	Machining of External Thread cutting using a Lathe.	
7	Machining of Eccentric Turning using a Lathe.	
8	Drilling & Tapping in plates using drilling machine.	
9	Surface grinding of a plate using surface grinder.	
	Total Instructional Hours	45

Course Outcome

- Upon completion of this course, the students can be able to use various lathe, drilling and grinding machines to fabricate various operations.

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PROGRAMME	NAME OF THE COURSE	L	T	P	C
B.E.	19ME3002 COMPUTER AIDED DRAWING LAB	0	0	3	1.5

Course Objective
1. To develop skills on using software for preparing 2D Drawings and 3D modeling.
2. To learn the importance of computer aided design and drawing in Engineering society.

S.No **Description of the Experiments Concepts and Conventions:**

Understand the basic idea of software and its features like draw panel, modify panel, line types, creating dimensions, hatching techniques, layer Creations, text styles, and template drawings, use of Blocks, Design Center, Tool Palettes and Plotting.

LIST OF EXERCISES USING DRAFTING SOFTWARE

1. Study of drafting software– Coordinate systems (absolute, relative, polar, etc.) – Creation of simple geometries like polygon, conic and special curves.
2. Draw the orthographic projections of simple solids like Prism, Pyramid, Cylinder, Cone and its dimensioning.
3. Draw and dimension the orthographic projections of Shaft Support.
4. Draw and dimension the orthographic projections of Machine Component.
5. Draw and dimension the orthographic projections of simple gate valve.
6. Draw the Plan and Elevation of simple Residential Building.

LIST OF EXERCISES USING MODELLING SOFTWARE

7. Study of Modeling software-Sketching and Part modeling - Tool familiarizations on Extrude, Revolve, Hole, shell.
8. Creation of Machine Block using 3D Modeling software.
9. Creation of solid journal bearing using 3D Modeling software.
10. Creation of step cone pulley using 3D Modeling software.

Total Instructional Hours 45

Course Outcome

Upon completion of the course students can be able to:
CO1: Apply the software package for drafting and modeling.
CO2: Create 2D Drawing and 3D modeling of Engineering Components.
CO3: Apply basic concepts to develop construction drawing techniques

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19MC3191	INDIAN CONSTITUTION	L	T	P	C
		2	0	0	0

Course Objectives

1. Sensitization of student towards self, family (relationship), society and nature.
2. Understanding (or developing clarity) of nature, society and larger systems, on the basis of human relationships and resolved individuals.
3. Strengthening of self reflection.
4. Development of commitment and courage to act.

UNIT I BASIC FEATURES AND FUNDAMENTALE PRINCIPLES (4)

Meaning of the constitution law and constitutionalism – Historical perspective of the constitution of India – salient features and characteristics of the constitution of India.

UNIT I FUNDAMENTAL RIGHTS (4)

Scheme of the fundamental rights – fundamental duties and its legislative status – The directive principles of state policy – its importance and implementation - Federal structure and distribution of legislative and financial powers between the union and states.

UNIT III PARLIAMENTARY FORM OF GOVERNMENT (4)

The constitution powers and the status of the president in India. – Amendment of the constitutional powers and procedures – The historical perspective of the constitutional amendment of India – Emergency provisions : National emergency, President rule, Financial emergency.

UNIT IV LOCAL GOVERNANCE (4)

Stages of combustion, vapourisation of fuel droplets and spray formation, air motion, swirl combustion, knock and engine variables, Features and design considerations of combustion chambers, delay period correlations.

UNIT V INDIAN SOCIETY (4)

Constitutional Remedies for citizens – Political Parties and Pressure Groups; Right of Women, Children and Scheduled Castes and Scheduled Tribes and other Weaker Sections.

TOTAL: 20 PERIODS

Course Outcomes

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

CO1: Illustrate the functions of the Indian government

CO2: Illustrate the the rules of the Indian constitution.

Text Books

T1 Durga Das Basu, "Introduction to the Constitution of India ", Prentice Hall of India, New Delhi.

T2 R.C.Agarwal, "Indian Political System", S.Chand and Company, New Delhi, 1997.

T3 Maciver and Page, " Society: An Introduction Analysis ", Mac Milan India Ltd., New Delhi.

T4 K.L.Sharma, "Social Stratification in India: Issues and Themes", Jawaharlal Nehru University, New Delhi,1977

References

R1 Sharma, Brij Kishore, " Introduction to the Constitution of India:, Prentice Hall of India, New Delhi.

R2 U.R.Gahai, "Indian Political System ", New Academic Publishing House, Jalaendhar.

R3 R.N. Sharma, "Indian Social Problems ", Media Promoters and Publishers Pvt. Ltd.

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Programme	Name of the Course	L	T	P	C
B.E.	19MA4101 NUMERICAL METHODS	3	1	0	4

Course Objective

1. Solve algebraic, transcendental and system of linear equations by using various techniques.
2. Analyze various methods to find the intermediate values for the givendata.
3. Explain concepts of numerical differentiation and numerical integration of the unknown functions.
4. Explain single and multi step methods to solve Ordinary differential equations
5. Describe various methods to solve ordinary differential equations and partial differential equations.

Unit	Description	Instructional Hours
	SOLUTION OF ALGEBRAIC AND TRANSCENDENTAL EQUATIONS	
I	Solution of Algebraic and Transcendental equations: Newton Raphson method . Solution of linear system: Gauss Elimination - Gauss Jordan method -Gauss seidel method. Matrix inversion by Gauss Jordan method. Mechanical Application – Trunnion- hub-girder assembly.	12
	INTERPOLATION	
II	Interpolation - Newton's forward and backward difference formulae – Newton's divided difference formula and Lagrangian interpolation for unequal intervals. Mechanical Application – Conduction analysis.	12
	NUMERICAL DIFFERENTIATION AND INTEGRATION	
III	Numerical Differentiation: Newton's forward and backward interpolation formulae for equal intervals –Newton's divided difference formula for unequal intervals. Numerical integration: Trapezoidal and Simpson's 1/3 rule - Double integration using Trapezoidal and Simpson's rules. Mechanical Application - To find a Coefficient of thermal expansion.	12
	INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS	
IV	Single step methods for solving first order equations: Taylor's series method – Euler and Modified Euler methods – Fourth order Runge-kutta method -Multi step method: Milne's predictor and corrector method. Mechanical Application – Heat Transfer Analysis.	12
	BOUNDARY VALUE PROBLEMS IN ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS	
V	Solution of second order ordinary differential equation byFinite difference method – Solution of partial differential equation: one dimensional heat equation by Bender schmidt method – One dimensional Wave equation by Explicit method– Poisson Equations by Finite difference method. Mechanical Application – Study State Heat Conduction Analysis.	12
	Total Instructional Hours	60

Course Outcome

At the end of the course, the students can be able to
CO1: Solve the system of linear algebraic equations which extends its applications in the field of engineering
CO2: Apply various methods to find the intermediate values for the given data.
CO3: Identify various methods to perfrom numerical differentiation and l integration
CO4: Classify and solve ordinary differential equations by using single and multi step methods.
CO5: Illustrate various methods to find the solution of ordinary and partial differential equations.

TEXT BOOKS:

T1 - Sankara Rao K, "Numerical Methods for Scientists and Engineers", 3rd edition, Prentice Hall of India Private limited, New Delhi,2008.
T2 - M.K.Jain,S.R.K.Iyengar, R.K.Jain "Numerical methods for Scientific and Engineering Computation", Fifth Edition, New Age International publishers 2010.

REFERENCE BOOKS :

R1 - Kreyszig.E."Advanced Engineering Mathematics", Tenth Edition, John Wiley and sons (Asia) limited,2017
R2 - Grewal B.S. and Grewal J.S. " Numerical Methods in Engineering and Science ", 6th Edition, Khanna publishers, New Delhi 2015.
R3 - S.K.Gupta, Numerical Methods for Engineers" , New Age International Pvt.Ltd Publishers,2015.

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Programme	Name of the Course	L	T	P	C
B.E.	19ME4201 MANUFACTURING TECHNOLOGY – II	3	0	0	3

Course Objective

1. To acquire knowledge of Metal Cutting Theoryconcepts.
2. To impart knowledge on the working and various functions of Turning Machines.
3. To know about Shaping, Milling and Gear cutting machines.
4. To gain knowledge about grinding and broaching machines.
5. To learn the basic concepts in CNC machines.

Unit	Description	Instructional Hours
	THEORY OF METAL CUTTING	
I	Mechanism of metal cutting – types – cutting force – chip formation – Merchant's circle diagram – calculations – tool geometry – machinability – tool wear – tool life – cutting tool materials – cutting fluids – types , problems on cutting force and tool life.	9
	TURNING MACHINES	
II	Centre lathe, constructional features, specification, operations –taper turning methods, thread cutting methods, special attachments. Capstan and turret lathes- tool layout – automatic lathes: semi-automatic – single spindle: Swiss type, automatic screw type – multi spindle. Problems on thread cutting and taper turning.	9
	SHAPER, SLOTTING, MILLING AND GEAR CUTTING MACHINES	
III	Shaper - Types of operations. Slotting machine- Types of operations. Milling operations-types of milling cutter. Gear cutting – forming and generation principle and construction of gear milling, hobbing and gear shaping processes –finishing of gears. Drilling machine - Types of operations.	9
	ABRASIVE PROCESS AND BROACHING	
IV	Grinding, broaching, spinning: grinding wheel – specifications and selection, types of grinding process– cylindrical grinding, surface grinding, centreless grinding and internal grinding-Typical applications. Broaching machines: broach construction – push, pull, surface and continuous broaching machines and its applications. Super finishing – honing and lapping-precision machining processes, Nano Machining.	9
	CNC MACHINING	
V	Numerical Control (NC) machine tools – CNC types, constructional details, special features, machining centre, part programming fundamentals CNC – manual part programming – micromachining and IOT.	9
	Total Instructional Hours	45

Course Outcome

At the end of the course, the students can be able to
CO1: understand the concept of metal cutting principles and tool life
CO2: Fabricate engineering components using various lathes and special attachments.
CO3: conduct experiments on conventional machining processes
CO4: demonstrate the basic concepts of abrasive process and gear cutting operations.
CO5: demonstrate the understanding of surface finishing process in the CNC machine tools.

TEXT BOOKS:

T1 - HajraChoudhury, "Elements of Workshop Technology", Vol.II., Media Promoters, 2015.
T2 - Rao. P.N "Manufacturing Technology - Metal Cutting and Machine Tools", Tata McGraw-Hill, New Delhi, 2013.
T3 - Gary F. Benedict 'Nontraditional Manufacturing Processes' , Taylorfrancis, Boca Raton 2019

REFERENCES:

R1 - HMT, "Production Technology", Tata McGraw Hill, 2015.
R2 - GeofreyBoothroyd, "Fundamentals of Metal Machining and Machine Tools", McGraw Hill, 2014.
R3 - Roy. A.Lindberg, "Process and Materials of Manufacture," Fourth Edition, PHI/Pearson Education, 2016.

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Programme	Name of the Course	L	T	P	C
B.E.	19ME4202 THERMAL ENGINEERING	3	0	0	3

Course Objective

1. To learn the concepts of gas power cycles.
2. To study the components and performance of internal combustionengines.
3. To acquire knowledge on steam nozzles and steam turbines.
4. To impart knowledge on working principles and performance of aircompressors.
5. To study the working principle of refrigeration and air conditioning systems.

Unit	Description	Instructional Hours
I	**GAS POWER CYCLES** Air standard cycles-assumptions- Otto, Diesel, Dual and Brayton cycles-calculation of mean effective pressure-and air standard efficiency - comparison of cycles.	8
II	**INTERNAL COMBUSTION ENGINES** Classification - components and their functions. valve timing and port timing diagrams – actual and theoretical p-V diagrams of four stroke and two stroke engines. Fuel supply systems for SI and CI engines. Types of ignition systems, Principles of Combustion and knocking in SI and CI Engines. Lubrication and Cooling systems. Performance calculations of IC engines.	10
III	**STEAM NOZZLES AND TURBINES** Flow of steam through nozzles-shapes of nozzles-effect of friction-critical pressure ratio and supersaturated flow. Impulse and Reaction principles. Compounding, velocity diagram for simple steam turbines.	9
IV	**AIR COMPRESSOR, FANS AND BLOWERS** Classification and working principle of various types of compressors-work of compression with and without clearance, compressor efficiency, Multistage air compressor and inter cooling –work of multistage air compressor, Fans & blowers-types and its industrial applications.	9
V	**REFRIGERATION AND AIR CONDITIONING** Refrigeration cycles: vapour compression systems- working principle and performance calculations. vapour absorption systems – working principle of ammonia –water and lithium bromide – water systems (Description only). Refrigerants propertiesand selection. Air conditioning system: Types-summer, winter and year around air conditioning systems, description of window and split air conditioning system, Cooling load calculations – simple problems only.	9
	Total Instructional Hours	45

Upon completion of the course, the students will be ableto

CO1: Understand the process of air standard cycles.

Course Outcome

CO2: Demonstrate the operating characteristics of internal combustion engines.
CO3: Apply the thermodynamic laws to various thermal equipments like steam nozzles and steam turbines.
CO4: Understand the types of compressors, fans and blowers and its applications.
CO5: Understand the principles of air-conditioning system and estimate the cooling loads.

TEXT BOOKS:

T1- Rajput. R. K., "Thermal Engineering" S.Chand Publishers, 2000 Third edition, 2015.
T2- Kothandaraman.C.P., Domkundwar. S,Domkundwar. A.V., "A course in thermal Engineering", Fifth Edition,"Dhanpat Rai & sons, 2012.
T3- Eastop, T.D., Mcconkey, A., Applied Thermodynamics for Engineering Technologies, 5th Edition, New Age International (p) Ltd., New Delhi,2012

REFERENCE BOOKS:

R1 - Arora.C.P,"Refrigeration and Air Conditioning," Tata McGraw-Hill Publishers 2014.
R2 - Ganesan V.," Internal Combustion Engines", Third Edition, Tata Mcgraw-Hill 2017.
R3 - Rudramoorthy, R, "Thermal Engineering ", Tata McGraw-Hill, New Delhi, 2013.

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Programme	Name of the Course	L	T	P	C
B.E.	19ME4203 KINEMATICS OF MACHINERY	3	1	0	4

Course Objective

1. To impart the knowledge on the concept of simple mechanisms.
2. To provide knowledge on kinematic analysis of simple mechanisms.
3. To study and construct the cam profile for the various follower motions.
4. To learn the gear nomenclature and calculate speed ratio of gear trains.
5. To introduce the concept of friction drives in kinematics of machines.

Unit	Description	Instructional Hours
I	**BASICS OF MECHANISMS** Basic Terminology – Degree of Freedom – Mobility - Gruebler's & Kutzbach criterion - Grashoff's law- Kinematic Inversions of Four bar chain and Slider crank chain - Mechanical Advantage - Transmission angle - Straight line generators - Ratchets and escapements - Indexing Mechanisms	12
II	**KINEMATICS ANALYSIS** Velocity and acceleration analysis of simple mechanisms using relative velocity method – Rubbing velocity of kinematic pair - Coriolis component of acceleration. Analyzer tools used	12
III	**KINEMATICS OF CAM** Basic Terminology – Classifications of Cams and Followers – Types of follower motions – Construction of cam profile for radial cam - Pressure angle and undercutting.	12
IV	**GEARS AND GEAR TRAINS** Gear tooth terminology - Classification of gears – Law of toothed gearing - Involute and Cycloidal tooth profiles – Interference and undercutting - Gear trains – Simple, Compound and Epicyclic gear trains - Differentials.	12
V	**FRICTION IN MACHINE ELEMENTS** Friction in screw jack - Plate clutches - Belt and rope drives - Block brakes, band brakes.	12
	Total Instructional Hours	60

Course Outcome

Upon completion of the course, the students will be ableto

CO1: Understand the process of air standard cycles.

CO2: Demonstrate the operating characteristics of internal combustion engines.

CO3: Apply the thermodynamic laws to various thermal equipments like steam nozzles and steam turbines.

CO4: Understand the types of compressors, fans and blowers and its applications.

CO5: Understand the principles of air-conditioning system and estimate the cooling loads.

TEXT BOOKS:

T1 – Thomas Bevan, "Theory of Machines", CBS Publishers and Distributors, 2015.

T2 – Rattan,S.S., "Theory of Machines", Tata Mcgraw-Hill Publishing Company Ltd., New Delhi, 2015.

REFERENCE BOOKS:

R1 - Khurmi,R.S., and Gupta, J.K., "Theory of Machines", S.Chand & Company, 2014.

R2 - Uicker J.J.,Pennock G.R., Shigley J.E., "Theory of Machines and Mechanisms"(Indian Edition), Oxford University Press, 2009.

R3 - Ghosh A and A.K.Mallick, "Theory of Mechanisms and Machines", Affiliated East- West Pvt. Ltd., New Delhi, 2016.

R4 - Rao J.S and Dukkipati R.V, "Mechanism and Machine Theory", Wiley-Eastern Ltd., New Delhi, 2016.

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Programme	Name of the Course	L	T	P	C
B.E.	19ME4251 STRENGTH OF MATERIALS (Mechanical Engineering)	3	0	2	4

Course Objective

1. To study the principles of simple stress, strain and deformation incomponents.
2. To assess stresses and deformations through mathematical models of beams.
3. To learn about torsion of components.
4. To gain knowledge about deflections on beams.
5. To understand the stress analysis in thin cylinders & Spherical Shells

Unit	Description	Instructional Hours
I	**ANAYSIS OF STRESSES** Rigid and Deformable bodies - Mechanical Properties - Deformation of simple and compound bars - Thermal stresses - Elastic constants - Volumetric strains, Principal Planes & Stress - Mohr's circle. *Hardness test on metals* -***Brinell and Rockwell. Tension test on a mild steel rod.***	9+3
II	**STRESSES IN BEAMS** Types of beams: Supports and Loads - Shear force and Bending Moment in beams - Cantilever, Simply supported - Stresses in beams - Theory of simple bending - Stress distribution alonglength in beam section - Shear stresses in beams. ***Deflection test on beams.***	9+3
III	**TORSION IN SHAFTS AND HELICAL SPRINGS** Analysis of torsion of circular and hollow shafts - Deflection in shaft subjected to variousboundary conditions - Stresses in helical springs and Leaf springs. ***Torsion test on mild steel rod***	9+3
IV	**DEFLECTION OF BEAMS** Evaluation of beam deflection - Double integration method - Macaulay Method - Strain Energy - Strain energy in uniaxial loads. ***Compression test on helicalsprings.***	9+3
V	**STRESS ANALYSIS IN THIN CYLINDERS & SPHERICAL SHELLS** Stresses in Thin cylindrical shell due to internal pressure, Circumferential and Longitudinal stresses and deformation in Thin Cylinders - Spherical shells subjected to internal pressure - Deformation in spherical shells. ***Testing of impacting resistance of steels.***	9+3
	Total Hours	(45+15) 60

Course Outcome

Upon completion of the course student can be able to

CO1: Apply mathematical knowledge to estimate the deformation behavior of simple structures.
CO2: Calculate shear force and bending moment in different types of beams.
CO3: Determine torsion in shafts and stresses in various types of springs.
CO4: Analyze deflection in various beams.
CO5: Estimate the stresses developed in cylinders and spherical shells.

TEXT BOOKS:

T1 -Bansal.R.K, "Text Book of Strength of Materials", Laxmi Publications, New Delhi, 2017.
T2 -Khurmi.R.S, "Strength of Materials", S.Chand Publications, 2016.

REFERENCE BOOKS:

R1 - Beer F. P. and Johnston R," Mechanics of Materials", McGraw-Hill Book Co, Seventh Edition, 2017.
R2 - Popov E.P, "Engineering Mechanics of solids", Prentice -Hall of India, New Delhi, Second edition, 2017.
R3 - Ryder G.H, "Strength of Materials, Macmillan India Ltd", Third Edition, 2012.

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Programme	Name of the Course	L	T	P	C
B.E.	19ME4001 MANUFACTURING TECHNOLOGY LAB-II	0	0	4	2

Course Objective

- To Study and acquire knowledge on various basic machining operations in special machines and its applications in real life manufacture of components in the industry

S.No	DESCRIPTION OF THE EXPERCISE	Hrs
	LIST OF EXERCISE	
1	Contour milling using vertical milling machine.	
2	Spur gear cutting in milling machine.	
3	Helical Gear Cutting in milling machine.	
4	Gear generation in gear hobbing machine.	
5	Surface machining and V groove using shaping machine.	
6	Internal grooving in slotter machine.	
7	Machining operation using Centreless grinding.	
8	Tool angle grinding with tool and Cutter Grinder.	
9	Measurement of cutting forces in Milling / Turning Process / cycle timeestimation.	
10	Surface machining in Planner machine.	
11	Machining operation using Turret and capstan lathe.	
12	CNC Part Programming.	
	Total Instructional Hours	45

Course Outcome

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

CO1: Demonstrate various machining operations using machine tools
CO2: Fabricate different types of components for industrial applications
CO3: Manufacture tools using cutter grinder.
CO4: Develop CNC part programming for the simple components.

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Programme	Name of the Course	L	T	P	C
B.E.	19ME4002 THERMAL ENGINEERING LAB	0	0	3	1.5

Course Objective

1. To study the valve timing and port timing diagram.
2. To understand the basic concepts and working of IC engines.
3. To study the characteristics of fuels/Lubricants used in ICengines.
4. To study the principle of air compressor.
5. To study the principle of centrifugal blower.

Expt. No.	Description of the Experiments
1.	Draw the Valve and Port Timing diagrams.
2.	Determination of Brake Thermal Efficiency of a four stroke Diesel Engine.
3.	Determination of heat losses by Heat Balance Test in a four stroke Diesel Engine.
4.	Determination of Indicated Power of a Multi-cylinder Petrol Engine using Morse Test.
5.	Determination of Friction Power of a Diesel Engine using Retardation Method.
6.	Determination of Flash and Fire Point of fuels and lubricants by using Pensky Marten's apparatus.
7.	Determination of Calorific Value of fuels.
8.	Determination of Viscosity of lubricants using Redwood viscometer.
9.	Determination of Volumetric and Isothermal Efficiencies of a Two Stage Reciprocating Air Compressor.
10.	Determination of stage efficiency of a Centrifugal Blower.

Total Practical Hours 45

Course Outcome

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

CO1: Demonstrate the principles of spark ignition and compression ignition engines.

CO2: Evaluate the various performance parameters of Internal Combustion Engines.

CO3: Determine the properties of fuels and lubricating oils.

CO4: Evaluate the performance of air compressors.

CO5: Evaluate the performance of centrifugal blower.

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PROGRAMME	COURSE CODE	NAME OF THE COURSE	L	T	P	C
B.E.	19MC4191	ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE	2	0	0	0

Course Objective

1. The course aims at imparting basic principles of thought process, reasoning and inferencing.
2. Sustainability is at the core of Indian Traditional Knowledge Systems connecting society and nature.
3. Holistic life style of Yogic-science and wisdom capsules in Sanskrit literature are also important in modern society with rapid technological advancements and societal disruptions.
4. The course focuses on introduction to Indian Knowledge System, Indian perspective of modern scientific world-view, basic principles of Yoga and holistic health care system, Indian philosophical traditions, Indian linguistic tradition and Indian artistic tradition.

Unit	Description	Instructional Hours
I	Basic Structure of Indian Knowledge System	4
II	Modern Science and Indian Knowledge System	4
III	Yoga and Holistic Health care	4
IV	Philosophical tradition	4
V	Indian linguistic tradition (Phonology, Morphology, Syntax and semantics), Indian artistic traditionnd Case Studies.	4
	TOTAL INSTRUCTIONAL HOURS	**20**

Course Outcome

CO1: Ability to understand the structure of Indian system of life.
CO2: Connect up and explain basics of Indian Traditional knowledge in modern scientific perspective

REFERENCE BOOKS:

R1. V. Sivaramakrishna (Ed.), Cultural Heritage of India-Course Material, Bharatiya Vidya Bhavan, Mumbai, 5th Edition, 2014

R2. Swami Jitatmanand, Modern Physics and Vedant, BharatiyaVidyaBhavan

R3. Fritzof Capra, Tao of Physics

R4. Fritzof Capra, The wave of Life.

R5.V N Jha(Eng. Trans,), Tarkasangraha of Annam Bhatta, International Chinmay Foundation, Velliarnad, makuam

R6. Yoga Sutra of Patanjali, Ramakrishna Mission, Kolkatta.

R7. GN Jha(Eng. Trans.) Ed. R N Jha, Yoga-darshanam with VyasaBhashya, VidyanidhiPrakasham, Delhi, 2016.

R8. RN Jha, Science of Consciousness Psychotherapy and Yoga Practices, Vidyanidhi Prakasham, Delhi,2016.

R9. P R Sharma (English translation), Shodashang Hridayam

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16ME5201	CAD / CAM	3	0	0	3

Course Objective

1. To learn the basics of computer based modelling.
2. To Study important methods of principles of modeling features.
3. To Gain knowledge in CNC machine tools and part programming.
4. To develop process planning techniques and product data management.
5. To learn about integrated manufacturing systems.

