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

2018-2019

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

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

SEMESTER I

S.No	Course Code	Course Title	Course Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	16MA1101	Engineering Mathematics-I	BS	3	1	0	4	25	75	100
2	16PH1101	Engineering Physics	BS	3	0	0	3	25	75	100
3	16CY1101	Engineering Chemistry	BS	3	0	0	3	25	75	100
4	16HE1101R	Essential English for Engineers -I	HS	3	1	0	4	25	75	100
5	16GE1103	Problem Solving and Python Programming	ES	3	0	0	3	25	75	100
6	16GE1102	Engineering Graphics	ES	3	1	0	4	25	75	100
PRACTICAL										
7	16PS1001	Physical Sciences Lab – I	BS	0	0	2	1	50	50	100
8	16GE1001	Problem Solving and Python Programming Lab	ES	0	0	4	2	50	50	100
9	16GE1002	Engineering Practices Laboratory	ES	0	0	4	2	50	50	100
10	16GE1003	Value Added Course – I Language Competency Enhancement Course I	HS	0	0	2	1	100	0	100
Total:				**18**	**3**	**12**	**27**	**400**	**600**	**1000**

SEMESTER II

S.No	Course Code	Course Title	Course Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	16MA2102	Engineering Mathematics-II	BS	3	1	0	4	25	75	100
2	16PH2102	Physics of Materials	BS	3	0	0	3	25	75	100
3	16CY2102	Environmental Sciences	BS	3	0	0	3	25	75	100
4	16HE2101R	Essential English for Engineers -II	HS	3	1	0	4	25	75	100
5	16GE2101	Engineering Mechanics	ES	3	1	0	4	25	75	100
6	16EE2202	Basics of Electrical and Electronics Engineering	ES	3	0	0	3	25	75	100
PRACTICAL										

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7	16PS2001	Physical Sciences Lab - II	BS	0	0	2	1	50	50	100
8	16ME2001	Computer Aided Drafting Lab	ES	0	0	4	2	50	50	100
9	16GE2001	Value Added Course – II Language Competency Enhancement Course II	HS	0	0	2	1	100	0	100
Total :				**18**	**3**	**8**	**25**	**350**	**550**	**900**

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

SEMESTER III

S.No	Course Code	Course Title	Course Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	16MA3103	Fourier Analysis and Statistics	BS	3	1	0	4	25	75	100
2	16ME3201	Manufacturing Technology – I	PC	3	0	0	3	25	75	100
3	16ME3202	Engineering Thermodynamics	PC	3	1	0	4	25	75	100
4	16ME3203	Fluid Mechanics and Machinery	PC	3	1	0	4	25	75	100
5	16ME3204	Strength of Materials	PC	3	0	0	3	25	75	100
6	16EE3231	Electrical Drives and Controls	PC	3	0	0	3	25	75	100
PRACTICAL										
7	16ME3001	Manufacturing Technology Lab – I	PC	0	0	4	2	50	50	100
8	16ME3002	Solid and Fluid Mechanics Lab	PC	0	0	4	2	50	50	100
9	16EE3031	Electrical Engineering Lab	PC	0	0	4	2	50	50	100
Total:				**18**	**3**	**12**	**27**	**300**	**600**	**900**

SEMESTER IV

S.No	Course Code	Course Title	Course Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	16MA4107	Numerical Methods	BS	3	1	0	4	25	75	100
2	16ME4201	Manufacturing Technology – II	PC	3	0	0	3	25	75	100
3	16ME4202	Thermal Engineering	PC	3	0	0	3	25	75	100
4	16ME4203	Kinematics of Machinery	PC	3	1	0	4	25	75	100
5	16ME4204	Engineering Materials and Metallurgy	PC	3	0	0	3	25	75	100
6	16ME4205	Machine Drawing	PC	1	4	0	3	25	75	100
PRACTICAL										
7	16ME4001	Manufacturing Technology Lab–II	PC	0	0	4	2	50	50	100
8	16ME4002	Thermal Engineering Lab-I	PC	0	0	4	2	50	50	100
9	16ME4701	Communication Skills Lab	HS	0	0	2	1	50	50	100
Total:				**16**	**6**	**10**	**25**	**300**	**600**	**900**

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For the students admitted during the academic year 2017-2018 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	Course 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
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:				**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

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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

CREDIT DISTRIBUTION

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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SYLLABUS

SEMESTER-I

Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16MA1101	ENGINEERING MATHEMATICS – I (COMMON TO ALL BRANCHES)	3	1	0	4

Course Objective

1. Develop the skill to use matrix algebra techniques that is needed by engineers for practical applications.
2. Find curvature, evolutes and envelopes using the concept of differentiation.
3. Solve ordinary differential equations of certain types using Wronskian technique.
4. Familiarize the functions of several variables which are needed in many branches of engineering.
5. Understand the concept of double and triple integrals.

Unit	Description	Instructional Hours
I	**MATRICES** Eigen values and Eigen vectors of a real matrix – Properties of Eigen values and Eigen vectors (without proof) – Cayley - Hamilton Theorem (excluding proof) – Orthogonal matrices – Diagonalization of matrices by orthogonal transformation–Reduction of a quadratic form to canonical form by orthogonal transformation.	12
II	**DIFFERENTIAL CALCULUS** Curvature in cartesian co-ordinates – Radius and Centre of curvature - Circle of curvature – Involutes and Evolutes(parabola, ellipse, cycloid, asteroid) – Envelopes - single parameter and two parameter family of curves.	12
III	**ORDINARY DIFFERENTIAL EQUATIONS** Second and higher order linear differential equations with constant coefficients and with RHS of the form e^{ax} , x^n, sinax or cosax , $e^{ax}f(x)$ and $xf(x)$ where $f(x)$ is sinbx or cosbx – Method of variation of parameters – Linear differential equations with variable coefficients (Euler's equation)	12
IV	**FUNCTIONS OF SEVERAL VARIABLES** Total differentiation (excluding implicit functions) - Partial derivatives of composite functions - Taylor's series for functions of two variables- Maxima and minima of functions of two variables - Lagrange's method of undetermined multipliers – Jacobians.	12
V	**MULTIPLE INTEGRALS** Double integrals in Cartesian coordinates – Change of order of integration – Area enclosed by the plane curves (excluding surface area) – Triple integrals in Cartesian co-ordinates – Volume of solids using Cartesian co-ordinates.	12
	Total Instructional Hours	**60**

Course Outcome

CO1: 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
CO2: Apply the concept of differentiation to find the radius, centre and circle of curvature of any curve
CO3: Develop sound knowledge of techniques in solving ordinary differential equations that model engineering problems
CO4: Identify the maximum and minimum values of surfaces.
CO5: Computation of area of a region in simpler way by changing the order of integration and evaluation of triple integrals to compute volume of three dimensional solid structures

TEXT BOOKS:

T1- Ravish R Singh, Mukul Bhatt, "Engineeing Mathematics", McGraw Hill education (India) Private Ltd.,Chennai,2017.
T2- Veerarajan T, "Engineering Mathematics–I", 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-Sivarama Krishna Das P and Rukmangadachari E., "Engineering Mathematics" Vol I, Second Edition, Pearson publishing, 2011.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16PH1101	ENGINEERING PHYSICS (Common to all Branches)	3	0	0	3

Course Objective

1. Illustrate the fundamental knowledge in mechanical properties of matter and thermal physics.
2. Gain knowledge about laser and their applications.
3. Conversant with principles of optical fiber, types and applications of optical fiber.
4. Discuss the architectural acoustics and applications of Ultrasonics.
5. Extend dual nature of matter and the Necessity of quantum mechanics to explore the behavior of sub atomic particles.

Unit	Description	Instructional Hours
I	**PROPERTIES OF MATTER AND THERMAL PHYSICS** Elasticity – Hooke's law – Stress-strain diagram - Relation between three modulii of elasticity (qualitative) — Poisson's ratio – Bending moment – Depression of a cantilever – Derivation of Young's modulus of the material of the beam by Uniform bending – I-shaped girder. Modes of heat transfer – Thermal conductivity – Newton's law of cooling - Lee's disc method - Conduction through compound media (series and parallel).	9
II	**LASER AND APPLICATIONS** Spontaneous emission and stimulated emission – Population inversion – Pumping methods – Derivation of Einstein's coefficients (A&B) – Types of lasers – Nd:YAG laser, CO2 laser, Semiconductor lasers:(homojunction and heterojunction) – Laser Applications – Industrial applications: laser welding, laser cutting, laser drilling – Holography – Construction and reconstruction of images.	9
III	**FIBER OPTICS AND APPLICATIONS** Principle and propagation of light through optical fibers – Derivation of numerical aperture and acceptance angle – Classification of optical fibers (based on refractive index, modes and materials) – Crucible-crucible technique for fiber fabrication – Sources (LED and LASER) and detectors (p-i-n photodiode and avalanche photodiode) for fiber optics - Fiber optical communication link –Fiber optic sensors – Temperature and displacement sensors.	9
IV	**ACOUSTICS AND ULTRASONICS** Classification of sound – Weber–Fechner law – Sabine's formula (no derivation) - Absorption coefficient and its determination –Factors affecting acoustics of buildings and their remedies. Production – Magnetostrictive generator – Piezoelectric generator – Determination of velocity using acoustic grating – Non destructive testing – Ultrasonic pulse echo system.	9
V	**QUANTUM PHYSICS AND APPLICATIONS** Black body radiation – Planck's theory (derivation) –Compton effect experimental verification only - Matter waves – Physical significance of wave function – Schroedinger's wave equations – Time independent and time dependent wave equations –Particle in a box (One dimensional) – Scanning electron microscope – Transmission electron microscope.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Enhance the fundamental knowledge in Properties of Matter and Thermal Physics.
CO2: Understand the advanced technology of LASER in the field of Engineering and medicine.
CO3: Exposed the fundamental knowledge of Optical fiber in the field of communication Engineering.
CO4: Understand the production of ultrasonics and its applications in NDT.
CO5: Impart the fundamental knowledge on Quantum Physics.

TEXT BOOKS:

T1 - Rajendran V, Applied Physics, Tata McGraw Hill Publishing Company Limited, New Delhi, 2011.
T2- Gaur R.K. and Gupta S.L., Engineering Physics, 8th edition, DhanpatRai Publications (P) Ltd., New Delhi, 2013.

