DEPARTMENT OF MECHANICAL ENGINEERING

B.Tech. Robotics and Automation (Full Time)
Curriculum – 2018 Regulation

I SEMESTER							
S.NO.	**SUBJECT CODE**	**SUBJECT NAME**	**Ty/Lb /ETL**	**L**	**T/ SLr**	**P/R**	**C**
1	BEN18001	Technical English –I	Ty	1	0/0	2/0	2
2	BMA18001	Mathematics - I	Ty	3	1/0	0/0	4
3	BPH18001	Engineering Physics –I	Ty	2	0/1	0/0	3
4	BCH18001	Engineering Chemistry –I	Ty	2	0/1	0/0	3
5	BES18001	Basic Electrical & Electronics Engineering	Ty	2	0/1	0/0	3
6	BES18002	Basic Mechanical & Civil Engineering	Ty	2	0/1	0/0	3
PRACTICALS*							
1	BES18L01	Basic Engineering Workshop	Lb	0	0/0	2/0	1
2	BES18ET1	Orientation To Entrepreneurship & Project	ETL	0	0/0	2/0	1

Credits Sub Total: 20

II SEMESTER							
S.NO.	**SUBJECT CODE**	**SUBJECT NAME**	**Ty/Lb /ETL**	**L**	**T/ SLr**	**P/R**	**C**
1	BMA18003	Mathematics-II	Ty	3	1/0	0/0	4
2	BPH18002	Engineering Physics –II	Ty	2	0/1	0/0	3
3	BCH18002	Engineering Chemistry – II	Ty	2	0/1	0/0	3
4	BES18003	Environmental Science*	NON CREDIT COURSE				NC
PRACTICALS*							
1	BEN18ET1	Communication Lab	ETL	1	0/0	2/0	1
2	BES18ET2	Basic Engineering Graphics	ETL	1	0/0	2/0	2
3	BES18L02	Integrated Physical Science Lab	Lb	0	0/0	2/0	1
4	BES18ET3	C Programming and Lab	ETL	1	0/0	2/0	2

Credits Sub Total: 16

TOTAL CREDITS: 36

C: Credits L: Lecture T: Tutorial S.Lr: Supervised Learning P: Problem / Practical R: Research
Ty/Lb/ETL: Theory /Lab/Embedded Theory and Lab * Internal Evaluation

III SEMESTER							
S.NO.	**SUBJECT CODE**	**SUBJECT NAME**	**Ty/Lb/ ETL**	**L**	**T/ SLr**	**P/R**	**C**
1	BMA18005	Mathematics-III for Mechanical and	Ty	3	1/0	0/0	4
2	BME18003	Engineering Mechanics	Ty	3	1/0	0/0	4
3	BRE18001	Electrical and Electronics Circuits	Ty	3	1/0	0/0	4
4	BRE18002	Electrical Machines	Ty	3	0/0	0/0	3
5	BRE18003	Basics of Robotics	Ty	3	0/0	0/0	3
PRACTICALS*							
1	BRE18ET1	Python Programming	ETL	1	0/1	3/0	3
2	BRE18L01	Electrical & Electronic Circuits Lab	Lb	0	0/0	3/0	1
3	BRE18L02	Electrical Machines Lab	Lb	0	0/0	3/0	1

Credits Sub Total: 23

IV SEMESTER							
S.NO.	**SUBJECT CODE**	**SUBJECT NAME**	**Ty/Lb/ ETL**	**L**	**T/ SLr**	**P/R**	**C**
1	BRE18004	Microprocessors and Microcontrollers	Ty	3	0/0	0/0	3
2	BME18006	Strength of Materials	Ty	3	1/0	0/0	4
3	BRE18005	Digital Electronics	Ty	3	1/0	0/0	4
4	BRE18006	Instrumentation and Control for Robots	Ty	3	0/0	0/0	3
5	BHS18NC1/	The Indian Constitution*/ The Indian	Ty	2	0/0	0/0	NC
PRACTICALS*							
1	BME18ET1	Machine Drawing	ETL	1	0/1	3/0	3
2	BME18L11	Strength of Materials Lab	Lb	0	0/0	3/0	1
3	BRE18L03	Instrumentation and Control Lab	Lb	0	0/0	3/0	1
4	BRE18L04	Digital Electronics and Microprocessors	Lb	0	0/0	3/0	1
5	BRE18TS1	Technical Skill-1	Lb	0	0/0	3/0	1
6	BEN18SK1	Soft Skill –I (Career and Confidence	ETL	0	0/0	3/0	1

Credits Sub Total: 22

C: Credits L: Lecture T: Tutorial S.Lr: Supervised Learning P: Problem / Practical R: Research Ty/Lb/ETL: Theory /Lab/Embedded Theory and Lab * Internal Evaluation

V SEMESTER							
S.NO.	**SUBJECT CODE**	**SUBJECT NAME**	**Ty/Lb/ ETL**	**L**	**T/ SLr**	**P/R**	**C**
1	BRE18007	Kinematics and Dynamics of Machinery	Ty	3	1/0	0/0	4
2	BRE18008	Programmable Logic Controllers	Ty	3	0/0	0/0	3
3	BME18014	CAD,CAM & CIM	Ty	3	0/0	0/0	3
4	BXX18EXX	Elective-I	Ty	3	0/0	0/0	3
5	BXX18OEX	Open Elective-I	Ty	3	0/0	0/0	3
PRACTICALS*							
1	BRE18ET2	Linear Integrated Circuits	ETL	1	0/1	3/0	3
2	BRE18L05	CAD/CAM Lab	Lb	0	0/0	3/0	1
3	BRE18L06	Programmable Logic Controllers Lab	Lb	0	0/0	3/0	1
4	BRE18TS2	Technical Skill 2	Lb	0	0/0	3/0	1
5	BRE18L07	Industrial Training	Lb	0	0/0	3/0	1

Credits Sub Total: 23

VI SEMESTER							
S.NO.	**SUBJECT CODE**	**SUBJECT NAME**	**Ty/Lb/ ETL**	**L**	**T/ SLr**	**P/R**	**C**
1	BRE18009	Design of Machine Elements	Ty	3	1/0	0/0	4
2	BRE18010	Hydraulics and Pneumatics	Ty	3	0/0	0/0	3
3	BRE18011	Power Electronics and Drives	Ty	3	0/0	0/0	3
4	BXX18EXX	Elective II	Ty	3	0/0	0/0	3
5	BXX18EXX	Elective III	Ty	3	0/0	0/0	3
PRACTICALS*							
1	BRE18L08	Industrial Automation Lab	Lb	0	0/0	3/0	1
2	BRE18L09	Power Electronics and Drives Lab	Lb	0	0/0	3/0	1
3	BEN18SK2	Soft Skill II (Qualitative and Quantitative	ETL	0	0/0	3/0	1
4	BRE18L10	Mini Project	Lb	0	0/0	3/0	1
5	BRE18TS3	Technical Skill 3	Lb	0	0/0	3/0	1

Credits Sub Total: 21

C: Credits L: Lecture T: Tutorial S. Lr : Supervised Learning P : Problem / Practical R : Research
Ty/Lb/ETL: Theory/Lab/Embedded Theory and Lab *Internal evaluation

VII SEMESTER							
S.NO.	**SUBJECT CODE**	**SUBJECT NAME**	**Ty/Lb/ ETL**	**L**	**T/ SLr**	**P/R**	**C**
1	BRE18012	Kinematics and Dynamics of Robots	Ty	3	1/0	0/0	4
2	BRE18013	Industrial Applications of Robots	Ty	3	0/0	0/0	3
3	BRE18014	Artificial Intelligence and Machine	Ty	3	0/0	0/0	3
4	BXX18EXX	Elective IV	Ty	3	0/0	0/0	3
PRACTICALS*							
1	BRE18L11	Robot Programming Lab	Lb	0	0/0	3/0	1
2	BXX18OLX	Open Lab	Lb	0	0/0	3/0	1
3	BRE18L12	Project Phase -I	Lb	0	0/0	3/3	2
4	BHS18FLX	Foreign Language	Lb	0	0/0	3/0	1

Credits Sub Total: 18

VIII SEMESTER							
S.NO.	**SUBJECT CODE**	**SUBJECT NAME**	**Ty/Lb /ETL**	**L**	**T/ SLr**	**P/R**	**C**
1	BXX18OEX	Open Elective-II	Ty	3	0/0	0/0	3
2	BMG18008	Engineering Economics and Industrial	Ty	3	0/0	0/0	3
3	BXX18EXX	Elective-V	Ty	3	0/0	0/0	3
PRACTICALS*							
1	BRE18L13	Project Phase – II	Lb	0	0/0	12/12	8

Credits Sub Total: 17

C: Credits L: Lecture T: Tutorial S.Lr: Supervised Learning P: Problem / Practical R: Research
Ty/Lb/ETL: Theory /Lab/Embedded Theory and Lab * Internal Evaluation

CREDIT SUMMARY

Semester: 1 : 20 Credits
Semester: 2 : 16 Credits
Semester: 3 : 23 Credits
Semester: 4 : 22 Credits
Semester: 5 : 23 Credits
Semester: 6 : 21 Credits
Semester: 7 : 18 Credits
Semester: 8 : 17 Credits

TOTAL CREDITS - 160

DEPARTMENT OF MECHANICAL ENGINEERING

ELECTIVE -I							
S.NO.	**SUBJECT CODE**	**SUBJECT NAME** **Elective: Mechanical Engineering**	**Ty/Lb/ ETL**	**L**	**T/ SLr**	**P/R**	**C**
1	BRE18E01	Maintenance and Safety Engineering	Ty	3	0/0	0/0	3
2	BRE18E02	Micro Electro Mechanical Systems	Ty	3	0/0	0/0	3
3	BRE18E03	Advanced Strength of Materials	Ty	3	0/0	0/0	3
4	BRE18E04	Computer Integrated Manufacturing	Ty	3	0/0	0/0	3
5	BRE18E05	Finite Element Analysis`	Ty	3	0/0	0/0	3

Credits Sub Total: 15

ELECTIVE -II							
S.NO.	**SUBJECT CODE**	**SUBJECT NAME** **Elective: Robotics**	**Ty/Lb/ ETL**	**L**	**T/ SLr**	**P/R**	**C**
1	BRE18E06	Automation System Design	Ty	3	0/0	0/0	3
2	BRE18E07	Industrial Networking	Ty	3	0/0	0/0	3
3	BRE18E08	Total Integrated Automation	Ty	3	0/0	0/0	3
4	BRE18E09	Micro Robotics	Ty	3	0/0	0/0	3
5	BRE18E10	Cognitive Robotics	Ty	3	0/0	0/0	3
6	BRE18E11	Cloud Robotics	Ty	3	0/0	0/0	3
7	BRE18E12	Medical Robotics	Ty	3	0/0	0/0	3
8	BRE18E13	Precision Equipment Design	Ty	3	0/0	0/0	3

Credits Sub Total: 24

ELECTIVE –III							
S.NO.	**SUBJECT CODE**	**SUBJECT NAME** **Elective: Electrical and Electronics Engineering**	**Ty/Lb/ ETL**	**L**	**T/ SLr**	**P/R**	**C**
1	BRE18E14	Virtual Instrumentation	Ty	3	0/0	0/0	3
2	BRE18E15	Advanced Microprocessors and Micro	Ty	3	0/0	0/0	3
3	BRE18E16	Digital Control System	Ty	3	0/0	0/0	3
4	BRE18E17	Special Machines and Controllers	Ty	3	0/0	0/0	3

ELECTIVE –IV							
S.NO.	**SUBJECT CODE**	**SUBJECT NAME** **Elective: Electronics and Communication Engineering**	**Ty/Lb/ ETL**	**L**	**T/ SLr**	**P/R**	**C**
1	BRE18E18	Digital Signal Processing	Ty	3	0/0	0/0	3
2	BRE18E19	Embedded systems Design	Ty	3	0/0	0/0	3
3	BRE18E20	Wireless Communication	Ty	3	0/0	0/0	3
4	BRE18E21	VLSI Design	Ty	3	0/0	0/0	3
5	BRE18E22	Internet of Things for Robot	Ty	3	0/0	0/0	3

ELECTIVE –V							
S.NO.	**SUBJECT CODE**	**SUBJECT NAME** **Elective: Computer Science and Engineering**	**Ty/Lb/ ETL**	**L**	**T/ SLr**	**P/R**	**C**
1	BRE18E23	Human Computer Interaction	Ty	3	0/0	0/0	3
2	BRE18E24	Advanced Machine Learning	Ty	3	0/0	0/0	3
3	BRE18E25	Randomized Algorithms	Ty	3	0/0	0/0	3
4	BRE18E26	Graph Algorithms	Ty	3	0/0	0/0	3
5	BRE18E27	Vision System and Image Processing	Ty	3	0/0	0/0	3
6	BRE18E28	System Software	Ty	3	0/0	0/0	3