Unit	Description	Instructional Hours
I	**PRODUCT CYCLE AND COMPUTER GRAPHICS** Design process-Product development cycle-Sequential engineering-Concurrent engineering-Evolution of CAD/CAM and CIM, Graphic Primitives-Point plotting-Drawing of lines-Bresenham's circle algorithm-View port-2D and 3D transformations- Clipping.	9
II	**GEOMETRIC MODELING TECHNIQUES** CAD process, Wireframe modeling- Surface modeling-Representation of curves and surfaces-Hermite, Bezier, B-Spline and Rational curve- Types of surfaces- Solid modeling, Drawing utilities-entities-blocks-display-hatching-pattern-dimensioning-enquiry-plotting-Customisation-file interchange-office management- Data transfer. Assembly, Drafting and mechanism.	9
III	**CNC MACHINE TOOLS** NC machine principles-Types of CNC machines-Features of CNC systems-Programming Features-Diagnostic Features-DNC and its Integration-Controllers-Technology and Procedure of CAM-Additive Manufacturing.	9
IV	**COMPUTER AIDED MANUFACTURING SYSTEMS** Process planning-computer aided process planning-Group technology-Part families-classification and coding-production flow analysis-Cellular manufacturing systems-Flexible manufacturing systems.	9
V	**COMPUTER INTEGRATED MANUFACTURING** CIM as a concept and a technology, Benefits of CIM, Product data management-Master production schedule-Material and capacity Requirement Planning, Production planning and control, Shop floor control -Inventory Management, Manufacturing resource planning.	9
	Total Instructional Hours	**45**

Course Outcome

Upon completion of the course Student will be able to:

CO1: Understand the mathematics behind 2D and 3D CAD models.

CO2: Learn, interpret and analyze different types of modeling techniques.

CO3: Prepare CNC programs and understand the CNC systems.

CO4: Apply computer aided process planning techniques.

CO5: Obtain knowledge of product data management.

TEXT BOOKS:

T1 – Mikell.P.Groover, "Automation, Production Systems and Computer-Integrated Manufacturing", Pearson Education, New Delhi, 2003.

T2 – Radhakrishnan. P and S. Subramanyan, Raju. V "CAD/CAM/CIM" New Age International(P) Ltd, New Delhi – 2002.

REFERENCE BOOKS:

R1 - Zeid Ibrahim, "CAD/CAM Theory and Practices", McGraw Hill International Edition,2000.

R2 - Mikell P. Groover and Enory W. Zimmers Jr. "CAD/CAM: Computer Aided Design and Manufacturing," Prentice Hall of India, New Delhi.2005.

R3 - Kundra T.K., Rao P.N. and Tiwari N.K. ,"CNC Machine Tools and Computer Aided Manufacturing," Tata McGraw Hill Pub. New Delhi, 1991.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16ME5202	HEAT AND MASS TRANSFER	3	0	0	3

Course Objective

1. To study the various modes of heat transfer and its applications.
2. To study about free and forced convection for various applications.
3. To learn about condensation, boiling, and basic design of heat exchange using LMTD, NTU methods.
4. To acquire knowledge about radiation laws and gas radiation.
5. To study about basic concepts of mass transfer.

Unit	Description	Instructional Hours
I	**CONDUCTION** General Differential equation of Heat Conduction– Cartesian and Polar Coordinates – One Dimensional Steady State Heat Conduction – plain and Composite Systems- Calculation of thermal conductivity of composite materials– Conduction with Internal Heat Generation – Extended Surfaces – Unsteady Heat Conduction – Lumped Analysis –Semi Infinite and Infinite Solids –Use of Heisler's charts.	9
II	**CONVECTION** Free and Forced Convection - Hydrodynamic and Thermal Boundary Layer. Free and Forced Convection during external flow over Plates and Cylinders and Internal flow through tubes.	9
III	**PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGERS** Nusselt's theory of condensation - Regimes of Pool boiling and Flow boiling. Correlations in boiling and condensation. Heat Exchanger Types - Overall Heat Transfer Coefficient Fouling Factors –Analysis of heat exchanger using LMTD – NTU method.	9
IV	**RADIATION** Basic Concepts, Laws of Radiation – Black Body Radiation – Grey body radiation –radiation shield - Shape Factor (parallel Plates, parallel circular disc) – Gas radiations (basics study).	9
V	**MASS TRANSFER** Basic Concepts – Diffusion Mass Transfer – Flick's Law of Diffusion – Steady state Molecular Diffusion– Convective Mass Transfer – Momentum, Heat and Mass Transfer Analogy – Convective Mass Transfer Correlations.	9
	Total Instructional Hours	**45**

Course Outcome

Students will be able to:

CO1: Apply conduction heat transfer concepts in the engineering applications.
CO2: Analyze convection heat transfer problems for free and forced mode.
CO3: Design and select heat exchangers, condensers and evaporator for various engineering applications
CO4: understand and apply the concepts of Black Body Radiation and Grey body radiation.
CO5: Apply the knowledge on mass transfer.

TEXT BOOKS:

T1 Sachdeva R C, "Fundamentals of Engineering Heat and Mass Transfer" New Age International, August 2007, Reprint 2008, 3rd edition.

T2 Yunus Cengal "Heat and Mass Transfer" Tata McGraw Hill, 3rd edition, 2008

REFERENCE BOOKS:

R1 Kothandaraman C.P "Fundamentals of Heat and Mass Transfer" New Age International, 3rdEdition, 2006, Reprint 2008.

R2 Nag P.K, "Heat Transfer" - Tata McGraw-Hill, New Delhi, 2002

R3 Holman J.P, "Heat Transfer" - Tata McGraw Hill, Ninth edition, 2007.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16ME5203	DYNAMICS OF MACHINES	3	0	0	3

Course Objective

1. To study the method of static force analysis and dynamic force analysis of mechanisms and flywheel.
2. To study the undesirable effects of unbalances in rotors and engines.
3. To learn the concept of natural vibratory systems and their analysis.
4. To learn the concept of forced vibratory systems and their analysis.
5. To know principles of governors and gyroscopes.

Unit	Description	Instructional Hours
I	**FORCE ANALYSIS AND FLYWHEELS** Static force analysis of mechanisms – D Alembert's principle - Inertia force and Inertia torque – Dynamic force analysis - Dynamic Analysis in Reciprocating Engines – Gas Forces – Equivalent masses - Bearing loads - Crank shaft torque – Engine shaking forces. Turning moment diagrams – Fluctuation of energy, speed - Flywheels of engines and punching press.	9
II	**BALANCING** Static and dynamic balancing – Balancing of rotating masses - Balancing of reciprocating masses in a single cylinder engine – Primary and secondary unbalanced forces - Balancing in multi-cylinder engines – Balancing machines.	9
III	**FREE VIBRATION** Basic features of vibratory systems - Basic elements and lumping of parameters - Degrees of freedom - Single degree of freedom - Free vibration - Equations of motion - Natural frequency - Whirling of shafts and critical speed - Torsional vibration of two and three rotor systems, torsionally equivalent shaft. Determination of frequency for various elements.	9
IV	**DAMPED AND FORCED VIBRATIONS** Damped vibration - Types of damping – Logarithmic decrement - Response to periodic forcing - Harmonic Forcing – Forced vibration caused by unbalance - Support motion – Force transmissibility and amplitude transmissibility - Vibration isolation.	9
V	**MECHANISMS FOR CONTROL** Governors - Types - Centrifugal governors – Porter & Proell governor, Hartnell, Hartung – Characteristics - Effect of friction - Controlling Force Gyroscopes - Gyroscopic couple - Gyroscopic stabilization - Gyroscopic effects in airplanes and ships.	9
	Total Instructional Hours	**45**

Course Outcome

Students will be able to:

CO1: Calculate the inertia forces in reciprocating and rotating masses and turning moments in flywheels.
CO2: Balance reciprocating and rotating masses.
CO3: Analyze free vibration systems.
CO4: Determine the frequency of damped forced vibration systems.
CO5: Evaluate the gyroscopic couple and sensitivity of governor.

TEXT BOOKS:

T1 -Rattan S.S., "Theory of Machines", 3rd edition, TMH, New Delhi, 2009.
T2 -Uicker. J.J, G.R. Pennock, J.E. Shigley, Theory of Machines and Mechanisms, 4th Ed, Oxford University Press, New York, 2011.

REFERENCE BOOKS:

R1 -Shigley J.E. and Uicker J.J., "Theory of Machines and Mechanisms", McGraw-Hill, Inc., 4th Ed, 2010.
R2 -Ghosh A. and Mallick A.K., "Theory of Mechanisms and Machines", Affiliated East- West Press Pvt. Ltd., New Delhi, 3rd edition, 2004.
R3 -Khurmi, R.S.,"Theory of Machines", 14th Edition, S Chand Publications, 2005.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16ME5204	DESIGN OF MACHINE ELEMENTS (COMMON TO MECHANICAL AND AUTOMOBILE ENGINEERING)	3	0	0	3

Course Objective

1. To study the design function in mechanical engineering, different steps involved in designing and the relation of design activity with manufacturing activity.
2. To know the different types of failure modes and criteria.
3. To learn the principles involved in evaluating the shape and dimensions of a component to satisfy functional and strength requirements.
4. To gain design knowledge of the different types of elements used in the machine design process, for e.g. Shafts, couplings etc. and will be able to design these elements for each application.
5. To learn to use catalogues and standard machine components

Unit	Description	Instructional Hours
I	**STEADY STRESSES IN MACHINE MEMBERS** Introduction to the design process - factors influencing machine design - calculation of principal stresses for various load combinations, eccentric loading – curved beams – crane hook and 'C' frame - theories of failure – Design based on strength and stiffness – stress concentration.	9
II	**VARIABLE STRESSES IN MACHINE MEMBERS** Variable stresses - Soderberg, Gerber and Goodman methods for combination of stresses and their application in design problems.	8
III	**DESIGN OF SHAFTS AND COUPLINGS** Design of solid & hollow shaft based on strength and rigidity with steady loading subjected to pure torsion. Design of shafts carrying pulleys & gears (Combined loading), Design and drawing of couplings – Rigid and Flexible.	10
IV	**DESIGN OF SPRINGS AND FLYWHEEL** Various types of springs, Design of helical springs and Leaf springs – Design of Flywheel considering stresses in rims and arms for engines and presses.	9
V	**DESIGN OF BEARINGS** Sliding contact and rolling contact bearings - Hydrodynamic journal bearings, Sommerfield Number, Raimondi and Boyd graphs, - Selection of Rolling Contact bearings.	9
	Total Instructional Hours	**45**

Course Outcome

Students will be able to:

CO1 - Demonstrate the use of stress analysis, theories of failure and materials in the design of machine components.

CO2 - Identify proper assumptions with respect to material, factor of safety, static and dynamic loads for various machine components.

CO3 - Design of shafts based on strength and rigidity and couplings.

CO4 - Design springs and considering stresses in flywheel components.

CO5 - Design of Sliding contact and rolling contact bearings.

TEXT BOOKS:

T1. Bhandari V, "Design of Machine Elements", 3rd Edition, Tata McGraw-Hill Book Co, 2010.

T2. Joseph Shigley, Charles Mischke, Richard Budynas and Keith Nisbett "Mechanical Engineering Design", 8th Edition, Tata McGraw-Hill, 2008.

REFERENCE BOOKS:

R1. Sundararajamoorthy T. V. Shanmugam .N, "Machine Design", Anuradha Publications, Chennai, 2003.

R2. Robert C. Juvinall and Kurt M. Marshek, "Fundamentals of Machine Design", 4th Ed, Wiley, 2005.

R3. Alfred Hall, Halowenko, A and Laughlin, H., "Machine Design", Tata McGraw-Hill BookCo.(Schaum's Outline), 2010.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16ME5205	AUTOMOBILE ENGINEERING	3	0	0	3

Course Objective

To learn the following

1. The anatomy of the automobile in general.
2. The location and importance of each part.
3. The functioning of the engine and its accessories, gear box, clutch, brakes, steering, axles and wheels.
4. Suspension, frame, springs and other connections.
5. Emissions, ignition, controls, electrical systems and ventilation.

Unit	Description	Instructional Hours
I	**VEHICLE STRUCTURES AND ENGINE** Types of Automobiles - Vehicle Construction, Chassis –Types, Frame and Body – Types. Engine types, Components of Engine – Functions and Materials. Vehicle aerodynamics, Introduction to Electronic Engine Management System.	9
II	**FUEL SUPPLY SYSTEM AND ELECTRICAL SYSTEM** Carburetion and Simple carburetor - Electronically controlled gasoline fuel injection system – Monopoint and MultiPoint Fuel Injection Systems (MPFI). Diesel engine fuel supply system - Types, Electronically controlled diesel fuel injection system – CRDI. General layout of electrical system – Different sub circuits. Construction and operation of Lead Acid battery - Lighting system – Starting motor and drives.	9
III	**TRANSMISSION SYSTEMS** Clutch – Types and Construction, Gear Boxes – Types, Manual and Automatic, Selector mechanism - Over Drives – Transfer Box - Fluid flywheel - Torque converter – Propeller shaft – Slip Joint – Universal Joints – Differential unit. Rear Axle – Hotchkiss drive and Torque Tube drive. Turbocharger and supercharger.	9
IV	**STEERING, BRAKES AND SUSPENSION SYSTEMS** Wheels and Tyres – Wheel alignment parameters, Types of Front axle - Steering geometry and mechanism - Steering gear box and types – Power Steering. Brakes – Types, Hydraulic and Pneumatic braking systems - Construction and working, Antilock Braking System, electronic brake force distribution (EBD) and Traction Control. Suspension systems – Types – Independent suspension systems.	9
V	**ALTERNATE FUELS IN AUTOMOBILES** Properties and applications of Natural Gas, LPG, Biodiesel, Bioethanol, Gasohol, Biogas, Producer gas and Hydrogen in Automobiles, Electric vehicles - Hybrid vehicles - Solar powered vehicles - Fuel Cells. Emission Control & Safety: Global Standards, Indian Pollution norms for Petrol & Diesel vehicles, Safety measures in automobiles.	9
	Total Instructional Hours	**45**

Course Outcome

Student upon completion of the course will be able to:

CO1 - Understand the function of various automobile components and engine parts.
CO2 - Understand the fuel supply systems and electrical systems in automobiles.
CO3 - Understand the working of transmission system and its various elements.
CO4 - know the working of suspension, steering and braking systems.
CO5 - Understand the various alternate fuels that could be used in automobiles.

TEXT BOOKS:

T1 Kirpal Singh, "Automobile Engineering", Vol 1 & 2, Seventh Edition, Standard Publishers, New Delhi, 2011.

T2 Jain K.K. and Asthana .R.B, "Automobile Engineering" Tata McGraw Hill Publishers, New Delhi, 2002.

REFERENCE BOOKS:

R1 Joseph Heitner, "Automotive Mechanics," Second Edition, East-West Press, 1999.

R2 Martin W, Stockel and Martin T Stockle , "Automotive Mechanics Fundamentals," The Good heart –Will Cox Company Inc, USA ,1985.

R3 Ganesan V. "Internal Combustion Engines", Third Edition, Tata McGraw-Hill, 2007.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16ME5001	CAD / CAM LABORATORY	0	0	4	2

Course Objective

1. To acquire practical experience in using 2D drafting and 3D modeling software.
2. To study the features of CNC Machine Tools.
3. To learn the applications of modern control systems.

S.No	Description of the Experiments	Practical Hours
	I. 3D GEOMETRIC MODELING	
	List of Experiments Creation of 3D assembly model of following machine elements using 3D Modeling software 1. Flange Coupling 2. Screw Jack 3. Universal Joint 4. Connecting rod 5. Lathe Tailstock	24
	II. Manual Part Programming.	
	(i) Part Programming - CNC Turning Centre 6. Step Turning 7. Taper Turning and Circular Interpolation 8. Drilling, Grooving and Thread Cutting	21
	(ii) Part Programming - CNC Machining Centre 9. Milling of a Contour Profile 10. Milling an arc or Circular Profile	
	III. Computer Aided Part Programming a) Demonstration on CL Data and Post process generation using CAM software. ➢ Study and practical demonstration on Coordinate measuring machine. ➢ Study and practical demonstration on Rapid Prototyping Technologies.	
	Total Instructional Hours	**45**

Course Outcome

The Students will be able to
CO1 - Develop 2D drawing and 3D models using modeling software.
CO2 - Understand the CNC control in modern manufacturing system.
CO3 - Prepare CNC part programming and manufacture engineering components.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16ME5002	THERMAL ENGINEERING LABORATORY – II	0	0	4	2

Course Objective

To learn the following

1. Determination of thermal conductivity of conduction apparatus.
2. Determination of the heat transfer coefficient of convection apparatus.
3. Calculation of effectiveness of heat exchangers.
4. Determination of emissivity of a grey surface.
5. Performance of air conditioning and refrigeration systems.

Expt. No.	Description of the Experiments	Practical Hours
	HEAT TRANSFER LAB	
1	Thermal conductivity measurement using guarded plate apparatus.	
2	Thermal conductivity measurement of pipe insulation using lagged pipe apparatus.	
3	Determination of heat transfer coefficient under natural convection from a vertical cylinder.	
4	Determination of heat transfer coefficient under forced convection from a tube.	
5	Determination of Thermal conductivity of composite wall.	30
6	Determination of Thermal conductivity of insulating powder.	
7	Heat transfer from pin-fin apparatus.	
8	Determination of Stefan – Boltzmann constant.	
9	Determination of emissivity of a grey surface.	
10	Effectiveness of Parallel / counter flow heat exchanger.	
	REFRIGERATION AND AIR CONDITIONING LAB	
11	Determination of COP of a refrigeration system (Calorimetry test).	
12	Determination of COP of an air-conditioning system.	15
13	Determination of COP of a domestic refrigerator using hydro carbon refrigerants.	
	Total Practical Hours	**45**

Course Outcome

Students will be able to:

CO1: Apply the various modes of heat transfer in thermal systems.

CO2: understand the working principle of refrigeration and air conditioning systems.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16ME5003	DYNAMICS LAB	0	0	4	2

Course Objective

1. To learn the concepts of generalized forces and the Principle of Virtual Work.
2. To acquire concepts of static and dynamic mass balancing and flywheels.
3. To be aware of the approaches and mathematical models used dynamical analysis of machinery.
4. To learn the applications of measuring devices used for dynamic testing.

Expt. No.	Description of the Experiments
1.	Experimental study of velocity ratio for various types of gear trains – simple and Compound.
2.	To draw the profile of the CAM and to determine the jump speed of the cam.
3.	To perform the static balancing on static balancing machine.
4.	To perform the dynamic balancing on dynamic balancing machine.
5.	To determine the of Moment of Inertia of Round bar by Bifilar Suspension and Compound Pendulum.
6.	To determine the following: a) Natural Frequency of Longitudinal Vibrations of helical spring. b) Transverse Vibrations and Verification of Dunkerley"s Rule.
7.	To determine the Natural Frequency of Torsional Vibrations
8.	To determine the following: a) Critical speed of Shaft. b) Transmissibility Ratio of vibrating table.
9.	To perform experiment on Watt and Porter Governors and draw the performance characteristic Curves, and to find stability & sensitivity.
10.	To perform experiment on Proell Governor and draw the performance characteristic Curves and find stability & sensitivity.
11.	To perform experiment on Hartnell Governors and draw the performance characteristic Curves, and find stability & sensitivity.
12.	To determine the gyroscopic couple on Motorized Gyroscope.
	Total Practical Hours 45

Course Outcome

Students will be able to:

CO1: Conduct experiments on vibrating bodies for predicting natural frequency.

CO2: Perform experiments on balancing of masses and determine the unbalanced force.

CO3: Determine the characteristic curves for governors and effect of gyroscopic couple.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16ME6201	FINITE ELEMENT ANALYSIS (COMMON TO MECHANICAL AND AUTOMOBILE ENGINEERING)	3	0	0	3

Course Objective

1. To equip the students with the finite element analysis fundamentals
2. To enable the students to formulate the design problems using Finite Element Analysis
3. To acquire knowledge on solving 2-D structural and thermal problems.
4. To develop proficiency in the application of FEM to realistic axisymmetric engineering problems.
5. To enable the students to solve Isoparametric elements.

Unit	Description	Instructional Hours
I	**INTRODUCTION** Historical background – Matrix approach – Application to the continuum – Discretization – Matrix algebra – Gaussian elimination – Governing equations for continuum – Classical Techniques in FEM– Weighted residual method – Ritz method.	9
II	**ONE DIMENSIONAL PROBLEMS** Finite element modeling –shape functions- Potential energy approach – Galerkin approach – Assembly of stiffness matrix and load vector – General form of finite element equations –linear bar element– Quadratic element –Nodal approximation-Development of shape function-Element matrices and vectors-Extension to plane trusses-Development of element equations-Assembly-Element connectivity-Global equations-Beam elements and one dimensional heat transfer problems.	9
III	**TWO DIMENSIONAL SCALAR VARIABLE PROBLEMS** Introduction – Finite element modeling – Scalar valued problem – Poisson equation –Laplace equation – Triangular elements – Element stiffness matrix – Force vector – Galerkin approach - Stress calculation – Temperature effects-Heat transfer problems-Torsion of non circular shafts.	9
IV	**TWO DIMENSIONAL VECTOR VARIABLE PROBLEMS** Axisymmetric formulation – Element stiffness matrix and force vector – Galerkin approach – Body forces and temperature effects – Stress calculations – Boundary conditions – Applications to cylinders under internal or external pressures.	9
V	**ISOPARAMETRIC FORMULATION** Natural coordinate systems-Isoparametric elements-The four node quadrilateral element– Shape functions for isoparametric elements – Element stiffness matrix and force vector – Lagrangean and serendipity elements – Numerical integration - Stiffness integration – Stress calculations – Four node quadrilateral for axisymmetric problems-Higher order elements.	9
	Total Instructional Hours	**45**

Course Outcome

Students will be able to:

CO1: Formulate the mathematical model for solution of engineering design problems
CO2: Determine the solution for real time 1D structural problems and heat transfer problems.
CO3: Solve heat transfer and structural problems using 2D elements
CO4: Explain the stages in solving engineering problems under axisymmetric condition
CO5: Analyse and solve the real time problems using isoparametric elements

TEXT BOOKS:

T1 Reddy. J.N., "An Introduction to the Finite Element Method", 3rd Edition, Tata McGraw-Hill, 2006

T2 Seshu.P, "Text Book of Finite Element Analysis", Prentice-Hall of India Pvt. Ltd., New Delhi, 2007.

REFERENCE BOOKS:

R1 Rao, S.S., "The Finite Element Method in Engineering", 3rd Edition, Butterworth Heinemann, 2011

R2 Logan, D.L., "A first course in Finite Element Method", Thomson Asia Pvt. Ltd., 2002

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16ME6202	METROLOGY AND QUALITY CONTROL	3	0	0	3

Course Objective

1. To study basic principles of measurements.
2. To learn about the various linear & angular measuring equipments.
3. To learn the basics of form measurements.
4. To acquire knowledge on advanced measuring techniques.
5. To learn concepts of control charts for the variables.

Unit	Description	Instructional Hours
I	**BASICS OF METROLOGY** General concept – Generalized measurement system - Units and Standards - Measuring instruments - sensitivity, stability, range, readability, accuracy and precision - static and dynamic response - repeatability - Errors in Measurements, calibration - Introduction to Dimensional and Geometric Toleranceing.	9
II	**LINEAR AND ANGULAR MEASUREMENTS** Linear Measuring Instruments – Vernier, Micrometer, Slip gauges, Comparators -Types, Limit gauges – Tool Makers Microscope. Angular measuring instruments - Sine bar, Sine center, Bevel protractor, Angle Decker & Autocollimator – Applications.	9
III	**FORM MEASUREMENT** Measurement of screw threads: Thread gauges, Floating carriage micrometer - Measurement of gear parameters - Gear tooth vernier caliper method, Constant chord, Base tangent method - Parkinson gear roller tester - Surface finish - Analysis, Measuring Equipments - Straightness Measurement and Roundness measurements.	9
IV	**ADVANCES IN METROLOGY** Basic concept of lasers - Advantages of lasers – Laser Inspection - Laser Interferometers – Types – AC Laser Interferometer, NPL Flatness Interferometer, Michelson Interferometer - Applications. Basic concept of CMM – Types of CMM – Constructional features – Probes – Accessories – Software – Applications – Basic concepts of Machine Vision System – Applications.	9
V	**PROCESS CONTROL FOR VARIABLES** Introduction, definition of quality, basic concept of quality, definition of SQC, benefits and limitation of SQC, Quality assurance, Quality cost-Variation in process- factors – process capability – process capability studies and simple problems – Theory of control chart- uses of control chart – Control chart for variables – X chart, R chart and control chart for variables.	9
	Total Instructional Hours	**45**

Course Outcome

Students will be able to:

CO1: understand the principles of measurements.

CO2: Acquire the knowledge about linear and angular measuring instruments.

CO3: Gain the detailed informations about form measurements.

CO4: know the advance measurement concepts in metrology.

CO5: Apply the control charts for the process control.

TEXT BOOKS:

T1 - Jain R.K., "Engineering Metrology", Khanna Publishers, 19th edition, 2005.

T2 - Alan S. Morris, "The Essence of Measurement", Prentice Hall of India, 1997.