REFERENCE BOOKS:

R1 - Arthur Beiser "Concepts of Modern Physics" Tata McGraw Hill, New Delhi – 2010
R2 - M.N Avadhanulu and PG Kshirsagar "A Text Book of Engineering physics" S. Chand and Company Ltd., New Delhi,2014
R3 - Dr. G. Senthilkumar "Engineering Physics – I" VRB publishers Pvt Ltd., 2013

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16CY1101	ENGINEERING CHEMISTRY (Common to all Branches)	3	0	0	3

Course Objective

1. The student should be conversant with boiler feed water requirements, related problems and water treatment techniques.
2. The student should be conversant with the principles of polymer chemistry and engineering applications of polymers and composites
3. The student should be conversant with the principles and generation of energy in batteries, nuclear reactors, solar cells, wind mills and fuel cells.
4. To acquaint the student with important concepts of spectroscopy and its applications.
5. To acquaint the students with the basics of nano materials, their properties and applications

Unit	Description	Instructional Hours
I	**WATER TECHNOLOGY** Hard water and soft water- Disadvantages of hard water- Hardness: types of hardness, calculations, estimation of hardness of water – EDTA method - scales and sludges – boiler corrosion – priming and foaming – caustic embrittlement; Conditioning methods of hard water – External conditioning - demineralization process- Internal conditioning - domestic water treatment: screening, sedimentation, coagulation, filtration, disinfection – chlorine – UV method; desalination: definition, reverse osmosis.	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, Teflon – moulding of plastics (extrusion and compression); rubber: vulcanization of rubber, synthetic rubber – butyl rubber, SBR; composites: definition, types of composites – polymer matrix composites – FRP.	9
III	**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- solar energy conversion- solar cells- wind energy. Batteries and fuel cells: Types of batteries- alkaline battery lead storage battery- nickel-cadmium battery- lithium battery- fuel cell H_2 -O_2 fuel cell applications.	9
IV	**ANALYTICAL TECHNIQUES** Beer-Lambert's law – UV-visible spectroscopy and IR spectroscopy – principles – instrumentation (block diagram only) – estimation of iron by colorimetry – flame photometry – principle – instrumentation (block diagram only) – estimation of sodium by flame photometry – atomic absorption spectroscopy – principles – instrumentation (block diagram only) – interferences - estimation of nickel by atomic absorption spectroscopy.	9
V	**NANOMATERIALS** Basics - distinction between molecules, nanoparticles and bulk materials; size-dependent properties. Nanoparticles: definition, carbon nanotubes (CNT), types of carbon nano tubes – single walled and multi walled carbon nanotubes – synthesis of carbon nanotubes: chemical vapour deposition – laser ablation – arc-discharge method; properties of CNT: mechanical, electrical, thermal and optical properties; applications of carbon nanotubes in chemical field, medicinal field, mechanical field and current applications.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Illustration of the basic parameters of water, different water softening processes and effect of hard water in industries.
CO2: Knowledge on basic properties and application of various polymers and composites as an engineering material.
CO3:Summarize the various energy sources and energy storage devices
CO4: Analyze various analytical skills in handling various machines, instruments, apart from understanding the mechanism involved.
CO5: Describe the basic properties and application of nanomaterials.

TEXT BOOKS

T1 - P.C.Jain and Monica Jain, "Engineering Chemistry" DhanpatRai Pub, Co., New Delhi (2015).
T2 - O.G.Palanna, "Engineering chemistry" McGraw Hill Education India (2017).

REFERENCES

R1 - B.Sivasankar "Engineering Chemistry" Tata McGraw-Hill Pub.Co.Ltd, New Delhi (2008).
R2 - B.K.Sharma "Engineering Chemistry" Krishna Prakasan Media (P) Ltd., Meerut (2005).

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16HE1101R	ESSENTIAL ENGLISH FOR ENGINEERS - I (Common to all Branches)	3	1	0	4

Course Objective

1. It fulfills the necessary skills needed in today's global workplaces.
2. Student will be able to interpret and illustrate formal communication.
3. It empowers students in choosing right lexical techniques for effective presentation
4. It equips the learner to analyze and list out things in logical order
5. The learner develops the ability to create and integrate ideas in a professional way.

Unit	Description	Instructional Hours
I	Getting to know people – Introduction – Talking about jobs (Present Simple) – Talking about working conditions(Adverb of Frequency) - Talking about company history and structure (Past simple, Prepositions of Time) – Talking about company activities (Connectors of addition and contrast, Present Continuous) – Focus on language – Parts of Speech – Gerund and Infinitives – Instruction- **General Vocabulary**.	12
II	Vocabulary practice – (Telephoning Leaving and taking messages) – requests and obligation – Describing trends (Adjectives and Adverbs) – Talking about company performance (present perfect and past simple, Reasons and consequences) – Reading Test Practice Describing products Dimensions, (Comparatives and Superlatives, Question formation) – Talking about product development (Sequencing words, Present continuous and going to) – Articles – Prepositions- Synonyms – Antonyms- Recommendations-**Interpretation of a chart**.	12
III	Talking about business equipment (Giving Instruction) – Letter Phrases- Writing Test Practice- Talking about facilities(Asking for and giving direction)- Presentation on a general topic -Talking about traffic and transport(making predictions)-**Discussion on current affairs**– Tenses- Present – Past-Future-Forms of verbs- Word techniques- Formation-Prefixes-Suffixes.	12
IV	Talking about conference arrangement(checking and confirming) – Talking about a conference before, after, when, until etc. – Listening Test Practice- talking about production process – passive- Talking about quality control Conditional 1 (real) (Making suggestions) – Itinery- Jumbled sentences- Paragraph writing- Essay writing – Checklist- Letter to Inviting Dignitaries – Accepting invitation- Declining Invitation.	12
V	Talking about call centers, insurance and changes in working practices (future possibility/probability)- Talking about banking- Speaking Test practice – Talking about delivery services (preposition of Time)- Talking about trading (Tense review)- Talking about recruitment conditional 2 (hypothetical) – talking about job applications (indirect questions) – Reading, Writing and Listening Test – Job application Letter and Resume Writing- Permission letters.	12
	Total Instructional Hours	**60**

Course Outcome

CO1 - Recognize different parts of speech for better usage.
CO2 - Interpret and illustrate formal communication
CO3 - Choosing right lexical techniques for effective presentation.
CO4 - Analyze and list out things in logical order.
CO5 - Create and integrate ideas in a professional way.

TEXT BOOKS:

T1 - NormanWhitby, Cambridge English: Business BENCHMARK Pre-intermediate to Intermediate – 2nd Edition. 2014.

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

REFERENCE BOOKS:

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

R2 - Rizvi, Ashraf. M. Effective Technical Communication. Tata McGraw-Hill, New Delhi, 2005

R3 - KamaleshSadanan "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.	16GE1103	PROBLEM SOLVING AND PYTHON PROGRAMMING (Common to all Branches)	3	0	0	3

Course Objective

1. To know the basics of algorithmic problem solving
2. To read and write simple Python programs.
3. To develop Python programs with conditionals and loops.
4. To define Python functions and call them.
5. To use Python data structures – lists, tuples, dictionaries.
6. 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 (pseudocode, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: To find the greatest among three numbers, prime numbers, find minimum in a list, Towers of Hanoi.	9
II	**DATA, EXPRESSIONS, STATEMENTS** Python interpreter and interactive mode; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; modules and functions, function definition and use, flow of execution, parameters and arguments; Illustrative programs: exchange the values of two variables, compute Simple interest for a given amount, Factorial of a given number ,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; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing -list comprehension; Illustrative programs: selection sort, insertion 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, copy file.	9
	Total Instructional Hours	**45**

Course Outcome

Upon completion of the course, students will be able to
CO1:Develop algorithmic solutions to simple computational problems
CO2: Structure simple Python programs for solving problems.
CO3: Decompose a Python program into functions.
CO4: Represent compound data using Python lists, tuples, and dictionaries.
CO5: Read and write data from/to files in Python Programs.

TEXTBOOKS:

T1 –Ashok Namdev Kamthane ,Amit Ashok Kamthane ," Programming and Problem solving with Python" McGrawHill Education

T2-Sheetal Taneja, "Python Programming A Modular Approach With Graphics,Database,Mobile and Web Applications, PEARSON .

REFERENCES:

R1 - Reema Thareja " Python Programming Using Problem Solvimg Approach " OXFORD.

R2-E.Balagurusamy, "Problem solving and Python Programming" McGrawHill Education.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16GE1102	ENGINEERING GRAPHICS (Common to all Branches)	3	1	0	4

Course Objective
1. To provide drafting skills for communicating the Engineering concepts and ideas.
2. To expose to BIS and International standards related to engineering drawings.

Unit	Description	Total Hours
I	**PLANE CURVES** Importance of engineering drawing, drafting instruments,drawing sheets – layout and folding, Lettering and dimensioning, BIS standards and scales. Geometrical constructions, 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.	15
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).	15
III	**PROJECTIONS OF SOLIDS** Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is perpendicular and inclined to one plane and objects inclined to both the planes by rotating object method.	15
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. Intersection of solids-cylinder vs cylinder.	15
V	**ISOMETRIC AND ORTHOGRAPHIC PROJECTIONS** Isometric views and projections of 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. Perspective projection of solids in simple position using visual ray method.	15
	Total Instructional Hours	**75**

Course Outcome
CO1: Draw the orthographic and isometric views of regular solid objects including sectional views.
CO2:Recognize the International Standards in Engineering Drawing practices.

TEXT BOOKS:

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", Dhanalaksmi Publishers, Chennai.

REFERENCE BOOKS:

R1 - BasantAgrawal and C.M.Agrawal, "Engineering Drawing", Tata McGraw Hill Publishing Company Limited,New Delhi 2008.
R2 - K. R. Gopalakrishnan, "Engineering Drawing" (Vol. I & II), Subhas Publications, Bangalore, 1998.
R3 - M.B.Shah and B.C.Rana, "Engineering Drawing", Pearson Education, India, 2005.
R4 - 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.	16PS1001	PHYSICAL SCIENCES LAB - I PHYSICS LAB I (COMMON TO ALL BRANCHES)	0	0	2	1

Course Objective

1. Evaluate the particle size of micro particles and acceptance angle of fibres.
2. Employ instrumental method to determine Young's modulus of a beam of metals.
3. Apply the concept of diffraction and getting ability to calculate the wavelength of the mercury spectrum.

Expt. No.	Description of the Experiments
1.	Determination of Wavelength, and particle size using Laser
2.	Determination of acceptance angle and numerical aperature in an optical fiber.
3.	Determination of velocity of sound and compressibility of liquid – Ultrasonic Interferometer.
4.	Determination of wavelength of mercury spectrum – spectrometer grating
5.	Determination of thermal conductivity of a bad conductor – Lee's Disc method
6.	Determination of Young's modulus by Non uniform bending method
7.	Determination of specific resistance of a given coil of wire – Carey Foster's Bridge.
8.	Post office box Measurement of an unknown resistance
	Total Practical Hours **30**

Course Outcome

CO: 1 Point out the particle size of micro particles and acceptance angle of fibres using diode laser.
CO: 2 Assess the Young's modulus of a beam using non uniform bending methods.
CO:3 Illustrate the concept of diffraction and getting ability to calculate the wavelength of the mercury spectrum Using spectrometer.
CO: 4 Identify the velocity of ultrasonic's in the given liquid.
CO: 5 Illustrate phenomena of thermal conductivity of a bad conductor.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16PS1001	PHYSICAL SCIENCES LAB - I CHEMISTRY LAB – I (Common to all Branches)	0	0	2	1

Course Objective

1. Acquire practical skills in the determination of water quality parameters.
2. Acquaint the students with the determination of molecular weight of a polymer by viscometry.
3. Acquaint the students with the estimation of chemical substances using instrumental analysis techniques.