SYLLABUS

SEMESTER – I

DEPARTMENT OF MECHANICAL ENGINEERING

Subject Code: BEN18001	Subject Name: **TECHNICAL ENGLISH - I**	Ty/Lb /ETL	L	T/SLr	P/ R	C
	Prerequisite: None	Ty	1	0/0	2/0	2

L: Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL: Theory / Lab / Embedded Theory and Lab

OBJECTIVES:

- Strengthen their vocabulary in both technical and business situations
- Get practice in functional grammar
- Learn the effective way of corresponding with officials
- Learn to give instructions, suggestions, recommendation sand comprehend and infer the information from the given passages.
- Train learners in organized academic and professional writing

COURSE OUTCOMES (COs): (3 – 5)

Students completing the course would be able to

CO1	Strengthen their active and technical vocabulary
CO2	Understand functional grammar and gain proficiency in technical writing
CO3	Learn the appropriate technique of writing formal and business letters; interpret the advertisements and prepare the resume relevantly
CO4	Learn to give instructions, suggestions, recommendations and comprehend and infer the information from the given passages/ reports
CO5	Focus on academic and technical writing

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1				**H**						**H**		**H**
CO2				**H**						**H**		**H**
CO3				**H**		**M**			**H**	**H**		**H**
CO4				**H**					**H**	**H**		**H**
CO5				**H**					**H**	**H**		**H**

H/M/L indicates strength of correlation H – High, M – Medium, L – Low

Category	Basic Sciences	Engg Sciences	Humanities & Social Sciences	Program core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skills	Soft Skills
			√						
Approval									

Subject Code: BEN18001	Subject Name: **TECHNICAL ENGLISH - I**	Ty/Lb/ETL	L	T/SLr	P/R	C
	Prerequisite: None	Ty	1	0/0	2/0	2

UNIT I VOCABULARYBUILDING **6**

The concept of Word Formation-Root words and affixes from foreign languages and their use in English to form derivatives-Homophones- Words often confused-Verbal analogy

UNIT II BASIC WRITING SKILLS **6**

Using Idioms and phrases in sentences-Sentence structures: statements, interrogative and imperative-Use of Conditional/if' clauses in sentences-Importance of proper punctuation-Creating coherence with sentence markers-Organizing coherent paragraphs in essays

UNIT III IDENTIFYING COMMON ERRORS IN WRITING **6**

Subject-verb agreement-Noun-pronoun agreement- Misplaced Modifiers-Articles-Prepositions- Redundancies and Clichés

UNIT IVWRITING PRACTICE- NATURE AND STYLE OF TECHNICAL WRITING **6**

Describing Gadgets- Defining Concepts-Classifying Data-Comprehension-Essay Writing-Informal and Formal Letter Writing:

UNIT V ORAL COMMUNICATION AND INTERACTIVE LEARNING **6**

(This unit involves interactive practice sessions in Language Lab)

Activities to develop knowledge in Word formation, Vocabulary and analytical thinking-Instructions and –Recommendations-Formal and Informal Registers in Speech-Listening and taking notes

Total no. of Periods: 30

TEXT BOOK:

1. Quest: A Textbook of Communication Skills, Vijay Nicole, 2017.
2. Pushkala, R, PadmasaniKannan S, Anuradha. V, ChandrasenaMRajeswaran

SUGGESTED READINGS:

(i) Practical English Usage. Michael Swan. OUP. 1995.
(ii) Remedial English Grammar. F.T. Wood. Macmillan.2007
(iii)On Writing Well.William Zinsser. Harper Resource Book. 2001
(iv) Study Writing. Liz Hamp-Lyons and Ben Heasly.Cambridge University Press. 2006.
(v) Communication Skills. Sanjay Kumar and PushpLata.Oxford University Press. 2011.
(vi) Exercises in Spoken English. Parts.I-III. CIEFL, Hyderabad. Oxford University Press
(vi) Pronunciation in Use,Mark Hancock. Cambridge University Press. 2012

DEPARTMENT OF MECHANICAL ENGINEERING

Subject Code:	Subject Name: **MATHEMATICS – I**	Ty/Lb/ ETL	L	T/SLr	P/ R	C
BMA18001	Prerequisite: None	Ty	3	1/0	0/0	4

L: Lecture, T: Tutorial,SLr: Supervised Learning, P: Project, R: Research, C: Credits
T/L/ETL: Theory / Lab / Embedded Theory and Lab

OBJECTIVES:

- Apply the Basic concepts in Algebra
- Use the Basic concepts in Matrices
- Identify and solve problems in Trigonometry
- Understand the Basic concepts in Differentiation
- Apply the Basic concepts in Functions of Several variables

COURSE OUTCOMES (COs): (3 – 5)

Students completing the course were able to

CO1	Find the summation of the given series of binomial, exponential & logarithmic
CO2	Transform a non–diagonal matrix into an equivalent diagonal matrix using orthogonal transformation.
CO3	Find expansion of trigonometric function into an infinite series and to separate a complex function into real and imaginary parts.
CO4	Apply knowledge and concepts in finding the derivative of given function and to find the maxima / minima of the given function.
CO5	Evaluate the partial / total differentiation and maxima / minima of a function of several variables.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**H**	**H**			**M**	**M**			**H**	**H**		**H**
CO2	**H**	**H**			**H**	**L**						**H**
CO3	**H**	**H**			**M**				**M**	**H**		**L**
CO4	**H**	**H**			**L**				**M**	**H**		**M**
CO5	**H**	**H**				**M**			**M**	**M**		**H**

H/M/L indicates strength of correlation H – High, M – Medium, L – Low

Category	Basic Sciences	Engg Sciences	Humanities & Social Sciences	Program	Program Electives	Open Electives	Practical / Project	Internships / Technical Skills	Soft Skills
	√								
Approval									

Subject Code:	Subject Name: **MATHEMATICS – I**	Ty/Lb/ ETL	L	T/SLr	P/R	C
BMA18001	Prerequisite: None	Ty	3	1/0	0/0	4

UNIT I ALGEBRA **12**

Binomial, Exponential, Logarithmic Series (without proof of theorems) – Problems on Summation, Approximation and Coefficients.

UNIT II MATRICES **12**

Characteristic equation – Eigen values and Eigen vectors of a real matrix – Properties of Eigen values – Cayley - Hamilton theorem(without proof) – Orthogonal reduction of a symmetric matrix to Diagonal form.

UNIT III TRIGONOMETRY **12**

Expansions of Sin nθ, Cos nθ in powers of Sinθ and Cosθ – Expansion of Tan nθ – Expansions of $\text{Sin}^n\theta$ and $\text{Cos}^n\theta$ in terms of Sines and Cosines of multiples of θ – Hyperbolic functions– Separation into real and imaginary parts.

UNIT IV DIFFERENTIATION **12**

Basic concepts of Differentiation – Elementary differentiation methods – Parametric functions – Implicit function –Leibnitz theorem (without proof) – Maxima and Minima – Points of inflection.

UNIT V FUNCTIONS OF SEVERAL VARIABLES **12**

Partial derivatives – Total differential – Differentiation of implicit functions – Taylor's expansion – Maxima and Minima by Lagrange's Method of undetermined multipliers – Jacobians.

Total no. of Periods: 60

TEXT BOOKS

1. Kreyszig E., *Advanced Engineering Mathematics (10 th ed.)*, John Wiley & Sons, (2011).
2. Veerarajan T., *Engineering Mathematics (for first year)*, Tata McGraw Hill Publishing Co., (2008).

REFERENCES

1. *Grewal B.S., Higher Engineering Mathematics, Khanna Publishers, (2012).*
2. *John Bird, Basic Engineering Mathematics (5th ed.), Elsevier Ltd, (2010).*
3. *P.Kandasamy, K.Thilagavathy and K. Gunavathy, Engineering Mathematics Vol. I (4th Revised ed.), S.Chand& Co., Publishers, New Delhi (2000).*
4. *John Bird, Higher Engineering Mathematics (5th ed.), Elsevier Ltd, (2006).*

DEPARTMENT OF MECHANICAL ENGINEERING

Subject Code: **BPH18001**	Subject Name: **ENGINEERING PHYSICS - I**	Ty/Lb/ ETL	L	T/SLr	P/R	C
	Prerequisite: None	Ty	2	0/1	0/0	3

L: Lecture T: Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL: Theory / Lab / Embedded Theory and Lab

OBJECTIVES:

- Outline the relation between Science, Engineering & Technology.
- Demonstrate competency in understanding basic concepts.
- Apply fundamental laws of Physics in Engineering & Technology.
- To identify & solve problems using physics concepts.
- Produce and present activities associated with the course through effective technical communication

COURSE OUTCOMES (COs): (3 – 5)

Students completing this course were able to

CO1	Demonstrate competency in understanding basic concepts.
CO2	Utilize scientific methods for formal investigations & demonstrate competency with experimental methods and verify the concept to content knowledge.
CO3	Identify and provide solutions for engineering problems.
CO4	Relate the technical concepts to day to day life and to practical situations.
CO5	Think analytically to interpret concepts.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**H**	**H**		**M**	**M**	**M**						
CO2	**H**	**H**	**M**	**M**	**M**	**M**			**M**	**M**		
CO3	**H**	**H**	**H**	**M**	**M**	**M**				**M**		**M**
CO4	**H**	**H**	**M**	**M**		**M**			**M**	**M**		**M**
CO5	**H**	**H**	**M**			**M**		**M**				**L**

H/M/L indicates strength of correlation H – High, M – Medium, L – Low

Category	Basic Sciences	Engg Sciences	Humanities & Social Sciences	Program core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skills	Soft Skills
	√								
Approval									

Subject Code:	Subject Name: **ENGINEERING PHYSICS - I**	Ty/Lb/ ETL	L	T/SLr	P/R	C
BPH18001	Prerequisite: None	Ty	2	0/1	0/0	3

UNIT I MECHANICS & PROPERTIES OF MATTER 9

Mechanics: Introduction- scalar and vector quantities - rigid body - moment of inertia - forces in nature - Newton's laws of motion - derivation of Newton's second law of motion - motion of rocket – dynamical concepts - kinematics - conservation of energy and momentum - conservative and non-conservative forces - mechanics of continuous media - friction and its applications.

Properties of Matter: Elasticity - stress, strain and Hook's law - Poisson's ratio - three moduli of elasticity - twisting couple on a wire - viscosity - flow of liquid through a narrow tube: Poiseuille's law - Ostwald`s viscometer - flow of blood in human body.

UNIT II SHM AND ACOUSTICS 9

SHM: Simple harmonic motion - differential equation of SHM - graphical representation of SHM - average kinetic energy of vibration - total energy of vibration - free and forced vibrations - damped and undamped vibrations - resonance - transverse wave on a string - law of transverse vibration of string - verification of the laws of transverse vibration of string - standing waves.

Acoustics: Fundamentals of acoustics - reverberation- reverberation time - factors affecting acoustics. Ultrasonics -Production of ultrasonic waves - detection of ultrasonic waves - acoustic grating - application of ultrasonic waves.

UNIT III WAVE OPTICS 9

Huygen`s principle - interference of light –wavefront splitting and amplitude –airwedge - Newton`s rings - Michelson interferometer and its applications - Fraunhofer diffraction from a single slit - Rayleigh criterion for limit of resolution - diffraction grating and resolving power of a telescope.

UNIT IV ELECTROMAGNETIC THEORY 9

Electric field - coulomb`s law - alternating emf - rms and average value of an alternating current & voltage - resistors, capacitors and inductor - energy stored in a capacitor - LCR circuit & resonance – magnetism-definition - types - BiotSavart law - energy stored in a magnetic field - Domain theory - electromagnetic induction - self and mutual inductance - Faraday`s law of electromagnetic induction -Lenz law.

UNIT V LASER 9

Laser principle and characteristics - amplification of light by population inversion - properties of laser beams: mono-chromaticity, coherence, directionality and brightness - different types of lasers - Ruby laser-Nd-YAG laser-He-Ne laser-CO_2 laser - semiconductor laser - applications of lasers in science, engineering and medicine.

Total No of Periods: 45

TEXT BOOKS

1. Brijlal, M. N. Avadhanulu& N. Subrahmanyam, Text Book of Optics, S. Chand Publications, 25th edition, 2012
2. R. Murugeshan, Electricity and Magnetism, S.Chand Publications, 10th edition, 2017
3. R. Murugeshan & Kiruthiga Sivaprasath, Modern Physics, S.Chand Publications, 2016

REFERENCES:

1.Dr. Senthil Kumar Engineering Physics I VRB Publishers, 2016
2.N Subrahmanyam & Brijlal, Waves and Oscillations, Vikas Publications, New Delhi,1988
3.N Subrahmanyam & Brijlal, Properties of Matter, S. Chand Co., New Delhi, 1982
4.N Subrahmanyam & Brijlal, Text book of Optics, S. Chand Co., New Delhi, 1989
5.R. Murugeshan, Electricity and Magnetism, S. Chand & Co., New Delhi, 1995

DEPARTMENT OF MECHANICAL ENGINEERING

Subject Code: **BCH18001**	Subject Name: **ENGINEERING CHEMISTRY – I**	Ty/ Lb/ ETL	L	T/SLr	P/R	C
	Prerequisite: None	Ty	2	0/1	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory / Lab / Embedded Theory and Lab

OBJECTIVES:

- Providing an insight into basic concepts of chemical thermodynamics
- To create awareness about the water quality parameters, water analysis and softening of water from industrial perspective.
- Imparting fundamentals of EMF, storage and fuel cells.
- Creating awareness about corrosion and its control methods.
- Introducing modern materials such as composites along with basic concepts of polymer chemistry and plastics.