REFERENCE BOOKS:

R1 - Charles Reginald Shotbolt, "Metrology for Engineers", 5th edition, Cengage Learning EMEA, 1990.

R2 - Gupta. I.C., "Engineering Metrology", Dhanpatrai Publications, 2005.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16ME6203	HYDRAULIC AND PNEUMATIC CONTROLS	3	0	0	3

Course Objective

1. To study the physical properties of the hydraulic systems.
2. To learn the operations of pumps, cylinders and the directional control valves.
3. To learn basic properties of the compressed air as medium used in energy transmission for the purpose of control systems.
4. To learn the basic operations and working principles of various pneumatic components and circuits.
5. To be aware of various problems and maintenance of Hydraulic and Pneumatic circuits for various engineering applications.

Unit	Description	Instructional Hours
I	**INTRODUCTION TO FLUID POWER AND HYDRAULIC PUMPS** Introduction to fluid power, Advantages of fluid power, Application of fluid power system. Types of fluid power systems, Properties of hydraulic fluids – Fluid power symbols. Basics of Hydraulics - Applications of Pascal's Law. Pumping theory – Pump classification – Gear pump, Vane Pump, piston pump, construction and working of pumps.	9
II	**HYDRAULIC ACTUATORS AND CONTROL VALVES** Actuators: Linear hydraulic actuators – Types of hydraulic cylinders – Single acting, Double acting, special cylinders like tandem, Rodless, Telescopic, Cushioning mechanism, Construction of double acting cylinder. Control Valves: Direction control valve – 3/2 way valve – 4/2 way valve – Shuttle valve – check valve – pressure control valve – pressure reducing valve, sequence valve, Flow control valve – Fixed and adjustable.	9
III	**DESIGN OF HYDRAULIC SYSTEMS AND INDUSTRIAL APPLICATIONS** Reciprocating circuit, Synchronizing circuit, Regenerative circuit, Pump unloading circuit, Counterbalance valve circuit. Automation solution for any manual applications. Types of accumulators – Accumulators circuits, sizing of accumulators-Intensifier, Fail-safe circuits - Speed control circuits.	9
IV	**PNEUMATIC SYSTEMS AND COMPONENTS** Properties of air – Compressors – Filter, Regulator, Lubricator, and Muffler – Air control valves, Quick exhaust valves, pneumatic actuators. Sequential circuit design for simple applications using cascade method.	9
V	**SERVO SYSTEMS AND MAINTENANCE** Servo systems – Hydro Mechanical servo systems, Electro hydraulic servo systems and proportional valves. Fluidics – Introduction to fluidic devices, simple circuits, Introduction to Electro Hydraulic Pneumatic logic circuits, ladder diagrams, PLC applications in fluid power control. Fluid power circuits; failure and troubleshooting.	9
	Total Instructional Hours	**45**

Course Outcome

Students will be able to:

CO1: Demonstrate the applicability of fluid power systems for engineering applications.
CO2: Design customized circuits in hydraulics, pneumatics and servo systems for various industrial needs.
CO3: Draw and explain the working of various types of pumps and hydraulic motors and cylinders.
CO4: Explain the fundamentals of pneumatic systems and working of pneumatic components.
CO5: Draw ladder logic diagrams and explain about low cost automation.

TEXT BOOKS:

T1- Anthony Esposito, "Fluid Power with Applications", Pearson Education 2000.
T2- Peter Rohner, "Industrial Hydraulic Control" 4th Revised Edition 2005.
T3- Majumdar S.R., "Oil Hydraulics", Tata McGraw-Hill, 2000.

REFERENCE BOOKS:

R1- Majumdar S.R.,"Pneumatic systems – Principles and maintenance", Tata McGraw Hill, 1995.
R2- Harry L. Stevart D.B, "Practical guide to fluid power", Taraoeala sons and Port Ltd. Broadey, 1976.
R3- Michael J, Prinches and Ashby J. G, "Power Hydraulics", Prentice Hall, 1989.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16ME6204	DESIGN OF TRANSMISSION SYSTEMS	3	0	0	3

Course Objective

1. To acquire knowledge for the selection of various flexible elements like belt and chain drives.
2. To study design and analysis of parallel and non-intersecting type of gear drives.
3. To impart knowledge on design and analysis of non-parallel and intersecting type of gear drives.
4. To acquire the knowledge on design of gear boxes.
5. To learn an overview of the design of transmission elements like brakes and clutches.

Unit	Description	Instructional Hours
I	**DESIGN OF FLEXIBLE ELEMENTS** Selection of V belts and pulleys-selection of Flat belts and pulleys-Wire ropes and pulleys – Selection of Transmission chains and Sprockets. Design of pulleys and sprockets. Case studies on design of material handling systems.	9
II	**DESIGN OF SPUR GEARS AND HELICAL GEARS** Gear Terminology-Force analysis -Tooth stresses - Dynamic effects - Fatigue strength – Factor of safety - Gear materials – Module and Face width-power rating calculations based on strength and wear considerations - Helical Gears – Pressure angle in the normal and transverse plane- Equivalent number of teeth-forces and stresses.	9
III	**DESIGN OF BEVEL AND WORM GEARS** Straight bevel gear: Tooth terminology, tooth forces and stresses, equivalent number of teeth. Estimating the dimensions of pair of straight bevel gears. Worm Gear: terminology, Merits and demerits.	9
IV	**DESIGN OF GEAR BOXES** Geometric progression - Standard step ratio - Ray diagram, kinematics layout -Design of sliding mesh gear box - Constant mesh gear box. – Design of multi speed gear box.	9
V	**DESIGN OF CLUTCHES AND BRAKES** Design of plate clutches, cone clutches – jaw clutches - internal expanding brakes. Design of shoe and band Brakes.	9
	Total Instructional Hours	**45**

Course Outcome

Students will be able to:

CO1: Select the appropriate flexible elements in power transmission systems.
CO2: Design spur and helical gear drives employed in transmission systems.
CO3: Design Bevel and Worm gear drives employed in transmission systems.
CO4: Design single and multispeed gear box.
CO5: Design brakes and clutches.

TEXT BOOKS:

T1 - Bhandari V, "Design of Machine Elements", 3rd Edition, Tata McGraw-Hill Book Co, 2010.
T2 - Joseph Shigley, Charles Mischke, Richard Budynas and Keith Nisbett "Mechanical Engineering Design", 8th Edition, Tata McGraw-Hill, 2008.

REFERENCE BOOKS:

R1 - Shigley J.E and Mischke C. R., "Mechanical Engineering Design", 8th Edition, Tata McGraw-Hill , 2008.
R2 - Sundararajamoorthy T. V, Shanmugam .N, "Machine Design", Anuradha Publications, Chennai, 2003.
R3 - Prabhu. T.J., "Design of Transmission Elements", Mani Offset, Chennai, 2000.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16ME6001	SIMULATION AND ANALYSIS LAB	0	0	4	2

Course Objective

1. To develop the student's skills in proper modeling, meshing, and setting up material properties, loads, and constraints for computer simulation and analysis.
2. To expose the students to different applications of simulation and analysis tools and then solve the problem using software packages.
3. To provide the student with some knowledge in multi-physics analysis –interaction between structure and thermal.

LIST OF EXPERIMENTS

Expt. No.	Description of the Experiments
A	**Analysis (Using Software)**
1.	Stress analysis of beams.
2.	Stress analysis of a plate with a circular hole.
3.	Stress analysis of rectangular L – bracket.
4.	Stress analysis of an axi-symmetric component.
5.	Modal analysis of beams.
6.	Modal analysis of a 2D component.
7.	Harmonic analysis of a 2D component.
8.	Thermal stress analysis of a 2D component.
9.	Conductive heat transfer analysis of a 2D component.
10.	Convective heat transfer analysis of a 2D component.
B	**Simulation basics** ➢ Simulation of air conditioning system with condenser temperature and evaporator temperatures as input to get COP. ➢ Simulation of Hydraulic / Pneumatic cylinder. ➢ Simulation of cam and follower mechanism.
	Total Instructional Hours **45**

Course Outcome

Students will be able to:

C01: Determine engineering design problem that involves interaction between heat and stress, generate the model using a proper element type, and then solve the problem.

C02: Solve linear and non-linear structural, thermal, and flow problems using software packages.

C03: Analyze and display the results such as von-Mises stress, displacement, temperature, pressure, and velocity etc. obtained from computer analysis.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16ME6002	METROLOGY LAB	0	0	4	2

Course Objective

1. To learn the basics of metrology & quality control.
2. To study the applications of different measuring instruments and use them in industry for quality inspection.
3. To learn the basic concepts of accuracy, error, and calibration.

Expt. No.	Description of the Experiments
1.	Calibration of Vernier Caliper.
2.	Calibration of Micrometer.
3.	Measurement of Gear tooth parameters using Gear Tooth Vernier.
4.	Measurement of Taper Angle using sine bar.
5.	Checking the limits of dimensional tolerances using mechanical comparators.
6.	Measurement of dimensions by using Vernier Height Gauge.
7.	Measurement of straightness and flatness by using auto collimator.
8.	Measurement of Screw thread parameters by using Profile Projector.
9.	Measurement of dimensions for a threaded specimen using Tool makers Microscope.
10.	Measurement of thread parameters using floating carriage micrometer.
11.	Measurement of Temperature using Thermocouple.
12.	Measurement of Force using load cell.
13.	Measurement of Torque.
14.	Study of Coordinate Measuring Machine.

Total Practical Hours **45**

Course Outcome

Students will be able to:

CO1: Understand the calibration of various measuring instruments.

CO2: Analyze the surface characteristics of components.

CO3: Examine the various profiles of the components.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16ME6003	DESIGN AND FABRICATION PROJECT	0	0	4	2

Course Objective	1. To develop skills to formulate a technical project. 2. To give guidance on the various tasks of the project and standard procedures. 3. To teach use of new tools, algorithms and techniques required to carry out the projects. 4. To get hands on training in the fabrication of one or more components of a complete working models. 5. To train the students in preparing project reports and to face reviews and viva voce examination.

GUIDELINE FOR REVIEW AND EVALUATION

The students may be grouped into 2 to 4 and work under a project supervisor. The device/system/component to be fabricated may be decided in consultation with the supervisor and if possible with an industry. A project report to be submitted by the group and the fabricated model, which will be reviewed and evaluated for internal assessment by a Committee constituted by the Head of the Department. At the end of the semester examination the project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

Total Practical Hours 60

Course Outcome	Students will be able to: CO1: Identify the requirement and develop the design solutions. CO2: Identify technical ideas, strategies and methodologies. CO3: Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project. CO4: Take up any challenging practical problems and find solution by formulating proper methodology. CO5: Fabricate any components using different manufacturing tools.

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ELECTIVES - I

Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16ME5301	ADVANCED FOUNDRY TECHNOLOGY	3	0	0	3

Course Objective

To learn the following

1. To develop problem solving skills among students in various foundry technologies.
2. To promote understanding of basic facts and concepts in foundry process while retaining the excitement of foundry industry.
3. To make students capable of studying foundry technology in academic and Industrial courses.
4. To expose and to develop interest in the fields of foundry concepts like investment castings, shell moulding, die castings, etc.
5. To study about testing and quality assurance in foundry.

Unit	Description	Instructional Hours
I	**SPECIAL MOULDING AND CASTING PROCESSES** Moulding processes with permanent moulds, Die casting processes, basic features of die design, equipment description, selection, pressure die casting, gravity die casting, cast products, protection of dies. Centrifugal casting processes – Description of true and semi centrifugal casting products and specific application areas, Centrifuging. Shell moulding, Investment casting and other precision casting processes.	9
II	**MELTING AND POURING PRACTICE** Classification of melting furnaces used in Foundry, Selection of melting furnaces, essential features of a melting furnace, Refractory materials – types, properties and application. Cupola melting - Cupola furnace: types of cupola- divided blast, hot blast, oil fired, coke less etc., brief description of design, operation and quality control aspects, charge calculation. Furnaces heated by electricity - Resistance, Arc and Induction furnaces various types, brief description and application and merits of each. Influence of melting and pouring practice on casting quality, shop floor tests for quality assurance. Solidification: Nucleation and growth.	9
III	**PRODUCTION PRACTICE FOR FERROUS AND NON-FERROUS METALS** Important aspects of foundry practice for castings of Cast irons – grey, malleable and ductile irons, modularizing treatment. Steel foundry practice, practice and quality control in moulding, melting and pouring for production of carbon and alloy steel castings, High – manganese and Stainless steel castings, finishing operations and safety aspects. Foundry practice for copper and aluminum alloys, melting and pouring practice, degassing and dross removal, precautions required.	9
IV	**CAST METALS TECHNOLOGY** Solidification of pure metal and alloys. Basic concepts of structure of pure metals, cast metals and alloys, hardness and tensile properties. Cast Irons - types, forms of graphite in cast irons, Alloy Cast irons-effect of alloying elements on properties, applications of Cast Iron. Cast steels- plain carbon and alloy steels – properties and applications. Properties and applications of important cast non-ferrous alloys.	9
V	**TESTING AND QUALITY ASSURANCE IN FOUNDRY** Cleaning of castings: knockout, fettling, shot blasting and grinding of casting components. Hardness tests and Tensile tests of castings, Non-destructive tests of castings. Casting defects: Causes and remedial measures.	9
	Total Instructional Hours	**45**

Course Outcome

Student upon completion of the course shall be able to:

CO1: Solidification process for different metals.
CO2: Construct structure properties relationship for pure metals.
CO3: Design riser and getting system for castings of different shapes.
CO4: Explain the Investment casting, Shell moulding and Die casting processes in steel manufacturing.
CO5: Improve theoretical knowledge in casting process.

TEXT BOOKS:

T1: Principal of metal casting by Richard W.Heine , Carl R Hoper, Philip C. Rosenthal, Tata McGraw Hill.
T2: Principal of foundry technology by P. L. Jain , Tata McGraw Hill
T3: Foundry practice by W.H. Salmon

REFERENCE BOOKS:

R1: Materials and processes in manufacturing by E. P. degnamo, McMillan publishing
R2: Production technology by P. C. Sharma, S. Chand and Co.
R3: American Standard of metals (ASM) (Vol. 1-14)

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16ME5302	METAL FORMING PROCESSES	3	0	0	3

Course Objective

1. Understand the basics principles of metal behavior.
2. Gain knowledge about forging process.
3. To study the Rolling process.
4. To impart the knowledge of various Extrusion process.
5. To learn the drawing process.

Unit	Description	Instructional Hours
	INTRODUCTION TO METAL FORMING	
I	Metallurgical aspects of metal forming, , slip, twinning mechanics of plastic deformation, effects of temperature, strain rate, microstructure and friction in metal forming-yield criteria and their significance, Classification of Metal Forming Processes, Advantages and Limitations, Stress strain relations in elastic and plastic deformation, concept of flow stresses, deformation mechanisms, Hot and Cold Working Processes and Its Effect on Mechanical Properties.	9
	FORGING	
II	Introduction and Classification, operation and principle of Forging Processes and Equipment, Methods of forging, Open and Close Die Forging Processes, Defects, Structure and Properties of Forged Products. Force Analysis in forging. Other Related Processes like Cold Heading, Rotary Swaging, Sizing, Coining, Embossing and Roll Forging.	9
	ROLLING	
III	Introduction and Classification, Types of Rolling Mills, Forces and Geometrical Relationships in Rolling, Calculation of Rolling Load, Roll Pass Design, Defects in Rolled Products. Other Related Processes like Roll Piercing, Ring Rolling, Pipe and tube production by rolling processes.	9
	EXTRUSION	
IV	Introduction and Classification, Extrusion Equipment, Forces in extrusion, Analysis of Extrusion Process, Extrusion of components including Seamless Pipes and Tubes. Extrusion of pipes by cold working, Other Related Processes like Impact Extrusion, Hydrostatic Extrusion, Piercing, Drawing, cupping and bending.	9
	DRAWING	
V	Introduction and Classification, Wire Drawing, Rod Drawing, Tube Drawing, Deep Drawing, Analysis of Wire Drawing Process and Load Calculations.	9
	Total Instructional Hours	**45**

Course Outcome

Students will be able to:

CO1: Understand the various metal behaviors.
CO2: Know the forging process and equipments.
CO3: Gain knowledge about Rolling mills and types.
CO4: Impart the knowledge about extrusion process.
CO5: Understand the drawing process.

TEXT BOOKS:

T1 - Taylan Altan, "Cold and Hot Forging, Fundamentals and Applications", ASM International Materials Park Ohio, 2005.
T2 - Dieter G E, "Mechanical Metallurgy", McGraw Hill Co., New York, 2001.

REFERENCE BOOKS:

R1 - Sharma P C, "A Text Book of Production Engineering", S. Chand & Co. Ltd., 2005.
R2 - Mikell P Groover, "Fundamentals of Modern Manufacturing", John Wiley & Sons, 2002.
R3 - Serope Kalpakjian and Steven R Schmid, "Manufacturing Process for Engineering Materials", Pearson Education Pvt. Ltd., 2003.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16ME5303	UNCONVENTIONAL MACHINING PROCESSES	3	0	0	3

Course Objective

1. To learn about various unconventional machining processes.
2. To know the various mechanical energy based process parameters and their influence on performance and their applications.
3. To understand the electrical energy based machining processes.
4. To know the chemical energy based metal removal processes.
5. To learn about thermal energy used in machining processes.

Unit	Description	Instructional Hours
I	**INTRODUCTION** Traditional machining process - Need for non-traditional machining – classification on the base of energy sources - Brief overview.	6
II	**MECHANICAL ENERGY BASED PROCESSES** Abrasive Jet Machining – Water Jet Machining – Abrasive Water Jet Machining - Ultrasonic Machining. (AJM, WJM, AWJM and USM). Working Principles – equipment used – Process parameters – MRR- Applications.	9
III	**ELECTRICAL ENERGY BASED PROCESSES** Electric Discharge Machining (EDM) - working Principle-equipments-Process Parameters-Surface Finish and MRR- electrode / Tool – Power and control Circuits-Tool Wear – Dielectric – Flushing – Wire cut EDM – Applications.	9
IV	**CHEMICAL AND ELECTRO-CHEMICAL ENERGY BASED PROCESSES** Chemical machining and Electro-Chemical machining (CHM and ECM)-Etchants – Maskant techniques of applying Maskants - Process Parameters – Surface finish and MRR-Applications. Principles of ECM- equipments-Surface Roughness and MRR Electrical circuit-Process Parameters ECG and ECH - Applications.	11
V	**THERMAL ENERGY BASED PROCESSES** Laser Beam machining and drilling (LBM), Oxyfuel cutting, (Plasma Arc machining (PAM) and Electron Beam Machining (EBM). Principles – Equipment –Types - Beam control techniques-Applications. **VISUAL STUDY:** Basics of thermal cutting process-Sample product manufacturing process.	10
	Total Instructional Hours	**45**

Course Outcome

Students will be able to:

CO1: Upon completion of this course Demonstrate different unconventional machining processes.
CO2: Identify the influence of difference process parameters and their applications.
CO3: know the mechanical energy based process.
CO4: Gain knowledge about chemical energy processes.
CO5: Understand thermal energy based manufacturing processes.

TEXT BOOKS:

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.

REFERENCES:

R1 - Benedict. G.F. "Nontraditional Manufacturing Processes", Marcel Dekker Inc., New York, 1987.
R2 -Paul De Garmo, J.T.Black, and Ronald.A.Kohser, "Material and Processes in Manufacturing" Prentice of India Pvt. Ltd., 8thEdition, New Delhi, 2001. Hall
R3 - Mc Geough, "Advanced Methods of Machining", Chapman and Hall, London, 1998.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16ME5304	CNC TECHNOLOGY	3	0	0	3

Course Objective

1. To impart knowledge in CNC machine tool building.
2. To design Tooling and work holding devices.
3. Learn numerical control techniques and functions.
4. Generation of CNC codes using CAM software.
5. Develop part programming skills.

Unit	Description	Instructional Hours
	CNC MACHINE TOOLS	
I	CNC Systems-machine control-Interpolations and components. Machining and Turning centres, CNC drilling, milling and grinding machines.	9
	CNC CONSTRUCTIONAL FEATURES	
II	Spindle drives-Transmission belting-Axes feed drives-Sideways-Accessories of Machining and Turning centres. Tools-Tool holders-Tool planning-work holding-fixtures.	9
	AUTOMATION	
III	Direct numerical control-Flexible manufacturing cells and systems-Integration of manufacturing systems-Tools for manufacturing-Functions of a computer integrated manufacturing.	9
	MANUAL PART PROGRAMMING	
IV	Nomenclature – CNC machines, block format-preparatory functions- fixed canned cycles-miscellaneous function- tool offset- tool nose radius compensation-Datum setting-Programs on Turning and Milling	9
	COMPUTER AIDED PART PROGRAMMING	
V	Languages for computer aided part programming-Geometric statements in APT-Point To Point Programming-Programming a tool path-Post processor statements.	9
	Total Instructional Hours	**45**

Course Outcome

Students will be able to:

CO1: Estimate the parameters of metal cutting and understand the components of CNC system.
CO2: Choose the appropriate drives and controls for CNC machines.
CO3: Develop Flexible manufacturing cells and systems.
CO4: Part Programming for various machining process Select.
CO5: Compute operation and maintenance cost of CNC machines.

TEXT BOOKS:

T1 - Kalpakjian S. and Schmid S.R., —Manufacturing Engineering and Technologyl, 5th Edition, Pearson Education India, New Delhi, 2014.
T2 - Radhakrishnan P., —Computer Numerical Control Machinesl, New Central Book Agency, 2013.

REFERENCE BOOKS:

R1 - Narang J.S. and Narang V.D.S., —CNC Machines and Automationl, DhanpatRai and Co. Pvt. Ltd., 2014.
R2 - HMT Limited, —Mechatronics, Tata McGraw-Hill, New Delhi, 2001.
R3 -Thyer G.E., —Computer Numeric Control of Machine Tools, 2nd Edition, Butterworth-Heinemann, Burlington, 1996.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16ME5305	ADVANCED WELDING TECHNOLOGY	3	0	0	3

Course Objective

1. To develop basic skill in welding technologies.
2. To develop the special processes which require competency & certification to perform the job activity.
3. Identify some common hazards in welding.
4. Explain and identify proper personal protection used in welding.
5. Explain safety techniques for storing and handling cylinders.

UNIT	DESCRIPTION	Instructional Hours
I	**INTRODUCTION** Welding as compared with other fabrication processes, Importance and application of welding, classification of welding processes, Health & safety measures in welding. **Welding Power Sources:** Physics of welding Arc, Basic characteristics of power sources for various arc welding processes, Transformer, rectifier and generators. **Physics of Welding Arc:** Welding arc, arc initiation, voltage distribution along the arc, arc characteristics, arc efficiency, heat generation at cathode and anode, Effect of shielding gas on arc, isotherms of arcs and arc blow. **Metal Transfer:** Mechanism and types of metal transfer in various arc welding processes.	9
II	**WELDING PROCESSES** Manual Metal Arc Welding (MMAW), TIG, MIG, Plasma Arc, Submerged Arc Welding, Electro gas and Electro slag, Flux Cored Arc Welding, Resistance welding, Friction welding, Brazing, Soldering and Braze welding processes, Laser beam welding, Electron beam welding, Ultrasonic welding, Explosive welding, Friction Stir Welding, Underwater welding & Microwave welding.	9
III	**HEAT FLOW WELDING** Calculation of peak temperature; Width of Heat Affected Zone (HAZ); cooling rate and solidification rates; weld thermal cycles; residual stresses and their measurement; weld distortion and its prevention	9
IV	**REPAIR & MAINTENANCE WELDING** Hard facing, Cladding, Surfacing, Metalizing processes and Reclamation welding **Weldability:** Effects of alloying elements on weld ability, welding of plain carbon steel, Cast Iron and aluminum. Micro & Macro structures in welding.	9
V	**WELD DESIGN** Types of welds & joints, Joint Design, Welding Symbols, weld defects, Inspection/testing of welds, Introduction to Welding Procedure Specification & Procedure Qualification Record.	9
	Total Instructional Hours	**45**

Course Outcome

Student upon completion of the course shall be able to:

CO1: Improve Knowledge in advanced welding technology.
CO2: Select and operate tools and equipment to support welding and related activities.
CO3: Read and interpret basic blueprints and welding symbols to fabricate components.
CO4: Perform Gas Metal Arc Welding to industry standards.
CO5: Perform Gas Tungsten Arc Welding to industry standards and pass the AWS Aluminum Aerospace Certification.

TEXT BOOKS:

T1: Welding Engineering and Technology – R. S. Parmar, M/s. Khanna Publishers, 2-B Nath Market, Nai Sarak, Delhi – 6.
T2: Welding Handbook, American Welding Society, Section-II: Gas Arc and Resistance.

REFERENCE BOOKS:

R1: Welding and Welding Technology, by- Richard L. Little, McGraw Hill Education.
R2: Welding Principals and Practices, by- Edwars R. Bohnart, McGraw Hill Education.
R3: Welding Engineering and Technology, by- R. S. Parmar, Khanna Publishsers.

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ELECTIVE – II

Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16ME6301	REFRIGERATION AND AIR CONDITIONING	3	0	0	3

Course Objective

1. To learn the working principle of Refrigeration & Air conditioning systems.
2. To recognize various components and accessories of refrigeration systems.
3. To understand the applications of refrigeration and air conditioning systems.
4. To become familiarize with refrigeration and air conditioning cooling load calculations.
5. To provide knowledge on design and selection of Air conditioning systems.