Expt. No.	Description of the Experiments
1.	Preparation of molar and normal solutions and their standardization.
2.	Estimation of total, permanent and temporary hardness of Water by EDTA
3.	Determination of chloride content of water sample by argentometric method.
4.	Determination of available chlorine in bleaching powder.
5.	Conductometric titration of strong acid vs strong base (HClvsNaOH).
6.	Conductometric titration (Mixture of weak and strong acids)
7.	Conductometric precipitation titration using $BaCl_2$ and Na_2SO_4
8.	Determination of molecular weight and degree of polymerization using viscometry.
9.	Estimation of iron content of the water sample using spectrophotometer. (1, 10 phenanthroline / thiocyanate method).
	Total Practical Hours **30**

Course Outcome

CO1: Estimate the different types of hardness in a water sample.
CO2: Determine the chloride content of water sample.
CO3: Calculate the strength of acid using conductometric titrations.
CO4: Calculate the strength of strong and weak acid using conductometric titrations.
CO5: estimate the amount of salt using conductometric precipitation titrations.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16GE1001	PROBLEM SOLVING AND PYTHON PROGRAMMING LAB (Common to all Branches)	0	0	4	2

COURSE OBJECTIVE

1. To write, test, and debug simple Python programs.
2. To implement Python programs with conditionals and loops.
3. Use functions for structuring Python programs.
4. Represent compound data using Python lists, tuples, and dictionaries.
5. Read and write data from/to files in Python.

Expt. No.	Description of the Experiments	Total Instructional Hours
1.	Compute the GCD of two numbers.	3
2.	Find the square root of a number (Newton's method)	3
3.	Exponentiation (power of a number)16	3
4.	Find the factorial of a given number	3
5.	Print prime numbers from 1 to n numbers	3
6.	Find the maximum of a list of numbers	3
7.	Linear search and Binary search	3
8.	Selection sort, Insertion sort	3
9.	Merge sort	3
10.	First n prime numbers	3
11.	Multiply matrices	3
12.	Programs that take command line arguments(word count)	3
13.	Find the most frequent words in a text read from a file	3
14.	Simulate elliptical orbits in Pygame	3
15.	Simulate bouncing ball using Pygame	3
	Total Practical Hours	**45**

COURSE OUTCOME

CO1: Write, test, and debug simple Python programs.
CO2: Implement Python programs with conditionals and loops.
CO3: Develop Python programs step-wise by defining functions and calling them.
CO4: Use Python lists, tuples, dictionaries for representing compound data.
CO5: Read and write data from/to files in Python.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16GE1002	ENGINEERING PRACTICES LABORATORY (Common to all Branches)	0	0	4	2

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

GROUP A (CIVIL & MECHANICAL)

Expt. No. **Description of the Experiments**

I CIVIL ENGINEERING PRACTICE

Study of plumbing and carpentry components of Residential and Industrial buildings.

(A) PLUMBING WORKS:

1. Study on pipe joints, its location and functions: Valves, taps, couplings, unions, reducers, elbows in household fittings.
2. Study of pipe connection requirements for pumps.
3. Preparation of plumbing line sketches for water supply and sewage works.
4. Hands-on-exercise:
   - Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components.
5. Demonstration of plumbing requirements of high-rise buildings.

(B) CARPENTRY USING POWER TOOLS ONLY:

1. Study of the joints in roofs, doors, windows and furniture.
2. Hands-on-exercise in wood works by sawing, planning and cutting.

IIMECHANICAL ENGINEERING

(A) Welding:

1. Preparation of arc welding of Butt joints, Lap joints and Tee joints

(B) Machining:

1. Practice on Simple step turning and taper turning
2. Practice on Drilling Practice

(C) Sheet Metal Work:

1. Practice on Models– Trays, cone and cylinder.

DEMONSTRATION

(D) Smithy

- Smithy operations : Upsetting, swaging, setting down and bending.
- Demonstration of Production of hexagonal headed bolt.

(E) Gas welding

(F) Foundry Tools and Operations.

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GROUP B (ELECTRICAL & ELECTRONICS)

S.No	Description of the Experiments
	ELECTRICAL ENGINEERING PRACTICES
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 RLC circuit.
5	Measurement of energy using single phase energy meter.
	ELECTRONICS ENGINEERING PRACTICES
1	Study of Electronic components and equipments – Resistors - colour coding
2	Measurement of DC signal - AC signal parameters (peak-peak, RMS period, frequency) using CRO.
3	Study of logic gates AND, OR, NOT and NAND .
4	Soldering practice – Components Devices and Circuits – Using general purpose PCB.
5	Measurement of average and RMS value of Half wave and Full Wave rectifiers.
	Total Practical Hours **45**

Course Outcome	CO1: Fabricate wooden components and pipe connections including plumbing works. CO2: Fabricate simple weld joints. CO3: Fabricate electrical and electronics circuits.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16GE1003	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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SEMESTER-II

Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16MA2102	ENGINEERING MATHEMATICS – II (COMMON TO ALL BRANCHES)	3	1	0	4

Course Objective

1. Learn the basics of vector calculus comprising gradient, divergence, Curl and line, surface, volume integrals.
2. Understand analytic functions of complex variables and conformal mappings.
3. Know the basics of residues, complex integration and contour integration.
4. Apply Laplace transform techniques to solve linear differential equations.
5. Know the effective mathematical tools for the solutions of partial differential equations that model several physical problems in mathematical physics

Unit	Description	Instructional Hours
I	**VECTOR CALCULUS** Gradient, divergence and curl – Directional derivative – Irrotational and solenoidal vector fields – Vector integration – Green's theorem in a plane, Gauss divergence theorem and Stokes' theorem (excluding proofs) – Simple applications involving cubes and rectangular parallelopipeds.	12
II	**ANALYTIC FUNCTIONS** Analytic function - Cauchy-Riemann equations - sufficient conditions (excluding proof) – Harmonic - conjugate harmonic functions– Construction of analytic functions (Milne-Thompson method) – Conformal mapping: $w = z+c$, cz, $1/z$ and bilinear transformation without problems related to the concept of conformal mapping.	12
III	**COMPLEX INTEGRATION** Complex integration – Statements of Cauchy's integral theorem – Taylor's and Laurent's series expansions - Singular points – Residues – Cauchy's residue theorem – Evaluation of real definite integrals as contour integrals around unit circle.	12
IV	**LAPLACE TRANSFORM** Laplace transform –Basic properties – Transforms of derivatives and integrals of functions - Transforms of unit step function and impulse function – Transform of periodic functions. Inverse Laplace transform - Convolution theorem (without proof) – Solution of linear ODE of second order with constant coefficients using Laplace transformation techniques.	12
V	**PARTIAL DIFFERENTIAL EQUATIONS** Formation of partial differential equations by elimination 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- Linear homogeneous partial differential equations of second and higher order with constant coefficient.	12
	Total Instructional Hours	**60**

Course Outcome

CO1: Know the gradient, divergence and curl of vectors useful for engineering application like fluid flow, electricity and magnetism.
CO2: Test the analyticity to construct the analytic function and transform complex functions from one plane to another plane graphically.
CO3: Evaluate real and complex integrals over suitable closed paths or contours.
CO4: Know the applications of Laplace transform and its properties and to solve certain linear differential equations using Laplace transform technique.
CO5: Solve the engineering problems using Partial Differential Equations.

TEXT BOOKS:

T1- Ravish R Singh, Mukul Bhatt, "Engineering Mathematics", McGraw Hill education (India) Private Ltd.,Chennai,2017.

T2- Veerarajan T, "Engineering Mathematics–II", 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-Sivarama Krishna Das P and Rukmangadachari E., "Engineering Mathematics" Vol II, Second Edition, Pearson publishing, 2011.
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.	16PH2102	PHYSICS OF MATERIALS	3	0	0	3

Course Objective

1. Gain knowledge about conducting materials.
2. Provide fundamental knowledge of semiconducting materials which is related to the engineering program.
3. Extend the properties of magnetic materials, applications and super conducting materials.
4. Defend the various types of dielectric materials and their uses.
5. Expose the students to smart materials and the basis of nano technology.

Unit	Description	Instructional Hours
I	**CONDUCTING MATERIALS** Introduction – Conductors – Classical free electron theory of metals – Electrical and thermal conductivities – Wiedemann–Franz law – Lorentz number – Draw backs of classical theory – Quantum theory – Fermi distribution function – Effect of temperature on Fermi function – Density of energy states – Carrier concentration in metals.	9
II	**SEMICONDUCTING MATERIALS** Introduction – Intrinsic semiconductor – carrier concentration derivation – Fermi level – Variation of Fermi level with temperature – electrical conductivity – band gap determination – compound semiconductors –direct and indirect band gap- derivation of carrier concentration in n-type and p-type semiconductor – variation of Fermi level with temperature and impurity concentration — Hall effect – Determination of Hall coefficient – Applications.	9
III	**MAGNETIC & SUPERCONDUCTING MATERIALS** **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. **Superconducting Materials:** Superconductivity: properties – Type I and Type II superconductors – BCS theory of superconductivity (Qualitative) - High Tc superconductors – Applications of superconductors – SQUIDS, cryotron, magnetic levitation.	9
IV	**DIELECTRIC & COMPOSITES MATERIALS** Introduction – Electrical susceptibility – dielectric constant – polarization - electronic, ionic, orientation and space charge polarization –internal field – Claussius – Mosotti relation (derivation) – dielectric loss and dielectric breakdown (qualitative).Introduction – types of composites materials – Polymer, metallic and ceramic matrix composites (qualitative). Application in surgery, sports equipment.	9
V	**SMART MATERIALS AND NANOTECHNOLOGY** **New Engineering Materials:** Metallic glasses – preparation, properties and applications – shape memory alloys (SMA)– characteristics, properties of NiTi alloy applications. **Nano Materials**: Synthesis - plasma arcing – Chemical vapour deposition – properties of nanoparicles and applications. – Carbon nano tubes – fabrication – pulsed laser deposition - Chemical vapour deposition - properties & applications	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Illustrate the electrical / thermal conductivity of conducting materials.
CO2: Understand the purpose of the acceptor or donor levels and the band gap of a semiconductor.
CO3: Interpret the basic idea behind the process of magnetism and applications of magnetic materials in every day life
CO4: Identify and compare the various types of dielectric polarization and dielectric breakdown.
CO5: Evaluate the properties and applications of various advanced engineering materials and develop the new ideas to synthesis Nanomaterials

TEXT BOOKS:

T1 - S.O.Pillai "Solid State Physics" New Age International Publishers, New Delhi – 2011
T2- Rajendran V "Materials Science" McGraw-Hill Education" New Delhi -2016.

REFERENCE BOOKS:

R1 – William D Callister, Jr "Material Science and Engineering" John wiley and Sons, New York, 2014.
R2 - Raghavan, V. "Materials Science and Engineering – A First Course" Prentice Hall of India, New Delhi 2016.
R3 -Dr. G. Senthilkumar "Engineering Physics – II" VRB publishers Pvt Ltd., 2013

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PROGRAMME	COURSE CODE	NAME OF THE COURSE	L	T	P	C
B.E.	16CY2102	ENVIRONMENTAL SCIENCES	3	0	0	3

Course Objective

1. To gain knowledge on the importance of environmental education, ecosystem and biodiversity.
2. To acquire knowledge about environmental pollution – sources, effects and control measures of environmental pollution.
3. To find and implement scientific, technological, economic and political solutions to environmental problems.
4. To study about the natural resources, exploitation and its conservation
5. To be aware of the national and international concern for environment and its protection.