COURSE OUTCOMES (COs): (1– 5)

CO1	Gain a clear understanding of the basics of chemical thermodynamics which include concepts such as Enthalpy, Entropy and Free energy.
CO2	Obtain an overall idea of Water quality parameters, Boiler requirements, problems, Water softening and Domestic Water treatment.
CO3	Improving the basic knowledge in electrical conductance and emf and also understand the chemical principles of storage devices.
CO4	Observe the information about corrosion and understand the mechanisms of corrosion and the methods of corrosion control.
CO5	Articulate the science of polymers and composites.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**H**	**H**										**M**
CO2	**H**	**H**	**M**	**H**		**H**	**H**					**M**
CO3	**H**	**M**	**H**				**L**					**L**
CO4	**H**		**L**	**H**								**L**
CO5	**H**											**M**

H/M/L indicates strength of correlation H – High, M – Medium, L – Low

Category	Basic Sciences	Engg Sciences	Humanities & Social Sciences	Program core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skills	Soft Skills
	√								
Approval									

DEPARTMENT OF MECHANICAL ENGINEERING

Subject Code: **BCH18001**	Subject Name: **ENGINEERING CHEMISTRY – I**	Ty/ Lb/ ETL	L	T/SLr	P/R	C
	Prerequisite: None	Ty	2	0/1	0/0	3

UNIT I CHEMICAL THERMODYNAMICS 8

Introduction, Terminology in thermodynamics –System, Surrounding, State and Path functions,Extensive and intensive properties. Laws of thermodynamics – I and II laws-Need for the II law. Enthalpy, Entropy, Gibbs free energy, Helmholtz free energy - Spontaneity and its criteria. Maxwell relations, Gibbs -Helmholtz equation (relating E & A) and (relating H & G), Van't Hoff equations.

UNIT II TECHNOLOGYOF WATER 9

Water quality parameters – Definition and expression. Analysis of water – alkalinity, hardness and its determination (EDTA method only).Boiler feed water and Boiler troubles-Scales and sludges, Caustic embrittlement, Priming and Foaming and Boiler corrosion. Water softening processes – Internal and external conditioning – Lime soda, Zeolite, Demineralisation methods.Desalination processes-RO and Electrodialysis.Domestic water treatment.

UNIT III ELECTROCHEMISTRY AND ENERGY STORAGE DEVICES 10

Conductance – Types of conductance and its Measurement. Electrochemical cells – Electrodes and electrode potential, Nernst equation – EMF measurement and its applications.Types of electrodes- Reference Electrodes- Standard hydrogen electrode- Saturated calomel electrode-Quinhydrone electrode – Determination of P^H using these electrodes.Reversible and irreversible cells– Fuel cells- H_2–O_2 fuel cell, Batteries-Lead storage battery,Nickel– Cadmium and Lithium-Battery.

UNIT IV CORROSION AND PROTECTIVE COATING 9

Introduction–Causes of Corrosion–Consequences- Factors affecting corrosion. Theories of corrosion-Chemical corrosion and Electrochemical corrosion. Methods ofcorrosion control – corrosion inhibitors, Sacrificial anode and Impressed current cathodic protection.

Protective coatings- Metallic coatings- Chemical conversion coatings-paints-Constituents and functions.

UNIT V POLYMERS AND COMPOSITES 9

Monomers – Functionality – Degree of polymerization-Tacticity.Polymers – Classification, Conducting Polymers,Biodegradable polymers- Properties and applications.Plastics – Thermoplastics and thermosetting plastics,Compounding of plastics – Compression moulding, injection moulding and extrusion processes.

Polymer composites-introduction-Types of composites-particle reinforced-fiber reinforced-structural composites-examples.Matrix materials, reinforcement materials-Kevlar, Polyamides, fiber glass, carbon fibers, ceramics and metals.

Total number of Periods: 45

TEXTBOOKS:

1. P.Udhayakala.,S.Dinakar&L.Sankar., "Chemistry for Engineers", Charulatha Publications (2018).
2. C.SreekuttanUnnithan, "Applied Chemistry", Sreelakshmi Publications, (2007).
3. Dr.R.Sivakumar, Dr.R.Jayaprakasamand Dr.N.Sivakumar "Engineering Chemistry – I & II" Tata McGraw Hill Publishing Company Ltd, Reprint 2013.

REFERENCES:

1. *P.C. Jain & Monika Jain, "Engineering Chemistry", DhanpatRai publishing Co., (Ltd.) (2013).*
2. *J. C. Kuriacose& J. Rajaram, "Chemistry in Engineering & Technology", Tata McGraw Hill (1996).*

DEPARTMENT OF MECHANICAL ENGINEERING

Subject Code:	Subject Name: **BASIC ELECTRICAL & ELECTRONICS ENGINEERING**	Ty/Lb /ETL	L	T/SLr	P/R	C
BES18001	Prerequisite: None	Ty	2	0/1	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory / Lab / Embedded Theory and Lab

OBJECTIVES:

- Understand the concepts of circuit elements, circuit laws and coupled circuits.
- Acquire knowledge on conventional &non-conventional energy production.
- Gain information on measurement of electrical parameters.
- Identify basic theoretical principles behind the working of modern electronic gadgets.
- Demonstrate digital electronic circuits and assemble simple devices.

COURSE OUTCOMES (Cos) : (3 – 5)

Students completing the course were able to

CO1	Students understand Fundamental laws and theorems and their practical applications
CO2	Predict the behavior of different electric and magnetic Circuits.
CO3	Identify conventional and Non-conventional Electrical power Generation, Transmission and Distribution.
CO4	Identify & Apply schematic symbols and understand the working principles of electronic devices
CO5	Analyze basics of digital electronics and solving problems and design combinational circuits

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**H**	**H**	**H**	**H**							**M**	**L**
CO2	**H**	**H**	**H**	**M**	**M**		**M**				**M**	
CO3	**H**	**M**	**H**	**M**	**H**		**M**		**M**			**L**
CO4	**H**	**M**		**M**			**M**				**M**	**L**
CO5	**H**	**M**	**H**	**M**	**H**				**M**		**M**	**L**

H/M/L indicates strength of correlation H – High, M – Medium, L – Low

Category	Basic Sciences	Engg Sciences	Humanities & Social Sciences	Program core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skills	Soft Skills
		√							
Approval									

DEPARTMENT OF MECHANICAL ENGINEERING

Subject Code:	Subject Name: **BASIC ELECTRICAL & ELECTRONICS ENGINEERING**	Ty/Lb /ETL	L	T/SLr	P/R	C
BES18001	Prerequisite: None	Ty	2	0/1	0/0	3

UNIT I ELECTRIC CIRCUITS **9**

Electrical Quantities – Ohms Law – Kirchhoff's Law – Series and Parallel Connections – Current Division and Voltage Division Rule - Source Transformation – Wye (Y) – Delta (Δ), Delta (Δ) – Wye (Y) Transformation – Rectangular to Polar and Polar to Rectangular.

UNIT II MACHINES & MEASURING INSTRUMENTS **9**

Construction & Principle of Operation of DC motor & DC Generator – EMF equation of Generator – Torque Equation of Motor – Construction & Principle of operation of a Transformer – PMMC – Moving Iron types of meter – Single Phase Induction Type Energy Meter.

UNIT III BASICS OF POWER SYSTEM **9**

Generation of Electric Power (Thermal, Hydro, Wind and Solar) – Transmission & Distribution of Electric Power – Types of Transmission & Distribution Schemes – Representation of Substation.

UNIT IV ELECTRON DEVICES **9**

Passive Circuit Components-Classification of Semiconductor-PN Junction Diode-Zener diode- Construction and Working Principle –Applications--BJT-Types of configuration-JFET.

UNIT V DIGITAL SYSTEM **9**

Number System – Binary, Decimal, Octal, Hexadecimal – Binary Addition Subtraction, Multiplication & Division– Boolean Algebra – Reduction of Boolean Expressions – Logic Gates - De-Morgan's Theorem, Adder – Subtractor.

Total no of Periods: 45

TEXT BOOKS:

1. D P Kothari, I J Nagrath, Basic Electrical Engineering, Second Edition, Tata McGraw-Hill Publisher
2. A Course in Electrical and Electronic Measurements and Instrumentation. A.K. Sawhney, publisher DHANPAT RAI&CO
3. Text Book of Electrical Technology: Volume 3: Transmission, Distribution and Utilization. B.L.Theraja, A.K.Theraja, publisher S.CHAND
4. Morris Mano, M. (2002) Digital Logic and Computer Design. Prentice Hall of India
5. Millman and Halkias1991, Electronic Devices and Circuits, Tata McGraw Hill,

REFERENCES:

1. *R.Muthusubramanian, S.Salivahanan, K A Muraleedharan, Basic Electrical, Electronics And Computer Engineering, Second Edition, ,Tata McGraw-Hill publisher.*

DEPARTMENT OF MECHANICAL ENGINEERING

Subject Code: **BES18002**	Subject Name: **BASIC MECHANICAL & CIVIL ENGINEERING**	Ty/Lb /ETL	L	T/SLr	P/R	C
	Prerequisite: None	Ty	2	0/1	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory / Lab / Embedded Theory and Lab

OBJECTIVES:

- Learn Basics of Internal Combustion Engines, power plants and boilers
- Demonstrate How metals are formed, joined, using machining operations Lathe, Milling and Drilling machines
- To identify & solve problems in Engineering Mechanics
- Learn basics of Building materials and construction
- Know the basic process of concrete, types of masonry Construction of Roads, Railways, Bridges and Dams

COURSE OUTCOMES (COs): (3 – 5)

Students completing the course were able to

CO1	Demonstrate the working principles of power plants, IC Engines and boilers.
CO2	Utilize the concept of metals forming, joining process and apply in suitable machining process
CO3	Identify and provide solutions for problems in engineering mechanics
CO4	Utilize the concept of Building materials and construction able to perform concrete mix and masonry types
CO5	Demonstrate how Roads, Railways, dams, Bridges have been constructed

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**H**					**M**		**H**	**H**	**H**		**H**
CO2	**H**				**L**	**M**		**M**	**M**	**M**		**M**
CO3	**H**	**H**			**L**	**L**		**M**	**M**	**M**		**M**
CO4	**H**				**L**	**L**			**M**	**M**		**M**
CO5	**H**				**L**	**L**		**M**	**M**	**M**		**M**

H/M/L indicates strength of correlation H – High, M – Medium, L – Low

Category	Basic Sciences	Engg Sciences	Humanities & Social Sciences	Program core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skills	Soft Skills
		√							
Approval									

DEPARTMENT OF MECHANICAL ENGINEERING

Subject Code: BES18002	Subject Name: **BASIC MECHANICAL & CIVIL ENGINEERING**	Ty/Lb /ETL	L	T/SLr	P/R	C
	Prerequisite: None	Ty	2	0/1	0/0	3

UNIT I THERMAL ENGINEERING 9

Classification of internal combustion engine – two stroke, four stroke petrol and diesel engines. Classification of Boilers – Cochran boiler – Locomotive boilers – Power plant classification – Working of Thermal and Nuclear power plant.

UNIT II MANUFACTURING PROCESS 13

Metal forming processes – Rolling, forging, drawing, extrusion and sheet metal operations- fundamentals only. Metal Joining processes – Welding - arc and gas welding, Soldering and Brazing. Casting process – Patterns - Moulding tools - Types of moulding - Preparation of green sand mould -Operation of Cupola furnace.
Basics of metal cutting operations – Working of lathe- parts-Operations performed. Drilling machine – Classification – Radial drilling machine - Twist drill nomenclature.

UNIT III MECHANICS 9

Stresses and Strains – Definition – Relationship – Elastic modulus – Centre of gravity – Moment of Inertia – Problems. (Simple Problems Only).

UNIT IV BUILDING MATERIALS AND CONSTRUCTION 7

Materials:Brick - Types of Bricks - Test on bricks - Cement – Types, Properties and uses of cement – Steel - Properties and its uses – Ply wood and Plastics.
Construction:Mortar – Ingredients – Uses – Plastering - Types of mortar - Preparation – Uses – Concrete – Types – Grades – Uses – Curing – Introduction to Building Components (foundation to roof) – Masonry – Types of masonry (Bricks & Stones)

UNIT V ROADS, RAILWAYS, BRIDGES & DAMS 7

Roads – Classification of roads – Components in roads – Railways -Components of permanent way and their function – Bridges – Components of bridges – Dams – Purpose of dams – Types of dams.