Unit	Description	Instructional Hours
I	**VAPOUR COMPRESSION REFRIGERATION SYSTEM** Introduction to Refrigeration: Ton of refrigeration and C.O.P. Vapor compression cycle: p-h and T-s diagrams, deviations from theoretical cycle, sub cooling and super heating, wet and dry compression, effects of system operating pressures, multi-evaporators systems, multi-expansion systems, two stage systems, cascade systems, auto-cascade systems. Refrigerants: classification, designation and nomenclature.	9
II	**SYSTEM COMPOENENTS CONTROLS AND ACCESSORIES** System components: compressors, condensers, expansion devices and evaporators- types and its working principle. Refrigerant controls: pressure, temperature and refrigerant flow and humidity sensors, actuators & safety controls.etc. Electrical controls: relay, over load protectors, capacitors etc. Accessories: liquid receiver, flash chamber, accumulator, refrigerant driers etc.	9
III	**OTHER REFRIGERATION CYCLES AND APPLICATIONS** Other refrigeration cycles: Vapour absorption, adsorption, steam jet, ejector and thermoelectric refrigeration systems. Magnetic – Vortex and Pulse tube refrigeration systems. Air craft refrigeration cycles. Applications: Refrigeration applications such as milk chilling plant, ice plants, cold storage, food processing plants etc. Air conditioning: space cooling and heating.	9
IV	**COOLING LOAD CALCULATIONS** Refrigeration load calculations: Heat gain through the walls, infiltration load, product load. Air conditioning loads: Outside and inside design conditions; Heat transfer through structure, Solar radiation, Electrical appliances, Infiltration and ventilation, internal heat load; Apparatus selection; fresh air load, effective temperature & chart, calculation of summer & winter air conditioning load.	9
V	**DESIGN AND SELECTION OF AIR CONDITIONING SYSTEMS** Types of air conditioning systems: All air systems, all water systems, Air-water systems, unitary systems. Air distribution: factors considered in air distribution, types of air distribution, Indoor air quality and human comfort. Sizing of ducts: Classification of air conditioning ducts, duct design methods.	9
	Total Instructional Hours	**45**

Course Outcome

Upon completion of this course, The Students will be able to:

CO1: Understand the working principle of various refrigeration cycles.
CO2: Identify the system components and its functions.
CO3: Understand the applications of refrigeration and air conditioning systems.
CO4: Calculate cooling load for an air conditioning buildings.
CO5: Design and selection of air conditioning systems.

TEXT BOOK:

T1 - Arora CP. "Refrigeration and Air Conditioning", 3rd edition, McGraw Hill, New Delhi, 2010.
T2 - Jones WP. "Air conditioning engineering", 5th edition, Elsevier Butterworth-Heinemann, 2001.

REFERENCES:

R1 - Dossat RJ., "Principles of Refrigeration", 4th edition, Pearson Education Asia, 2009.
R2 - Stoecker WF, Jones JW. "Refrigeration and Air Conditioning", McGraw Hill, New Delhi, 1986.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16ME6302	ADVANCED I.C ENGINES	3	0	0	3

Course Objective

1. To understand the combustion phenomena in IC engines.
2. To learn the knocking tendency in SI and CI engines.
3. To understand the significance of alternative fuels and their feasibility.
4. To update the knowledge in engine exhaust emission control.
5. To enable the students to understand the recent developments in IC Engines.

Unit	Description	Instructional Hours
I	**SPARK IGNITION ENGINES** Mixture requirements – Fuel injection systems – Monopoint, Multipoint & Direct injection - Stages of combustion – Normal and Abnormal combustion – Knock - Factors affecting knock – Combustion chambers.	9
II	**COMPRESSION IGNITION ENGINES** Diesel Fuel Injection Systems - Stages of combustion – Knocking – Factors affecting knock – Direct and Indirect injection systems – Combustion chambers – Fuel Spray behavior – Spray structure and spray penetration – Air motion - Introduction to Turbo charging.	9
III	**POLLUTANT FORMATION AND CONTROL** Pollutant – Sources – Formation of Carbon Monoxide, Unburned hydrocarbon, Oxides of Nitrogen, Smoke and Particulate matter – Methods of controlling Emissions – Catalytic converters, Selective Catalytic Reduction – Particulate Traps – Emission norms.	9
IV	**ALTERNATIVE FUELS** Alcohol, Hydrogen, Compressed Natural Gas, Liquefied Petroleum Gas and Bio Diesel - Properties, Suitability, Merits and Demerits - Engine Modifications.	9
V	**RECENT TRENDS** Air assisted Combustion, Homogeneous charge compression ignition engines – Variable Geometry turbochargers – Common Rail Direct Injection Systems - Hybrid Electric Vehicles – Solar Assisted Vehicle.	9
	Total Instructional Hours	**45**

Course Outcome

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

CO1: Determine the performance and combustion characteristics of SI and CI engines.
CO2: Identify the usage of alternative fuels for IC engines.
CO3: Acquire knowledge on recent trends in IC engines.
CO4: Explain the abnormalities of internal combustion engines and its identification.
CO5: Acquire knowledge on engine pollution and emission norms.

TEXT BOOKS:

T1 - Ramalingam. K.K., "Internal Combustion Engine Fundamentals", SciTech Publications, 2002.
T2 - Ganesan. V, "Internal Combustion Engines", II Edition, TMH, 2002.

REFERENCE BOOKS:

R1 - Mathur. R.B. and R.P. Sharma, "Internal Combustion Engines"., Dhanpat Rai & Sons2007
R2 - Duffy Smith, "Auto Fuel Systems", The Good Heart Willcox Company, Inc., 1987
R3 - Eric Chowenitz, "Automobile Electronics", SAE Publications, 1999.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16ME6303	DESIGN OF HEAT EXCHANGERS	3	0	0	3

Course Objective

1. To expose the students about the classification of heat exchangers and its applications.
2. To know the factors considered for design of heat exchangers.
3. To develop the student skill to quickly evaluate the size and main parameters of Shell and Tube heat exchangers.
4. To impart the knowledge about phase changes and special application to Condensers and Evaporators.
5. To enable the students to design heat exchanger.

Unit	Description	Instructional Hours
I	**INTRODUCTION TO HEAT EXCHANGERS** Classification of heat exchangers: regenerators, recuperators, mixtures. Heat transfer laws used for design of heat exchangers. Factors considered in heat exchanger analysis: heat transfer coefficients, wall conductive resistance, fouling resistance, overall heat transfer coefficient. TEMA standards, selection criteria for different types of shells and front and rear head ends, geometrical characteristics of TEMA heat exchangers.	9
II	**DESIGN OF PROCESS HEAT EXCHANGERS** Heat transfer correlations used for predicting the heat transfer coefficients. Design methods: LMTD and NTU method of heat exchanger analysis. Design of finned tube air cooled heat exchangers, shell and tube heat exchangers, tube-in-tube heat exchangers, compact heat exchangers, plate heat exchangers and geothermal heat exchangers. Calculations: Fouling factor, pressure drop.	9
III	**DESIGN OF COOLING TOWERS** Types of cooling towers, design procedures, tower characteristics, factors influencing the tower performance, Energy savings in cooling towers, water treatment, site selection for installation, selection fans and pumps.	9
IV	**DESIGN OF CONDENSERS AND EVAPORATORS** Condensers: types of condensers, factors considered in design of air cooled condensers, correlations used for heat exchanger design, water cooled condensers and evaporative condensers. Evaporators: types of evaporators, factors considered in design of evaporators of different configurations.	9
V	**DESIGN OF SOLAR COLLECTORS AND HEAT PIPES** Solar collectors: types of solar collectors, factors considered in design of solar air heaters, solar water heaters and solar stills. Heat pipes: Types of heat pipes, applications of heat pipes, design of heat pipes. Use of Software for design of heat exchangers.	9
	Total Instructional Hours	**45**

Course Outcome

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

CO1: Understand the Industrial applications of heat exchangers.
CO2: Design the process heat exchanger.
CO3: Design the cooling towers, condensers, evaporators and solar collectors.
CO4: To perform thermal analysis using LMTD and NTU methods.
CO5: To do thermal design including phase change heat transfer.

TEXT BOOKS:

T1 - R.S. Khandpur, Handbook of Analytical Instruments, McGraw Hill Education (India) Private Limited, Third edition, 2015.

T2 - Shah,R. K., Dušan P. Sekulić, "Fundamentals of heat exchanger design", John Wiley & Sons, 2003.

REFERENCE BOOKS :

R1 - Robert W. Serth, "Process heat transfer principles and applications", Academic press, Elesevier, 2007.

R2 - Sarit Kumar Das, "Process heat transfer", Alpha Science International, 2005.

R3 - John E. Hesselgreaves, "Compact heat exchangers: selection, design, and operation", Elsevier science Ltd, 2001.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16ME6304	GAS DYNAMICS AND JET PROPULSION	3	0	0	3

(Use of Standard Gas Tables permitted)

Course Objective

1. To understand the difference between incompressible and compressible flow.
2. To understand the concept of nozzle and diffuser in flow through variable area duct.
3. To know the concept of fanno flow and Rayleigh flow.
4. To study the phenomenon of shock waves and its effect on flow.
5. To gain knowledge about Jet and Rocket Propulsion.

Unit	Description	Instructional Hours
I	**COMPRESSIBLE FLOW – FUNDAMENTALS** Energy and momentum equations for compressible fluid flows, various regions of flows, reference velocities, stagnation state, velocity of sound, critical states, Mach number, critical Mach number, types of waves, Mach cone, Mach angle, Effect of Mach number on compressibility.	9
II	**FLOW THROUGH VARIABLE AREA DUCT** Isentropicflow through variable area ducts, T-s,h-diagrams for nozzle and diffuser flows, area ratio as a function of Mach number, mass flow rate through nozzles and diffusers, effect of friction in flow through nozzles.	9
III	**FANNO AND RAYLEIGH FLOW** Flow in constant area ducts with friction (Fanno flow) - Fanno curves and Fanno equation, variation of flow properties, variation of Mach number with duct length. Flow in constant area ducts with heat transfer (Rayleigh flow), Rayleigh line and Rayleigh flow equation, variation of flow properties, maximum heat transfer.	9
IV	**NORMAL SHOCK** Governing equations, variation of flow parameters like static pressure, static temperature, density, stagnation pressure and entropy across the normal shock, Prandtl-Meyer equation, impossibility of shock in subsonic flows, flow in convergent and divergent nozzle with shock, flows with oblique shock (elementary treatment only).	9
V	**PROPULSION** Aircraft propulsion- types of jet engines-energy flow through jet engines, study of turbojet engine components-diffuser, compressor, combustion chamber, turbine and exhaust systems, performance of turbojet engines-thrust, thrust power, propulsive and overall efficiencies, thrust augmentation in turbojet engines, ramjet and pulsejet engines. Rocket propulsion –propellants-Theory of rocket propulsion-Performance study-specific impulse -characteristic velocity.	9
	Total Instructional Hours	**45**

Course Outcome

After completion of the course, the students should be able to

CO1: Understand the compressible flow in nozzles and diffusers.
CO2: Solve problems in fanno and Rayleigh flow.
CO3: Evaluate the kinds of shock phenomena while the deviation in flow properties.
CO4: Apply the knowledge of gas turbines for jet propulsion.
CO5: Understand the knowledge about rocket propulsion.

TEXT BOOKS:

T1-Yahya.S.M., 'Fundamentals of Compressible flow", New Age International (P) Ltd., New Delhi, 1996.
T2-Anderson, J.D., Modern Compressible flow, McGraw Hill, 3rd Edition, 2003.

REFERENCES BOOKS:

R1-Patrich.H. Oosthvizen, Willam E. Carscallen, "Compressible fluid flow", McGraw-Hill, 1997.
R2- Cohen.H.,RogersR.E.CandSravanamutoo,"Gasturbinetheory", Addison Wesley Ltd.,1987.
R3-Ganesan.V., "Gas Turbines", Tata McGraw-Hill, New Delhi,1999.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16ME6305	COMPUTATIONAL FLUID DYNAMICS	3	0	0	3

Course Objective

1. To enable the students to solve one and two-dimensional ordinary and partial differential equations using traditional CFD tools.
2. To teach students how to express derivatives and differential equations through discretization techniques.
3. To help the students to understand the general transformation equations for grid generation.
4. To teach students how to apply explicit, implicit and semi-implicit methods of finite differencing.
5. To help the students solve fluid flow field using some popular CFD techniques.

Unit	Description	Instructional Hours
I	**INTRODUCTION AND GOVERNING EQUATIONS** Introduction - Impact and applications of CFD in diverse fields - Governing equations of fluid dynamics – Continuity - Momentum and energy - Generic integral form for governing equations - Initial and Boundary conditions – Governing equations for boundary layers - Classification of partial differential equations – Hyperbolic – Parabolic - Elliptic and Mixed types - Applications and relevance.	9
II	**DISCRETIZATION** Basic aspects of discretization - Discretization techniques – Finite difference – Finite volume and Finite Element Method– Comparison of discretization by the three methods - Introduction to Finite differences - Transient one-dimensional and two-dimensional conduction – Explicit - Implicit - Crank-Nicolson - ADI scheme – Stability criterion. Difference equations - Numerical errors - Grid independence test - Optimum step size.	9
III	**GRIDGENERATION** Grid generation – General transformation of the equations - Form of the governing equations suitable for CFD – Boundary fitted co-ordinate systems – Elliptic grid generation - Adaptive grids - Modern developments in grid generation.	9
IV	**CONVECTION-DIFFUSION** Steady one-dimensional convection and diffusion - Central difference, upwind, quick, exponential, false diffusion, hybrid and power law schemes. Transient one dimensional heat conduction equation.	9
V	**CALCULATION OF FLOW FIELD** Representation of the pressure - Gradient term and continuity equation – Staggered grid -momentum equations - Pressure and velocity corrections - Pressure Correction equation - Numerical procedure for simple algorithm - Boundary conditions for the pressure correction method.	9
	Total Instructional Hours	**45**

Course Outcome

Students will be able to:

CO1: Possess the knowledge of CFD techniques, basic aspects of discretization and grid generation.
CO2: Create numerical modeling and its role in the field of fluid flow.
CO3: Use the various discretization methods, solution procedures and turbulence modeling to solve the fluid flow problems.
CO4: Solve fluid flow fields using CFD methods.
CO5: To model the fluid flow problems and heat transfer.

TEXT BOOKS:

T1 - K.A. Hoffman, (2000), Computational Fluid Dynamics for Engineering, Vol.I-III. Engineering Education System, Austin, Texas.
T2- K. Muralidhar, T. Sundarajan, (2001), Computational Fluid Flow and Heat Transfer, Narosa Publishing House, New Delhi.

REFERENCE BOOKS :

R1- J.D. Anderson, Jr., (2000), Computational Fluid Dynamics – The basics with applications, McGraw-Hill, Incs.
R2 - Abdulnaser Sayma, (2009), Computational Fluid Dynamics, © 2009 Abdulnaser Sayma & Ventus Publishing ApS, Download free books at BookBooN.com
R3 - S.V. Patankar, (1999), Numerical Heat Transfer and Fluid Flow, Hemisphere,New York.

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OPEN ELECTIVE

Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16ME6401	RAPID PROTOTYPING AND LEAN MANUFACTURING	3	0	0	3

Course Objective

1. To know the principle methods, areas of usage, possibilities and limitations as well as environmental effects of the Rapid Prototyping technologies.
2. To acquire knowledge of solid and liquid based Rapid prototyping system.
3. To provide information about Power based prototyping system.
4. To be familiar with the characteristics of the different materials those are used in lean Manufacturing.
5. To impart knowledge of characteristics and issues of Just in time.

Unit	Description	Instructional Hours
I	**INTRODUCTION** Need - Development of RP systems – RP process chain - Impact of Rapid Prototyping and Tooling on Product Development – Benefits- Applications – Digital prototyping – Virtual prototyping	7
II	**SOLID AND LIQUID BASED RAPID PROTOTYPING SYSTEMS** Stereo lithography Apparatus, Fused deposition Modeling, Laminated object manufacturing, three dimensional printing: Working Principles, details of processes, products, materials, advantages, limitations and applications - Case studies.	10
III	**POWDER BASED RAPID PROTOTYPING SYSTEM** Selective Laser Sintering, Direct Metal Laser Sintering, Three Dimensional Printing, Laser Engineered Net Shaping, Selective Laser Melting, Electron Beam Melting: Processes, materials, products, advantages, applications and limitations – Case Studies.	10
IV	**LEAN MANUFACTURING** Origin of lean production system – Customer focus – Muda (waste) – Standards – 5S system – Total Productive Maintenance – standardized work –Man power reduction – Overall efficiency - Kaizen – Common layouts - Principles of JIT - Jidoka concept – Poka-Yoke (mistake proofing) - Worker Involvement– Quality circle activity – Kaizen training - Suggestion Programmes – Hoshin Planning System (systematic planning methodology) – Lean culture.	9
V	**JUST IN TIME** Characteristics of JIT - Pull method - quality -small lot sizes - work station loads - close supplier ties – flexible work force - line flow strategy - preventive maintenance - Kanban system - strategic implications - implementation issues.	9
	Total Instructional Hours	**45**

Course Outcome

Upon completion of this course, the students can be able to

CO1: Compare different methods and discuss the effects of the Rapid Prototyping technologies.
CO2: Analyse the characteristics of solid and liquid based Rapid prototyping manufacturing.
CO3: Apply the powder based Rapid prototyping manufacturing.
CO4: Execute Lean manufacturing concepts to achieve profit.
CO5: Implement the Just in time technique in industries.

TEXT BOOKS:

T1 Rapid prototyping: Principles and applications, second edition, Chua C.K., Leong K.F., and Lim C.S., World Scientific Publishers, 2003.

T2 Rapid Tooling: Technologies and Industrial Applications, Peter D.Hilton, Hilton/Jacobs, PaulF.Jacobs, CRC press, 2000.

REFERENCE BOOKS:

R1 Rapid Manufacturing – D.T. Pham and S.S. Dimov, Springer , 2011.

R2 Dennis P Hobbs, Lean Manufacturing Implementation,

J. Ross Publications,2004 R3 Richard J Schonberger, World

Class Manufacturing, Free Press, 2008

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16ME7201	ENTREPRENEURSHIP AND BUSINESS CONCEPTS	3	0	0	3

Course Objective

1. Understanding of the scope of an entrepreneur, key areas of development.
2. To motivate the entrepreneurial instinct.
3. To give a clear picture about the process and procedures involved in setting up a small scale Industrial unit or a bigger unit.
4. To develop various businesses related skills of marketing, quality management production, distribution and human resource management etc.
5. To develop and strengthen basic entrepreneurial skills and understanding to run a business efficiently and effectively.

Unit	Description	Instructional Hours
I	**ENTREPRENEURSHIP CONCEPTS** Meaning and concept of entrepreneurship, Role of Entrepreneurship in Economic Development. Factors affecting Entrepreneurship – Creativity, Innovation and Entrepreneurship, Intrapreneurship.	9
II	**ENTREPRENEUR** Definition, Entrepreneurial Motivation, Characteristics of Entrepreneurs, Distinction between an Entrepreneur and a Manager.	9
III	**ENTREPRENEURIAL ECO SYSTEM** Forms of Business Ownership, Sources of Finance, Institutional Support to Entrepreneurs.	9
IV	**BUSINESS PLAN** Objectives of a Business Plan, Business Planning Process, Opportunity Identification and Selection, Contents of a Business Plan, Functional Plans.	9
V	**SMALL BUSINESS MANAGEMENT** Definition of Small Scale Industries, Strengths and Weaknesses of Small Business, Growth Strategies in Small Scale Enterprises, Sickness in Small Enterprises – Symptoms, Causes and Consequences.	9
	Total Instructional Hours	**45**

Course Outcome

On completion of the course the students will be able to

CO1: Understand the concepts of entrepreneurship and its importance.
CO2: Understand the traits of an entrepreneur and the sources of his motivation.
CO3: Demonstrate knowledge of various sources of finance and institutions supporting entrepreneurship.
CO4: Understand the components of a business plan.
CO5: Understand the nature of small business and causes of industrial sickness.

TEXT BOOKS:

T1 - Khanka.S.S. —Entrepreneurial Development, 4th Edition, S.Chand & Company Ltd., 2012.

T2 - Madhurima Lall and Shikha Sahai, —Entrepreneurship, 2nd Edition, Excel Books, New Delhi, 2008.

REFERENCE BOOKS:

R1 - Raj Shankar, —Entrepreneurship, Theory and Practice, Vijay Nicole Imprints Pvt. Ltd., Chennai 2012.

R2 - Barringer and Ireland, —Entrepreneurship, 3rd Edition, Pearson Education, 2012.

R3 - Zimmer and Scarborough, —Essentials of Entrepreneurship and Small Business Management, 5th Edition, PHI Learning Pvt. Ltd., 2009.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16ME7202	POWER PLANT ENGINEERING	3	0	0	3

Course Objective

1. To understand the steam power plants.
2. To learn about Nuclear Power Plants.
3. To gain knowledge about Renewable Energy Power Plant.
4. To evaluate about Energy Economics.
5. To study about pollution control and waste disposal.

Unit	Description	Instructional Hours
I	**STEAM POWER PLANTS** Rankine cycle - improvisations, Layout of modern coal power plant, Super Critical Boilers, FBC Boilers, Turbines, Condensers, Steam & Heat rate, Subsystems of thermal power plants – Fuel and ash handling, Draught system, Feed water treatment. Binary Cycles and Cogeneration systems. Performance and maintenance of boilers. Pollution control technologies including Waste Disposal Options for Coal Power Plants.	10
II	**DIESEL, GAS TURBINE AND COMBINED CYCLE POWER PLANTS** Otto, Diesel, Dual & Brayton Cycle - Analysis & Optimization. Components of Diesel and Gas Turbine. Power plants. Combined Cycle Power Plants. Integrated Gasifier based Combined Cycle systems.	10
III	**NUCLEAR POWER PLANTS** Basics of Nuclear Engineering, Layout and subsystems of Nuclear Power Plants, Working of Nuclear Reactors: Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), Canadian deuterium uranium reactor (CANDU), Breeder, Gas Cooled and Liquid Metal Cooled Reactors. Safety measures for Nuclear Power plants. Pollution control technologies including Waste Disposal Options for Nuclear Power Plants.	8
IV	**RENEWABLE ENERGY POWER PLANTS** Hydro Electric Power Plants – Classification, Typical Layout and associated components including Turbines. Principle, Construction and working of Wind, Tidal, Solar Photo Voltaic (SPV), Solar Thermal, Geo Thermal, Biogas and Fuel Cell power systems. MHD Power plants.	10
V	**ENERGY ECONOMICS** Power tariff types, Load distribution parameters, load curve, Comparison of site selection criteria, relative merits & demerits, Capital & Operating Cost of different power plants.	7
	Total Instructional Hours	**45**

Course Outcome

Students will be able to:

CO1: Describe the operation and maintenance of power plant.

CO2: Understand the design, operation and maintenance of Hydro-electric power plant from mechanical engineering perspective.

CO3: Explain the role of mechanical engineers in the design, operation and maintenance of steam and Nuclear power plant.

CO4: Provender the essential of renewable energy.

CO5: Analyze the power plant economics, renovation and moderation of old power plant.

TEXT BOOKS:

T1 - Nag. P.K., "Power Plant Engineering", Third Edition, Tata McGraw – Hill Publishing Company Ltd., 2008.
T2 - Thomas C. Elliott, Kao Chen and Robert C. Swanekamp, "Power Plant Engineering", Second Edition, Standard Handbook of McGraw – Hill, 1998.

REFERENCE BOOKS:

R1 - El-Wakil. M.M., "Power Plant Technology", Tata McGraw – Hill Publishing Company Ltd., 2010.
R2 - Black & Veatch, Springer, "Power Plant Engineering", 1996.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16ME7203	PRINCIPLES OF MANAGEMENT	3	0	0	3

Course Objective

1. To provide an overview of the theory and practice of management concepts.
2. To educate students in planning and decision making.
3. To understand the evolution of management, its history and the development of management concepts.
4. To expose the theories of management, organizing strategies and management practice in organizations
5. To familiarize with various controlling techniques of Management activities

Unit	Description	Instructional Hours
I	**INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS** Definition of Management – Science or Art – Manager Vs Entrepreneur - types of managers - managerial roles and skills – Evolution of Management – Scientific, human relations , Types of Business organization - Sole proprietorship, partnership, company-public and private sector enterprises - Impact of Environment and cultural variables on organization structure & Style – Current trends and issues in Management.	9
II	**PLANNING** Nature and purpose of planning – Forecasting and planning process – types of planning – objectives – setting objectives – policies – Planning premises – Strategic planning process –Decision making steps, process ,Rational decision making models and techniques – Decision Tree, PERT and CPM.	9
III	**ORGANISING** Nature and purpose – Formal and informal organization – organization chart – organization structure– types – Line and staff authority – departmentalization – delegation of authority – centralization and decentralization – Job Design - Human Resource Management – HR Planning, Recruitment, selection, Training and Development, Performance Management , Career planning and management.	9
IV	**DIRECTING** Foundations of individual and group behaviour – motivation – motivation theories – motivational techniques – job satisfaction – job enrichment – leadership – types and theories of leadership – communication – process of communication – barrier in communication – effective communication – communication and IT.	9
V	**CONTROLLING** System and process of controlling – budgetary and non-budgetary control techniques – use of computers and IT in Management control – Productivity management – control of cost , maintenance and performance – direct and preventive control – reporting.	9
	Total Instructional Hours	**45**

Course Outcome

Students will be able to:

CO1: Understand the principles and concepts of management.
CO2: Carry out the process of planning and decision making on employment.
CO3: Perform organizing, departmentation, Recruitment and training in various organizations.
CO4: Apply different controlling techniques to control organizational activities.
CO5: Analyze and apply basic knowledge of management tools & techniques and ISO concepts.