Unit	Description	Instructional hours
I	**ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY** Importance of environment – need for public awareness – concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers – energy flow in the ecosystem – ecological succession processes – Introduction, types, characteristic features, structure and function of the a) Forest ecosystem b) grassland ecosystem c) desert ecosystem d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – biogeographical classification of India – value of biodiversity: consumptive use, productive use, social, ethical aesthetic and option values – Biodiversity at global, national and local levels – India as a mega diversity nation – hot spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.	9
II	**ENVIRONMENTAL POLLUTION** Definition – causes, effects and control measures of: Air pollution – Air pollution standards – control methods – Water pollution – Water quality parameters – Soil pollution – Marine pollution – Noise pollution – Thermal pollution – Nuclear hazards – role of an individual in prevention of pollution – pollution case studies.	9
III	**NATURAL RESOURCES** Forest resources: use and over exploitation, deforestation, case studies – timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and overutilization of surface and ground water, dams – benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer – pesticide problems, water logging, salinity, case studies. Energy resources; Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. Land resources: Land as resource, land degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources – Equitable use of resources for sustainable life styles.	9
IV	**SOCIAL ISSUES AND THE ENVIRONMENT** From unsustainable to sustainable development – urban problems related to energy – energy conversion – electrical energy calculations – environmental ethics: Issues and possible solutions – 12 principles of green chemistry – Current environmental issues at country level – management of municipal sewage, municipal solid waste, hazardous waste and biomedical waste – Global issues – Climate change, Acid rain, green house effect and ozone layer depletion. Disaster management: floods, earthquake, cyclone and landslides.	9
V	**HUMAN POPULATION AND THE ENVIRONMENT** Population growth, variation among nations – population explosion – family welfare programme – environment and human health – 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 – case studies.	9
	Total Instructional Hours	**45**

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Course Outcome

CO1: Understand the natural environment and its relationships with human activities.
CO2: Characterize and analyze human impacts on the environment
CO3: Apply systems concepts and methodologies to analyze and understand interactions between social and environmental processes
CO4: Reflect critically about their roles and identities as citizens, consumers and environmental actors in a complex, interconnected world.
CO5: Understand and implement scientific research strategies, including collection, management, evaluation, and interpretation of environmental data.

TEXT BOOKS:

T1- Anubha Kaushik and C. P. Kaushik, "Environmental Science and Engineering", Fourth edition, New Age International Publishers, New Delhi, 2014.
T2 – Deeksha Dave and S.S.Katewa, "Textbook of Environmental Studies", Second Edition, Cengage Learning, 2012.

REFERENCES:

R1 - Trivedi R.K. "Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards", Vol. I and II, Enviro Media.
R2 - G.Tyler Miller, Jr and Scott E. Spoolman"Environmental Science" Thirteenth Edition, Cengage Learning, 2010.
R3 - Gilbert M. Masters, "Introduction to Environmental Engineering and Science", 2nd edition, Pearson Education, 2004

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16HE2101R	ESSENTIAL ENGLISH FOR ENGINEERS – II	3	1	0	4

Course Objective

1. The learner will be introduced to global corporate culture and professional communication.
2. It helps the students to focus on organizing professional event and documentation.
3. The student will be able to describe the events and process in an effective way.
4. It trains the student to analyze the problems and to find solution to it.
5. The learner will be familiar with business communication.

Unit	Description	Instructional Hours
I	Introduction- talking about teamwork- Making arrangements- Improving Communication in spoken language – Taking and leaving Voice mail messages (present Tense, Past Tense and Present Perfect) Talking about Business Hotel- (Speaking Activity) Talking about Corporate Hospitality- Formal and Informal Language – Making accepting and declining invitations (Auxiliary Verb, Countable or Uncountable Nouns) – Focus on Language – Definitions and Extended Definitions-**Reading comprehension.**	12
II	Talking about orders – Clarity Written Language – Phone and Letter Phrases – Talking about Company Finances – Conditional 1 and 2 – Managing Cash Flow (Intention and Arrangements Conditional 1 and 2) – Talking about Brands and Marketing – Ethical Banking- Talking about Public Relations – Organizing a PR Event – Describing Duties and Responsibilities – (Future Tense and Articles) – Reported Speech – Modal Verbs and Passive, Impersonal Passive Voice-**interpretation of posters or advertisements.**	12
III	Talking about relocation – Report Phrases – Talking about Similarity and difference- Giving Directions- Asking for Information and Making Suggestions – Talking about Location (Comparatives and Superlatives, Participles) – Talking about Company Performances- Describing Trends – Describing Cause and Effect – Talking about Environmental Impact – Discussing Green Issues – Language of Presentations (Adjectives and Adverbs, Determiners)- Homophones – Homonyms-Acronyms-Abbreviations- British and American words.	12
IV	Talking about Health and Safety – Expressing Obligation- Discussing Regulations- Talking about personnel Problems – Passives – Talking about Problem at Work (modal Verbs, Passives)- Talking about Expenses Claims- Talking about Air Travel (Relative Pronoun, Indirect Questions) – E-mail Writing - Note completion- Transcoding.	12
V	Talking about staff Benefits- Talking about Appraisal Systems (gerunds and Infinitives, Reported Speech) – Talking about Marketing Disasters – Expressing hypothetical Situations- Talking about entering Foreign Market (Conditional 3, Grammar review) – Letter for calling quotations, Replying for quotations – Placing an order and Complaint and **reply to a complaint**.	12
	Total Instructional Hours	**60**

Course Outcome

CO1: Introduced corporate culture and professional communication.
CO2: It focused on organizing a professional event and its documentation.
CO3: Improved the ability to describe the events and process in an effective way
CO4: Trained to analyze the problems and to find solution to it.
CO5: Practiced to make business communication.

TEXT BOOKS:

T1 - Norman Whitby, Cambridge English: Business BENCHMARK Pre-intermediate to Intermediate – 2nd Edition. 2014.

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

REFERENCE BOOKS:

R1 - Communication Skills for Engineers, Sunitha Misra & C.Murali Krishna, Pearson Publishers

R2 - Technical Communication, Daniel G. Riordan, Cengage learning publishers.

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.	16GE2101	ENGINEERING MECHANICS	3	1	0	4

Course Objective

The main objectives of the course are to:

1. Understand the vector and scalar representation of forces and moments
2. Understand the static equilibrium of particles and rigid bodies both in two dimensions.
3. Understand the principle of work and energy.
4. Comprehend the effect of friction on equilibrium.
5. Write the dynamic equilibrium equation.

Unit	Description	Instructional hours
I	**BASICS & STATICS OF PARTICLES** Introduction – Units and Dimensions – Laws of Mechanics – Lame's theorem, Parallelogram and triangular Law of forces – Vectors – Vector representation of forces and moments – Coplanar Forces – Resolution and Composition of forces – Equilibrium of a particle –Forces in space – Equilibrium of a particle in space – Equivalent systems of forces – Principle of transmissibility.	12
II	**EQUILIBRIUM OF RIGID BODIES** Free body diagram – Types of supports and their reactions – requirements of stable equilibrium – Moments and Couples – Moment of a force about a point and about an axis– Scalar component of a moment – Varignon's theorem – Single equivalent force – Equilibrium of Rigid bodies in two dimensions.	12
III	**PROPERTIES OF SURFACES AND SOLIDS** Determination of Areas and Volumes – First moment of area and the Centroid of sections – Rectangle, circle, triangle from integration – T section, I section, - Angle section, Hollow section by using standard formula – Second and product moments of plane area – Rectangle, triangle, circle from integration – T section, I section, Angle section, Hollow section by using standard formula – Parallel axis theorem and perpendicular axis theorem – Polar moment of inertia – Principal moments of inertia of plane areas.	12
IV	**DYNAMICS OF PARTICLES** Displacements, Velocity and acceleration, their relationship – Relative motion – Curvilinear motion – Newton's law – Work Energy Equation of particles – Impulse and Momentum – Impact of elastic bodies. Co-efficient of restitution.	12
V	**FRICTION** Frictional force – Laws of Coloumb friction – Simple contact friction – Rolling resistance – Wedge friction - Belt friction, Applications of friction.	12
	Total Instructional Hours	**60**

Course Outcome

The outcomes of the course are the students shall have the ability:

CO1: To solve engineering problems dealing with force, displacement, velocity and acceleration.
CO2: To analyze the forces in any structure.
CO3: To solve rigid body subjected to dynamic forces.

TEXT BOOKS:

1. F.P.Beer, and Jr. E.R.Johnston., "Vector Mechanics for Engineers (In SI Units): Statics and Dynamics", 8th Edition, Tata McGraw-Hill Publishing company, New Delhi (2004).

REFERENCE BOOKS:

1. R.C.Hibbeller, and Ashok Gupta, "Engineering Mechanics: Statics and Dynamics", 11th Edition, Pearson Education 2010.
2. S.Rajasekaran and G.Sankarasubramanian, "Engineering Mechanics Statics and Dynamics", 3rd Edition, Vikas Publishing House Pvt. Ltd., 2005.
3. S.S.Bhavikatti, and K.G.Rajashekarappa, "Engineering Mechanics", New Age International (P) Limited Publishers, 1998.

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PROGRAMME	COURSE CODE	NAME OF THE COURSE	L	T	P	C
B.E.	16EE2202	BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING	3	0	0	3

Course Objective

1. To apply the basic laws used in Electrical circuits and the different components.
2. To impart knowledge on construction and working of DC and AC machines.
3. To provide knowledge on the fundamentals of semiconductor devices and their applications.
4. To impart knowledge on digital electronics and its principles.
5. To develop block diagrams for satellite and optical fiber communications.

Unit	Description	Instructional Hours
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	**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	**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
IV	**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
V	**FUNDAMENTALS OF COMMUNICATION ENGINEERING** Types of Signals: Analog and Digital Signals – Modulation and Demodulation: Principles of Amplitude and Frequency Modulations - Satellite and Optical Fibre communications (Block Diagram Approach only).	9
	Total Instructional Hours	**45**

Course Outcome

At the end of this Course, students will be able to:

CO1: Apply the KVL and KCL in Electrical circuits
CO2: Explain the constructional features of AC and DC machines.
CO3: Identify electronics components and use of them to design circuits.
CO4: Use appropriate logic gates in circuit design.
CO5: Construct block diagram and explain satellite and optical Fibre communication systems.

TEXT BOOKS

T1 - Mittle N., "Basic Electrical Engineering", Tata McGraw Hill Edition, New Delhi, 1990.
T2 - Sedha R.S., "Applied Electronics", S. Chand & Co., 2006.
T3 - Muthusubramanian R, Salivahanan S and Muraleedharan K A, "Basic Electrical, Electronics and Computer Engineering", Tata McGraw Hill, Second Edition, 2006.

REFERENCES

R1- Nagsarkar T K and Sukhija M S, "Basics of Electrical Engineering", Oxford press 2005.
R2 - Mehta V K, "Principles of Electronics", S.Chand & Company Ltd, 1994.
R3 - Premkumar N, "Basics of Electrical Engineering", Anuradha Publishers, 2003.
R4- T.Thyagarajan. "Fundamentals of Electrical and Electronics Engineering" Scitech Publications Pvt Ltd, 2011.