Total No. of Periods: 45

TEXT BOOKS

1. S. Bhaskar, S. Sellappan, H.N.Sreekanth,, (2002), "*Basic Engineering*" –Hi-Tech Publications
2. K. Venugopal, V. Prabhu Raja, (2013-14), "*Basic Mechanical Engineering*", Anuradha Publications.
3. K.V. Natarajan (2000), *Basic Civil Engineering*,Dhanalakshmi Publishers
4. S.C. Sharma(2002),*Basic Civil Engineering*,Dhanpat Raj Publications

REFERENCES

1. PR.SL. Somasundaram, (2002), "Basic Mechanical Engineering" –, Vikas Publications.
2. S.C. Rangawala(2002), Building Material and Construction, S. Chand Publisher

DEPARTMENT OF MECHANICAL ENGINEERING

Subject Code:	Subject Name: **BASIC ENGINEERING WORKSHOP**	Ty/Lb /ETL	L	T/SLr	P/R	C
BES18L01	Prerequisite: None	Lb	0	0/0	2/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory / Lab / Embedded Theory and Lab

OBJECTIVES:

- Familiarize the plumbing tools, fittings, carpentry tools, etc.
- Identify basic electrical wiring and measurement of electrical quantities.
- Identify Electronic components, logic gates and soldering process
- Display simple fabrication techniques
- Execute a project independently and make a working model

COURSE OUTCOMES (COs): (3 – 5)

Students completing the course were able to

CO1	Demonstrate fitting tools and carpentry tools, & Perform the process of Filing, Chipping, Cutting.
CO2	Perform the process of fabrication of tray, cones and funnels, Tee Halving Cross, Lap Joint Martise& Joints
CO3	Demonstrate various types of wirings and other equipments.
CO4	Measure fundamental parameters using the electronic instruments

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**H**	**H**	**H**	**M**	**M**			**L**	**M**			**L**
CO2	**H**		**H**	**L**	**M**			**L**	**L**			
CO3	**H**		**M**	**L**				**L**	**L**			
CO4	**H**	**H**	**M**	**L**				**L**	**L**			**M**
CO5												

H/M/L indicates strength of correlation H – High, M – Medium, L – Low

Category	Basic Sciences	Engg Sciences	Humanities & Social Sciences	Program core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skills	Soft Skills
							√		
Approval									

Subject Code: **BES18L01**	Subject Name: **BASIC ENGINEERING WORKSHOP**	Ty/Lb/ETL	L	T/SLr	P/R	C
	Prerequisite: None	Lb	0	0/0	2/0	1

MECHANICAL ENGINEERING PRACTICE

1. FITTING:

Study of fitting tools and Equipments – Practicing, filing, chipping and cutting – making V-joints, half round joint, square cutting and dovetail joints.

2. CARPENTRY:

Introduction – Types of wood – Tools – Carpentry processes – Joints – Planning practice – Tee Halving Joint – Cross Lap Joint – Maritse and Tenon Joint – Dovetail Joint

3. SHEET METAL:

Study of tools and equipments – Fabrication of tray, cones and funnels.

CIVIL ENGINEERING PRACTICE

1. Study of Surveying and its equipments
2. Preparation of plumbing line sketches for water supply and sewage lines
3. Basic pipe connection using valves, laps, couplings, unions, reduces and elbows in house hold fittings

ELECTRICAL ENGINEERING PRACTICE

1. Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit.
2. Measurement of energy using single phase energy meter.
3. Measurement of resistance to earth of an electrical equipment.
4. Residential house wiring using switches, fuse, indicator, lamp and energy meter.
5. Fluorescent lamp wiring.
6. Stair case wiring

ELECTRONIC ENGINEERING PRACTICE

1. Study of Electronic components and equipments – Resistor, colour coding measurement of AC signal parameter (peak- peak, rms period, frequency) using CRO

2. Soldering practice – Components Devices and Circuits – Using general purpose P

Total No. of Periods : 45

DEPARTMENT OF MECHANICAL ENGINEERING

Subject Code:	Subject Name: **ORIENTATION TO ENTREPRENEURSHIP & PROJECT LAB**	Ty/ Lb/ ETL	L	T/SLr	P/R	C
BES18ET1	Prerequisite: None	ETL	0	0/0	2/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory / Lab / Embedded Theory and Lab

OBJECTIVES:

- Understand how entrepreneurship Education transforms individuals into successful leaders.
- Identify individual potential &S have career dreams
- Understand difference between ideas & opportunities
- Identify components & create action plan.
- Use brainstorming in a group to generate ideas.

COURSE OUTCOMES (COs): (3 – 5)

Students completing the course were able to

CO1	Develop a Business plan & improve ability to recognize business opportunity
CO2	Do a self-analysis to build an entrepreneurial career.
CO3	Articulate an effective elevator pitch.
CO4	Analyze the local market environment & demonstrate the ability to find an attractive market
C05	Identify the required skills for entrepreneurship & develop

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		M	M	H	M	M	M		M	M	M	L
CO2	H	M		H	M	H	M	H	H	H	M	M
CO3		M	M	M		H		H	H	H		
CO4		H	M	M	M	M		H	M	M	H	
CO5		M	M	H	M	M	H	H	M	M	H	L

H/M/L indicates strength of correlation H – High, M – Medium, L – Low

Category	Basic Sciences	Engg Sciences	Humanities & Social Sciences	Program core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skills	Soft Skills
							√		
Approval									

Subject Code: BES18ET1	Subject Name: **ORIENTATION TO ENTREPRENEURSHIP & PROJECT LAB**	Ty/ Lb/ ETL	L	T/SLr	P/R	C
	Prerequisite: None	ETL	0	0/0	2/0	1

UNIT I CHARACTERISTICS OF A SUCCESSFUL ENTREPRENEUR

Introduction to entrepreneurship education – Myths about entrepreneurship – How has entrepreneurship changed the country – Dream it. Do it - Idea planes - Some success stories – Global Legends – Identify your own heroes.

UNITII ENTREPRENEURIAL STYLE

Entrepreneurial styles – Introduction, concept & Different types - Barrier to Communication – Body language speaks louder than words

UNIT III DESIGN THINKING

Introduction to Design thinking – Myth busters – Design thinking Process - Customer profiling – Wowing your customer – Personal selling – concept & process – show & tell concept – Introduction to the concept of Elevator Pitch

UNIT IV RISK MANAGEMENT

Introduction to risk taking & Resilience – Managing risks (Learning from failures, Myth Buster) – Understanding risks through risk takers – Why do I do? – what do I do?

UNIT VPROJECT

How to choose a topic – basic skill sets necessary to take up a project – creating a prototype – Pitch your project – Project presentation.

REFERENCE BOOKS& WEBSITE:

1. *Encyclopedia of Small Business (2011) – (e book)*
2. *Oxford Handbook of Entrepreneurship (2014)–(e book)*
3. *lms.learnwise.org*

Total No. of Periods : 15

SEMESTER-II

Subject Code: **BMA18003**	Subject Name: **MATHEMATICS – II**	Ty/Lb /ETL	L	T/SLr	P/R	C
	Prerequisite: None	Ty	3	1/0	0/0	4

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory / Lab / Embedded Theory and Lab

OBJECTIVES:

- Understand the Basic concepts in Integration
- Identify the Basic concepts in Multiple integrals
- Use the Basic concepts in Ordinary Differential equations
- Apply the Basic concepts of Analytical Geometry.
- Analyze the Basic concepts of Vector Calculus

COURSE OUTCOMES (COs): (3 – 5)

Students completing the course were able to

CO1	Integrate given function by using methods of integration and to find the area under curve and the volume of a solid by revaluation.
CO2	Evaluate the multiple integrals / area /volume and to change the order of integration.
CO3	Solve the ordinary differential equation and to solve Eulers differential equation.
CO4	Find the equation of planes, lines and sphere and to find the shortest distance between to skew lines.
CO5	Find the gradient, maximum directional derivative and work done by a force and to verify Green/ Stokes/ Gauss divergence theorem

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**H**	**H**			**M**	**M**			**M**	**M**		**H**
CO2	**H**	**H**			**M**	**H**			**H**	**H**		**M**
CO3	**H**	**H**			**M**	**H**			**H**	**H**		**M**
CO4	**H**	**H**			**L**	**M**			**M**	**H**		**M**
CO5	**H**	**H**			**M**	**M**			**M**	**H**		**M**

H/M/L indicates strength of correlation H – High, M – Medium, L – Low

Category	Basic Sciences	Engg Sciences	Humanities & Social Sciences	Program core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skills	Soft Skills
	√								
Approval									

Subject Code: **BMA18003**	Subject Name: **MATHEMATICS – II**	Ty/ Lb/ ETL	L	T/SLr	P/R	C
	Prerequisite: None:	Ty	3	1/0	0/0	4

UNIT I INTEGRATION **12**

Basic concepts of Integration – Methods of Integration– Integration by substitution – Integration by parts – Definite integrals– Properties of definite integrals – Problems on finding Area and Volume using single integrals (simple problems).

UNIT II MULTIPLE INTEGRALS **12**

Double integral in Cartesian and Polar Co-ordinates – Change of order of integration – Triple integral in Cartesian Co-ordinates – Spherical Polar Co-ordinates – Change of variables (simple problems).

UNIT III ORDINARY DIFFERENTIAL EQUATIONS **12**

First order differential equations – Second and higher order linear differential equations with constant coefficients and with RHS of the form: e^{ax}, x^n, Sin ax, Cos ax, $e^{ax}f(x)$, x f(x) where f(x) is Sin bx or Cos bx – Differential equations with variable coefficients (Euler's form) (simple problems).

UNIT IV THREE-DIMENSIONAL ANALYTICAL GEOMETRY **12**

Direction Cosines and Ratios – Equation of a straight line – Angle between two lines – Equation of a plane – Co-planar lines – Shortest distance between skew lines – Sphere – Tangent plane.

UNIT V VECTOR CALCULUS **12**

Scalar and Vector functions – Differentiation – Gradient, Divergence and Curl – Directional derivatives – Irrotational and Solenoidal fields– Line, Surface and Volume integrals – Green's, Stoke's and Gauss divergence theorems (statement only) – Verification.

Total no. of Periods: 60

TEXTBOOKS:

1. Kreyszig E., *Advanced Engineering Mathematics (10th ed.)*, John Wiley & Sons, (2011).
2. Veerarajan T., *Engineering Mathematics (for first year)*, Tata McGraw Hill Publishing Co., (2008).

REFERENCES:

1. *Grewal B.S., Higher Engineering Mathematics, Khanna Publishers, (2012).*
2. *John Bird, Basic Engineering Mathematics (5th ed.), Elsevier Ltd, (2010).*
3. *P.Kandasamy, K.Thilagavathy and K. Gunavathy, Engineering Mathematics Vol. I (4th Revised ed.), S.Chand& Co., Publishers, New Delhi (2000).*
4. *John Bird, Higher Engineering Mathematics (5th ed.), Elsevier Ltd, (2006).*

DEPARTMENT OF MECHANICAL ENGINEERING

Subject Code:	Subject Name: **ENGINEERING PHYSICS – II**	Ty/Lb /ETL	L	T/SLr	P/R	C
BPH18002	Prerequisite: None	Ty	2	0/1	0/0	3

L: Lecture T: Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL: Theory / Lab / Embedded Theory and Lab

OBJECTIVES:

- Design, conduct experiment and analyze data.
- Develop a Scientific attitude at micro and nano scale of materials
- Understand the concepts of Modern Physics
- Apply the science of materials to Engineering & Technology

COURSE OUTCOMES (COs): (3 – 5)

Students completing the course were able to

CO1	Demonstrate skills necessary for conducting research related to content knowledge and laboratory skills.
CO2	Apply knowledge and concepts in advanced materials and devices.
CO3	Acquired Analytical, Mathematical skills for solving engineering problems.
CO4	Ability to design and conduct experiments as well as function in a multi-disciplinary teams.
CO5	Generate analytical thought to interpret results & place them within a broader context

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**H**	**H**	**M**	**M**	**M**	**L**				**M**		**L**
CO2	**H**	**H**		**M**	**M**							**L**
CO3	**H**	**H**	**H**	**H**	**M**					**M**		
CO4	**H**	**H**	**H**	**H**	**M**				**H**	**M**		**L**
CO5	**H**	**M**	**M**	**M**	**M**	**L**			**M**	**M**		**L**

H/M/L indicates strength of correlation H – High, M – Medium, L – Low

Category	Basic Sciences	Engg Sciences	Humanities & Social Sciences	Program core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skills	Soft Skills
	√								
Approval									

Subject Code:	Subject Name: **ENGINEERING PHYSICS – II**	Ty/Lb /ETL	L	T/SLr	P/R	C
BPH18002	Prerequisite: None	Ty	2	0/1	0/0	3

UNIT I QUANTUM PHYSICS **9**

Quantum free electron theory - deBroglie waves - derivation of deBroglie waves - Davisson and Germer experiment - uncertainty principle - electron microscope-scanning electron microscope - physical significance of wave function - Schrodinger wave equation and its applications - Fermi energy- effective mass - phonons - Fermi function-density of states - origin of bandgap in solids - 1D scattering of electrons in periodic potential.