TEXT BOOKS:

T1 - Stephen P. Robbins & Mary Coulter, "Management", Prentice Hall (India)Pvt. Ltd., 10th Ed,2009.
T2 - JAF Stoner, Freeman R.E and Daniel R Gilbert "Management", 6th Edition, Pearson Education, 2004.

REFERENCE BOOKS :

R1 -Harold Koontz & Heinz Weihrich, "Essentials of Management", Tata McGraw Hill, 1998.
R2 -Tripathy PC & Reddy PN, "Principles of Management", Tata Mcgraw Hill, 1999
R3 -Harold Koontz & Heinz Weihrich, "Essentials of Management", Tata McGraw Hill, 1998.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16ME7001	COMPREHENSION LAB	0	0	4	2

Course Objective

To provide opportunity and encourage the student to apply the knowledge acquired during the earlier semesters to real life problems which he / she may have to face in future as an engineer through periodic exercise.

Description

METHOD OF EVALUATION:

- The problems given to the students should be of real, like industrial problems selected by the faculty members of the concerned course.
- While learning as how to solve the real time problems, student will receive guidance from the faculty and also review various courses learnt earlier.
- The students work individually and as a group to solve a variety of problems given to them.
- Further this comprehension is to achieve an understanding of the fundamentals of contemporary manufacturing systems including design, materials, manufacturing, process, product and process control, computer integrated manufacture and quality.
- The evaluation is based on continuous assessment by the Faculty Member constituted by the professor in-charge of the course.
- The students will be assessed 100% internally through weekly test with objective type questions on all the subject related topics.

Total Instructional Hours 45

Course Outcome

Students will be able to:
CO1: Understand and comprehend any given problem related to mechanical engineering field.
CO2: Apply knowledge to real time industrial solutions.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16ME7901	PROJECT WORK PHASE - I	0	0	6	3

Course Objective

- To identify a problem in the field of Mechanical Engineering and provide solutions, which are technically, economically and environmentally feasible.
- To train the students in preparing a project reports, presentations to face the reviews and final university viva examinations.

Project work assignment:

- Enable the students to form a convenient group with not more than four students.
- The project groups are assigned with a supervisor who is the faculty member of the respective department.
- In the case of industrial projects, one additional supervisor may be assigned as external supervisor.
- The students have to identify a technical problem related to the Mechanical Engineering based on the technical knowledge gained during the period of study.
- Four hours per week have been allotted in the time table.
- During project works, students can get the guidance from the supervisor(s), visiting library for literature review, conducting experiments related to the project work, computer simulation studies, field work, visiting industries (in the case of industry sponsored project works), case studies or basic research and development work assigned by the supervisor.
- The student has to make two presentations based on their project works.
- The solutions provided by the students should be technically, economically and environment friendly feasible.
- The project evaluation committee (constituted by the Head of Department) has evaluated the problem identification.
- The students has to consolidate the work as project report, which includes Introduction, Literature review, Modeling or simulation details, Experimental details, Results and discussions and Conclusions.
- The student should follow the guidelines for preparing the project work.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16ME8902	PROJECT WORK - PHASE II	0	0	24	6

Course Objective

- To learn the practical knowledge and skills in the field of Mechanical Engineering.
- To get an experience and confidence level in a particular domain.
- To train the students in preparing a project reports to face the reviews and viva examinations.

Project work assignment:

- Enable the students to form a convenient group of not more than four students and assigning them in a task involving theoretical and experimental studies related to Mechanical Engineering.
- The project groups are assigned with a supervisor who is the faculty member of the respective department. In the case of industrial projects, one additional supervisor may be assigned as external supervisor.
- Twelve hours per week have been allotted in the time table. The students can get the guidance from the supervisor(s), visiting library for literature review, conducting experiments related to the project work, computer simulation studies, field work, visiting industries (in the case of industry sponsored project works), case studies or basic research and development work assigned by the supervisor. Moreover, the student has to present three seminars based on the progress of their project works.
- The student has to apply his/her knowledge and skills to identify a suitable problem in the field of Mechanical Engineering and has to provide solutions, which are technically, economically and environment friendly feasible solution.
- The project evaluation committee (constituted by the Head of Department) has evaluated the project progress based on three reviews.
- The students has to consolidate the comprehensive review report, which includes Introduction (An Overview, Background and motivation, Objectives and methodology), Literature review (the studies reported during last ten years, problem identification and solution), Modeling or simulation details (equations used in the modeling, assumptions, specifications, details of the project work etc.), Experimental details (Description of experimental setup, instrumentation, experimental procedure), Results and discussions (comprehensive summary of experimental observations and discussions on improvements observed) and Conclusions (comprehensive summary of the major outcomes observed in the project work). The student should follow the guidelines for preparing the project work.

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ELECTIVE – III

Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16ME7301	DESIGN OF JIGS, FIXTURES AND PRESS TOOLS (COMMON TO MECHANICAL AND AUTOMOBILE ENGINEERING)	3	0	0	3

Course Objective

1. To understand the functions and design principles of Jigs, fixtures and press tools Study important methods of analysis of in chromatography.
2. To gain proficiency in the development of required views of the final design.
3. To impart knowledge in Jigs and fixtures, and various kinds of locating devices.
4. To understand the Principles of jigs and fixtures.
5. To know the important considerations while designing Jigs and Fixtures.

Unit	Description	Instructional Hours
I	**PURPOSE TYPES AND FUNCTIONS OF JIGS AND FIXTURES** Tool design objectives - Production devices – inspection devices, Materials used in Jigs and Fixtures – Types of Jigs - Types of Fixtures-Mechanical, pneumatic and hydraulic actuation-Analysis of clamping force-Tolerance and error analysis.	9
II	**JIGS** Drill bushes –different types of jigs-plate latch, channel, box, post, angle plate, angular post, turnover, pot jigs-Automatic drill jigs-Rack and pinion operated. Air operated Jig components. Design and development of Jigs for given components.	9
III	**FIXTURES** General principles of boring, lathe, milling and broaching fixtures- Grinding, planning and shaping fixtures assembly, Inspection and welding fixtures- Modular fixtures. Design and development of fixtures for given components.	9
IV	**PRESS WORKING TERMINOLOGIES AND ELEMENTS OF DIES AND STRIP LAY OUT** Press working terminology-Presses and press accessories-Computation of capacities and tonnage requirements. Elements of progressive combination and compound dies: Die block-die shoe. Bolster plate-punch plate- punch holder-guide pins and bushes – strippers – knockouts-stops –pilots-Selection of standard die sets strip layout-strip lay out calculations.	9
V	**DESIGN AND DEVELOPMENT OF DIES** Design and development of progressive and compound dies for Blanking and piercing operations. Bending dies – development of bending dies-forming and drawing dies-Development of drawing dies. Design considerations in forging, extrusion, casting and plastic dies.	9
	Total Instructional Hours	**45**

Course Outcome

On completion of the course the students will be able to

CO1: demonstrate and analyze the types and functions of jigs and fixtures.
CO2: design, specify and analyze the jigs for various applications.
CO3: demonstrate and design the fixtures for various applications.
CO4: demonstrate and analyze the press working terminologies of die and strip layout.
CO5: design, specify and analyze the dies for different applications.

TEXT BOOKS:

T1 - Edward G. Hoffman, —Jigs & Fixture Design, 5th Edition, Thomson-Delmar Learning, Singapore, 2004.
T2 - Donaldson C, —Tool Design, 4th Edition, Tata McGraw-Hill, 1986.

REFERENCE BOOKS:

R1 - Joshi P.H., —Jigs & Fixtures, 2nd Edition, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2004.
R2 - Kempster, —Jigs & Fixtures Design, 3rd Edition, The English Language Book Society, 1978.
R3 - Hiram E. Grant, —Jigs and Fixture, 1st Edition, Tata McGraw-Hill, New Delhi, 1989.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16ME7302	DESIGN FOR MANUFACTURE AND ASSEMBLY	3	0	0	3

Course Objective

1. To understand the selection of materials, methods, fit and tolerance concepts to design a product.
2. To familiarize the basic concept of design for castings, welding, sheet metal, forging and manufacturing processes
3. To understand the basic procedure of design for assembly and remanufacture.
4. To impart knowledge in Techniques to reduce environmental impact.
5. To learn global issues and design for environments.

Unit	Description	Instructional Hours
I	**Introduction to Tolerances** Tolerances- Limits, Fits, tolerance Chains, Charts and identification of functional dimensions- Design for manufacturability considerations - Geometric tolerances- Indian standards, ASME standards and Applications- surface finish.	7
II	**Design for Castings, Welding, Sheet Metal and Forging Processes** Materials - Selection Factors- Space factor - Size - Weight - Surface properties and Manufacturing methods. Design for castings- parting line, Minimization of core – Design for welding process - Welding defects – Design for Sheet metal operations- Design for Forging process- Case Studies.	12
III	**Design for Machining Processes** Design features for machining – Lathe, Drilling, Milling operations- Keyways - Doweling, Counter sunk screws - Simplification by separation and amalgamation- Design for machinability, economy, clamp ability and accessibility- factors for reducing machining area.	12
IV	**Design for Assembly** Rules and methodologies to design components-manual, automatic and flexible assembly- DFMA Tools- concurrent engineering – Redesign, DFA-index, poke-yoke, lean and six sigma concepts, design for manual and automatic assembly.	7
V	**Design for the Environment** Introduction – Environmental objectives – Global issues – Regional and local issues – Guide lines, Methods and applications – Lifecycle assessment –Techniques to reduce environmental impact – Design to minimize material usage – Design for disassembly – Design for Recyclability – Design for remanufacture.	7
	Total Instructional Hours	**45**

Course Outcome

Students will be able to:

CO1: Understand the selection of materials, methods, fit and tolerance concepts to design a product.

CO2: Familiar in the basic concept of design for castings, welding, sheet metal, forging and manufacturing processes

CO3: Understand the basic procedure of design for assembly and remanufacture.

CO4: Impart knowledge in Techniques to reduce environmental impact.

CO5: Studied the global issues and design for environments.

TEXT BOOKS:

T1 - Chitale A. K. and R. C. Gupta, Product Design and Manufacturing, Prentice Hall Inc.2007.

T2- Boothroyd. G., P. Dewhurst and W. Knight, Product Design for Manufacture and Assembly, Marcell Dekker, 2002.

REFERENCE BOOKS:

R1 - Bryan R. Fischer, Mechanical Tolerance stackup and analysis, Marcell Dekker, 2004.

R2 - Spotts M. F., Dimensioning and Tolerance for Quantity Production, Prentice Hall Inc., 2002.

R3- Bralla J. G., Hand Book of Product Design for Manufacturing, McGraw Hill Publications, 2000.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16ME7303	TOOL AND DIE DESIGN	3	0	0	3

Course Objective

1. To understand the fundamentals of work holding devices.
2. To impart knowledge in design tools, dies, jigs and fixtures.
3. To analyze and optimize an existing jig and fixture.
4. To gain proficiency when design of dies for press work and forging.
5. To design tools to maintain precision accuracy of the component produced.

Unit	Description	Instructional Hours
I	**DESIGN OF CUTTING TOOLS** Metal cutting process - Selection of tool materials - Design of single point and multipoint cutting tool - Form tools, Drills, Milling cutters, broaches and chip breakers – Problems on design of single point cutting tools only.	9
II	**LOCATING AND CLAMPING METHODS** Basic Principles of Location - Locating methods and devices - Principles of clamping - Mechanical, Pneumatic and Hydraulic actuation - Clamping force analysis – Design problems.	9
III	**DESIGN OF JIGS AND FIXTURES** Types of drill jigs - General considerations in the design of drill jigs - Drill bushings - Types, methods of construction - Simple designs of Plate, Channel, Boxes, Post, Angle plate, Turnovers and Pot Jigs. Types of fixtures - Fixtures for machine tools: Lathe, Milling, Boring, Broaching and grinding - Assembly fixtures - Inspection and Welding fixtures.	9
IV	**DESIGN OF DIES** Press tools - Fundamentals of die-cutting operations - Cutting action in punch and die operations - Die clearance - Blanking and Piercing Die construction – Pilots - Strippers and Pressure Pads.	9
V	**PRESS WORK MATERIALS AND MOULD DESIGN** Strip layout - Design of simple progressive and compound die sets - Forging Die – Flow lines, parting lines, open and close die forging; Materials for die block. General mould construction. Design of ejection, feed and cooling systems. Parting surface design. Side cores and side cavities. Product design for die casting and injection molding.	9
	Total Instructional Hours	**45**

Course Outcome

Students will be able to:

CO1: Identify the importance of work holding device.
CO2: Design jigs and fixtures.
CO3: Calculate the required specifications of a press for required operations.
CO4: Design tools and dies for required operations.
CO5: Design, specify and analyze the dies for different applications.

TEXT BOOKS:

T1 - Donaldson C., Lecain G.H. and Goold V.C. (2007), Tool Design, 3rd edition, Tata McGraw- Hill Publishing Company Ltd., New Delhi.
T2 - Jeff Lantrip, David A. Smith and John G. Nee, (2003) Fundamentals of Tool Design, 5th Edition, Society of Manufacturing Engineers.

REFERENCE BOOKS:

R1 - Joshi P. H., (2004) Jigs and Fixtures, 2nd Edition, Tata McGraw-Hill Publishing Company Ltd., New Delhi.
R2 - Edward G. Hoffman (2004) Jigs and Fixtures Design, Thomson - Delmar Learning Series, Singapore.

Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16ME7304	DESIGN OF MATERIAL HANDLING EQUIPMENTS	3	0	0	3

Course Objective

1. To impart knowledge to the students on the need, uses and applications of different material handling equipments.
2. To understand various types of material handling equipments.
3. To gain knowledge on selection and applications of material handling equipments.
4. To understand the design concepts of various hoists.
5. To learn about the design concepts of conveyors and elevators.

Unit	Description	Instructional Hours
I	**MATERIALS HANDLING EQUIPMENT** Types, selection and applications.	5
II	**DESIGN OF HOISTS** Design of hoisting elements: Welded and roller chains - Hemp and wire ropes - Design of ropes, pulleys, pulley systems, sprockets and drums, Load handling attachments. Design of forged hooks and eye hooks – crane grabs - lifting magnets - Grabbing attachments - Design of arresting gear - Brakes: shoe, band and cone types.	10
III	**DRIVES OF HOISTING GEAR** Hand and power drives - Traveling gear - Rail traveling mechanism - cantilever and monorail cranes - slewing, jib and luffing gear - cogwheel drive - selecting the motor ratings.	10
IV	**CONVEYORS** Types - description - design and applications of Belt conveyors, apron conveyors and escalators Pneumatic conveyors, Screw conveyors and vibratory conveyors.	10
V	**ELEVATORS** Bucket elevators: design - loading and bucket arrangements - Cage elevators - shaft way, guides, counter weights, hoisting machine, safety devices - Design of fork lift trucks.	10
	Total Instructional Hours	**45**

Course Outcome

CO1: Gain knowledge on the need, uses and applications of different material handling equipments.
CO2: Obtain knowledge on various types of material handling equipments.
CO3: Gain knowledge on selection and applications of material handling equipments.
CO4: Understand the design concepts of various hoists.
CO5: Apply knowledge and solve problems on design concepts of conveyors and elevators.

TEXT BOOKS:

T1 - Rudenko, N., Materials handling equipment, ELnvee Publishers, 1970.
T2 - Spivakovsy, A.O. and Dyachkov, V.K., Conveying Machines, Volumes I and II, MIR Publishers, 1985.

REFERENCE BOOKS :

R1 -Alexandrov, M., Materials Handling Equipments, MIR Publishers, 1981.
R2 - Boltzharol, A., Materials Handling Handbook, The Ronald Press Company, 1958.
R3 - P.S.G. Tech., "Design Data Book", Kalaikathir Achchagam, Coimbatore, 2003.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16ME7305	INDUSTRIAL ROBOTICS AND EXPERT SYSTEMS	3	0	0	3

Course Objective

1. To understand the functions of the basic components of a Robot.
2. To study the use of various types of End Effectors and Sensors.
3. To impart knowledge in Robot Kinematics and Programming.
4. To learn Robot safety issues and economics.
5. To impart knowledge in Robot cell design.

Unit	Description	Instructional Hours
I	**INTRODUCTION AND ROBOT KINEMATICS** Definition need and scope of Industrial robots – Robot anatomy – Work volume – Precision movement – End effectors – Sensors. Robot Kinematics – Direct and inverse kinematics – Robot trajectories – Control of robot manipulators – Robot dynamics – Methods for orientation and location of objects.	10
II	**ROBOT DRIVES AND CONTROL** Controlling the Robot motion – Position and velocity sensing devices – Design of drive systems – Hydraulic and Pneumatic drives – Linear and rotary actuators and control valves – Electro hydraulic servo valves, electric drives – Motors – Designing of end effectors – Vacuum, magnetic and air operated grippers.	9
III	**ROBOT SENSORS** Transducers and Sensors – Tactile sensor – Proximity and range sensors – Sensing joint forces – Robotic vision system – Image Representation - Image Grabbing –Image processing and analysis – Edge Enhancement – Contrast Stretching – Band Rationing - Image segmentation – Pattern recognition – Training of vision system.	9
IV	**ROBOT CELL DESIGN AND APPLICATION** Robot work cell design and control – Safety in Robotics – Robot cell layouts – Multiple Robots and machine interference – Robot cycle time analysis. Industrial application of robots.	9
V	**ROBOT PROGRAMMING, ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS** Methods of Robot Programming – Characteristics of task level languages lead through programming methods – Motion interpolation. Artificial intelligence – Basics – Goals of artificial intelligence – AI techniques – problem representation in AI – Problem reduction and solution techniques - Application of AI and KBES in Robots.	8
	Total Instructional Hours	**45**

Course Outcome

Students will be able to:

CO1: Understand the functions of the basic components of a Robot.
CO2: Study the use of various types of End Effectors and Sensors.
CO3: Gain knowledge in Robot Kinematics and Programming.
CO4: Impart knowledge on the use Robot safety issues and economics.
CO5: Impart knowledge in Robot cell design.

TEXT BOOKS:

T1 – Fu.K.S., R.C. Gonzalez and C.S.G. Lee, "Robotics Control, Sensing, Vision and Intelligence", McGraw Hill, 1987.
T2 - Yoram Koren," Robotics for Engineers' Mc Graw-Hill, 1987.

REFERENCE BOOKS :

R1 - Mikell, P. Groover, Mitchell Weis, Roger, N. Nagel, Nicholas G. Odrey," Industrial Robotics Technology, Programming and Applications", Mc Graw-Hill, Int. 1986.
R2 - Richard. D, Klafter, Thomas, A, Chmielewski, Michael Negin, "Robotics Engineering – An Approach", Prentice-Hall of India Pvt. Ltd., 1984.
R3 - Deb, S.R." Robotics Technology and Flexible Automation", Tata Mc Graw-Hill, 1994.

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ELECTIVE – IV

Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16ME7306	OPERATIONS RESEARCH (COMMON TO MECHANICAL AND AUTOMOBILE ENGINEERING)	3	0	0	3

Course Objective

1. To provide knowledge in using optimization techniques under limited resources for the Engineering and business problems.
2. To understand the Transportation Models and project Management Network Models.
3. To study the inventory management Techniques.
4. To understand the Queuing Models.
5. To understand various Decision making approaches.

Unit	Description	Instructional Hours
I	**LINEAR MODELS** The phase of an operation research study – Linear programming – Graphical method– Simplex algorithm – Duality formulation – Sensitivity analysis.	9
II	**TRANSPORTATION MODELS AND NETWORK MODELS** Transportation Assignment Models –Traveling Salesman problem-Networks models – Shortest route– Minimal spanning tree – Maximum flow models –Project network – CPM and PERT networks – Critical path scheduling – Sequencing models.	9
III	**INVENTORY MODELS** Forecasting Methods - Inventory models – Economic order quantity models – Quantity discount models – Stochastic inventory models – Multi product models – Inventory control models in practice.	9
IV	**QUEUEING MODELS** Queueing models - Queueing systems and structures – Notation parameter – Single server and multi server models – Poisson input – Exponential service – Constant rate service – Infinite population – Simulation.	9
V	**DECISION MODELS** Decision models – Game theory – Two person zero sum games – Graphical solution- Algebraic solution– Linear Programming solution – Replacement models – Models based on service life – Economic life– Single / Multi variable search technique.	9
	Total Instructional Hours	**45**

Course Outcome

Students will be able to:

CO1: Understand the optimization techniques under limited resources for the Engineering and business Problems.
CO2: Solve the problems on Transportation Models and project Management Network Models.
CO3: Gain knowledge about the inventory management Techniques.
CO4: understand and solve the numerical on Queuing Models.
CO5: Gain knowledge about various Decision making approaches.

TEXT BOOKS:

T1 - Taha H.A., "Operations Research", Sixth Edition, Prentice Hall of India, 2003.
T2 - Melynk, Denzler, " Operations management – A value driven approach" Irwin Mcgraw hill.

REFERENCE BOOKS:

R1 - Shennoy G.V. and Srivastava U.K., "Operation Research for Management", Wiley Eastern, 1994.
R2 - Upendra Kachru, "Production and Operations Management – Text and cases", 1st Ed, Excel books 2007.
R3 - Kanishka Bedi, "Production and Operations management", 2nd Edition, Oxford university press, 2007.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16ME7307	INDUSTRIAL ENGINEERING	3	0	0	3

Course Objective

1. To introduce the concepts, principles and framework of contents of Industrial Engineering.
2. To introduce the principles of work study, Method study and Value Engineering.
3. To introduce the concepts and frame work of work measurements.
4. To introduce the concepts of various cost accounting and financial management practices as applied in industries and facility design.
5. To acquaint the students with different aspects of Industrial Safety rules.

Unit	Description	Instructional Hours
I	**INTRODUCTION TO INDUSTRIAL ENGINEERING AND PRODUCTIVITY** Introduction: Definition and Role of Indus trial Engineering, Contribution of Taylor and Gilbreth, Organization: Concept of organization, characteristics of organization, elements of organization, organizational structure, organization charts; Types of organization. - Formal line, military organization, functional organization, line & staff organization; Introduction to management principles, authority and responsibility, span of control, delegation of authority. Productivity: Definition of productivity, Productivity of materials, land, building, machine and power. Measurement of productivity: factors affecting the productivity, Productivity Models and Index (Numerical), productivity improvement programmers.	9
II	**METHOD STUDY** Work Study: Definition, objective and scope of work-study. Human factors in work-study. 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, two handed chart and multiple activity charts. Charts to record movement at work place -principles of motion economy, classification of moments, SIMO chart, and micro motion study. Definition and installation of the improved method, brief concept about synthetic motion studies.(Numerical); Introduction to Value Engineering and Value Analysis;.	9
III	**WORK MEASUREMENTS** Work Measurements: Definition, objectives and uses; Work measurement techniques. Work sampling - need, confidence levels, sample size determinations, random observation conducting study with the simple problems. Time study: Definition, time study equipment, selection of job, steps in time study. Breaking jobs into elements, recording information. Rating and standard rating, standard performance, scales of rating, factors affecting rate of working, allowances and standard time determination; Introduction to PMTS and MTM. (Numerical), Introduction to MOST.	9
IV	**FACILITY DESIGN** Facility location Factors and Evaluation of Alternate Locations; Types of Plant Layout; Computer Aided Layout Design Techniques; Assembly Line Balancing (Numerical); Material Handling: Principles, Types of Material Handling Devices; Stores Management Inventory Control: Functions, costs, classifications - deterministic and probabilistic inventory models, Concept of EOQ, purchase model without shortages (Numerical); ABC and VED Analysis.	9
V	**ENGINEERING ECONOMY AND INDUSTRIAL SAFETY** Engineering Economy and Costing: Elementary Cost Accounting and Methods of Depreciation; Break-Even Analysis (Numerical); Introduction to Debit and Credit Note, Financial Statements (Profit and Loss Account and Balance Sheet), Techniques for Evaluation of Capital Investments. Industrial Safety: Safety Organization, Safety Programme, General Safety Rules.	9
	Total Instructional Hours	**45**

Course Outcome

Students will be able to:

CO1: Apply the Industrial Engineering concepts in the industrial environment.

CO2: Manage and implement different concepts involved in methods study and understanding of work content in different situations. Undertake project work based on the course content.

CO3: Describe different aspects of work system design and facilities design pertinent to manufacturing industries.

CO4: Identify various cost accounting and financial management practices widely applied in industries.