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COURSE CODE	NAME OF THE COURSE	L	T	P	C
16PS2001	PHYSICAL SCIENCES LAB – II PHYSICS LABORATORY	0	0	2	1

Course Objective

1. Evaluate the band gap of a semiconductor.
2. Apply the concept of interference and calculate the thickness of thin wire.
3. Acquire the practical skills in Young's modulus by uniform bending method.

S.NO	Description of the Experiments (Any FIVE Experiments)	Practical Hours
1	Determination of Young's modulus by uniform bending method	3
2	Determination of band gap of a semiconductor	3
3	Determination of Coefficient of viscosity of a liquid –Poiseuille's method	3
4	Determination of Dispersive power of a prism - Spectrometer	3
5	Determination of thickness of a thin wire – Air wedge method	3
6	Determination of Rigidity modulus – Torsion pendulum	3
7	Magnetic hysteresis experiment	3
8	Calibration of ammeter using potentiometer	3
	Total Instructional Hours	15

Course Outcome

CO: 1. Experiment involving the physical phenomena of the Rigidity modulus of wire.
CO: 2. Determine the band gap of a semiconductor and variation of Energy Gap (E_g)with temperature.
CO: 3 Assess the Young's modulus of a beam using non uniform bending method.
CO: 4. Explain the concept of interference and calculate the thickness of thin wire and other fine objects.
CO: 5. Experiment provides a unique opportunity to validate Dispersive power of a prism using Spectrometer.

*** Student will prepare lab record during the course of the semester.

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PROGRAMME	COURSE CODE	NAME OF THE COURSE	L	T	P	C
B.E.	16PS2001	PHYSICAL SCIENCES LAB – II CHEMISTRY LABORATORY	0	0	2	1

Course Objective

1. Acquire practical skills in the quantitative analysis of water quality parameters.
2. Acquire practical skills in the instrumental methods for quantitative estimation of metal ion content.
3. Gain knowledge in determination of rate of corrosion.

S.No	Description of the Experiments (Any FIVE Experiments)	Practical Hours
1	Determination of Dissolved Oxygen in water by Winkler's method	3
2	Estimation of alkalinity of water sample by indicator method.	3
3	Estimation of hydrochloric acid by pH metry	3
4	Estimation of ferrous iron by Potentiometry	3
5	Estimation of copper by EDTA	3
6	Determination of sodium by flame photometry	3
7	Determination of corrosion rate of mild steel by weight loss method	3
	Total Instructional Hours	**15**

Course Outcome

CO1: Determine the level of DO in a water sample.
CO2: Identify and estimate the different types of alkalinity in water sample.
CO3: Estimate the acidity of water sample using pH metry.
CO4: Estimate the amount of copper in a brass sample.
CO5: Determine the metal ion content using instrumental methods.

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PROGRAMME	COURSE CODE	NAME OF THE COURSE	L	T	P	C
B.E.	16ME2001	COMPUTER AIDED DRAFTING LAB	0	0	4	2

Course Objective

1. To develop skills on using software for preparing 2D Drawings.
2. To provide the importance of computer aided 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 and general multi-line figures.
2	Drawing the conic and special curves.
3	Draw the orthographic projections of simple solids like Prism, Pyramid, Cylinder, Cone and its dimensioning.
4	Draw the symbols of fasteners, weld, rivets, bolts nuts and screws.
5	Drawing Isometric projection of simple objects.
6	Draw the orthographic projections of Bush bearing.
7	Draw the orthographic projections of Oldham's coupling.
8	Draw the orthographic projections of cotter joint.
9	Draw the orthographic projections of simple gate valve.
10	Draw the Plan and Elevation of simple Residential Building.

Total Instructional Hours **45**

Course Outcome

The outcome of the course are:

CO1: The students shall be able to use the software package for drafting
CO2: The students shall be able to create 2D Drawing of Engineering Components
CO3: The students shall be able to apply basic concepts to develop construction drawing techniques

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16GE2001	LANGUAGE COMPETENCY ENHANCEMENT COURSE- II (COMMON TO ALL BRANCHES)	0	0	2	1

Course Objective

1. To introduce to business communication.
2. To train the students to react to different professional situations.
3. To make the learner familiar with the managerial skills
4. To empower the trainee in business writing skills.
5. 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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SEMESTER III

Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16MA3103	FOURIER ANALYSIS AND STATISTICS (Common to AERO, AUTO, MECH, EEE and E&I)	3	1	0	4

Course Objective

1. Introduce Fourier series analysis which is central to many applications in engineering.
2. Solve boundary value problems by applying Fourier series.
3. Acquaint with Fourier transform techniques used in wide variety of situations.
4. Provide the necessary basic concepts of some statistical methods.
5. Manipulate different kinds of problems occurring in engineering and technology by applying the design of experiments.

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. A spring -mass system deriven by an alterating square force, A series circuit with a sqaure –wave voltage, power delievered by a periodic current and modelling radiation intensity.	12
II	**BOUNDARY VALUE PROBLEMS** Classification – solution of one dimensional wave equation – one dimensional heat equation –steady state solutions of two dimensional heat equations (excluding insulated edges) - Fourier series solution in Cartesian coordinates.	12
III	**FOURIER TRANSFORMS** Fourier Transform Pairs - Fourier sine and cosine transforms – Properties - Transforms of Simple functions – Convolution Theorem – Parseval's identity.	12
IV	**TESTING OF HYPOTHESIS** Large sample test based on Normal distribution for single mean and difference of means - 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	**DESIGN OF EXPERIMENTS** One way and two way classifications - Completely randomized design – Randomized block design –Latin square design.	12
	Total Instructional Hours	**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: Acquire the knowledge of application of Fourier series in solving the heat and wave equations.
CO3: Obtain the knowledge of Fourier transform techniques which extend its applications in Electrical circuit analysis, control system design and signal processing.
CO4: Acquire skills in analyzing statistical methods.
CO5: Have a clear perception of the statistical ideas and demonstrate the applications of these techniques to problems drawn from industry, management and other engineering fields.

TEXT BOOKS:

T1 - Veerarajan. T.,"Transforms and Partial Differential Equations", Tata McGraw Hill Education Pvt. Ltd., Second reprint, New Delhi, 2012.
T2 - Gupta, S.C., & Kapoor, V.K., Fundamentals of Mathematical Statistics, Sultan Chand & Sons, Reprint 2011.

REFERENCE BOOKS :

R1 - C.Roy Wylie " Advance Engineering Mathematics" Louis C. Barret, 6th Edition, Mc Graw Hill Education India Private Limited, New Delhi 2003.
R2 - Kandasamy P., Thilagavathy K. and Gunavathy K.,"Engineering Mathematics Vol III", S.Chand & Company Ltd.,NewDelhi,1996.
R3 - Walpole. R.E., Myers.., "Probability and Statistics for Engineers and Scientists", 8th Edition, Pearson Education, Asia, 2007.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16ME3201	MANUFACTURING TECHNOLOGY – I	3	0	0	3

Course Objective

1. To introduce the concepts of some basic manufacturing processes and fabrication techniques
2. To understand the manufacturing of metal components in different methods such as metal casting.
3. To understand the metal joining, metal forming techniques.
4. To understand the bulk forming process such as forging and rolling.
5. To understand 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	**BULK 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: Apply the different manufacturing process and use this in industry for component production.
CO2: Understand and compare the functions and applications of different manufacturing process.
CO3: Know the metal joining and forming techniques.
CO4: Gain knowledge about deformation process.
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 Private Limited, Mumbai, 1997.
T2 -Gowri.S, Hariharan.P, SureshBabu.A, "Manufacturing Technology I", Pearson Education, 2008.

REFERENCES:

R1 -Sharma, P.C., "A Text book of production Technology", S.Chand and Co. Ltd., 2004.
R2 -Paul Degarma E, Black J.T and Ronald A. Kosher, "Materials and Processes, in Manufacturing" 8th Ed, Prentice – Hall of India, 1997.
R3 -Rao, P.N. "Manufacturing Technology Foundry, Forming and Welding", 2nd Ed, TMH-2003.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16ME3202	ENGINEERING THERMODYNAMICS (COMMON TO MECHANICAL AND AUTOMOBILE ENGINEERING)	3	1	0	4

Course Objective

1. Understand and quantify the energy conversion.
2. Understand the energy degradation in thermodynamic systems.
3. Understand the behavior of pure substances and working principle of steam power cycles.
4. Understand the thermodynamic relations.
5. Understand the properties of atmospheric air and its applications.

Unit	Description	Instructional Hours
I	**BASIC CONCEPTS AND FIRST LAW** Basic concepts - concept of continuum, microscopic and macroscopic approach, path and point functions. Intensive and extensive, total and specific quantities, thermodynamic system, equilibrium, state, path and process. Quasi-static, reversible and irreversible processes. Heat and work transfer, definition and comparison, sign convention. Displacement work and other modes of work. P-V diagram. Zeroth law of thermodynamics – concept of temperature and thermal equilibrium. First law of thermodynamics –application to closed and open systems – steady and unsteady flow processes.	12
II	**SECOND LAW AND AVAILABILITY ANALYSIS** Heat Reservoir, source and sink. Heat Engine, Refrigerator, and Heat pump. Statements of second law and its corollaries. Carnot cycle, Reversed Carnot cycle, Performance, 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 analysis.	12
III	**PROPERTIES OF PURE SUBSTANCE AND STEAM POWER CYCLE** Formation of steam and its thermodynamic properties, p-v, p-T, T-v, T-s, h-s diagrams. p-v-T surface. Use of Steam Table and Mollier Chart. Determination of dryness fraction. Estimation of steam properties. Ideal and actual Rankine cycles, Cycle Improvement Methods - Reheat and Regenerative cycles, Economiser, Preheater.	12
IV	**IDEAL, REAL AND GASES GAS MIXTURES AND THERMODYNAMIC RELATIONS** 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 use. Gas mixtures – mole and mass fractions, Daltons law, gas constant, density, change in internal energy, enthalpy, entropy and Gibbs function. Maxwell relations, Tds Equations, Difference and ratio of heat capacities, Energy equation, Joule-Thomson Coefficient, Clausius Clapeyron equation.	12
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. Applications: evaporative coolers, drying, cooling towers etc.	12
	Total Instructional Hours	**60**

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", 4th Edition, Tata McGraw-Hill, New Delhi, 2008.
T2 - Cengel. Y. and MBoles, "Thermodynamics - An Engineering Approach",7th Edition, TataMcGraw Hill, 2010.

REFERENCES:

R1 - Natarajan E., "Engineering Thermodynamics: Fundamentals and Applications", Anuragam Publications, 2012.
R2 - Holman.J.P., "Thermodynamics", 3rd Edition. McGraw-Hill, 1995.

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PROGRAMME	COURSE CODE	NAME OF THE COURSE	L	T	P	C
B.E.	16ME3203	FLUID MECHANICS AND MACHINERY	3	1	0	4

Course Objective

1. To understand the behavior of fluid particles under rest and moving conditions.
2. To study important concept of flow through pipes.
3. To gain knowledge about the Dimensional and model analysis.
4. To learn about the performance of pump and its types.
5. To know the design considerations of Turbine.