UNIT II SEMICONDUCTORS **9**

Introduction - properties of semiconductors - classification of semiconductor - effect of temperature in semiconductor - hole current - carrier concentration in intrinsic semiconductor (electron and hole density) - variation of Fermi energy level and carrier concentration with temperature in an intrinsic semiconductor - carrier transport - diffusion - drift - mobility - Hall effect - determination of Hall coefficient and its applications - diodes.

UNIT III LIGHT SEMICONDUCTOR INTERACTION **9**

Types of electronic materials: metals, semiconductors and insulators - qualitative analysis of extrinsic semiconductor & its applications - optical transition in bulk semiconductors: absorption, spontaneous and stimulated emission - exciton and its types - traps and its types - colour centers and its types and importance - luminescence - classifications of luminescence based on excitation - optical loss and gain - Photovoltaic effect - Photovoltaic potential - spectral response - solar energy converters - solar cells.

UNIT IV OPTO ELECTRONIC DEVICES **9**

Photodetectors-photoconductors-photodiodesprinciple, construction, working and characteristics-Phototransistors-Laser diodes - LED theory, construction and working - seven segment display, advantages of LED - LCD theory, construction and working.

UNIT V ENGINEERED MATERIALS **9**

Classification of engineered materials - Nano phase materials - its synthesis and properties - shape memory alloys and its applications - biomaterials – nonlinear optical materials - metallic glasses - metamaterials - homo and hetero junction semiconductors - semiconducting materials for optoelectronic devices - quantum wells, wires and dots.

Total no. of Periods: 45

TEXT BOOKS:

(1) P.K. Palanisamy, Semiconductor Physics and Optoelectronics, Scitech Publications, 2010
(2) Jyoti Prasad Bandyopadhyay, Semicoductor Devices, S. Chand Publications, 2014
(3) Charles Kittal, Introduction to Solid State Physics, Wiley Publications, 2012

REFERENCES:

(1) S. Shubhashree, S. Bharathi Devi & S. Chellammal Madhusudanan, Engineering Physics, Sree Lakshmi Publications, 2004
(2) G. Senthil Kumar, N. Iyandurai, & G. Vijayakumar, Material Science, VRB Publishers, 2017
(3) R.Murugeshan & Kiruthigasivaprakash, Modern Physics, 14th edition, S. Chand & Co, 2008
(4) Pallab Bhattacharya, Semiconductor optoelectronic devices, second edition, Pearson Education,2003

Subject Code:	Subject Name: **ENGINEERING CHEMISTRY – II**	Ty/Lb/ ETL	L	T/SLr	P/R	C
BCH18002	Prerequisite: None	Ty	2	0/1	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory / Lab / Embedded Theory and Lab

OBJECTIVES:

- Imparting the basic concepts of phase rule and apply the same to one and two component systems.
- Introducing the chemistry of engineering materials such as cement, lubricants, abrasives, refractories, alloys and nano materials.
- To impart a sound knowledge on the principles of chemistry involving different application-oriented topics
- Introducing salient features of fuels and combustion.
- To give an overview on modern analytical techniques

COURSE OUTCOMES (COs: (1 – 5)

Students completing the course were able to

CO1	Understand the science of phase equilibria and apply the phase rule to different systems.
CO2	Gain an overview of Engineering Materials such as Lime, Cement, Lubricants, Abrasives, Refractories, Alloys and Nanomaterials.
CO3	Recognize the essential information about consumer products such as Soaps and Detergents, also gaining the basic knowledge about Explosives and Propellants.
CO4	Discover the fuel Chemistry and Combustion process.
CO5	Inferring few important Analytical Techniques and their applications.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**H**											**L**
CO2	**H**		**H**			**L**	**H**					**L**
CO3	**H**					**H**						**L**
CO4	**H**	**M**	**H**	**H**			**H**					**M**
CO5	**H**				**M**							**H**

H/M/L indicates strength of correlation H – High, M – Medium, L – Low

Category	Basic Sciences	Engg Sciences	Humanities & Social Sciences	Program core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skills	Soft Skills
	√								
Approval									

DEPARTMENT OF MECHANICAL ENGINEERING

Subject Code:	Subject Name: **ENGINEERING CHEMISTRY – II**	Ty/Lb/ ETL	L	T/SLr	P/R	C
BCH18002	Prerequisite: None	Ty	2	0/1	0/0	3

UNIT I PHASE EQUILIBRIA 8

Introduction – Definition of terms involved in phase rule. Derivation of Gibbs phase rule – Applications to one component system – water system. Binary system – Eutectic system – Pb – Ag system, Bi – Cd system. Thermal analysis – Cooling curves.

UNIT II MATERIAL CHEMISTRY 10

Cement – Manufacture, Chemistry of setting and hardening. Lubricants – Requirements of good lubricants, Mechanism, Properties of lubricants, Classification – Examples.Abrasives–Classification –Moh'sscale-Hardandsoftabrasives,Preparation ofartificial abrasives(siliconcarbide,boroncarbide),Applications ofabrasives.Refractories– Classification, Properties-Refractoriness, RUL, Porosity, Thermalspalling.Alloys-Classification ofalloys–Purposeofmakingalloys-Ferrous andnon-Ferrousalloys-Heat treatment. Nano materials – properties, carbonnano tubes – properties, fabrication – carbon arc method, laser vapourization method.

UNIT III APPLIED CHEMISTRY 9

Soapsanddetergents:Soaps – Saponification of oils and fats, manufacture of soaps, classification of soap – soft soap, medicated soap, herbal soap, shaving soap and creams.

Detergents – Anionic detergents – manufacture and applications, Comparison of soaps and detergents.

Rocket propellants and explosives:Rocket propellants – characteristics, solid and liquid propellants – examples.Explosives- Introduction, characteristics, classification, Oxygen balance, preparation, properties and uses of detonators, low explosives and high explosives, Dynamites, Gun cotton, Cordite.

Food adulterants- Common adulterants in different foods – milk and milk products, vegetableoils, and fats, spices and condiments, cereals, pulses, sweetening agents and beverages, Contamination with toxic chemicals – pesticides and insecticides.

UNIT IV FUELS & COMBUSTION 9

Introductionto Fuels – classification – Calorific value – GCV, LCV.Solid Fuels–Coal-Proximate Analysis, Metallurgical Coke–Manufacture of Metallurgical Coke.Liquid Fuel–Refining of Petrol, Synthetic Petrol–Manufacturing Process–HydrogenationofCoal, Polymerization,Cracking–Knocking–OctaneNumber–LeadedPetrol(or)Anti–knocking – Cetane Number–Ignition Lag. Gaseous fuels–CNG–LPG–WaterGas, Producer gas–Biogas- Combustion– FlueGasanalysis– Orsat's method.

UNIT V ANALYTICAL AND CHARACTERIZATION TECHNIQUES 9

Electron microscopes: Scanning electron microscope & Transmission electron microscope, instrumentation and applications. Absorption and Emission Spectrum - Beer - Lambert's law.Visible and UV Spectroscopy – instrumentation – Block diagram - working.IR Spectroscopy – instrumentation - Block diagram – molecular vibrations – stretching and bending – H_2O, CO_2. –Characterization of some important organic functional groups. Chromatographic techniques – column, thin layer and paper.

Total no. of Periods: 45

TEXTBOOKS:

1. P.Udhayakala., S.Dinakar&L.Sankar., "Chemistry for Engineers", Charulatha Publications (2018).
2. Dr.R.Sivakumar, Dr.R.Jayaprakasam and Dr.N.Sivakumar "Engineering Chemistry – I & II" Tata McGraw Hill Publishing Company Ltd, Reprint 2013.
3. C. S.Unnithan, T. Jayachandran& P. Udhayakala, "Industrial Chemistry", Sreelakshmi Publications (2009).

REFERENCES:

1. P.C. Jain & Monika Jain, "Engineering Chemistry", DhanpatRai publishing Co., (Ltd.) (2013).

DEPARTMENT OF MECHANICAL ENGINEERING

Subject Code: **BES18003**	Subject Name: **ENVIRONMENTAL SCIENCE** (Non- Credited)	Ty/Lb /ETL	L	T/SLr	P/R	C
	Prerequisite: None	Ty	Non Credit			

L: Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL: Theory / Lab / Embedded Theory and Lab

OBJECTIVES:

- To acquire knowledge of the Environment and Ecosystem & Biodiversity
- To acquire knowledge of the different types of Environmental pollution
- To know more about Natural Resources
- To gain understanding of social issues and the Environment
- To attain familiarity of human population and Environment

COURSE OUTCOMES (COs): (3 – 5)

Students completing the course were able to

CO1	To know about Environment and Ecosystem & Biodiversity
CO2	To clearly comprehend air, water, Soil, Marine, Noise, Thermal and Nuclear Pollutions and Solid Waste management and identify the importance of natural resources like forest, water, and food resources
CO3	To discover water conservation and watershed management
CO4	To identify its problems and concerns climate change, global warming, acid rain, ozone layer depletion etc.,
CO5	To explain family welfare programmes and role of information technology in human health and environment

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO 8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1						**M**	**H**	**M**				**M**
CO2						**M**	**H**			**M**		**M**
CO3						**M**	**H**	**M**				**M**
CO4						**M**	**H**	**M**		**M**		**M**
CO5						**M**	**H**			**M**		**M**

H/M/L indicates strength of correlation H – High, M – Medium, L – Low

Category	Basic Sciences	Engg Sciences	Humanities & Social Sciences	Program core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skills	Soft Skills
			√						
Approval									

Subject Code: BES18003	Subject Name: **ENVIRONMENTAL SCIENCE** (Non- Credited)	Ty/Lb /ETL	L	T/SLr	P/R	C
	Prerequisite: None	Ty	Non Credit			

UNIT I ENVIRONMENT AND ECOSYSTEM

Definition, Scope and Importance of environment – need for public awareness – concept, structure and function of an ecosystem- producers, consumers and decomposers – energy flow in the ecosystem. Biodiversity at national and local levels – India

UNIT II ENVIRONMENT POLLUTION

Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Nuclear hazards (g) E-Wastes and causes, effects and control measures.

UNIT III NATURAL RESOURCES

Forest resources: Use and over-exploitation, deforestation. Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems.

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT

From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns climate change, global warming, acid rain, ozone layer depletion, nuclear accidents, central and state pollution control boards- Public awareness.

UNIT V HUMAN POPULATION AND THE ENVIRONMENT

Population growth, variation among nations – population explosion, environment and human health – human rights – value education – HIV/AIDS – women and child welfare – role of information technology in environment and human health

TEXT BOOKS

1. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education (2004).
2. Benny Joseph, 'Environmental Science and Engineering', Tata McGrawHill,NewDelhi, (2006).

REFERENCES

1. *Vairamani, S. and Dr. K. Sankaran.* ***Elements of Environmental and Health Science.****Karaikudi: KPSV Publications, 5th Edition, July 2013.*
2. *Ifthikarudeen, Etal,* ***Environmental Studies****, Sooraj Publications,2005.*
3. *R.Murugesan,* ***Environmental Studies,*** *Millennium Publishers and Distributors, 2nd Edition, July, 2009.*

Subject Code: **BEN18ET1**	Subject Name: **COMMUNICATION LAB**	Ty/Lb/ ETL	L	T/SLr	P/R	C
	Prerequisite: None	ETL	1	0/0	2/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory / Lab / Embedded Theory and Lab

OBJECTIVES:

- Strengthen the academic and interpersonal advanced vocabulary
- Strengthen learners' writing skill such as summarizing, describing and report writing
- Learn to keep the simple conversations in day to day life
- Get to know certain life skills such as marketing, advertising and do presentation
- Improve the reading skill with comprehension

COURSE OUTCOMES (COs): (3 – 5)

Students completing the course would be able to

CO1	strengthen their active vocabulary and appropriate language usage through reading poems, stories, texts, newspapers, magazines and research articles
CO2	use appropriate technical vocabulary in interpreting data
CO3	engage effectively in role-play, dialogue, conversation and interviews
CO4	equip them for effective interaction with people in all situations both academic and professional
CO5	learn English language as a 'life skill' and prepare for placement interviews

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1				**H**						**H**		**H**
CO2				**H**						**H**		**H**
CO3				**H**		**M**			**H**	**H**		**H**
CO4				**H**					**H**	**H**		**H**
CO5				**H**					**H**	**H**		**H**

H/M/L indicates strength of correlation H – High, M – Medium, L – Low

Category	Basic Sciences	Engg Sciences	Humanities & Social Sciences	Program core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skills	Soft Skills
			√						
Approval									

Subject Code: **BEN18ET1**	Subject Name: **COMMUNICATION LAB**	Ty/Lb/ ETL	L	T/SLr	P/ R	C
	Prerequisite: None	ETL	1	0/0	2/0	1

UNIT I **6**
Listening and Speaking- Informal and Formal Contexts

UNIT II **6**
Compeering -Anchoring -Group Discussion

UNIT III **6**
Poster Presentation -Welcome Speech -Vote of Thanks

UNIT IV **8**
Formal Presentation -Power point presentation of charts/ Diagrams

UNIT V **4**
Facing an Interview- Mock Interview

Total no. of Periods: 30

SUGGESTED READINGS:

(1) *Practical English Usage.* Michael Swan. OUP. 1995.
(2) *Remedial English Grammar.* F.T. Wood. Macmillan.2007
(3) *On Writing Well.*William Zinsser. Harper Resource Book. 2001
(4) *Study Writing.* Liz Hamp-Lyons and Ben Heasly.Cambridge University Press. 2006.
(5) *Communication Skills*. Sanjay Kumar and PushpLata.Oxford University Press. 2011.
(6) *Exercises in Spoken English.* Parts.I-III. CIEFL, Hyderabad. Oxford University Press
(7) Pronunciation in Use, Mark Hancock. Cambridge University Press. 2012

.