CO5: Develop capability in integrating knowledge of design along with other aspects of value addition in the conceptualization and manufacturing stage of various products.

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TEXT BOOKS:

T1 - Martend Telsang, Industrial Engineering, S. Chand Publication.

T2 - Banga and Sharma, Industrial Organization & Engineering Economics, Khanna publication.

REFERENCE BOOKS:

R1 - Introduction to Work Study by ILO, ISBN 978-81-204-1718.

R2 - Oxford & IBH Publishing Company, New Delhi, Second Indian Adaptation, 2008.

R3 – Maynard.H.B., KJell, Maynard's Industrial Engineering Hand Book, McGraw Hill Education.

R4 – Khanna.O. P., Industrial engineering and management, Dhanpat Rai publication.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16ME7308	PRODUCTION PLANNING AND CONTROL	3	0	0	3

Course Objective

1. To understand the major production planning and control issues in both service and manufacturing industries.
2. To know the qualitative and quantitative forecasting techniques and their influence on production planning and control.
3. To understand the push and pull philosophies in production planning and compare different methods in production scheduling
4. To know the recent trends like manufacturing requirement Planning (MRP II) and Enterprise Resource Planning (ERP).
5. To Solve inventory control and planning issues using either deterministic or stochastic modeling.

Unit	Description	Instructional Hours
I	**INTRODUCTION** Objectives and benefits of planning and control-Functions of production control-Types of production-job- batch and continuous-Product development and design-Marketing aspect - Functional aspects-Operational aspect-Durability and dependability aspect aesthetic aspect. Profit consideration.	9
II	**FORECASTING AND WORK STUDY** Forecasting - Subjective estimate - survey - Delphi method - Regression models - Single variable model Two variable model -Econometric models - Input-output model. Method study, Implementation - Micro motion and memo motion study – work measurement - Techniques of work measurement - Time study - Production study - Work sampling.	9
III	**SHOP FLOOR CONTROL, JUST IN TIME AND MPS** Shop Floor Control Techniques – Basic Shop floor control concepts – Gantt charts. Just in Time – Major elements of JIT – JIT corner stones and the linkages to MPC, Master production scheduling techniques, Bill of material structuring for the MPS.	9
IV	**PRODUCTION SCHEDULING** Frame work for the MPC system - the system and the frame work, Material flows, Individual firm. MRP in MPC: MRP and MRP II: Basic MRP record, Linking MRP records, Scheduled receipts versus planned order releases, MRP planner, MRP system output, MRP Database.	9
V	**INVENTORY CONTROL AND RECENT TRENDS IN PPC** Inventory control-Purpose of holding stock-Effect of demand on inventories-Ordering procedures. Two bin system -Ordering cycle system-Determination of Economic order quantity and economic lot size-ABC analysis-Recorder procedure-Introduction to computer integrated production planning systems.	9
	Total Instructional Hours	**45**

Course Outcome

Upon completion of this course, the students can able to

CO 1.Prepare the major production planning and control activities.

CO 2.Identify qualitative and quantitative forecasting techniques and their influence on production planning and control.

CO 3.Know to prepare the Master Production Scheduling and aggregate planning.

CO 4.Prepare manufacturing requirement Planning (MRP II) and Enterprise Resource Planning (ERP).

CO 5.Determine Economic order quantity in either deterministic or stochastic modeling.

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TEXT BOOKS:

T1 - Martand Telsang, "Industrial Engineering and Production Management", First edition, S. Chand and Company, 2000.

T2. - James.B.Dilworth,"Operations management – Design, Planning and Control for manufacturing and services" Mcgraw Hill International edition 1992.

REFERENCE BOOKS:

R1 - Samson Eilon, "Elements of Production Planning and Control", Universal Book Corpn.1984

R2 - Elwood S.Buffa, and Rakesh K.Sarin, "Modern Production / Operations Management", 8th Edition, John Wiley and Sons, 2000.

R3 - Kanishka Bedi, " Production and Operations management", 2nd Edition, Oxford university press, 2007. Majumdar S.R.,"Pneumatic systems – Principles and maintenance", Tata McGraw Hill, 1995.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16ME7309	TOTAL QUALITY MANAGEMENT (COMMON TO MECHANICAL, MECHATRONICS AND AUTOMOBILE ENGINEERING)	3	0	0	3

Course Objective

1. Acquire knowledge on TQM concepts.
2. To Acquire knowledge on customer satisfaction, motivation etc.
3. Develop skills to use TQM tools for domain specific applications.
4. To explore industrial applications of Quality function deployment and taguchi quality concepts
5. To impart detail exposure to students on various quality systems like ISO and its standards.

Unit	Description	Instructional Hours
I	**INTRODUCTION** Introduction - Definition of quality - Dimensions of quality - Basic concepts of TQM - TQM Framework – Gurus of TQM - Contributions of Deming, Juan and Crosby - Barriers to TQM Implementation– Principles of TQM- Quality statements - Quality Council - Quality circle- Costs of Quality- Leadership.	9
II	**TQM PRINCIPLES** Customer satisfaction - Strategic quality planning - Customer complaints, Customer retention - Employee involvement - Motivation, Empowerment – Teams - Recognition and Reward, Performance appraisal - PDSA Cycle, 5S, Kaizen - Supplier Partnership - Partnering, Supplier selection, Supplier Rating – Supplier Certification.	9
III	**STATISTICAL PROCESS CONTROL** The seven traditional tools of Quality - New Seven Management tools – Statistical Fundamentals – Measures of central Tendency and Dispersion, Population and Sample - Control Charts - Concept of Six sigma- Process capability - Bench marking - Reason to bench mark, Bench marking process.	9
IV	**TQM TOOLS** Quality Function Deployment (QFD) -Taguchi quality loss function – Total Productive Maintenance (TPM) - Concepts, improvement needs - Performance measures - FMEA - Stages, Types.	9
V	**QUALITY SYSTEMS** Need for ISO 9000 and other Quality System - ISO 9001-2008 Quality System – Elements - Implementation of Quality System - Documentation, Quality Auditing - QS 9000 - ISO 14000 - Concepts, Requirements and Benefits.	9
	Total Instructional Hours	**45**

Course Outcome

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

CO1: Understand quality concepts and philosophies of TQM.
CO2: Apply TQM principles and concepts of continuous improvement.
CO3: Apply and analyze the quality tools, management tools and statistical fundamentals to improve quality.
CO4: Understand the TQM tools as a means to improve quality.
CO5: Remember and understand the ISO quality systems and procedures adopted.

TEXT BOOK:

T1 - Dale H. Besterfiled, et at., "Total quality Management", Third Edition, Pearson Education Asia, Indian Reprint, 2006.
T2 - Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006.

REFERENCES:

R1 - James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8th Edition, First Indian Edition, Engage Learning, 2012.
R2 - Janakiraman. B and Gopal .R.K., "Total Quality Management - Text and Cases", Prentice Hall. (India) Pvt. Ltd., 2006.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16ME7310	EXPERIMENTAL METHODS FOR ENGINEERS	3	0	0	3

Course Objective

1. Understand the basic concept of engineering experimentation.
2. Understand the working principle of measuring instruments.
3. Identify the necessity of controllers.
4. Recognize and analysis various experimental methods.
5. Calculate error and uncertainty analysis.

Unit	Description	Instructional Hours
I	**DESIGN OF EXPERIMENTS** Planning of experiments and documenting experiments, various stages in experimental investigations; preliminary, intermediate and final, steady state and transient techniques, selection of measuring devices based on static, dynamic characteristics and allowable uncertainties, basics of Taguchi method for design of experiments, optimization of experimentation, statistical methods for analyzing the experimental data. Review of literature, problem identification; identify a possible solution, preparation of technical report.	9
II	**MEASURING INSTRUMENTS** Temperature measuring instruments: thermocouples, thermometers, RTDs, Infra red thermometers, calibration of thermocouples, thermo positive elements, thermocouples in series & parallel, pyrometry, design of temperature measuring instruments. Pressure measuring instruments: pressure gauges, manometers, pressure transducers, calibration of pressure measuring instruments. Flow measuring instruments: orifice meter, venturimeter, Rotameters, corrolius mass flow meters, anemometers, non contact type mass flow meters. Miscellaneous measurements: Measurement of shaft loads, heat flux, thermal radiation, turbulence, noise etc. Measurement of material properties: mechanical and thermal properties.	9
III	**ADVANCEMENT IN MEASUREMENTS** Data logging and acquisition, use of sensors for error reduction, elements of micro computer interfacing, intelligent instruments and their use, Basics of P, PI, PID controllers, pneumatic and hydraulic controllers, electronic controllers.	9
IV	**ADVANCE MEASUREMENT TECHNIQUES AND ANALYSIS** Shadowgraph, Sunshine recorder, Quality of indoor air, Interferometer, Laser Doppler Anemometer, Hot wire Anemometer, Telemetry in measurement, Orsat apparatus, Gas Analyzers, Smoke meters, gas chromatography, spectrometry, load	9
V	**ERROR ANALYSIS** Errors in instruments, Analysis of experimental data and determination of overall uncertainties in experimental investigations, uncertainties in measurement of pressure, temperature, flow, torque, properties, power and calculated parameters under various conditions.	9
	Total Instructional Hours	**45**

Course Outcome

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

CO1 - Plan the experimentation.
CO2 - Selecting appropriate measuring instruments.
CO3 - Identify the suitable controls.
CO4 - Understanding the working principle of advanced measuring instruments.
CO5 - Calculate the errors in experiments.

TEXT BOOK:

T1: J.P. Holman, Experimental methods for Engineers. Tata McGrawHill Publishers. 2016.
T2. Barney G.C, Intelligent Instrumentation, Second Edition, Prentice Hall of India, 1988.

REFERENCES:

R1. Bolton.W, Industrial Control & Instrumentation, Universities Press, Second Edition, 2001.
R2. Doblin E.O, Measurement System Application and Design, Second Edition, McGraw Hill, 1978.
R3. Nakra, B.C., Choudhry K.K., Instrumentation, Measurements and Analysis Tata McGraw Hill, 2nd ED 2003.

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ELECTIVE – V

Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16ME8301	MAINTENANCE ENGINEERING	3	0	0	3

Course Objective

1. To study the principles and functions of maintenance planning.
2. To learn the types of maintenance.
3. Gain knowledge about condition monitoring.
4. Understand the repair methods for machine elements.
5. Understand the repair methods for material handling equipments.

Unit	Description	Instructional Hours
I	**PRINCIPLES AND PRACTICES OF MAINTENANCE PLANNING** Basic Principles of maintenance planning – Objectives and principles of planned maintenance activity – Importance and benefits of sound Maintenance systems – Reliability and machine availability – MTBF, MTTR and MWT – Factors of availability – Maintenance organization – Maintenance economics.	9
II	**MAINTENANCE POLICIES – PREVENTIVE MAINTENANCE** Maintenance categories – Comparative merits of each category – Preventive maintenance, maintenance schedules, repair cycle - Principles and methods of lubrication – TPM.	9
III	**CONDITION MONITORING** 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.	9
IV	**REPAIR METHODS FOR BASIC MACHINE ELEMENTS** 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.	9
V	**REPAIR METHODS FOR MATERIAL HANDLING EQUIPMENT** Repair methods for Material handling equipment - Equipment records –Job order systems -Use of computers in maintenance.	9
	Total Instructional Hours	**45**

Course Outcome

Students will be able to:

CO1: Understand the maintenance planning functions.
CO2: Identify maintenance policies and types.
CO3: Gain knowledge about methods and instruments for CM.
CO4: To analyze failure of machine parts.
CO5: Implement failure analysis in material handling equipments.

TEXT BOOKS:

T1 - Srivastava S.K., "Industrial Maintenance Management", S. Chand and Co., 1981.
T2 - Venkataraman .K "Maintancence Engineering and Management", PHI Learning, Pvt. Ltd., 2007.

REFERENCE BOOKS:

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 & Co., 1986.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16ME8302	INDUSTRIAL SAFETY ENGINEERING	3	0	0	3

Course Objective

1. To provide in depth knowledge in Principles of safety and Prevention of accident in various fields.
2. To understand the basics on safety organization.
3. To expose the students to the basics in Human safety and hazard management.
4. To learn about human safety.
5. To study about Industrial Hygiene and Hazards.

Unit	Description	Instructional Hours
I	**INTRODUCTION ANDACCIDENT PREVENTION** Definition-Development before industrial revolution-Milestones in industrial safety movement-Development of accident prevention programs-3 E's of safety- Development of Safety Organizations-Safety and health movement- Managing emergency in industries. Safety and productivity-Fallacies about safety-Industrial psychology in accident prevention-Basic philosophy of accident prevention-Unsafe condition, Unsafe act, Injury, Fault of persons- Cost of accidents- Safety education.	9
II	**SAFETY ORGANIZATION** Purpose of a safety organization-Safety policy- Safety committee- types- Role of safety coordinator-Responsibilities, Interferences and Sufferings of safety supervisor-Safety Publicity-Accident Reporting-Accident Investigation-Accident Statistics-Safety audits.	9
III	**INDUSTRIAL PROCESS SAFETY** Overview-Safety performance by industry sector-Incident Pyramid-Process hazard and risk-Failure of defences- Process safety management-Scope, Functions, Features and Characteristics-Role of organizational levels in Process Safety Management-Assessing organizations safety effectiveness.	9
IV	**HUMAN SIDE OF SAFETY** Management of change-Process and equipment integrity-Human behaviour aspects and modes-The Swiss cheese model of industrial accidents-Active and Latent failures-examples - Safety lessons-Human Factors influencing the likelihood of failure-Organizational culture, Demographic effects.	9
V	**INDUSTRIAL HYGIENE AND HAZARDS** OSHA and industrial hygiene-work site analysis-recognizing and controlling hazards-Occupational diseases prevention-Employee Welfare-Statutory welfare schemes, Non-statutory schemes-Health Hazards-Control strategies- Fire hazards and prevention, Electrical hazard prevention and safety.	9
	Total Instructional Hours	**45**

Course Outcome

After successful completion of the course, the students should be able to

CO1: Apply the philosophies behind industrial accidents
CO2: Apply the hierarchical levels in a safety organization
CO3: Understand the concept of industrial process safety
CO4: Understand the safety procedures for human and apply Industries.
CO5: Apply the types of industrial hazards and preventive measures.

TEXT BOOKS:

T1- Krishnan N.V., "Safety in Industry", Jaico Publisher House, 2005.
T2- Singh, U.K. and Dewan, J.M., "Safety, Security and risk management", APH Publishing Company, New Delhi, 2005.

REFERENCES

R1- C. Ray Asfahl, David W. Rieske"Industrial Safety and health management", Prentice Hall,2009.
R2- R.K. Mishra,"Safety Management", AITBS publishers, 2012.
R3- Krishnan N.V., "Safety in Industry", Jaico Publisher House, 2005.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16ME8303	INDUSTRIAL ERGONOMICS	3	0	0	3

Course Objective

1. To study ergonomics for the integration of man and machine.
2. To manufacture manageable products those are comfortable to use.
3. To optimize the integration of man and machine in order to increase productivity with accuracy.
4. To familiarize the factors affecting human performance.
5. To evaluate work measurement.

Unit	Description	Instructional Hours
I	**INTRODUCTION** Focus of ergonomics-areas of application in work system-History of ergonomics-Humanization of work -modern ergonomics-future directions for ergonomics-designing for population of users-sources of human variability-Anthropometry in ergonomics-Types of anthropometric data.	9
II	**WORK CAPACITY AND FATIGUE** Stress and fatigue- Muscle function –Types and fatigue-fatigue and discomfort-fatigue after prolonged exertion-fatigue and pain-Electromyography-Cardiovascular system-Respiratory system- work capacity-Factors affecting work capacity.	9
III	**HUMAN ERROR AND SAFETY** Factors influencing human error-Mental work load in human-machine interaction-physiological and psychological measures of mental work load-error categorization-error production-error detection-Heuristics and biases in human decision making- Accidents and safety-Scope of accident investigation.	9
IV	**PHYSICAL ERGONOMICS** Physical work load and energy expenditure, Anthropometry – measures – design procedure, Work postures-sitting, standing - measurement – ergonomic implications. Design of displays and controls.	9
V	**ENVIRONMENTAL FACTORS** Sources & effects of Noise, Vibration, lighting, temperature, humidity & atmosphere. Measures for monitoring control & mitigation.	9
	Total Instructional Hours	**45**

Course Outcome

Students will be able to:

CO1: Understand basic principles of ergonomics in humanization.
CO2: Apply the principles of work capacity and fatigue.
CO3: Describe and apply ergonomics principles to promote safety, health and productivity.
CO4: Recognize the different environmental factors that affect human performance.
CO5: Identify the different work measurement techniques.

TEXT BOOKS:

T1 - Martin Helander, A Guide to human factors and Ergonomics, Taylor and Francis, 2006.
T2 - Bridger, RS, "Introduction to ergonomics", Taylor and Francis, 2003.

REFERENCES:

R1 - Khan MI, "Industrial Ergonomics" PHI Learning, 2010.
R2 - Megaw ED,"Contenmprory ergonomics",Taylor & Francis, 2009.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16ME8304	METROLOGY AND NON DESTRUCTIVE TESTING	3	0	0	3

Course Objective

1. To impart the knowledge of quality assurance and inspection techniques.
2. To familiarize with the various inspection and measurement techniques like contact and non-contact measurement by adapting Computer Aided Inspection.
3. To impart the knowledge of working principles and calibration of various Systems.
4. To study and understand the various non-destructive evaluation and testing methods, theory and their industrial applications.
5. To provide exposure to the students on various advanced measuring methods and nondestructive testing techniques.

Unit	Description	Instructional Hours
I	**MEASURING MACHINES** Tool Maker's microscope - Co-ordinate measuring machines - Universal measuring machine - Laser viewers for production profile checks - Image shearing microscope - Use of computers - Machine vision technology - Microprocessors in metrology.	9
II	**STATISTICAL QUALITY CONTROL** Data presentation - Statistical measures and tools - Process capability - Confidence and tolerance limits - Control charts for variables and for fraction defectives - Theory of probability - Sampling - ABC standard - Reliability and life testing.	9
III	**LIQUID PENETRANT AND MAGNETIC PARTICLE TESTS** Characteristics of liquid penetrants - different washable systems - Developers - applications - Methods of production of magnetic fields - Principles of operation of magnetic particle test - Applications - Advantages and limitations.	9
IV	**RADIO GRAPHY** Sources of ray-x-ray production - properties of d and x rays - film characteristics – exposure charts - contrasts - operational characteristics of x ray equipment - applications.	9
V	**ULTRASONIC AND ACOUSTIC EMISSION TECHNIQUES** Production of ultrasonic waves - different types of waves - general characteristics of waves - pulse echo method - A, B, C scans - Principles of acoustic emission techniques – Advantages and limitations - Instrumentation - applications.	9
	Total Instructional Hours	**45**

Course Outcome

Students will be able to:

CO1: The student shall be able to understand the concept of Laser Metrology and Computer Integrated Machining Machine.

CO2: The student shall be able to understand the techniques used in statistical quality control.

CO3: The student shall be able to analysis the materials characteristics through various non-destructive tests.

CO4: The student shall be able to understand the knowledge various radiography characteristics and operations.

CO5: The student shall be able to understand the knowledge of ultrasonic and Acoustic emission techniques.

TEXT BOOKS:

1. Jain, R.K. "Engineering Metrology ", Khanna Publishers, 1997.
2. Barry Hull and Vernon John, "Non Destructive Testing ", MacMillan, 1988.

REFERENCE BOOKS:

1. American Society for Metals, "Metals Hand Book ", Vol.II, 1976.
2. Progress in Acoustic Emission, "Proceedings of 10th International Acoustic Emission Symposium ", Japanese Society for NDI, 1990.
3. Halmshaw, "Non-destructive testing", 2nd edition, Edward Arnold, 1991.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16ME8305	LOGISTICS AND SUPPLY CHAIN MANAGEMENT	3	0	0	3

Course Objective

1. To make students understand the importance of Logistics and Supply Chain operations in the industrial and business systems.
2. To acquire knowledge on Supply chain integration.
3. To familiarize the best practices of supply chain management.
4. To provide information of procurement and outsourcing strategies.
5. To enable the students about customer relationship management.

Unit	Description	Instructional Hours
I	**LOGISTICS & SUPPLY CHAIN MANAGEMENT** Evolution of Supply Chain, Classification of Logistics Applications, Total logistics cost, Logistics to Supply Chain Management focus, Objectives of Supply Chain Management, Key factors (Drivers and Obstacles) of SCM, Size and potential of SCM market in India, Framework for supply chain planning and decision making, Strategic aspects and managing uncertainty.	9
II	**DYNAMICS OF SCM** Alignment processes with customer order- management system, Supply chain integration through push-pull mechanism, Bullwhip effect mechanism.	9
III	**WORLD-CLASS BEST PRACTICES IN SCM** Supplier tierization, Reverse logistics, Vendor-managed inventory, Milk round system, Hub and spoke, Third and Fourth party logistics (3PL and 4PL), Cross docking, Drop shipping, Trans-shipment, Risk-pooling, RFID, Lean operations.	9
IV	**PROCUREMENT AND OUTSOURCING STRATEGIES** Operational decisions and trends, Strategic outsourcing and partnerships, Bidding and negotiation processes, Vendor rating and development, e-procurement, Vendor Quality Assurance system.	9
V	**CUSTOMER RELATIONSHIP MANAGEMENT AND INFORMATION TECHNOLOGY IN SCM** Concept of CRM and its linkage with SCM, Marketing implications such as value added services, New product development, Strategic pricing, Need and role of IT in SCM, ERP and SCM, Implementing SCM, Performance Measurement of SCM.	9
	Total Instructional Hours	**45**

Course Outcome

After learning the course the students should be able to:

CO1: Understand the concept of logistics and supply chain management.

CO2: Appreciate the importance of logistics function in overall success of any business and industrial sector.

CO3: Apply world-class best practices in supply chain management.

CO4: Execute Vendor Quality Assurance systems.

CO5: Implement very good customer relationship methods.

TEXT BOOKS:

T1- D.K.Agrawal"Textbook Of Logistics And Supply Chain Management Macmillan Publishing House 2003.

T2- Martin Christoper, "Logistics And Supply Chain Management", 4th Edition. 2011.

REFERENCE BOOKS:

R1- R.B. Handfield And E.L. Nochols, Jr. Introduction To Supply Chain Management. Prentice Hall, 1999.

R2- Sunil Chopra And Peter Meindel. Supply Chain Management: Strategy, Planning,And Operation,Prentice Hall Of India,2002.

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ELECTIVE – VI

Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16ME8306	TWO AND THREE WHEELER VEHICLE TECHNOLOGY	3	0	0	3

Course Objective

1. The different types of two and three wheelers types, construction and working.
2. The different power unit functions of two and three wheelers.
3. The location and importance of each part.
4. The maintenance and fault tracing of two and three wheelers.
5. The anatomy of the two and three wheeler in general.

Unit	Description	Instructional Hours
I	**POWER UNIT** Two stroke SI engine, four stroke SI engine; merits and demerits. Symmetrical and unsymmetrical port timing diagrams. Types of scavenging processes; merits and demerits, scavenging pumps. Rotary valve engine. Fuel system. Lubrication system. Magneto coil and battery coil spark ignition system, electronic ignition system. Starting system; Kick starter system.	9
II	**CHASSIS AND SUB-SYSTEMS** Mainframe and its types. Chassis and shaft drive, Single, multiple plates and centrifugal clutches. Gear box and gear controls. Front and rear suspension systems. Shock absorbers. Panel meters and controls on handle bar.	9
III	**BRAKES, WHEELS AND TYRES** Drum brakes, disc brakes, front and rear brake links, layouts. Spokes wheel, cast wheel, disc wheel, disc types. Tyres and tubes.	9
IV	**TWO WHEELERS** Case study of major Indian models of motorcycles, scooters and mopeds. TVS mopeds and motorcycles, HeroHonda motorcycles, Bajaj scooters and motorcycles, Yamaha, Enfield motorcycles. Servicing and maintenance.	9
V	**THREE WHEELERS** Case study of Indian models. Auto rickshaws, pickup van, delivery van and trailer, Maintenance and Fault tracing.	9
	Total Instructional Hours	**45**

Course Outcome

Students will be able to:

CO1: Demonstrate with the various systems in two and three wheeled vehicles.
CO2: Understand different types of two and three wheelers.
CO3: Understand the special parts and their importance and working in two and three wheelers.
CO4: Know the maintenance of two and three wheelers.
CO5: Understand the functioning of clutch and gear box.

TEXT BOOKS:

T1 Irving.P.E. - Motor Cycle Engineering - Temple Press Book, London – 1992.
T2 The Cycle Motor Manual - Temple Press Limited, London - 1990

REFERENCE BOOKS:

R1 Encyclopedia of Motorcycling - 20 volume Marshall, Cavensih, UK – 1989.
R2 Brayant R.V,Vespa - Maintenance and Repair Series – S.Chand & Co., New Delhi - 1986.
R3 Raymond Broad Lambretta - A Practical Guide to maintenance and repair – S.Chand & Co., New Delhi - 1987.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16ME8307	MANUFACTURING OF AUTOMOTIVE COMPONENTS	3	0	0	3

Course Objective

1. The functioning of the engine and its accessories, gear box, clutch, brakes, steering, axles and wheels.
2. Suspension, frame, springs and other connections.
3. Emissions, ignition, controls, electrical systems and ventilation.
4. The manufacturing methods for chassis, dead axle, leaf spring, coil spring and shock absorbers.
5. Understand the basic theory of metal working and metal cutting principles.