Unit	Description	Instructional Hours
I	**FLUID PROPERTIES AND FLOW CHARACTERISTICS** Properties of fluids- mass density, specific weight, specific volume, specific gravity, viscosity, compressibility, surface tension, capillarity, vapor pressure and cavitation. Fluid Flow–continuity equation, Euler's equation, Bernoulli's theorem and its applications, momentum equation, moment of momentum equation. Pascal's law-Pressure measurement and flow measurement devices (Description only).	12
II	**BOUNDARY LAYER CONCEPT AND FLOW THROUGH PIPES** Boundary layer concepts – types of boundary layer thickness- Losses of energy in pipes -Moody diagram-Darcy Weisbach equation –friction factor– Flow through pipes in series, parallel and equivalent pipe. Hydrostatic forces on surfaces-plane surfaces.	12
III	**DIMENSIONAL AND MODEL ANALYSIS** Dimensions, Dimensional homogeneity, methods of dimensional analysis-Rayleigh and Buckingham's-π theorem – Model analysis- Similitude –types of similarities - classification of models.	12
IV	**PUMPS** Classifications of pumps –Centrifugal pumps– work done by the impeller -Head and efficiencies-performance curves-velocity triangles - Multistage pumps - priming- Reciprocating pump-slip, Indicator diagram, Air vessel – Rotary pumps(Description only).	12
V	**TURBINES** Classification of turbines – heads and efficiencies – velocity triangles. Axial, radial and mixed flow turbines. Pelton wheel, Francis turbine and Kaplan turbines- work done by water on the runner – draft tube. Specific speed– performance curves.	12
	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 - Yunus A Cengel & John M. Cimbala, Fluid Mechanics-Fundamentals & Applications, 2nd Edition, Tata McGraw Hill Edition, New Delhi.
T2 - Bansal R.K., —Fluid Mechanics and Hydraulic Machines, 9th Edition, Laxmi Publications, New Delhi, 2015.

REFERENCE BOOKS:

R1 - Som S.K., Biswas G., —Introduction to Fluid Mechanics and Fluid Machinesl, 2nd Edition, Tata McGraw Hill Publishing Company, New Delhi, 2007.
R2 - Ramamrutham.S and Narayanan.R., "Fluid Hydraulics and Fluid Machines", Dhanpat rai Publishing House (P) Ltd , New Delhi, 2012.
R3 – Kumar K. L., "Engineering Fluid Mechanics", Eurasia Publishing House(p) Ltd., New Delhi 2004.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16ME3204	STRENGTH OF MATERIALS (COMMON TO MECHANICAL AND AUTOMOBILE ENGINEERING)	3	0	0	3

Course Objective

1. To study the principles of simple stress, strain and deformation in components.
2. To assess stresses and deformations through mathematical models of beams.
3. To learn about torsion of components.
4. Gain knowledge about deflections on beams.
5. Understand the stress analysis concepts in two dimension objects.

Unit	Description	Instructional Hours
	STRESS- STRAIN AND DEFORMATION OF SOLIDS 12	
I	Rigid and Deformable bodies – Mechanical Properties – Stress-Strain Curve - Tension, Compression and Shear stresses – Deformation of simple and compound bars – Thermal stresses – Elastic constants – Volumetric strains, Principal Planes & Stresses - Mohr's circle.	9
	BEAMS - LOADS AND STRESSES 12	
II	Types of beams: Supports and Loads – Shear force and Bending Moment in beams – Cantilever, Simply supported and Overhanging beams – Stresses in beams – Theory of simple bending – Stress variation along the length and in the beam section – Transverse shear stresses in beams.	9
	TORSION	
III	Formulation-stress and deformation in circular and hollow shafts – Stepped shaft – Deflection in shaft subjected to various boundary conditions–Stresses in helical springs – Deflection of helical springs, Leaf springs.	9
	BEAM DEFLECTION	
IV	Double integration method – Macaulay Method – Area moment Method for computation of slopes and deflection in beams – Conjugate beam and Strain Energy problems.	9
	ANALYSIS OF STRESSES IN TWO DIMENSIONS	
V	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.	9
	Total Instructional Hours	**45**

Course Outcome

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, Third Edition, 2002.
R2 - Kazimi S.M.A, "Solid Mechanics", Tata McGraw-Hill Publishing Co., Tata McGraw-Hill Publishing Co.
R3 - Ryder G.H, "Strength of Materials, Macmillan India Ltd".,Third Edition, 2002.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16EE3231	ELECTRICAL DRIVES AND CONTROLS	3	0	0	3

Course Objective

1. Acquire the fundamentals of the electrical drive system.
2. Learn the Different speed control methods of electrical drive system.
3. Identify the various starters and controllers for electrical motors.
4. Gain the knowledge on speed control methods for electrical drives.
5. Study the power electronics based speed control of electrical drives

Unit	Description	Instructional Hours
I	**INTRODUCTION** Basic Elements – Types of Electric Drives – factors influence the choice of electrical drives – Heating and cooling curves – Loading conditions and classes of duty – Selection of power rating for drive motors with regard to thermal overloading and Load variation factors.	9
II	**DRIVE MOTOR CHARACTERISTICS** Mechanical characteristics – Speed-Torque characteristics of various types of load and drive motors – Braking of Electrical motors – DC motors: Shunt, series and compound - single phase and three phase induction motors. (Only elementary aspects of the above types are expected).	9
III	**STARTING METHODS** Types of D.C Motor starters – Typical control circuits for shunt and series motors –-Three phase squirrel cage and slip ring induction motors, Control devices.	9
IV	**CONVENTIONAL AND SOLID STATE SPEED CONTROL OF D.C.DRIVES** Speed control of DC series and shunt motors - Ward-Leonard control system - Using controlled rectifiers and DC choppers –applications. (Qualitative Treatment).	9
V	**CONVENTIONAL AND SOLID STATE SPEED CONTROL OF A.C. DRIVES** Speed control of three phase induction motor –VFD motor–- Voltage control, voltage / frequency control, slip power recovery scheme – Using inverters and AC voltage regulators – applications. (Qualitative Treatment).	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Identify the basic components of electric drive systems.
CO2: Describe the performance characteristics of electrical motor.
CO3: Design the starters for electrical motors used in drives.
CO4: Apply the speed control techniques of electrical drives.
CO5: Investigate the power converter based speed control of AC & DC drives.

TEXT BOOKS:

T1 - Vedam Subrahmaniam, "Electric Drives (Concepts and Applications", Tata McGraw-Hill, 2001.
T2 - Gopal K.Dubey, Fundamentals of Electrical Drives, Narosa Publishing House, 1992.

REFERENCE BOOKS:

R1 - De. N.K and Sen.P.K 'Electric Drives' Prentice Hall of India Private Ltd, 2002.
R2 - Pillai.S.K "A First Course on Electric Drives", Wiley Eastern Limited, 1998.
R3 - Nagrath .I.J. & Kothari .D.P, "Electrical Machines", Tata McGraw-Hill, 1998.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16ME3001	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
	LIST OF EXPERIMENTS
1	Step Turning
2	Knurling & Grooving
3	Taper Turning
4	Boring
5	Internal Thread Cutting
6	External Thread cutting
7	Eccentric Turning
8	Drilling & Tapping
9	Surface grinding
	Total Instructional Hours **45**

Course Outcome

- Upon completion of this course, The Students will be able to use various lathe, drilling and grinding machines to fabricate various operations.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16ME3002	SOLID AND FLUID MECHANICS LAB	0	0	4	2

Course Objective

1. Apply the knowledge gained on flow meters by experiments.
2. Understand the characteristics of pumps and turbines through practical learning.
3. To familiarize with the working of pumps and turbines through practical learning.
4. Understand the materials behavior and strength due to tension, compression and torsion by Experiments.
5. Carry out the tests of materials before selecting for a particular application.

Expt. No.	Description of the Experiments	Total Practical Hours
1.	Determination of the Coefficient of discharge of given Venturi meter & Orifice meter.	
2.	Determination of friction factor of a pipe.	
3.	Conducting experiments and drawing the characteristic curves of Centrifugal pump or Submersible pump.	
4.	Conducting experiments and drawing the characteristic curves of reciprocating pump.	
5.	Conducting experiments and drawing the characteristic curves of Pelton wheel.	
6.	Conducting experiments and drawing the characteristics curves of Francis turbine.	
7.	Tension test on given specimen using universal testing machine.	
8.	Deflection test on beams.	
9.	Torsion test on given specimen.	
10.	Hardness tests (Brinels and Rockwell).	
11.	Compression test on helical springs.	
12.	Testing of impact resistance of steels.	
	Total Practical Hours	**45**

Course Outcome

At the end of the course, the student can

CO1: Determine the performance characteristics of pumps and turbines.

CO2: Demonstrate the flow rate of venturi meter and orifice meter.

CO3: Evaluate the material behavior and strength due to tension, compression and torsion by experiments.

CO4: Carryout various tests of materials.

CO5: Examine the properties of materials before selecting for a particular application.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16EE3031	ELECTRICAL ENGINEERING LAB	0	0	4	2

Course Outcome

CO1: Experimentally obtain the load characteristics of various DC generators and motors.
CO2: Analyze the operation of Electric Machines under different loading conditions.
CO3: Evaluate the efficiency and the regulation of transformers from load test and no-load test.
CO4: Construct and test the experimental procedures on different types of Electrical Machines.
CO5: Design and analysis the various speed control technique of electrical machines.

Expt. No.	Description of the Experiments
1.	Open circuit characteristics and Load characteristics of DC shunt generator.
2.	Load test on DC Series motor.
3.	Load test on DC Shunt motor.
4.	Speed control of DC shunt motor (Armature and Field control).
5.	Load test on DC Compound motor.
6.	Open circuit and short circuit test on single phase transformer.
7.	Study of starters for DC motors.
8.	Load test on single phase induction motor.
9.	Load test on three phase squirrel cage induction motor.
10.	Speed control of three phase slip ring induction motor.
11.	Speed control of three phase squirrel cage induction motor.
12.	Study of starters for AC motors.
	Total practical hours **45**

Course Outcome

CO1: Experimentally obtain the load characteristics of various DC generators and motors.
CO2: Analyze the operation of Electric Machines under different loading conditions.
CO3: Evaluate the efficiency and the regulation of transformers from load test and No-load test.
CO4: Construct and test the experimental procedures on different types of Electrical Machines.
CO5: Design and analysis the various speed control technique of electrical machines.

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SEMESTER – IV

Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16MA4107	NUMERICAL METHODS (Common to AERO, AUTO, MECH, EEE & EIE)	3	1	0	4

Course Objective

1. Solve algebraic, transcendental and system of linear equations by using various techniques.
2. Apply various methods to find the intermediate values for the given data.
3. Be Familiar with the concepts of numerical differentiation and numerical integration of the unknown functions.
4. Understand the concept of solving Ordinary differential equations by applying single and multi step methods.
5. Appraise the methods introduced in the solution of ordinary differential equations and partial differential equations.