DEPARTMENT OF MECHANICAL ENGINEERING

Subject Code: BES18ET2	Subject Name: **BASIC ENGINEERING GRAPHICS**	Ty/Lb/ ETL	L	T/SLr	P/R	C
	Prerequisite: None	ETL	1	0/0	2/0	2

L: Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL: Theory / Lab / Embedded Theory and Lab

OBJECTIVES:

- Learn to know what kind of pencils to be used to sketch lines, numbers, Letters and Dimensioning in drawing sheet.
- Draw Projection of points, line, planes and solids using Drafters
- To identify the angle of projection and development of surfaces, isometric projection and Orthographic projection
- Know the basics of elevation and plan of building.
- Learn the basics of Drafting using AutoCAD Software

COURSE OUTCOMES (COs) : (3 – 5)

Students completing the course were able to

CO1	Utilize the concept of Engineering Graphics Techniques to draft letters, Numbers, Dimensioning in Indian Standards
CO2	Demonstrate the drafting practice visualization and projection skills useful for conveying ideas in engineering applications.
CO3	Identify basic sketching techniques of engineering equipments
CO4	Demonstrate the projections of Points, Lines, Planes and Solids.
CO5	Draw the sectional view of simple buildings and utilize Auto CAD Software.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**H**	**H**	**H**	**M**	**M**	**M**			**H**	**H**		**H**
CO2	**H**	**H**	**H**	**M**	**M**	**M**			**H**	**H**		**H**
CO3	**H**	**H**	**H**	**L**		**M**			**M**	**M**		**M**
CO4	**H**	**H**	**M**	**M**		**H**		**M**	**H**	**H**		**H**
CO5	**H**	**H**	**H**	**M**	**H**	**L**		**M**	**H**	**H**		**H**

H/M/L indicates strength of correlation H – High, M – Medium, L – Low

Category	Basic Sciences	Engg Sciences	Humanities & Social Sciences	Program core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skills	Soft Skills
							√		
Approval									

Subject Code: BES18ET2	Subject Name: **BASIC ENGINEERING GRAPHICS**	Ty/Lb /ETL	L	T/SLr	P/R	C
	Prerequisite: None	ETL	1	0/0	2/0	2

CONCEPTS AND CONVENTIONS (Not for examination) **3**

Introduction to drawing, importance and areas of applications – BIS standards – IS: 10711 – 2001 : Technical products Documentation – Size and layout of drawing sheets – IS 9606 – 2001: Technical products Documentation – Lettering – IS 10714 & SP 46 – 2003: Dimensioning of Technical Drawings – IS : 15021 – 2001 : Technical drawings – Projections Methods – drawing Instruments, Lettering Practice – Line types and dimensioning – Border lines, lines title blocks Construction of polygons – conic sections – Ellipse, Parabola, Hyperbola and cycloids.

UNITI PROJECTION OF POINTS, LINES AND PLANE SURFACES **6**

Projection of points and straight lines located in the first quadrant – Determination of true lengths and true inclinations – projection of polygonal surface and circular lamina in simple position only.

UNIT II PROJECTION OF SOLIDS **6**

Projection of simple solids like prism, pyramid, cylinder and cone in simple position

Sectioning of above solids in simple vertical position by cutting plane inclined to one reference plane and perpendicular to the other.

UNIT IIIDEVELOPMMENT OF SURFACES AND ISOMETRIC PROJECTION **6**

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

Principles of isometric projection – isometric scale – isometric projections of simple solids, like prisms pyramids, cylinders and cones.

UNIT IV ORTHOGRAPHICS PROJECTIONS **6**

Orthographic projection of simple machine parts – missing views

BUILDING DRAWING

Building components – front, Top and sectional view of a security shed.

UNIT V COMPUTER AIDED DRAFTING **3**

Introduction to CAD – Advantages of CAD – Practice of basic commands – Creation of simple components drawing using CAD software.

Total no. of Periods: 30

Note: First angle projection to be followed**.**

TEXT BOOKS:

1. Bhatt, N.D. and Panchal, V.M. (2014) Engineering Drawing Charotar Publishing House
2. Gopalakrishnan, K.R. (2014) Engineering Drawing (Vol.I& II Combined) Subhas Stores, Bangalore.

DEPARTMENT OF MECHANICAL ENGINEERING

Subject Code: **BES18L02**	Subject Name: **INTEGRATED PHYSICAL SCIENCE LAB**	Ty/Lb/ ETL	L	T/SLr	P/R	C
	Prerequisite: None	Lb	0	0/0	2/0	1

L: Lecture T: Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL: Theory / Lab / Embedded Theory and Lab

OBJECTIVES:

- Demonstrate the ability to make physical measurements & understand the limits of precision in measurements.
- Display the ability to measure properties of variety of mechanical, optical, electrical and electronic systems.
- To help learners measure conductivity and EMF using electrical equipment.
- To understand the analytical skills through chromatography &viscometry
- To familiarize the concepts of chem. Informatics

COURSE OUTCOMES (COs): (3 – 5)

Students completing the course were able to

CO1	Recognize the correctness and precision in the results of measurements.
CO2	Construct and compare the properties of variety of mechanical, optical, electrical and electronic systems.
CO3	Familiarizing the titration methods using conductometry & potentiometry
CO4	Developing the Research spirit through the knowledge of Cheminformatics & Analytical skills.

Mapping of Course Outcomes with Program Outcomes (Pos)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	L	H	H							
CO2	H	H	M	H	H					M		
CO3	H	H	M	H	H				H			
CO4	H	H	H	H	H				H		H	M

H/M/L indicates strength of correlation H – High, M – Medium, L – Low

Category	Basic Sciences	Engg Sciences	Humanities & Social Sciences	Program core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skills	Soft Skills
							√		
Approval									

Subject Code: **BES18L02**	Subject Name: **INTEGRATED PHYSICAL SCIENCE LAB**	Ty/Lb/ ETL	L	T/SLr	P/R	C
	Prerequisite: None	Lb	0	0/0	2/0	1

LIST OF EXPERIMENTS

1. Determination of Coefficient of Viscosity of a given liquid by Poiseuille`s method.
2. Particle Size determination using Laser Source.
3. Determination of Numerical Aperture of an Optical Fiber.
4. Spectrometer- Refractive Index/Dispersive power/i-d curve.
5. Potentiometer - Resistance of a wire.
6. Transistor Characteristics -Input Resistance, Output Resistance and Gain.
7. Studies on acid-base conductometric titration.
8. Determination of redox potentials using potentiometry.
9. Determination of $R_f$values of various components using thin layer chromatography.
10. Viscosity studies using capillary viscometer.
11. Compute the structures of the given polymers, drugs, bio molecules using Chem Draw.
12. Studies on potential energy surface of the given molecules.
13. Estimate NMR spectra from a Chem Draw structure.

Total no. of Periods: 30

DEPARTMENT OF MECHANICAL ENGINEERING

Subject Code:	Subject Name: **C PROGRAMMING AND LAB**	Ty/Lb/ ETL	L	T/SLr	P/R	C
BES18ET3	Prerequisite: None	ETL	1	0/0	2/0	2

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory / Lab / Embedded Theory and Lab

OBJECTIVES:

- Outline the basics of C Language.
- Apply fundamentals in C programming.
- Produce and present activities associated with the course.

COURSE OUTCOMES (COs): (3 – 5)

Students completing the course were able to

CO1	Acquire knowledge how to write and execute c programs
CO2	Understand the fundamental expression and statements of C Language.
CO3	Work with arrays, functions, pointers, structures, Strings and Files in C.
CO4	Identify and provide solutions for engineering problems in C programming

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**H**	**H**			**M**	**M**		**H**	**M**			**H**
CO2	**H**	**M**			**H**	**M**		**M**	**H**			**M**
CO3	**H**			**H**		**M**		**M**	**H**			**M**
CO4	**H**			**M**		**M**		**H**	**M**			**M**

H/M/L indicates strength of correlation H – High, M – Medium, L – Low

Category	Basic Sciences	Engg Sciences	Humanities & Social Sciences	Program core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skills	Soft Skills
							√		
Approval									

Subject Code:	Subject Name: **C PROGRAMMING AND LAB**	Ty/Lb /ETL	L	T/SLr	P/R	C
BES18ET3	Prerequisite: None	ETL	1	0/0	2/0	2

UNIT I INTRODUCTION **6**

Fundamentals, C Character set, Identifiers and Keywords, Data Types, Variables and Constants, Structure of a C Program, Executing a C Program.

UNIT II EXPRESSION AND STATEMENT **6**

Operators, Types-Complex and Imaginary, Looping Statement-For, While, Do, Break, continue, Decision Statement-If, If else, Nested if, Switching Statement, Conditional Operator.

UNIT III ARRAYS AND FUNCTIONS **6**

Defining an Array, Using Array elements as counters, Generate Fibonacci number, Generate Prime Numbers, Initializing Arrays, Multidimensional Arrays, Defining a Function, Function call -types of Function calls -Function pass by value -Function pass by reference, Write a Program in Recursive Function.

UNIT IV STRUCTURES AND POINTERS **6**

Working with Structures -Introduction -Syntax of structures -Declaration and initialization -Declaration of structure variable -Accessing structure variables, Understanding Pointers -Introduction -Syntax of Pointer.

UNIT V STRINGS AND FILE HANDLING **6**

Strings -Syntax for declaring a string -Syntax for initializing a string -To read a string from keyboard, Files in C -File handling functions -Opening a File closing a file --example: fopen, fclose -Reading data from a File- Problem solving in C

Total no. of Periods: 30

1. **www.spoken-tutorials.org**
2. **http://www.learn-c.org/**

REFERENCE:

Stephen G. Kochen"Programming in C- A complete introduction to the C Programming Language. Third Edition, Sams Publishing -2004

Ajay Mital, "Programming in C: A Practical Approach", Pearson Publication-2010

LIST OF PROGRAMS

1. Write a program to check 'a' is greater than 'b' or less than 'b' Hint: use if statement.
2. Write another program to check which value is greater 'a', 'b' or 'c'. Hint: use else-if statement. (Take values of a, b, c as user inputs)
3. Write a Program to find the sum of the series: $x + X^3/3! + X^5/5! + \ldots\ldots\ldots\ldots\ldots X^n/n!$
4. Write a C Program to solve a Quadratic Equation by taking input from Keyboard
5. Write a C Program to arrange 20 numbers in ascending and descending Order. Input the Numbers from Keyboard
6. Write a C Program to Multiply a 3 x 3 Matrix with input of members from Keyboard
7. Write a program that takes marks of three students as input. Compare the marks to see which student has scored the highest. Check also if two or more students have scored equal marks.
8. Write a program to display records of an employee. Like name, address, designation, salary.
9. Write a C program, declare a variable and a pointer. Store the address of the variable in the pointer. Print the value of the pointer

Write a C program to concatenate String 'best' and String 'bus'. Hint: strcat(char str1, char str2); Explore the other functions in string library.

Write a program to create a file TEST. Write your name and address in the file TEST. Then display. it on the console using C program

SEMESTER-III

DEPARTMENT OF MECHANICAL ENGINEERING

Subject Code:	Subject Name : **MATHEMATICS III FOR MECHANICAL AND CIVIL ENGINEERS**	**Ty / Lb/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
BMA18005	**Prerequisite: Mathematics I & II**	**Ty**	**3**	**1/0**	**0/0**	**4**

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES: The student will learn

- Basic mathematical tools and techniques which emphasize the development of rigorous logical thinking and analytical skills.
- Theory and applications of partial differential equation, its applications, Fourier series, transforms and Laplace transformation.