Unit	Description	Instructional Hours
I	**CASTED ENGINE COMPONENTS** Material selection and Manufacturing methods for Piston, Piston rings, Cylinder block, wet and dry liners, Engine head, Oil pan, Carburetors. Thermal barrier coating of Engine head and valves.	9
II	**FORGED ENGINE COMPONENTS** Material selection and Manufacturing methods for Crank shaft, Connecting rod, Cam shaft, valve, Piston pin, Push rod, Rocker arm, tappets, spark plug.	9
III	**TRANSMISSION SYSTEM** Material selection and Manufacturing methods for Clutch – Clutch lining – Gear Box – Gear – Propeller Shaft – Differential – Axle Shaft – Bearing – fasteners – Wheel drum. Methods of Gear manufacture – Gear hobbing and gear shaping machines - gear generation – gear finishing and shaving – Grinding and lapping of hobs and shaping cutters – gear honing – gear broaching.	9
IV	**VEHICLE CHASSIS** Material selection and manufacturing methods for chassis, dead axle, leaf spring, coil spring and shock absorbers – wheel housing – steering system, Brake shoes, wheel rim, Tyres. Heat treatment procedures.	9
V	**RECENT DEVELOPMENTS** Surface treatment – Plastics – Plastics in Automobile vehicles – Processing of plastics – Emission control system – catalytic converter – Hydro forming of exhaust manifold and lamp housing – stretch forming of Auto body panels – MMC liners –Selection of materials for Auto components. Use of Robots in Body weldment.	9
	Total Instructional Hours	**45**

Course Outcome

Students will be able to:

CO1: Identify the different parts of the automobile.
CO2: Explain the working of various parts like engine, transmission, clutch, Brakes.
CO3: Describe how the steering and the suspension systems operate.
CO4: Understand the environmental implications of automobile emissions.
CO5: Develop a strong base for understanding future developments in the automobile industry.

TEXT BOOKS:

T1 Heldt.P.M, "High speed combustion engines", Oxford publishing Co., New York, 1990.
T2 Kirpal Singh, 'Automobile Engineering", Vol. I & II, Standard Publishers, New Delhi, 1997.

REFERENCE BOOKS:

R1 Newton and steels, the motor vehicle, ELBS, 1990
R2 Serope Kalpakjian and Steven R. Schmid, "Manufacturing Processes for Engineering Materials", Fourth Edition, Pearson Education publications – 2003.
R3 Gupta K.M. "Automobile Engineering" Vol.I & II, Umesh Publishers, 2000.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16ME8308	HYBRID VEHICLES	3	0	0	3

Course Objective

1. To understand the types of heating, ventilation and air conditioning (HVAC) systems.
2. To design and select appropriate HVAC system for a particular application.
3. To learn about air flow ducts and pipes.
4. To familiarize about fans and blowers.
5. To impart knowledge on air pollutants and controls.

Unit	Description	Instructional Hours
I	**INTRODUCTION TO HVAC SYSTMES** Types of air conditioning systems: All water systems, all air systems, air water systems, unitary systems and selection of air conditioning equipments. Air conditioning equipments: Window air conditioners, split air conditioners, packaged air conditioners, centralized air conditioners, evaporative coolers, passive cooling and heating systems. Constant and variable area volume systems.	9
II	**THERMAL LOAD CALCULATIONS** Cooling and heating load calculations: Heat transfer through building structure, occupancy load, electrical loads, occupancy load, ventilation load, infiltration load. Influence of relative humidity in thermal loads. Ventilation standards: Ventilation requirements in air conditioning buildings and ASHRAE standards. Insulation materials: types; properties and economic thickness.	9
III	**DUCTS AND PIPIES IN HVAC SYSTEMS** Air flow through ducts, duct standards, duct fittings, types of air outlets, design of air conditioning ducts. Chill water supply pipe sizing calculations: Piping network for supply and return water line - pipe fittings - lining and insulation - piping system as per ASHRAE standards	9
IV	**FANS AND BLOWERS** Types of fans and blowers, performance characteristics, fan laws, static and dynamic losses in fans, design and selection of fans and blowers for air conditioning plants, cooling towers and ventilation systems, testing, speed, flow and noise control. Test standards of fans and blowers	9
V	**INDOOR AIR QUALITY** Air pollution in air conditioning rooms: effects of air quality, ASHRAE standards. Air filtration: principle of air filtration in HVAC systems, HEPA and ULPA filters, electrostatic cleaners, filter standards, test methods and NAFA certification. Clean rooms: standards for clean rooms, design of clean rooms for hospitals, pharmaceutical and food industries. Measurement of indoor air pollutants, control of pollutants in air conditioning halls.	9
	Total Instructional Hours	45

Course Outcome

Upon completion of this course, the students will be able to:
CO1: Understand the types of HVAC systems.
CO2: Calculate the cooling and heating loads for various air conditioning rooms.
CO3: Design the air conditioning ducts and piping for HVAC systems.
CO4: Select fans and blowers for air conditioning, ventilation and cooling towers.
CO5: Understand the concept of indoor air quality.

TEXT BOOKS:

T1 HVAC Fundamentals / Samuel C. Sugarman / Fairmont Press / 2005.
T2 HVAC Fundamentals Volume-1 / James E. Brumbou / Audel / 4th Edition.

REFERENCE BOOKS:

R1 Fundamentals of HVAC Systems / Robert Mcdowall / Academic Press / 2007.
R2 Home Heating & Air Conditioning systems / James Kittle / MGH.
R3 Ventilation Systems: Design and Performance/ Hazim B. Awbi. / Routledge / 2007.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16ME8309	VEHICLE MAINTENANCE	3	0	0	3

Course Objective

1. To familiarize the maintenance and inspections procedures for various components and systems of automobiles.
2. To explain the needs of vehicle maintenance and their importance.
3. Understand the basic concepts of maintenance
4. Learn the engine maintenance and Impart the knowledge about automobile systems maintenance
5. Define the overhauling technique and Identify the maintenance of electrical systems

UNIT	DESCRIPTION	Instructional Hours
I	**MAINTENANCE OF RECORDS AND INSPECTION SCHEDULE** Need for maintenance, classification of maintenance work, requirements of maintenance, preparation of check lists. Inspection schedule, maintenance of records, log sheets and other forms, safety precautions in maintenance: General safety, tool safety.	9
II	**ENGINE MAINTENANCE** Dismantling of engine components, visual and dimensional inspections, minor and major reconditioning of various components, reconditioning methods, engine assembly, special tools used for maintenance overhauling, cleaning and inspection of engine components	9
III	**MAINTENANCE OF FUEL SYSTEM, COOLING & LUBRICATION SYSTEMS** Servicing and maintenance of fuel system, calibration and tuning of engine for optimum fuel supply, Cooling systems, water pump, radiator, thermostat, anticorrosion and antifreeze additives, Lubrication system maintenance,	9
IV	**CHASSIS MAINTENANCE - REPAIR AND OVERHAULING** Servicing and maintenance of clutch, gear box, universal joints, propeller shaft, differential system. service and maintenance of brake, disc and drum brakes, steering wheel and suspension systems, Overhauling and maintenance, wheel alignment, computerized alignment and wheel balancing.	9
V	**ELECTRICAL SYSTEM MAINTENANCE** Servicing and maintenance of battery, starter motor, alternator and generator, ignition system, lighting system, electric horn, and wiper motor, Fault diagnosis and maintenance of modern electronic controls, checking and servicing of dash board instruments.	9
	Total Instructional Hours	**45**

Course Outcome

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

CO1: Prepare the record of vehicle operation, maintenance, service schedules etc.

CO2: Interpret the maintenance procedures and inspections of various components along with systems of Automobile engines & chassis.

CO3: Learn the dismantling of engine components, visual inspections and maintenance of various automobile elements.

CO4: To impart the knowledge about fuel, cooling and lubricating systems of Automobile.

CO5: Explain the details of maintenance, fault diagnosis including inspections of various electrical components and electrical systems.

TEXT BOOKS:

T1 Knott and Phil Knott, "An Introductory Guide to Motor Vehicle Maintenance: Light Vehicles", EMS publishing, 2010.

T2 Ed May, "Automotive Mechanics Volume Two" , Mc Graw Hill Publications, 2003.

REFERENCES:

R1 William H. Crouse and Donald L. Anglin, "Automotive Mechanics", 10th edition, 2007.

R2 Tim Giles, "Automotive service: Inspection, maintenance and repair", 3rd edition, 2007.

R3 Service Manuals from Different Vehicle Manufacturers.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16ME8310	HEATING, VENTILATION AND AIR CONDITIONING SYSTEMS	3	0	0	3

Course Objective

1. To get knowledge on all the heating and cooling systems.
2. To understand the types of heating, ventilation and air conditioning (HVAC) systems.
3. To design and select appropriate HVAC system for a particular application.
4. To learn the theory and details of fans and blowers.
5. To identify and explain various system accessories.

Unit	Description	Instructional Hours
I	**INTRODUCTION TO HVAC SYSTMES** Types of air conditioning systems: All water systems, all air systems, air water systems, unitary systems and selection of air conditioning equipments. Air conditioning equipments: Window air conditioners, split air conditioners, packaged air conditioners, centralized air conditioners, evaporative coolers, passive cooling and heating systems. Constant and variable area volume systems.	9
II	**THERMAL LOAD CALCULATIONS** Cooling and heating load calculations: Heat transfer through building structure, occupancy load, electrical loads, occupancy load, ventilation load, infiltration load. Influence of relative humidity in thermal loads. Ventilation standards: Ventilation requirements in air conditioning buildings and ASHRAE standards. Insulation materials: types; properties and economic thickness.	9
III	**DUCTS AND PIPIES IN HVAC SYSTEMS** Air flow through ducts, duct standards, duct fittings, types of air outlets and design of air conditioning ducts. Chill water supply pipe sizing calculations: Piping network for supply and return water line - pipe fittings - lining and insulation - piping system as per ASHRAE standards.	9
IV	**FANS AND BLOWERS** Types of fans and blowers, performance characteristics, fan laws, static and dynamic losses in fans, design and selection of fans and blowers for air conditioning plants, cooling towers and ventilation systems, testing, speed, flow and noise control. Test standards of fans and blowers.	9
V	**INDOOR AIR QUALITY** Air pollution in air conditioning rooms: effects of air quality, ASHRAE standards. Air filtration: principle of air filtration in HVAC systems, HEPA and ULPA filters, electrostatic cleaners, filter standards, test methods and NAFA certification. Clean rooms: standards for clean rooms, design of clean rooms for hospitals, pharmaceutical and food industries. Measurement of indoor air pollutants, control of pollutants in air conditioning halls.	9
	Total Instructional Hours	**45**

Course Outcome

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

CO1: Understand the types of HVAC systems.
CO2: Calculate the cooling and heating loads for various air conditioning rooms.
CO3: Design the air conditioning ducts and piping for HVAC systems.
CO4: Select fans and blowers for air conditioning, ventilation and cooling towers.
CO5: Understand the concept of indoor air quality.

TEXT BOOKS:

T1 . HVAC Fundamentals / Samuel C. Sugarman / Fairmont Press / 2005.
T2. Fundamentals of HVAC Systems / Robert Mcdowall / Academic Press / 2007

REFERENCE BOOKS:

R1. HVAC Fundamentals Volume-I / James E. Brumbou / Audel / 4th Edition
R2. Home Heating & Air Conditioning systems / James Kittle / MGH
R3. Ventilation Systems: Design and Performance/ Hazim B. Awbi. / Routledge / 2007.

Chairman - BoS
MECH - HiCET

HINDUSTHAN COLLEGE OF ENGG & TECH ACADEMIC Chairman

Dean (Academics)
HiCET

OPEN ELECTIVE

Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16ME7402	RENEWABLE ENERGY SOURCES	3	0	0	3

Course Objective

1. To know about different primary energy sources and renewable energy sources.
2. To study the solar energy measurement and designing of various solar energy utilized systems.
3. To study the principles of different non-conventional energy sources and their utilization.
4. To understand the applications of energy from waste and designing of biogas plant.
5. To get an exposure in various direct energy conversion systems.

Unit	Description	Instructional Hours
I	**ENERGY AND ENVIRONMENT** Primary energy sources - world energy resources - energy cycle of the earth –environmental aspects of energy utilization, Emissions and Global warming – Renewable energy resources and their importance - Potential impacts of harnessing the different renewable energy resources.	9
II	**SOLAR ENERGY** Principles of solar energy collection -.solar radiation - measurements - instruments - data and estimation- types of collectors - characteristics and design principles of different type of collectors, performance and testing of collectors - Solar water and air heaters - performance and applications - solar cooling - solar drying - solar ponds - solar tower concept - solar furnace.	9
III	**WIND, TIDAL AND GEO THERMAL ENERGY** General theory of windmills - types of windmills - design aspects of horizontal axis windmills – applications - Energy from tides and waves – working principles of tidal plants and ocean thermal energy conversion plants - Geothermal power plants. Principle of ocean thermal energy conversion (OTEC).	9
IV	**BIO ENERGY** Energy from bio mass and bio gas plant – types and design of biogas plants – applications - Energy from wastes - utilization of industrial, municipal and agricultural wastes. Emission norms: emission from renewable fuels and its effect on environment, study of environment protection norms ISO 14000, 16000 etc.	9
V	**DIRECT ENERGY CONVERSION SYSTEM 9 Hours** Magneto hydrodynamic systems (MHD) - thermoelectric generators – thermionic generators - Fuel cells and its classification; Transport mechanism in fuel cells and concept of energy conversion. Solid oxide fuel cells (SOFC); PEM fuel cells; Direct methanol fuel cells (DMFC), Molten carbonate fuel cell (MCFC)- solar cells - types, Emf generated, power output, losses and efficiency applications. Hydrogen conversion and storage systems.	9
	Total Instructional Hours	**45**

Course Outcome

Student upon completion of the course shall be able to:

CO1: Identify the various renewable energy sources and national and international scenario.
CO2: Calculate the performance of solar collectors.
CO3: Explain the working principle of renewable energy power plants and direct energy conversion systems.
CO4: Develop skills in bio energy.
CO5: Implement the energy conversion system.

TEXT BOOKS:

T1 Rai G.D, "Non conventional Energy sources" 4th edition (24th Reprint), Khanna Publishers, New Delhi,2009

T2 "Renewable Energy Sources and Emerging Technologies", Kothari, Eastern Economy Edition, 2009.

REFERENCE BOOKS:

R1 Sukhatme, S.P., "Solar Energy, Principles of Thermal Collection and Storage", 3rd Edition, Tata MCGraw.Hill, 2008.

R2 S.Rao and Parul ehar, "Energy Technology – Non conventional, Renewable and Conventional, 3rd Edition, (6th Reprint), Khanna Publishers, 2009.

Chairman - BoS
MECH - HiCET

Chairman
100

Dean (Academics)
HiCET

Semester – I

Course Code & Name : 19HE1101/ TECHNICAL ENGLISH

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO11	PSO12
CO1	1	1	1	2	-	1	2	1	2	3	1	3	3	2
CO2	1	2	1	1	1	2	1	1	1	3	1	2	2	3
CO3	1	2	1	1	1	2	1	1	2	3	1	2	2	2
CO4	1	1	-	1	1	1	1	1	2	3	1	2	3	3
CO5	-	1	1	1	1	1	1	2	2	3	1	2	2	2
Avg	1	1.4	1	1.2	1	1.4	1.2	1.2	1.8	3	1	2.2	2.4	2.4

Course Code & Name : 19MA1102/ CALCULUS AND LINEAR ALGEBRA

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO11	PSO12
CO1	3	3	3	2	2	-	-	-	-	-	-	2	2	2
CO2	3	3	3	2	3	-	-	-	-	-	-	2	2	2
CO3	3	3	3	3	3	-	-	-	-	-	-	2	2	3
CO4	3	3	3	3	3	-	-	-	-	-	-	2	1	2
CO5	3	3	3	3	3	-	-	-	-	-	-	2	2	1
Avg	3	3	3	2.6	2.8	-	-	-	-	-	-	2	1.8	2

Course Code & Name : 19PH1151/ APPLIED PHYSICS

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO11	PSO12
CO1	3	2	2	1	1	1	-	-	-	-	-	1	2	1
CO2	3	3	1	1	2	-	-	-	-	-	-	1	3	3
CO3	3	2	1	2	2	-	-	-	-	-	-	1	3	3
CO4	3	2	3	2	3	1	-	-	-	-	-	1	2	2
CO5	3	2	3	2	2	2	-	-	-	-	-	1	2	3
Avg	3	2.2	2	1.6	2	1.333333	-	-	-	-	-	1	2.4	2.4

Course Code & Name : 19CY1151/ CHEMISTRY FOR ENGINEERS

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO11	PSO12
CO1	3	2	2	-	2	1	1	-	-	-	-	1	1	1
CO2	3	2	2	-	2	1	-	-	-	-	-	1	1	-
CO3	3	2	2	-	2	1	1	-	-	-	-	1	1	-
CO4	3	2	2	2	2	1	-	-	-	-	-	1	1	1
CO5	3	2	2	-	2	1	-	-	-	-	-	1	1	1
Avg	3	2	2	2	2	1	1	-	-	-	-	1	1	1

Course Code & Name : 19CS1151/PYTHON PROGRMMING PRACTICES

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO11	PSO12
CO1	2	3	3	-	2	-	-	-	-	-	-	2	2	2
CO2	2	3	3	-	2	-	-	-	2	-	-	2	2	2
CO3	2	3	3	-	2	-	-	-	2	-	-	2	2	2
CO4	2	3	3	-	2	-	-	-	2	-	-	2	2	2
CO5	2	3	3	-	2	-	-	-	2	-	-	2	2	2
Avg	2	3	3	-	2	-	-	-	2	-	-	2	2	2

Course Code & Name : 19ME1152 & 19ME2151 Engineering Graphics / Engineering Drawing

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	2	-	-	-	-	-	-	3	-	1	-	1
CO2	3	2	2	-	-	-	-	-	-	2	-	-	-	1
CO3	3	2	3	-	2	-	-	-	-	2	-	1	-	2
CO4	3	2	3	-	2	-	-	-	-	2	-	-	2	2
CO5	3	2	3	-	2	-	-	-	-	2	-	-	2	2
Avg	3	2	2.6	0	2	0	0	0	0	2.2	0	1	2	1.6

Course Code & Name : 19ME1201 Basic Civil and Mechanical Engineering

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	1	1	-	-	1	-	-	-	-	-	1	1	1
CO2	3	1	1	-	-	1	-	-	-	-	-	1	1	1
CO3	3	1	1	-	-	1	-	-	-	-	-	1	2	1
CO4	3	1	1	-	-	1	-	-	-	-	-	1	2	2
CO5	3	1	1	-	-	1	-	-	-	-	-	1	2	2
Avg	3	0	1	0	0	1	0	0	0	0	0	1	1.6	1.4

Semester – II

Course Code & Name : 19HE2101/ BUSINESS ENGLISH FOR ENGINEERS

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO11	PSO12
CO1	1	2	1	1	1	2	1	2	2	3	-	3	1	-
CO2	2	1	1	1	1	2	2	2	2	3	-	2	-	1
CO3	2	2	1	1	1	2	2	2	2	3	1	3	1	-
CO4	2	2	1	1	2	2	2	2	3	3	1	3	1	1
CO5	1	1	1	1	1	2	2	1	2	3	1	3	1	1
Avg	1.6	1.6	1	1	1.2	2	1.8	1.8	2.2	3	1	2.8	1	1

Course Code & Name : 19MA2101/ DIFFERENTIAL EQUATIONS AND COMPLEX VARIABLES

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO11	PSO12
CO1	3	3	3	2	2	-	-	-	-	-	-	2	2	2
CO2	3	3	3	2	2	-	-	-	-	-	-	2	2	2
CO3	3	3	3	3	3	-	-	-	-	-	-	2	2	2
CO4	3	3	3	2	2	-	-	-	-	-	-	2	2	2
CO5	3	3	3	3	3	-	-	-	-	-	-	2	2	2
Avg	3	3	3	2.4	2.4	-	-	-	-	-	-	2	2	2

Course Code & Name : 19PH2151/ MATERIAL SCIENCE

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO11	PSO12
CO1	3	2	1	1	1	1	-	-	-	-	-	1	2	1
CO2	3	3	1	1	2	-	-	-	-	-	-	1	2	2
CO3	3	2	1	2	2	-	-	-	-	-	-	1	2	3
CO4	3	3	1	2	2	1	-	-	-	-	-	1	2	2
CO5	3	2	2	3	2	1	2	-	-	-	-	1	2	3
Avg	3	2.4	1.2	1.8	1.8	1	2	-	-	-	-	1	2	2.2

Course Code & Name : 19CY2151/ ENVIRONMENTAL STUDIES

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO11	PSO12
CO1	2	-	-	-	-	2	3	3	2	-	-	2	-	-
CO2	2	-	-	-	-	2	3	3	2	-	-	2	-	-
CO3	2	1	1	-	-	2	3	3	2	-	-	2	-	-
CO4	2	1	2	-	-	2	3	3	2	-	-	2	-	-
CO5	2	1	2	-	-	2	3	3	2	-	-	2	-	-
Avg	2	1	1.7	-	-	1	2	3	2	-	-	2	-	-

Course Code & Name : 19EE2103/Basics of Electrical and Electronics Engineering

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO11	PSO12
CO1	3	3											3	3
CO2		2											3	0
CO3		1	2	1		2							3	3
CO4									1		1		3	0
CO5			1	1	1								3	0
Avg	3	3											3	3

Course Code & Name : 19ME2101 Engineering Mechanics

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	1				1				1	1	1	2
CO2	3	3	2	1			1				1	1	1	2
CO3	3	3	1			1	1			1	1		1	1
CO4	3	3	2	1		2	1			1	1	1	1	1
CO5	3	3	2	1		3	1			1	1	1	1	1
Avg	3	3	1.6	0.6	0	1.2	1	0	0	0.6	1	0.8	1	1.4

Course Code & Name : 19ME2001 Engineering Practices

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	1	-	-	-	2	-	-	-	-	1	2	3	1
CO2	2	1	-	1	-	3	-	-	-	-	2	2	3	1
CO3	3	1	-	1	-	3	-	1	-	2	2	2	3	1
CO4	2	1	-	1	-	2	-	1	-	2	2	2	3	1
CO5	3	-	-	-	-	2	-	1	-	1	2	3	3	1
Avg	2.6	0.8	0	0.6	0	2.4	0	0.6	0	1	1.8	2.2	3	1

Semester – III

Course Code & Name: 19MA3101/ Fourier Series and Statistics

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO11	PSO12
CO1	3	2	3	1	2	-	-	-	-	-	-	2	3	1
CO2	3	3	3	2	1	-	-	-	-	-	-	3	2	3
CO3	3	3	3	1	1	-	-	-	-	-	-	2	2	2
CO4	3	3	3	1	2	2	-	-	-	-	-	2	2	2
CO5	3	3	3	2	1	1	-	-	-	-	-	2	2	3
Avg	3	2.8	3	1.4	1.4	2	-	-	-	-	-	2.2	2.2	2.2

Course Code & Name : 19ME3201 Manufacturing Technology-I

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	1	2	2	1	-	-	1	-	-	-	1	1	1
CO2	3	1	2	2	2	-	-	1	-	-	-	1	1	1
CO3	3	1	2	2	1	-	-	1	-	-	-	1	1	1
CO4	3	1	2	2	1	-	-	1	-	-	-	1	1	1
CO5	3	1	2	2	1	-	-	1	-	-	-	1	1	1
Avg	3	1	2	2	1.2	0	0	1	0	0	0	1	1	1

Course Code & Name : 19ME3202 Engineering Thermodynamics

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	1	1	1										1	1
CO2	1	2	2	2									2	
CO3	2	2	3	2										
CO4	3	1	1	2										
CO5	2	2	3	2	1					1			2	1
Avg	1.8	1.6	2	1.6	0.2	0	0	0	0	0.2	0	0	1	0.4

Course Code & Name : 19ME3203 Engineering Materials and Metallurgy

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	-	-	-	-	2	2	-	-	1	-	3	1	2
CO2	3	-	-	-	-	2	2	-	-	1	-	3	1	1
CO3	3	-	-	-	-	2	2	-	-	1	-	3	1	1
CO4	3	-	-	-	3	3	3	-	-	1	-	3	2	2
CO5	3	-	-	-	-	2	2	-	-	1	-	3	1	1
Avg	3	0	0	0	0.6	2.2	2.2	0	0	1	0	3	1.2	1.4

Course Code & Name : 19ME3251 Fluid Mechanics and Machinery

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	1	2	1	1	1	1	1	1	1	1	1	2	1
CO2	1	1	3	1	1	1	1	1	1	1	1	1	3	1
CO3	1	1	2	2	1	1	1	1	1	1	1	1	2	1
CO4	2	1	1	1	2	1	1	1	1	1	1	1	2	1
CO5	1	1	1	1	1	3	2	1	1	3	1	1	1	2
Avg	1.4	1	1.8	1.2	1.2	1.4	1.2	1	1	1.4	1	1	2	1.2