Unit	Description	Instructional Hours
I	**SOLUTION OF ALGEBRAIC AND TRANSCENDENTAL EQUATIONS** Solution of equation – Fixed point iteration : x = g(x) method – Newton-Raphson method – Solution of linear system by Gauss Elimination and Gauss Jordan method – Iterative method : Gauss seidel method.	12
II	**INTERPOLATION** Interpolation: Newton's forward and backward difference formulae – Lagrangian interpolation for unequal intervals – Divided difference for unequal intervals : Newton's divided difference formula.	12
III	**NUMERICAL DIFFERENTIATION AND INTEGRATION** Differentiation using interpolation formula – Newton's forward and backward interpolation formulae for equal intervals – Newton's divided difference formula for unequal intervals - Numerical integration by Trapezoidal and Simpson's 1/3 and 3/8 rules – Romberg's method – Double integration using Trapezoidal and Simpson's rules	12
IV	**INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS** Single step methods: Taylor's series method – Euler and Modified Euler methods for first order equation – Fourth order Runge- kutta method for solving first order equations – Multi step method: Milne's predictor and corrector method and Adam – Bash forth predictor corrector method.	12
V	**BOUNDARY VALUE PROBLEMS IN ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS** Finite difference solution of second order ordinary differential equation – Finite difference solution of one dimensional heat equation by explicit and implicit methods – One dimensional Wave equation – Two dimensional Heat equations – Laplace and Poisson Equations.	12
	Total Instructional Hours	**60**

Course Outcome

CO1: Solve the system of linear algebraic equations representing steady state models and non linear equations arising in the field of engineering.
CO2: Understand the concept of interpolation in both cases of equal and unequal intervals.
CO3: Express the information from discrete data set through numerical differentiation and summary information through numerical integration.
CO4: Classify and solve ordinary differential equations by using single and multi step methods.
CO5: Acquire knowledge of finding the solution of ordinary and partial differential equations which are useful in attempting any engineering problems.

TEXT BOOKS:

T1 - Sankara Rao K, "Numerical Methods for Scientists and Engineers", 3rd edition, Prentice Hall of India Private limited, New Delhi,2007..
T2 - M.K.Jain,S.R.K.Iyengar, R.K.Jain "Numerical methods for Scientific and Computation", Fifth Edition, New Age International publishers 2010.

REFERENCE BOOKS :

R1 - Kreyszig.E. "Advanced Engineering Mathematics", Eight Edition, John Wiley and sons (Asia) limited.
R2 - Grewal B.S. and Grewal J.S. "Numerical Methods in Engineering and Science ", 6th Edition , Khanna publishers, New Delhi 2004.
R3 - S.K.Gupta, Numerical Methods for Engineers" , New Age International Pvt.Ltd Publishers,2015.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16ME4201	MANUFACTURING TECHNOLOGY – II	3	0	0	3

Course Objective

1. To provide an overview of Metal Cutting Theory concepts.
2. To educate students on the working and various functions of Turning Machines.
3. To give exposure about Shaping, Milling and Gear cutting machines.
4. To provide knowledge about grinding and broaching machines.
5. To provide the basic concepts in CNC machines.

Unit	Description	Instructional Hours
I	**THEORY OF METAL CUTTING** 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.	9
II	**TURNING MACHINES** 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.	9
III	**SHAPER, SLOTTING, MILLING AND GEAR CUTTING MACHINES** 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
IV	**ABRASIVE PROCESS AND BROACHING** 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.	9
V	**CNC MACHINING** Numerical Control (NC) machine tools – CNC types, constructional details, special features, machining centre, part programming fundamentals CNC – manual part programming – micromachining.	9
	Total Instructional Hours	**45**

Course Outcome

At the end of the course, the students can,

CO1: Apply the basics of Manufacturing machine tools and metal cutting theory to select suitable operation.
CO2: Fabricate engineering components using various lathes and special attachments.
CO3: Acquire the various special machine tool construction and operations.
CO4: Acquire the knowledge about abrasive process and gear cutting operations.
CO5: Acquire knowledge about the CNC machine tools.

TEXT BOOKS:

T1 -Hajra Choudhury, "Elements of Workshop Technology", Vol.II., Media Promoters.
T2 -Rao. P.N "Manufacturing Technology - Metal Cutting and Machine Tools", Tata McGraw-Hill, New Delhi, 2003.

REFERENCES:

R1 -HMT, "Production Technology", Tata McGraw Hill, 1998.
R2 -GeofreyBoothroyd, "Fundamentals of Metal Machining and Machine Tools", Mc Graw Hill, 1984.
R3 - Roy. A.Lindberg, "Process and Materials of Manufacture," Fourth Edition, PHI/Pearson Education 2006.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16ME4202	THERMAL ENGINEERING	3	0	0	3

Course Objective

1. To integrate the concepts, laws and methodologies from the first course in thermodynamics into analysis of cyclic processes.
2. To familiarize with the types and working principles of two stroke and four stroke engines.
3. To apply the thermodynamic concepts to IC Engines and its components.
4. To apply the thermodynamic laws to steam turbines, steam nozzles and air compressors.
5. To give exposure on refrigeration cycles and psychometry.

Unit	Description	Instructional Hours
I	**GAS POWER CYCLES** Otto, Diesel, Dual, Brayton and Stirling 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, Engine test methods, Emission norms.	10
III	**STEAM NOZZLES AND TURBINES** Flow of steam through nozzles, shapes of nozzles, effect of friction, critical pressure ratio, supersaturated flow. Impulse and Reaction principles, compounding, velocity diagram for simple steam turbines, speed regulations –Governors.	9
IV	**AIR COMPRESSOR, FANS AND BLOWERS** Classification and working principle of various types of compressors, work of compression with and without clearance, Volumetric efficiency, Isothermal efficiency and Isentropic efficiency of reciprocating compressors, Multistage air compressor and inter cooling –work of multistage air compressor, Fans-types, Blower-types and its industrial applications.	9
V	**REFRIGERATION AND AIR CONDITIONING** Vapour compression cycle, Sub cooling and super heating, refrigerants, performance calculations - working principle of vapour absorption system (Ammonia –Water, Lithium bromide – water systems - Description only). Air conditioning system - types and working principle. Cooling load calculations: SHF, RSHF, GSHF, ESHF, bypass factor.	9
	Total Instructional Hours	**45**

Course Outcome

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

CO1: Understand the process of air standard cycles.

CO2: Demonstrate knowledge of the operating characteristics of common 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, 2002.

REFERENCE BOOKS:

R1 - Arora.C.P,"Refrigeration and Air Conditioning," Tata McGraw-Hill Publishers 1994.

R2 - Ganesan V.." Internal Combustion Engines", Third Edition, Tata Mcgraw-Hill 2007.

R3 - Rudramoorthy, R, "Thermal Engineering ", Tata McGraw-Hill, New Delhi, 2003.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16ME4203	KINEMATICS OF MACHINERY	3	1	0	4

Course Objective

1. To understand the purpose of kinematics, Kinematic joint and mechanism and to study the relative motion of parts in a machine without taking into consideration the forces involved.
2. To understand the velocity and acceleration concepts and the methodology using graphical methods and principles and application of four bar chain and slider crank Mechanism.
3. To understand the theories and applications of cams.
4. To understand applications of different types of gears and gear profiles and its efficiency and gear trains.
5. To understand principles of friction applied to screw threads, clutches, brakes, belt and rope drives.

Unit	Description	Instructional Hours
I	**BASICS OF MECHANISMS** Introduction - Links - Pairs - Chain - Mechanism - Machine structure - Degrees of freedom - Four bar chains - Terminology and definition - Planar, Spherical and Spatial Mechanisms - Grashoff's law - Kutzback criterion - Grubler's criterion for plane mechanism. Inversion of mechanisms - Four bar, single slider crank and double slider crank mechanisms - Simple problems -Mechanical advantage – Transmission Angle – Description of some common mechanisms – Quick return mechanisms, Dwell mechanisms, Ratchets and Escapements, Universal Joint.	12
II	**KINEMATICS OF LINKAGE MECHANISMS** Displacement, velocity and acceleration analysis of simple mechanisms – Graphical method – Velocity and acceleration polygons – Velocity analysis using relative velocity method- Coriolis component of Acceleration.	12
III	**KINEMATICS OF CAM MECHANISMS** Types of cams and followers - Follower motion - Uniform, Parabolic, SHM and cycloidal. Cam terminology - Cam profiles construction for roller, flat faced and knife edge follower types - pressure angle - Derivatives of Follower motion - High speed cams - circular arc and tangent cams – Standard cam motion - Pressure angle and undercutting - Sizing of Cams.	12
IV	**GEARS AND GEAR TRAINS** Law of toothed gearing – Involutes and cycloidal tooth profiles – Spur Gear terminology and definitions – Gear tooth action – contact ratio – Interference and undercutting – Non–standard gear teeth – Helical, Bevel, Worm, Rack and Pinion gears – Gear trains – Speed ratio, train value – Parallel axis gear trains – Epicyclic Gear Trains – Differentials – Automobile gear box.	12
V	**FRICTION** Surface contacts –Friction in screw threads -Friction clutches -Belt and rope drives, Friction aspects in Brakes.	12
	Total Instructional Hours	**60**

Course Outcome

CO1: Classify mechanisms and inversions and determine mobility of a mechanism.
CO2: Estimate velocity and acceleration by graphical and analytical methods.
CO3: Construct cam profiles for various followers and their motions.
CO4: Classify various gear trains and apply to automation.
CO5: Apply friction principles to clutches, belt, brake and screw.

TEXT BOOKS:

T1 -Ratan.S.S, "Theory of Machines", Tata McGraw Hill Publishing company Ltd., 2nd Edition, 2005.
T2 -Thomas Bevan, "Theory of Machines", CBS Publishers and Distributors, 3rd Edition, 1984.

REFERENCE BOOKS:

R1 -Shigley.J.E, and Uicker.J.J, "Theory of Machines and Mechanisms", McGraw Hill, 1995.
R2 -Ghosh.A, and Mallick.A.K, "Theory of Mechanisms and Machines" , Affiliated East-West Pvt Ltd., New Delhi, 1988.
R3 -Rao.J.S, and Dukkipati.R.V, " Mechanism and Machine Theory" , Wiley-Eastern Ltd., New Delhi, 1995
R4 - Khurmi R.S., "Theory of Machines" Khanna Publishers, Delhi, 2006.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16ME4204	ENGINEERING MATERIALS AND METALLURGY	3	0	0	3

Course Objective

1. To Learn materials are formed and their classification based on atomic arrangement.
2. To Study the mechanical behavior of metallic and its Importance.
3. To study the mechanical behavior of metals.
4. To Gain knowledge on different types of materials and their applications.
5. To Study 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** Phase, Gibbs's Phase rule, Solubility and Solid Solutions -Iso-morphous alloy system -Binary Eutectic alloy system (Lead-Tin System), Eutectoid and Peritectic system, Iron-Iron carbide phase diagram-Invariant reactions, Evolution of Microstructure, 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 HEAT TREATMENTS** Heat Treatment –Annealing and its types, Normalizing, Aus-tempering, Mar-tempering, Quenching and Temper heat treatment, Hardenability –Basic concepts of wear and corrosion & their types - Surface hardening processes –Flame and induction hardening, Carburizing, Nitriding and Carbonitriding.	9
IV	**MECHANICAL PROPERTIES OF MATERIALS** Tension, Compression, Shear and Tensional Test of Metals -Stress-strain behavior of ferrous & non-ferrous metals, polymer and ceramics -True stress and strain relations -Flexural Test, Hardness measurement tests, Fracture of metals -Ductile Fracture, Brittle Fracture, Fatigue –Endurance limit of ferrous and non-ferrous metals –Fatigue test; Creep and stress rupture–mechanism of creep –stages of creep and creep test, Strengthening.	9
V	**NON FERROUS ALLOYS & ADVANCED MATERIALS** Non Ferrous Alloys of Aluminum, Magnesium, Copper, Nickel, Titanium –Microstructure and mechanical property relationships; Composites Classification, Processing, Metal Matrix, Ceramic Matrix, polymer matrix –properties and applications; Ceramics –Alumina, Zirconium, Silicon Carbide, Sialons, Reaction Bonded Silicon Nitride(RBSN), Processing, properties and applications of ceramics, Glasses –properties and applications.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Visualize the basic concepts in material science.
CO2: Analyze phase diagrams and explain iron-carbon equilibrium diagram.
CO3: Select an appropriate heat treatment process to impart a desired property for a given ferrous alloy.
CO4: Analyse the various mechanical properties of materials.
CO5: Select an appropriate alloying element to impart a desired property for a given non ferrous alloy.