COURSE OUTCOMES (COs) : (3- 5)

CO1	To understand the Basic concepts in Partial Differential equations
CO2	To understand the Basic concepts in Fourier series
CO3	To understand the Basic concepts in One & Two dimensional Heat and Wave equations
CO4	To understand the Basic concepts in Laplace Transforms
CO5	To understand the Basic concepts in Fourier Transforms

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**H**	**H**	**M**	**M**	**L**	**L**	**L**	**L**	**L**	**L**	**L**	**L**
CO2	**H**	**H**	**M**	**M**	**L**	**L**	**L**	**L**	**L**	**L**	**L**	**L**
CO3	**H**	**H**	**M**	**M**	**L**	**L**	**L**	**L**	**L**	**L**	**L**	**L**
CO4	**H**	**H**	**M**	**M**	**L**	**L**	**L**	**L**	**L**	**L**	**L**	**L**
CO5	**H**	**H**	**M**	**M**	**L**	**L**	**L**	**L**	**L**	**L**	**L**	**L**

COs / PSOs	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**			
CO1	**M**	**L**	**L**	**H**	**L**			
CO2	**M**	**L**	**L**	**H**	**L**			
CO3	**M**	**L**	**L**	**H**	**L**			
CO4	**M**	**L**	**L**	**H**	**L**			
CO5	**M**	**L**	**L**	**H**	**L**			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
	✓											
Approval												

Subject Code:	Subject Name : **MATHEMATICS III FOR MECHANICAL AND CIVIL ENGINEERS**	**Ty / Lb/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
BMA18005	**Prerequisite: Mathematics I & II**	**Ty**	**3**	**1/0**	**0/0**	**4**

UNIT- I: PARTIAL DIFFERENTIAL EQUATIONS **12**

Formation of PDE by eliminating arbitrary constants and eliminating arbitrary functions – Solutions of standard types of first order equations – Lagrange's equation – Linear partial differential equations of second and higher order with constant coefficients.

UNIT- II: FOURIER SERIES **12**

Dirichlet's conditions – General Fourier series – Half range Sine & Cosine series – Complex form of Fourier series – Parseval's identity – Harmonic Analysis.

UNIT- III: APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS **12**

Classification of second order linear partial differential equations – Solutions of one dimensional wave equation, one-dimensional heat equation – Steady state solution of two dimensional heat equations (Cartesian coordinates only) – Fourier series solutions.

UNIT- IV: LAPLACE TRANSFORMS **12**

Transforms of simple functions – Properties of Transforms – Inverse Transforms – Transforms of Derivatives and Integrals – Periodic functions – Initial and final value theorems – Convolution theorem – Applications of Laplace transforms for solving linear ordinary differential equations up to second order with constant coefficients and Linear simultaneous differential equations of first order with constant coefficients.

UNIT- V: FOURIER TRANSFORMS **12**

Statement of Fourier integral theorem – Fourier transform pairs – Fourier Sine and Cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's theorem.

Total no. of Periods: 60

TEXT BOOKS

1) Veerarajan T. (2007), *Engineering Mathematics (for first year)*, Tata McGraw-Hill Publishing Co.,
2) Veerarajan T. (2005), *Engineering Mathematics (for semester III)*, Tata McGraw Hill Publishing Co.,

REFERENCES:

1) Singaravelu (2009), Transforms and Partial Differential Equations, Meenakshi Agency.
2) Kreyszig E. (2011), Advanced Engineering Mathematics (9th ed.), John Wiley & Sons.
3) Grewal B.S. (2012), Higher Engineering Mathematics, Khanna Publishers.

DEPARTMENT OF MECHANICAL ENGINEERING

Subject Code:	Subject Name : **ENGINEERING MECHANICS**	**Ty / Lb/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
BME18003	**Prerequisite: Engineering Physics**	**Ty**	**3**	**1/0**	**0/0**	**4**

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE:

- To gain knowledge of statics ,dynamics ,friction, moment of inertia of the particle.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Will be able to analyse the concept of statics of a particle and rigid body
CO2	Will be able to analyse the properties of surface and solids
CO3	Will be able to analyse and calculate the frictional force in different objects.
CO4	Will be able to analyse the concept of dynamics of a particle.
CO5	Will be able to analyse the concept of dynamics of a rigid body.

Mapping of Course Outcomes with Program Outcomes (POs)

Cos/Pos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**M**	**H**		**M**								**H**
CO2	**M**	**H**										**H**
CO3	**M**	**H**		**M**								**H**
CO4	**M**	**H**										**H**
CO5	**M**	**H**		**M**								**H**

Cos / PSOs	**PSO1**	**PSO2**	**PSO3**	**PSO4**								
CO1	**M**	**H**		**M**								
CO2	**M**	**H**										
CO3	**M**	**H**										
CO4	**M**	**H**										
CO5	**M**	**H**										

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
		✓										
Approval												

Subject Code: BME18003	Subject Name : **ENGINEERING MECHANICS**	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Engineering Physics	**Ty**	**3**	**1/0**	**0/0**	**4**

UNIT- I: STATICS **12**

STATICS OF PARTICLE: Introduction – units and Dimensions – Laws of mechanics – concurrent forces in a plane-resolution and Composition of forces – equilibrium of the particle-resultant force. Forces in space – Equilibrium of a particle in space

STATICS OF RIGID BODY **:** Free body diagram – Types of supports and their reactions – Moments and Couples – Moment of a force about a point and about an axis – Varignon's theorem – equilibrium of Rigid bodies in two dimensions –Equilibrium of Rigid bodies in three dimensions

UNIT- II: PROPERTIES OF SURFACE AND SOLIDS **12**

Determination of Area and volume – Determination and derivation of First moment of area(Centroid), Second moment of area(Moment of Inertia) of Regular as well as irregular geometrical area – Centroid of line elements. Mass moment of inertia and polar moment of inertia. Principal moments of inertia of plane areas – Principal axes of inertia-Product of Inertia.

UNIT- III: FRICTION **12**

Introduction – Laws of Dry Friction – Coefficient of friction – friction of a body lying on an inclined plane. Application of friction-Ladder friction-Wedge friction-Screw friction.

UNIT- IV: DYNAMICS OF PARTICLES **12**

KINEMATICS**:** Displacement, Velocity-Constant and variable Acceleration, their relationship – linear and curvilinear motion- Projectile motion, relative motion. KINETICS: Linear and Curvilinear motion-Work-Energy method, Impulse and Momentum, Impact-collision of Elastic bodies. Newton's law-D'Alembert's principle.

UNIT- V: DYNAMICS OF RIGID BODIES **12**

KINEMATICS**:** Introduction-Rotation-Linear and Angular Velocity as well as acceleration. General plane motion-Absolute and Relative velocity in plane motion. Instantaneous centre of Rotation in plane motion-Location. KINETICS**:** Relation between Translatory and Rotary motion of the body-Work energy equation of particles –D'Alembert's principle.

Total no. of Periods: 60

TEXT BOOKS

1) R.S.Khurmi. (2008), "*A Textbook of Engineering Mechanics"*, S.Chand & co Ltd.
2) S.Rajasekaran et.al. (2009), "*Fundamentals of Engineering Mechanics"*,Vikas Publishing House Pvt Ltd., 3rd Edition.

REFERENCES:

1) *Arthur.P.Boresi,Richard.J.Schmidt, "Engineering Mechanics : Statics &Dynamics", Thomson Brooks/Cole,Chennai.*
2) *Palanichamy M.S, Nagan.S, (2001), "Engineering Mechanics – Statics and Dynamics" Tata Mc Graw Hill.*
3) *Beer & Johnson et.al, (2010) "Vector Mechanics for Engineers (Statics and Dynamics)", Tata Mc Graw Hill.*

DEPARTMENT OF MECHANICAL ENGINEERING

Subject Code:	Subject Name: **ELECTRICAL AND ELECTRONICS CIRCUITS**	**Ty / Lb/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
BRE18001	**Prerequisite: Basic Electrical and Electronics Engineering**	**Ty**	**3**	**1/0**	**0/0**	**4**

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

To give an understanding of:

- The methods of analyzing DC and AC electrical circuits using network theorems
- the basics of MOS Transistors
- Design of amplifiers, oscillators and their applications
- Working of various analog circuits

COURSE OUTCOMES (COs) : (3- 5)

Students will be able to

CO1	To understand the fundamentals of Analog circuits, differentiate the DC circuits.
CO2	To understand the fundamentals of Analog circuits, differentiate the AC circuits.
CO3	To learn the basics of MOS Transistors
CO4	To justify the basic applications of electronic devices like oscillators and amplifier
CO5	To study various analog circuits

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**H**	**H**	**H**	**H**	**M**	**M**	**L**	**M**	**H**	**M**	**H**	**H**
CO2	**H**	**H**	**H**	**H**	**H**	**M**	**L**	**H**	**M**	**M**	**H**	**H**
CO3	**H**	**H**	**H**	**H**	**H**	**L**	**L**	**M**	**H**	**H**	**H**	**H**
CO4	**H**	**H**	**H**	**H**	**H**	**L**	**L**	**L**	**H**	**H**	**M**	**H**
CO5	**H**	**H**	**M**	**H**	**H**	**L**	**L**	**L**	**H**	**M**	**L**	**H**

COs / PSOs	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**			
CO1	**H**	**M**		**H**				
CO2	**H**	**L**		**H**				
CO3	**H**	**L**		**H**				
CO4	**H**	**M**		**H**				
CO5	**H**	**H**		**H**				

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Interdisciplinary subject		
				✓								
Approval												

Subject Code:	Subject Name: **ELECTRICAL AND ELECTRONICS CIRCUITS**	**Ty / Lb/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
BRE18001	**Prerequisite: Basic Electrical and Electronics Engineering**	**Ty**	**3**	**1/0**	**0/0**	**4**

UNIT I : DC CIRCUITS **12**

Introduction – V-I relationships of circuit parameters – Voltage source and current source - Kirchhoff's laws – Network reduction techniques – Mesh and Node analysis – Superposition theorem – Thevenin's theorem – Norton's Theorem – Maximum power transfer theorem

UNIT II : AC CIRCUITS **12**

RMS and average values of periodic waves – Form factor – phase and phase difference – RL, RC, RLC circuits – Parallel circuits – power and power factor – Introduction to three phase system – Solution of balanced three phase circuits – Power measurement of 3-phase system

UNIT III : INTRODUCTION TO MOS TRANSISTORS **12**

NMOS and PMOS transistors – Fabrication, Process parameters for MOS and CMOS, Electrical properties of CMOS circuits and device modeling.

UNIT IV : AMPLIFIERS AND OSCILLATORS **12**

Transistor biasing - CE, CB and CC – Amplifiers - Current gain - Voltage gain - Frequency response - Power amplifiers - Feedback Amplifiers – Oscillators - RC Phase shift - Wein Bridge – Hartley - Collpit's analysis

UNIT V : ANALOG CIRCUITS **12**

Operational amplifier Ideal characteristics – Applications - Current to voltage - Voltage to current converters – Arithmetic circuit – Adder – Subtractor – Multiplier – Differentiator – Integrator - Inverting and Non-inverting amplifiers - Buffer - 555 Timer - Block diagram – Multivibrators

TEXT BOOKS **Total no. of Periods: 60**

1. Floyd (2005) Electronic Device, (7^{th} ed.), Pearson Education
2. David, A. Bell (2009) Fundamentals of Electronic Devices and Circuits, (5^{th} ed.), Oxford University Press
3. Sudhakar, Shyammohan (2010) Circuits & Networks Analysis & Synthesis, Tata McGraw Hill(unit 1 & 2)

REFERENCES:

1. *Milman, Halkias (2010) Integrated Electronic, TataMcgraw hill publication*
2. *Boyle stad Nashelsky (2009) Electronic Devices and Circuit theory , (10^{th} ed.), PHI*

DEPARTMENT OF MECHANICAL ENGINEERING

Subject Code:	**Subject Name: ELECTRICAL MACHINES**	**Ty/Lb/ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
BRE18002	**Prerequisite: Basic Electrical and Electronics Engineering**	**Ty**	**3**	**0/0**	**0/0**	**3**

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To familiarize the principles of operations and characteristics of DC machines
- To acquire the knowledge of electrical transformers and induction motors
- To study the operation of synchronous motors.
- To have exposure to transformers
- To gain knowledge in stepper and servo motors

COURSE OUTCOMES (COs) : (3- 5)

CO1	The students have gained knowledge in principles of operations and characteristics of DC machines .
CO2	The students have gained knowledge in transformers
CO3	The students have gained knowledge in electrical transformers and induction motors
CO4	The students have gained knowledge in synchronous motors
CO5	The students have gained knowledge in stepper and servo motors

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**H**	**H**	**H**	**H**	**H**	**L**	**M**	**H**	**H**	**H**	**M**	**M**
CO2	**H**	**H**	**H**	**H**	**H**	**L**	**M**	**H**	**H**	**H**	**M**	**M**
CO3	**H**	**M**	**H**	**H**	**H**	**M**	**L**	**H**	**H**	**H**	**M**	**M**
CO4	**H**	**H**	**H**	**H**	**H**	**M**	**L**	**H**	**H**	**H**	**M**	**M**
CO5	**H**	**H**	**H**	**H**	**H**	**H**	**H**	**H**	**H**	**H**	**H**	**H**

COs / PSOs	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**			
CO1	**H**	**H**	**M**	**H**	**H**			
CO2	**H**	**H**	**M**	**H**	**H**			
CO3	**H**	**H**	**M**	**H**	**H**			
CO4	**H**	**H**	**M**	**H**	**H**			
CO5	**H**	**H**	**M**	**H**	**L**			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				√								
Approval												

Subject Code: **BRE18002**	Subject Name : **ELECTRICAL MACHINES**	**Ty/Lb/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite: Basic Electrical and Electronics Engineering	**Ty**	**3**	**0/0**	**0/0**	**3**

UNIT I: D.C. MACHINES **9**

Constructional details – EMF equation – methods of excitation – self and separately excited generators – characteristics of series, and shunt generators – principle of operation of D.C. Motor – back emf and torque equation – characteristics of series and shunt motors - starting of D.C. Motors – types of starters - speed control and braking of DC. motors.