Course Code & Name : 19ME3231 Fluid Mechanics and Thermal Engineering

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	1	2	1	1	1	1	1	1	1	1	1	2	1
CO2	1	1	3	1	1	1	1	1	1	1	1	1	3	1
CO3	1	1	2	2	1	1	1	1	1	1	1	1	2	1
CO4	2	1	1	1	2	1	1	1	1	1	1	1	2	1
CO5	1	1	1	1	1	3	2	1	1	3	1	1	1	2
Avg	1.4	1	1.8	1.2	1.2	1.4	1.2	1	1	1.4	1	1	2	1.2

Course Code & Name : 19ME3001 Manufacturing Technology Lab – I

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	3	3	-	1	-	2	-	-	-	2	1
Avg	3	3	3	3	3	-	1	-	2	-	-	-	2	1

Course Code & Name : 19ME3002 Computer Aided Drawing Lab

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	3	3	-	1	-	2	-	-	-	2	1
CO2	3	3	3	3	3		1		2				2	1
CO3	3	3	3	3	3		1		2				2	1
CO4	3	3	3	3	3		1		2				2	1
CO5	3	1	2	2	1								1	1
Avg	3	2.6	2.8	2.8	2.6	0	0	0	0	0	0	0	1.8	1

Semester – IV

Course Code & Name: 19MA4101/NUMERICALL METHODS

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO11	PSO12
CO1	3	3	3	3	2	-	-	-	-	-	-	2	2	2
CO2	3	3	3	3	3	-	-	-	-	-	-	2	2	1
CO3	3	3	3	3	2	-	-	-	-	-	-	2	2	1
CO4	3	3	3	3	3	-	-	-	-	-	-	2	2	1
CO5	3	3	3	3	3	-	-	-	-	-	-	2	2	1
Avg	3	3	3	3	2.6	-	-	-	-	-	-	2	2	1.2

Course Code & Name : 19ME4201 Manufacturing Technology – II

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	1	2	2	1								1	1
CO2	3	1	2	2	2								1	1
CO3	3	1	2	2	1								1	1
CO4	3	1	2	2	1								1	1
CO5	3	1	2	2	1								1	1
Avg	3	1	2	2	1.2	0	0	0	0	0	0	0	1	1

Course Code & Name : 19ME4202 Thermal Engineering

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	1	1	1	-	1	-	-		-	-	1	1	1
CO2	3	1	1	1	-	2	2	-	1	-	1	1	1	1
CO3	3	1	1	1	-	-	-	-		-	-	1	1	1
CO4	3	1	1	1	-	-	-	-		-	-	1	1	1
CO5	3	1	1	1	-	2	1	-	1	-	1	1	1	1
Avg	**3**	**1**	**1**	**1**	**-**	**1**	**0.6**	**-**	**0.4**	**-**	**0.4**	**1**	**1**	**1**

Course Code & Name : 19ME4203 Kinematics of Machinery

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	1	3				2		2			2	1
CO2	3	1	2	1				1		1			2	
CO3	3	1	1	1				1		1			2	1
CO4	2	1	1										1	
CO5	3	2	1										2	
Avg	3	3	1	3				2		2			2	1

Course Code & Name : 19ME4251 Strength of Materials

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	1	2	-	-	-	-	-	-	2	2	3	3
CO2	3	3	1	2	-	-	-	-	-	-	2	2	3	3
CO3	3	3	1	2	-	-	-	-	-	-	2	2	3	3
CO4	3	3	1	2	-	-	-	-	-	-	2	2	3	3
CO5	3	3	1	2	-	-	-	-	-	-	2	2	3	3
Avg	3	3	1	2	0	0	0	0	0	0	2	2	3	3

Course Code & Name : 19ME4001 Manufacturing Technology Lab–II

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	3	3	-	1	-	2	-	-	-	2	1
CO2	3	3	3	3	3		1		2				2	1
CO3	3	3	3	3	3		1		2				2	1
CO4	3	3	3	3	3		1		2				2	1
CO5	3	1	2	2	1								1	1
Avg	3	2.6	2.8	2.8	2.6	0	0	0	0	0	0	0	1.8	1

Course Code & Name : 19ME4002 Thermal Engineering Lab

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	1	1	1	1	-	1	1	-	2	1	-	1	-	-
CO2	2	2	2	2	-	1	2	-	2	2	1	2	2	1
CO3	1	1	1	1	-	1	1	-	2	1	1	1	1	1
CO4	2	2	1	1	-	1		-	2	1	1	1	2	-
CO5	2	2	2	1	-	2	2	-	2	2	1	2	2	2
Avg	**1.6**	**1.6**	**1.4**	**1.2**	**-**	**1.2**	**1.2**	**-**	**2**	**1.4**	**0.8**	**1.4**	**1.4**	**0.8**

Semester – V

Course Code & Name: 16ME5201 CAD/CAM

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	1	2	-	3	-	-	-	-	3	2	3	3	1
CO2	3	2	2	2	3	-	-	-	-	3	3	3	3	1
CO3	3	1	2	2	3	-	-	-	-	3	3	3	3	2
CO4	3	1	2	-	3	-	-	-	-	2	2	3	2	1
CO5	3	1	2	-	3	-	-	-	-	3	3	3	3	2
Avg	3	1.2	2	2	3	0	0	0	0	2.8	2.6	3	2.8	1.4

Course Code & Name : 16ME5202 Heat and Mass Transfer

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	1	1	1		1						1	1	1
CO2	3	1	1	1		2	2		1		1	1	1	1
CO3	3	1	1	1								1	1	1
CO4	3	1	1	1								1	1	1
CO5	3	1	1	1		2	1		1		1	1	1	1
Avg	3	1	1	1		1	0.6		0.4		0.4	1	1	1

Course Code & Name : 16ME5203 Dynamics of Machines

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	2	2	-	-	1	-	-	-	-	1	1	2	2

CO2	2	1	-	2	-	-	1	-	-	-	2	1	2	1
CO3	3	1	1	1	1	2	-	-	-	-	1	2	3	1
CO4	2	1	1	1	1	2	-	-	-	-	1	2	2	1
CO5	1	1	1	1	-	1	-	-	-	-	-	-	1	1
Avg	2	1.2	1	1	0.4	1.2	0.2	0	0	0	1	1.2	2	1.2

Course Code & Name : 16ME5204 Design of Machine Elements

PO& PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3	2	1	2	2	-	-	-	-	-	2	2	3	2
CO2	3	3	1	2	2	-	-	-	-	-	-	1	3	3
CO3	3	3	1	2	1	-	-	-	-	-	1	1	3	3
CO4	3	3	2	2	2	-	-	-	-	-	1	1	3	3
CO5	3	3	3	2	2	-	-	-	-	-	1	1	3	3
Avg	3	2.8	1.6	2	1.8	0	0	0	0	0	1	1.2	3	2.8

Course Code & Name : 16ME5205 Automobile Engineering

PO& PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	2	1	2	1	1	1	1	1	1	1	1	1	2	1
CO2	1	1	3	1	1	1	1	1	1	1	1	1	3	1
CO3	1	1	2	2	1	1	1	1	1	1	1	1	2	1
CO4	2	1	1	1	2	1	1	1	1	1	1	1	2	1
CO5	1	1	1	1	1	3	2	1	1	3	1	1	1	2
Avg	**1.4**	**1**	**1.8**	**1.2**	**1.2**	**1.4**	**1.2**	**1**	**1**	**1.4**	**1**	**1**	**2**	**1.2**

Course Code & Name : 16ME5251 Machine Drawing

PO& PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3	2	2	1	-	1	-	-	-	-	-	2	-	1
CO2	2	2	1	1	-	-	-	-	-	-	-	1	-	1
CO3	2	3	3	1	1	-	-	-	-	-	-	1	-	1
CO4	3	2	2	2	1	-	-	-	-	-	-	2	1	1
CO5	3	2	2	2	1	-	-	-	-	-	-	2	1	1
Avg	3	2	2	1	-	1	-	-	-	-	-	2	-	1

Course Code & Name : 16ME5304 - CNC Technology

PO& PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	-	-	-	-	-	-	-	-	-	1	1	2	-	2
CO2	-	-	-	-	3	-	-	-	-	1	1	3	1	1
CO3	-	-	-	-	3	1	-	-	3	2	1	3	1	2
CO4	-	-	1	2	-	-	-	-	1	3	1	2	2	2
CO5	-	-	1	2	-	1	-	-	1	2	1	3	2	1
Avg	-	-	1	2	3	1	-	-	1.3	1.8	1	2.6	1.5	1.6

Course Code & Name : 16ME5303 Unconventional Machining Process

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	1	2	1	1	1	1	1	1	1	1	1	2	1
CO2	1	1	3	1	1	1	1	1	1	1	1	1	3	1
CO3	1	1	2	2	1	1	1	1	1	1	1	1	2	1
CO4	2	1	1	1	2	1	1	1	1	1	1	1	2	1
CO5	1	1	1	1	1	3	2	1	1	3	1	1	1	2
Avg	**1.4**	**1**	**1.8**	**1.2**	**1.2**	**1.4**	**1.2**	**1**	**1**	**1.4**	**1**	**1**	**2**	**1.2**

Code & Name : 16ME5001 CAD/CAM Labratory

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	2	2	1	1	-	-	-	-	3	3	3	3	2
CO2	1	2	2	1	2	-	-	-	-	2	2	3	2	2
CO3	1	2	2	1	2	-	-	-	-	2	2	3	2	1
Avg	1.3	2	2	1	1.6	0	0	0	0	2.3	2.3	3	1.3	1.6

Course Code & Name: 16ME5002 Thermal Engineering Laboratory II

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	1	1	1	1	1	-	-	1	-	1	-	-	-
CO2	2	2	1	2	-	-	-	-	1	1	1	1	2	2
CO3	2	2	2	2	-	2	-	-	1	1	1	1	2	2
CO4	2	2	2	1	-	2	2	-	1	2	1	1	2	2
CO5	2	2	2	2	-	2	2	-	-	2	1	-	2	2
Avg	**2**	**1.8**	**1.6**	**1.6**	**0.2**	**1.4**	**0.8**	**-**	**0.8**	**1.2**	**1**	**0.6**	**1.6**	**1.6**

Code & Name: 16ME5003 Dynamics Lab

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	-	-	-	-	2	-	-	-	-	1	2	3	1
CO2	3	-	-	-	-	2	-	-	-	-	2	2	3	1
CO3	3	-	-	-	-	2	-	-	-	-	2	2	3	1
CO4	3	-	-	-	-	2	-	-	-	-	2	2	3	1
CO5	3	-	-	-	-	2	-	-	-	-	2	3	3	1
Avg	3	0	0	0	0	2	0	0	0	0	1.8	2.2	3	1

Semester – VI

Course Code & Name : 16ME6201 Finite Element Analysis

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	1	1	2	-	1	2	-	-	1	1	2	1	1
CO2	3	1	1	2	-	1	2	-	-	1	1	2	1	1
CO3	3	1	1	2	-	1	2	-	-	1	1	2	1	1
CO4	3	1	1	2	-	1	2	-	-	1	1	2	1	1
CO5	3	2	2	2	-	1	2	-	-	2	1	2	1	1
Avg	3	2.2	2.2	2	0	1	2	0	0	2.2	1	2	1	1

Course Code & Name : 16ME6202 Metrology and Quality Control

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	1	1	2	-	1	2	-	-	1	1	2	1	1
CO2	3	1	1	2	-	1	2	-	-	1	1	2	1	1
CO3	3	1	1	2	-	1	2	-	-	1	1	2	1	1
CO4	3	1	1	2	-	1	2	-	-	1	1	2	1	1
CO5	3	2	2	2	-	1	2	-	-	2	1	2	1	1
Avg	3	1.2	1..2	2	-	1	2	-	-	1.2	1	2	1	1

Code & Name : 16ME6203 Hydraulic and Pneumatic Systems

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	1	2	1	1	1	1	1	1	1	1	1	2	1
CO2	1	1	3	1	1	1	1	1	1	1	1	1	3	1
CO3	1	1	2	2	1	1	1	1	1	1	1	1	2	1
CO4	2	1	1	1	2	1	1	1	1	1	1	1	2	1
CO5	1	1	1	1	1	3	2	1	1	3	1	1	1	2
Avg	**1.4**	**1**	**1.8**	**1.2**	**1.2**	**1.4**	**1.2**	**1**	**1**	**1.4**	**1**	**1**	**2**	**1.2**

Course Code & Name : 16ME6204 Design of Transmission Systems

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2	-	-	-	-	-	-	-	-	1	1	1
CO2	3	3	2	-	-	-	-	-	-	-	-	1	1	1
CO3	3	3	2	-	-	-	-	-	-	-	-	2	1	2

CO4	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**2**
CO5	**3**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**2**
Avg	**3**	**2.8**	**2.4**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1.6**	**1.4**	**1.6**

Course Code & Name : 16ME6301 - Refrigeration And Air Conditioning

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	1	1	1	-	1	-	-	-	-		1	1	1
CO2	3	1	1	1	-	2	2	-	1	-	1	1	1	1
CO3	3	1	1	1	-	-	-	-	-	-	-	1	1	1
CO4	3	1	1	1	-	-	-	-	-	-	-	1	1	1
CO5	3	1	1	1	-	2	1	-	1	-	1	1	1	1
Avg	**3**	**1**	**1**	**1**	**-**	**1**	**0.6**	**-**	**0.4**	**-**	**0.4**	**1**	**1**	**1**

Course Code & Name : 16ME6303 Design of Heat Exchangers

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	2	2	1	2	2	1	1	2	1	2	1	1
CO2	2	2	2	1	2	2	2	1	1	2	2	2	2	1
CO3	2	2	2	1	2	2	2	1	1	2	2	2	3	2
CO4	2	2	2	1	2	2	3	1	1	2	2	2	2	3
CO5	2	2	-	-	2	1	2	1	1	1	2	2	2	3
Avg	2.2	2	2	1.25	1.8	1.8	2.2	1	1	1.8	1.8	2	2	2

Course Code & Name : 16ME6304 Gas Dynamics and Jet Propulsion

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	1	1	1		1						1	1	1
CO2	3	1	1	1		2	2		1		1	1	1	1
CO3	3	1	1	1								1	1	1
CO4	3	1	1	1								1	1	1
CO5	3	1	1	1		2	1		1		1	1	1	1
Avg	3	1	1	1		1	0.6		0.4		0.4	1	1	1

Name: 16ME6401 Rapid prototyping and lean manufacturing

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	-	-	-	-	-	-	2	2	3	2	3	2	-	3

CO2	-	1	-	-	-	-	-	1	2	2	3	3	1	1
CO3	-	-	-	-	-	-	-	2	3	3	3	3	1	1
CO4	-	-	-	-	-	-	-	2	3	3	3	3	2	2
CO5	-	-	-	-	-	-	-	1	2	2	3	3	1	1
Avg	0	0.2	0	0	0	0	0.4	1.6	2.6	2.4	3	2.8	1	1.6

Course Code & Name : 16ME6001 Simulation and analysis Lab

PO& PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	2	2	2	1	1	-	-	-	-	3	3	3	3	2
CO2	1	2	2	1	2	-	-	-	-	2	2	3	2	2
CO3	1	2	2	1	2	-	-	-	-	2	2	3	2	1
Avg	1.3	2	2	1	1.6	0	0	0	0	2.3	2.3	3	1.3	1.6

Course Code & Name : 16ME6002 Metrology Lab

PO& PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3	2							3			2	1	2
CO2	2		2						3			2		1
CO3	3		3	2					3				1	1
CO4	3				2				3					
CO5	3			2					3			2	1	
Avg	3	2	2.5	2	2				3			2	1	1.3

Course Code & Name : 16ME6003 Design and Fabrication project

PO& PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	**3**	**2**	**2**	-	-	-	-	-	-	-	**1**	**3**	**2**	**2**
CO2	**3**	**2**	**3**	-	-	-	-	-	-	-	**2**	**3**	**2**	**2**
CO3	**3**	**3**	**3**	-	-	-	-	-	-	-	**1**	**3**	**2**	**2**
Avg	**3**	**2.3**	**2.6**	-	-	-	-	-	-	-	**1.3**	**3**	**2**	**2**

Semester – VII

Course Code & Name : 16ME7201 Entrepreneurship and business concepts

PO& PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3	1	1	2	-	1	2	-	-	1	1	2	1	1
CO2	3	1	1	2	-	1	2	-	-	1	1	2	1	1
CO3	3	1	1	2	-	1	2	-	-	1	1	2	1	1
CO4	3	1	1	2	-	1	2	-	-	1	1	2	1	1

CO5	3	2	2	2	-	1	2	-	-	2	1	2	1	1
Avg	3	2.2	2.2	2	0	1	2	0	0	2.2	1	2	1	1

Course Code & Name : 16ME7202 Power Plant Engineering

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	1	2	2	1	2	2	2	1	2	2	3	2	1
CO2	3	1	2	2	1	2	2	2	1	1	1	3	2	1
CO3	3	1	2	2	1	2	3	2	2	2	1	2	2	3
CO4	3	1	2	2	1	2	3	2	2	1	1	3	1	3
CO5	2	1	2	2	1	3	2	2	2	3	1	3	1	3
Avg	2.8	1	2	2	1	2.2	2.4	2	1.6	1.8	1.2	2.8	1.6	2.2

Course Code & Name: 16ME7203 Principles of Management

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	-	-	-	-	-	-	2	2	3	2	3	2	-	3
CO2	-	1	-	-	-	-	-	1	2	2	3	3	1	1
CO3	-	-	-	-	-	-	-	2	3	3	3	3	1	1
CO4	-	-	-	-	-	-	-	2	3	3	3	3	2	2
CO5	-	-	-	-	-	-	-	1	2	2	3	3	1	1
Avg	0	0.2	0	0	0	0	0.4	1.6	2.6	2.4	3	2.8	1	1.6

Course Code & Name : 16ME7302 Design for Manufacture and assembly

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	1	2	1	1	1	1	1	1	1	1	1	2	1
CO2	1	1	3	1	1	1	1	1	1	1	1	1	3	1
CO3	1	1	2	2	1	1	1	1	1	1	1	1	2	1
CO4	2	1	1	1	2	1	1	1	1	1	1	1	2	1
CO5	1	1	1	1	1	3	2	1	1	3	1	1	1	2
Avg	**1.4**	**1**	**1.8**	**1.2**	**1.2**	**1.4**	**1.2**	**1**	**1**	**1.4**	**1**	**1**	**2**	**1.2**

Course Code & Name : 16ME7305-Industrial Robotics and Expert Systems

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	**3**	**2**	**2**	-	**1**	-	-	-	-	-	-	-	**1**	**1**
CO2	**3**	**3**	**2**	-	**1**	-	-	-	-	-	-	-	**1**	**1**
CO3	**3**	**2**	**2**	-	**1**	-	-	-	-	-	-	-	**1**	**1**
CO4	**3**	**2**	**3**	-	**1**	-	-	-	-	-	-	-	**1**	**1**
CO5	**3**	**2**	**3**	-	**1**	-	-	-	-	-	-	-	**1**	**1**
Avg	**3**	**2.2**	**2.4**	-	**1**	-	-	-	-	-	-	-	**1**	**1**

Course Code & Name : 16ME7309 Total Quality Management

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	1	3				2		2			2	1
CO2	3	1	2	1				1		1			2	
CO3	3	1	1	1				1		1			2	1

CO4	2	1	1									1	
CO5	3	2	1									2	
Avg	3	3	1	3				2		2		2	1

Course Code & Name : 16ME7307 Industrial Engineering

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	2	2	3	3			1			1		2	1
CO2	2	2	2	3	2	1		1					3	1
CO3	2	3	3	3	2								2	1
CO4	2	2	3	3	3		1	1					2	1
CO5	3	3	3	3	3					1			1	2
Avg	2.2	2.4	2.6	3	2.6	1	1	1		1	1		2	1.2

Course Code & Name : 16ME7001 Comprehension Lab

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	3	3	-	1	-	2	-	-	-	2	1
Avg	3	3	3	3	3	-	1	-	2	-	-	-	2	1

Course Code & Name : 16ME7901 Project Work – Phase I

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	**3**	**2**	**2**	-	-	-	-	-	-	-	**1**	**3**	**2**	**2**
CO2	**3**	**2**	**3**	-	-	-	-	-	-	-	**2**	**3**	**2**	**2**
CO3	**3**	**3**	**3**	-	-	-	-	-	-	-	**1**	**3**	**2**	**2**
Avg	**3**	**2.3**	**2.6**	-	-	-	-	-	-	-	**1.3**	**3**	**2**	**2**

Course Code & Name : 16ME7310 Metrology And Nondestructive Testing

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	1	1	1	1	-	-	-	-	1	-	1	-	1
CO2	3	1	1	2	1	-	-	-	-	1	-	1	-	1
CO3	3	2	2	2	1	-	-	-	-	1	-	1	-	1
CO4	3	1	1	1	2	-	-	-	-	2	-	1	3	1
CO5	3	1	2	1	2	-	-	-	-	2	-	1	3	1
Avg	3	1.2	1.4	1.4	1.4	0	0	0	0	1.4	0	1	3	1

Course Code & Name : 16ME7401 Additive Manufacturing Techniques (OE)

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	**3**	**2**	**2**	-	**1**	-	-	-	-	-	-	-	**1**	**1**
CO2	**3**	**3**	**2**	-	**1**	-	-	-	-	-	-	-	**1**	**1**
CO3	**3**	**2**	**2**	-	**1**	-	-	-	-	-	-	-	**1**	**1**
CO4	**3**	**2**	**3**	-	**1**	-	-	-	-	-	-	-	**1**	**1**
CO5	**3**	**2**	**3**	-	**1**	-	-	-	-	-	-	-	**1**	**1**
Avg	**3**	**2.2**	**2.4**	-	**1**	-	-	-	-	-	-	-	**1**	**1**

Course Code & Name : 16ME7001 Computer Aided Analysis Lab

PO&	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO	PO	PO		

PSO										10	11	12	PSO 1	PSO 2
CO1	2	-	-	-	3	-	-	-	-	2	-	2	3	1
CO2	2	-	-	-	3	-	-	-	-	2	-	2	3	1
CO3	2	-	-	-	3	-	-	-	-	2	-	2	3	1
CO4	2				3					2		2	3	1
CO5	2				3					2		2	3	1
Avg	2	-	-	-	3	-	-	-	-	2	-	2	3	1

Semester – VIII

Course Code & Name : 16ME8301 Maintenance Engineering

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2							3			2	1	2
CO2	2		2						3			2		1
CO3	3		3	2					3				1	1
CO4	3				2				3					
CO5	3			2					3			2	1	
Avg	3	2	2.5	2	2				3			2	1	1.3

Course Code & Name : 16ME8302 Industrial Safety Engineerig

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	-	-	-	-	-	-	2	2	3	2	3	2	-	3
CO2	-	1	-	-	-	-	-	1	2	2	3	3	1	1
CO3	-	-	-	-	-	-	-	2	3	3	3	3	1	1
CO4	-	-	-	-	-	-	-	2	3	3	3	3	2	2
CO5	-	-	-	-	-	-	-	1	2	2	3	3	1	1
Avg	0	0.2	0	0	0	0	0.4	1.6	2.6	2.4	3	2.8	1	1.6

Course Code & Name : 16ME8304 Metrology And Nondestructive Testing

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	1	1	1	1	-	-	-	-	1	-	1	-	1
CO2	3	1	1	2	1	-	-	-	-	1	-	1	-	1
CO3	3	2	2	2	1	-	-	-	-	1	-	1	-	1
CO4	3	1	1	1	2	-	-	-	-	2	-	1	3	1
CO5	3	1	2	1	2	-	-	-	-	2	-	1	3	1
Avg	3	1.2	1.4	1.4	1.4	0	0	0	0	1.4	0	1	3	1

Course Code & Name : 16ME8307 Manufacturing of Automotive Components

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	1	2	-	2	1	2	1	-	1	2	3	2	2
CO2	3	1	2	-	2	1	2	1	-	1	2	3	2	2
CO3	3	1	2	-	2	1	2	1	-	1	2	3	2	2
CO4	3	1	2	-	2	1	2	1	-	1	2	3	2	2
CO5	3	1	2	-	2	1	2	1	-	1	2	3	2	2
Avg	3	1	2	0	2	1	2	1	0	1	2	3	2	2

Course Code & Name : 16ME8308 Hybrid Vehicles

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	2	2	3	3			1			1		2	1
CO2	2	2	2	3	2	1		1					3	1
CO3	2	3	3	3	2								2	1
CO4	2	2	3	3	3		1	1					2	1
CO5	3	3	3	3	3					1			1	2
Avg	2.2	2.4	2.6	3	2.6	1	1	1		1	1		2	1.2

Course Code & Name : 16ME8901 Project Work – Phase II

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	2	-	-	-	-	-	-	-	1	3	2	2
CO2	3	2	3	-	-	-	-	-	-	-	2	3	2	2
CO3	3	3	3	-	-	-	-	-	-	-	1	3	2	2
Avg	3	2.3	2.6	-	-	-	-	-	-	-	1.3	3	2	2

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