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 (2004), Foundations of Materials Science and Engineering 4th ed., Mc Graw Hill

REFERENCE BOOKS:

R1 - Anderson.C, K.D. Leaver, P. Leavers and R.D. Rawlings, (2003), Materials Science for Engineers, 5th edition, Tata McGraw Hill Publishers
R2 - Sidney H Avner, (2005) "Introduction to Physical Metallurgy, Tata McGraw Hill Publishing Company Limited
R3 - Krishnan K. Chawla, (2007) Composite materials, Science and Engineering 2nd edition, Springer

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16ME4205	MACHINE DRAWING	1	4	0	3

Course Objective

1. To impart the knowledge of limits, fits and tolerances, orthographic-sectional and assembly drawing procedures.
2. To provide the practice to draw assembly orthographic views of various machine parts.
3. To provide the practice and develop the detailed part drawing.
4. Understand the shape and structure of different types of screws, keys and Couplings.
5. To provide the practice and develop the detailed mechanical components drawing.

Unit	Description	Instructional Hours
I	**LIMITS, FITS AND TOLERANCES** Limit System- Tolerance, Limits , Deviation, Actual Deviation, Upper Deviation, Lower Deviation, Allowance, Basic Size, Design Size, Actual Size. Fits-Types, Tolerances of Form and Position-Form and Position Variation, Geometrical Tolerance, Tolerance Zone, Indicating Geometrical Tolerances. Indication of Surface Roughness, Standard Abbreviations and Symbols used in industries.	5
II	**SECTIONAL VIEWS** Sections- Hatching of Sections, Cutting Planes, Revolved or Removed Section, Sectional Views- Full Section, Half Sections and Auxiliary Sections.	5
III	**MACHINE ELEMENT DRAWINGS** Drawing standards and Designation of Bolts, nuts, screws, keys, pins, Rivets, Welded Joints-Dimensioning of Welds, Belt Driven Pulleys, Chain and Gears Drives.	7
IV	**DRAWINGS OF VARIOUS VIEWS** **Shaft joints:** Cotter joint and Knuckle joint. **Keys & Shaft coupling:** Flanged, Flexible, Universal and Oldhams coupling. **Shaft bearing**: Solid and bush bearing, Plummer block, Footstep bearing. **Pulley**: Belt pulley, V belt pulley, Fast and loose pulley, Speed cone pulley, Built up pulley.	14
V	**ASSEMBLY DRAWING OF MECHANICAL COMPONENTS** Lathe Tail stock, Machine Vice, Pipe Vice, Simple Eccentric, Screw jack, Stuffing Box, Plummer Block, Swivel Bearing and Safety Valve.	14
	Total Instructional Hours	**45**

Course Outcome

Students should be able to:

1. Use limits, fits and tolerances, orthographic-sectional and assembly drawing procedures in real world problems.
2. Apply sectional view, assembly and orthographic concepts to draw various machine parts.
3. Understand the Concept of fasteners and different joints.
4. Draw and demonstrate the projections and sectional views of various mechanical elements.
5. Construct assembly drawings of mechanical components.

TEXT BOOKS:

T1. Narayana K.L. and Kannaiah P., —Machine Drawing, 4th Edition, New Age International Publishers Ltd., New Delhi, 2010.

T2. Gopalakrishna K.R., —Machine Drawingl, 22nd Edition, Subhas Publications, New Delhi, 2013.

REFERENCE BOOKS:

R1. Bhatt N.D. and Panchal V.M., —Machine Drawingl, 45th Edition, Charotar Publishing House Pvt. Ltd., Gujarat, 2010.

R2. Sidheswar N., Kannaiah P., Sastry V.V., —Machine Drawingl, 27th Reprint, Tata-McGraw Hill Education, Chennai, 2004.

R3 Faculty of Mechanical Engineering —Design Datal, Revised Edition 1978, Reprint on October 2011, Kalaikathir Achchagam, 2011.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16ME4001	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 experiments
	LIST OF EXPERIMENTS
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	Gear generation in shaping machine.
6	Gear generation in slotter machine.
7	Cylindrical grinding.
8	Tool angle grinding with tool and Cutter Grinder.
9	Measurement of cutting forces in Milling / Turning Process / cycle time estimation.
10	Surface machining in Planner machine.
11	CNC Part Programming.
	Total Instructional Hours **45**

Course Outcome

CO1: Ability to use different machine tools to manufacturing gears.
CO2: Ability to use different machine tools for finishing operations.
CO3: Ability to manufacture tools using cutter grinder.
CO4: Develop CNC part programming for the simple components.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16ME4002	THERMAL ENGINEERING LAB - I	0	0	4	2

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 I C engines.
4. To learn the principle of emission measurement using Orsat apparatus.
5. To study the Performance of steam generator/turbines.

Expt. No.	Description of the Experiments
1.	Valve Timing and Port Timing diagrams.
2.	Performance Test on 4 – stroke Diesel Engine.
3.	Heat Balance Test on 4 – stroke Diesel Engine.
4.	Morse Test on Multi-cylinder Petrol Engine.
5.	Retardation Test on a Diesel Engine.
6.	Determination of Flash Point and Fire Point of various fuels / lubricants.
7.	Determination of calorific value of various fuels.
8.	Determination of viscosity of fuels.
9.	Performance test on reciprocating air compressor.
10.	Performance test on centrifugal blower.
11.	Determination of exhaust gas composition by Orsat apparatus.
	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: Determine various performance parameters of Internal Combustion Engines.

CO3: Determine the performance of air compressors.

CO4: Compute the properties of fuels and lubricating oils.

CO5: Estimate the emission levels of fuels using Orsat apparatus.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16ME4701	COMMUNICATION SKILLS LAB (ECE, MECH & B.Tech. IT)	0	0	2	1

Course Objective

1. Enable learners to understand different genres of oral presentation.
2. Empower the student to improve their ability to speak in formal forum without hesitation.
3. Make the students to read, interpret and analyze different types of writings.

Expt. No.	Description of the Experiments
1.	Listening to lectures, discussions, talk shows and news programmes.
2.	Watching videos on interesting events and interpreting it
3.	Conversational skills (formal and informal)
4.	Group discussion
5.	Interview skills
6.	Making presentations
7.	Reading different genres of texts ranging from newspapers to philosophical treatises
8.	Reading strategies such as graphic organizers, summarizing and interpretation
9.	Writing job applications – cover letter – resume
10.	Writing reports & Writing for publications.
11.	Intercultural communication
12.	Creative and critical thinking.

Total Practical Hours 45

Course Outcome

CO1- It enables learners to understand different genres of oral presentation.
CO2- Empowered the student to improve their ability to speak in formal forum without Hesitation.
CO3- Students read, interpret and analyze different types of writings.
CO4- Enhances the performance of students on formal writing.
CO5-Equips the learners in practicing better soft skills.

REFERENCE BOOKS:

R1 - Anderson, P.V, Technical Communication, Thomson Wadsworth, Sixth Edition, New Delhi, 2007.
R2 - Prakash, P,Verbal and Non-Verbal Reasoning, Macmillan India Ltd., Second Edition, New Delhi, 2004.
R3 - John Seely, The Oxford Guide to Writing and Speaking, Oxford University Press, New Delhi, 2004.

TEACHING METHODS:

1. To be totally learner-centric with minimum teacher intervention as the course revolves around practice.
2. Suitable audio/video samples from Podcast/YouTube to be used for illustrative purposes.
3. Portfolio approach for writing to be followed. Learners are to be encouraged to blog, tweet, text and email employing appropriate language.
4. GD/Interview/Role Play/Debate could be conducted off the laboratory (in a regular classroom) but learners are to be exposed to telephonic interview and video conferencing.
5. Learners are to be assigned to read/write/listen/view materials outside the classroom as well for graining proficiency and better participation in the class.

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SYLLABUS

SEMESTER – V

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.	30
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.	
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).	15
12	Determination of COP of an air-conditioning system.	
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 LABORATORY	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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SEMESTER – VI

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 & 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 Hall of India Pvt. Ltd., 8thEdition, New Delhi, 2001.
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 Technology‖, 5th Edition, Pearson Education India, New Delhi, 2014.
T2 - Radhakrishnan P., —Computer Numerical Control Machines‖, New Central Book Agency, 2013.

REFERENCE BOOKS:

R1 - Narang J.S. and Narang V.D.S., —CNC Machines and Automation‖, 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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Semester – I

Course Code & Name : 16MA1101/ Engineering Mathematics I

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 : 16PH1101/ Engineering 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	1.3	-	-	-	-	-	1	2.4	2.4

Course Code & Name : 16CY1101/ Engineering Chemistry

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 : 16HE101R Essential English for Engineers - I

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 : 16GE1103/ Problem Solving and Python Programming

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 : 16ME1102 Engineering Graphics

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 : 16PS1001/ Physical Science Lab

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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	1.3	-	-	-	-	-	1	2.4	2.4

Course Code & Name : 16GE1001/ Problem Solving and Python Programming Lab

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 : 16ME1002 Engineering Practices Laboratory

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 – II

Course Code & Name : 16MA2102/ Engineering Mathematics II

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 : 16PH2102/ Physics of Materials

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 : 16CY2102/ Environmental Sciences

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 : 16HE2101R/ Essential English For Engineers II

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 : 16GE2101 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 : 16EE2202/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 : 16ME2001 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

Course Code & Name : 16PS2001/ Physical Science Lab II

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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	1.3	-	-	-	-	-	1	2.4	2.4

Code & Name : 16ME2001 Computer Aided Drafting 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

Semester – III

Course Code & Name: 16MA3101/ 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 : 16ME3201 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 : 16ME3202 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 : 16ME3203 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 : 16ME3204 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	-	-	-	-	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 : 16ME3231 Electrical Drives and Control

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 : 16ME3001 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 : 16ME3002 Solid and Fluid Mechanics 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

Course Code & Name : 16ME3031 Electrical Engineering Lab

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 – IV

Course Code & Name: 16MA4107/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 : 16ME4201 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 : 16ME4202 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 : 16ME4203 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 : 16ME4204 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 : 16ME4205 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 : 16ME4001 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 : 16ME4002 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**

Course Code & Name : 16ME4701 Communication skills 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	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

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

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