UNIT II: TRANSFORMERS **9**

Constructional Details – Principle Of Operation – EMF Equation – Transformation Ratio – Transformer on No Load – Parameters Referred To HV/LV Windings – Equivalent Circuit – Transformer on Load – Regulation - Testing – Load Test - 3- PHASE Transformers connections.

UNIT III : INDUCTION MOTORS **9**

Construction – types – principle of operation of three-phase induction motors – equivalent circuit – starting and speed control – single-phase induction motors (only qualitative analysis).

UNIT IV: SYNCHRONOUS MACHINES **9**

Construction of Synchronous machines-types – induced emf – Equivalent circuit of excited-rotor synchronous motor- Equivalent circuit of excited-rotor synchronous motor - Starting - Permanent magnet synchronous motors

UNIT V: SPECIAL MACHINES **9**

Brushless alternators – reluctance motor – stepper motor servo motor - Hysteresis motors.

Total no. of Periods: 45

TEXT BOOKS :

1. Murugesh Kumar K. , „Electric Machines Vo I‟, Vikas Publishing House Pvt Ltd, 2010.
2. Murugesh Kumar K. , „Electric Machines Vol II‟, Vikas Publishing House Pvt Ltd, 2010
3. Mehta V.K. and Rohit Mehta, Principles of Power System‟, S.Chand and Company Ltd, 2003

REFERENCES:

1. *Fitzgerald A.E., Charles Kingsley, Stephen.D.Umans, „Electric Machinery", Tata McGraw Hill publishing Company Ltd, 2003.*
2. Gupta J.B., „Theory and Performance of Electrical Machines", S.K.Kataria and Sons, 2002
3. Kothari D.P. and Nagrath I.J., „Electric Machines", Tata McGraw Hill Publishing Company Ltd, 2002.
4. Bhimbhra P.S. "Electrical Machinery", Khanna Publishers, 2003.

Subject Code:	Subject Name: **BASICS OF ROBOTICS**	**Ty / Lb/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
BRE18003	**Prerequisite: None**	**Ty**	**3**	**0/0**	**0/0**	**3**

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To understand the robot anatomy.
- To understand the concept of various drives and end effectors
- To analyze different sensors, programming concepts and significance of robots in various industries.

COURSE OUTCOMES (COs) : (3- 5)
Students will be able to

CO1	Understand the automation of robotics and its significance
CO2	Understand the fundamentals of robots
CO3	Analyse the end effectors and sensors behind the design of robots
CO4	Understand the significance of robots in different domains
CO5	Analyse and understand the concept of different types of unmanned vehicles.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/Pos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**H**	**H**	**H**	**H**	**M**	**H**	**M**	**L**	**H**	**M**	**H**	**H**
CO2	**H**	**H**	**H**	**H**	**H**	**M**	**L**	**L**	**M**	**M**	**L**	**H**
CO3	**H**	**H**	**H**	**H**	**H**	**L**	**L**	**M**	**H**	**H**	**H**	**M**
CO4	**H**	**H**	**H**	**H**	**H**	**L**	**L**	**M**	**H**	**H**	**M**	**M**
CO5	**H**	**H**	**H**	**H**	**H**	**L**	**L**	**M**	**H**	**H**	**H**	**M**

COs / PSOs	**PSO1**	**PSO2**	**PSO3**	**PSO3**				
CO1	**L**	**L**	**H**	**H**				
CO2	**L**	**M**	**H**	**L**				
CO3	**L**	**M**	**M**	**M**				
CO4	**L**	**M**	**H**	**M**				
CO5	**L**	**M**	**M**	**M**				

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								
Approval												

Subject Code:	Subject Name: **BASICS OF ROBOTICS**	**Ty / Lb/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
BRE18003	**Prerequisite: None**	**Ty**	**3**	**0/0**	**0/0**	**3**

UNIT I: INTRODUCTION TO ROBOTICS **6**

Automation and Robotics -Robotics in Science Fiction -A Brief History of Robotics- The Robotics Market and the Future Prospects

UNIT II: FUNDAMENTALS OF ROBOTICS **12**

Definition of a Robot – Basic Components -Robot Anatomy- Robot Configurations: Polar, Cylindrical, Cartesian coordinate and Jointed – Arm, Robot Motion**:** Degrees of Freedom, types of movements – Vertical, Radial and Rotational Traverse, Roll, Pitch and Yaw: Joint Notation Scheme: Wok Volume. Robot drives Systems, Robot control types and precision of movement.

UNIT III: END EFFECTORS AND SENSORS **9**

Mechanical gripper, vacuum cups, magnetic gripper, Tools as end effectors, Tactile sensors, proximity and range sensors, vision sensors.

UNIT IV: APPLICATIONS OF ROBOT **9**

Applications: Use of Robot in manufacturing –material transfer, machining loading, unloading, welding & assembly. Medical, Agricultural and space applications.

UNIT V: UNMANNED VEHICLES **9**

Drones- Types and Applications; Unmanned Vehicles: Ground, Ariel and Underwater – Types and Applications – Biomimictic- Introduction

Total no. of Periods: 45

TEXT BOOKS:

1 Mikell P. Groover et. al., "Industrial Robots - Technology, Programming and Applications", McGraw Hill, Special Indiation Edition,(2012)
2. John J.Craig, “Introduction to Robotics”, Pearson, 2009.
3. Deb S. R. and Deb S., “Robotics Technology and Flexible Automation”, Tata McGraw Hill Education Pvt. Ltd, 2010.

REFERENCES:

1. *Richard D Klafter, Thomas A Chmielewski, Michael Negin, "Robotics Engineering – An Integrated Approach", Eastern Economy Edition, Prentice Hall of India Pvt. Ltd., 2006.*
2. Fu K S, Gonzalez R C, Lee C.S.G, "Robotics: Control, Sensing, Vision and Intelligence", McGraw Hill, 1987
3. https://www.robots.com/applications
4. https://www.asme.org/engineering-topics/articles/bioengineering/top-6robotic-applications-in-medicine**.**

DEPARTMENT OF MECHANICAL ENGINEERING

Subject Code: BRE18ET1	Subject Name : **PYTHON PROGRAMMING**	**Ty / Lb/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite: Basics of Computers with C programming	**ETL**	**1**	**0/1**	**3/0**	**3**

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

Ty/Lb/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To comprehend the fundamentals of object oriented programming, particularly in python.
- To use object oriented programming to implement data structures.
- To introduce linear, non-linear data structures and their applications.

COURSE OUTCOMES (COs) : (3- 5)

CO1	To acquire programming skills in core Python.
CO2	To acquire Object Oriented Skills in Python
CO3	To develop the skill of designing Graphical user Interfaces in Python
CO4	To develop the ability to write database applications in Python
CO5	To develop files, modules, packages in python programming

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	H	H	H	H	M	H	M	M	H	H	H	H
CO2	H	H	H	H	M	H	M	M	H	H	H	H
CO3	H	H	H	H	L	H	M	M	H	M	H	H
CO4	H	H	H	H	M	H	M	M	H	H	H	H
CO5	H	H	H	H	L	H	M	M	H	M	H	H

COs / PSOs	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1				**H**
CO2				**H**
CO3				**H**
CO4				**H**
CO5				**H**

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				√								
Approval												

Subject Code:	Subject Name:	T/ L/ ETL	L	T / S.Lr	P/ R	C
	PYTHON PROGRAMMING	**ETL**				
BRE18ET1	**Prerequisite: Basics of Computers with C programming**	**ETL**	**1**	**0/1**	**3/0**	**3**

UNIT-1 BASICS OF PYTHON **9**

Entering and Storing Data- Data Types- Binding Values to Names- More Python Syntax Basics- Reading and Converting User Input. Making Decisions- Conditions in Python- Making Decisions: Simple if Statements.- Multiple Choice Decisions.

Lab component: Programs for the above concepts.

UNIT-II ITERATION AND LISTS **9**

Iteration: For and While Loops- Terminating the Current Iteration. — Sequence Containers: Lists and Tuples- Writing Lists and Tuples- Accessing Sequence Values- Manipulating Lists and Tuples.

Lab component: Programs for the above concepts.

UNIT-III SETS AND DICTS **9**

Sets and Dicts- Creating Sets- Working with Sets- Working with Dicts- Applying Dicts: Counting Words.

Lab component: Programs for the above concepts.

UNIT-IV FORMATTING **9**

String Formatting- The format ( ) Method- Function Arguments- Format Field Names- More About Looping-- Fun with the range ( ) function- While Loops and User Input Validation.

Lab component: Programs for the above concepts.

UNIT-V FILES, MODULES, PACKAGES **9**

Files and exception: Text files Creating a New File- Writing to a File- Reading Files as Text ,format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file.

Lab components:

1. Write a program to compute distance between two points taking input from the user (Pythagorean Theorem)
2. Write a program add.py that takes 2 numbers as command line arguments and prints its sum.
3. Write a Program for checking whether the given number is a even number or not
4. Write a program using a while loop that asks the user for a number, and prints a countdown from that number to zero.
5. Write a program using a for loop that loops over a sequence.
6. Write a program using a while loop that asks the user for a number, and prints a countdown from that number to zero.

Total No. of Periods: 45

Text Books

1. Introduction to Programming Using Python, First Edition by Y. Daniel Liang,©2013 Prentice Hall
2. Dawson, Michael. Python Programming for the Absolute Beginner (3rd ed.). Boston, MA: Course Technology, 2010.

REFERENCES:

1. *Shaw, Zed A., 2012. Learn Python the Hard Way, Second Edition, Shavian Publishing, LLC, 183 p*

DEPARTMENT OF MECHANICAL ENGINEERING

Subject Code: BRE18L01	Subject Name : ELECTRICAL AND ELECTRONICS CIRCUITS LAB	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Theoretical concepts in Electrical And Electronics Engineering	**Lb**	**0**	**0/0**	**3/0**	**1**

L : Lecture T:Tutorial SLr : Supervised Learning P : Project R : Research C:Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES: The student will learn

- To verify practically the electric circuits analyzed by network theorems
- To verify experimentally the electronic circuits

COURSE OUTCOMES (COs) : (3- 5)

CO1	Students will practically analyze the various electric circuits verified theoretically by network theorems.
CO2	Students will be exposed practically various electronic circuit based experiments
CO3	Students will be able to design oscillators of various types.
CO4	Students will be able to design regulators of various types
CO5	Students will be able to design rectifiers of various types

Mapping of Course Outcomes with Program Outcomes (Pos)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	M	H	M	M	H	H	H	H
CO2	H	H	H	H	M	H	M	M	H	H	H	H
CO3	H	H	H	H	L	H	M	M	H	M	H	H
CO4	H	H	H	H	M	H	M	M	H	H	H	H
CO5	H	H	H	H	L	H	M	M	H	M	H	H

Cos / PSOs	PSO1	PSO2	PSO3	PSO4			
CO1				H			
CO2				H			
CO3				H			
CO4				H			
CO5				H			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical	Soft Skills			
							✓					
Approval												

Subject Code: BRE18L01	Subject Name : ELECTRICAL AND ELECTRONICS CIRCUITS LAB	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Theoretical concepts in Electrical And Electronics Engineering	**Lb**	**0**	**0/0**	**3/0**	**1**

LIST OF EXPERIMENTS:

ELECTRICAL CIRCUITS

1. Verification of KCL and KVL theorem.
2. Verification of Superposition theorem
3. Verification of maximum power transfer theorem
4. Verification of Norton theorem.
5. Verification of Thevenin's theorem.
6. Verification of Nodal and Mesh Analysis.

ELECTRONIC CIRCUITS

7. Characteristics of PN and Zener diode
8. I/P and O/P characteristics of BJT
9. I/P and O/p characteristics of FET
10. Design of Oscillators.
11. Rectifiers-Full Wave, Half Wave and their characteristics.
12. Design of Voltage Regulator

Total No. of Periods: 45

DEPARTMENT OF MECHANICAL ENGINEERING

Subject Code: BRE18L02	Subject Name : **ELECTRICAL MACHINES LAB**	**Ty /Lb/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite: Theoretical concepts in Electrical And Electronics Engineering	**Lb**	**0**	**0/0**	**3/0**	**1**

L : Lecture T:Tutorial SLr : Supervised Learning P : Project R : Research C:Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES: The student will learn

- To Study various types of DC machines and Transformers which mainly covers experiments with real machines and students gain practical experience in using various DC machines, transformers, starters etc.
- Various types of experiments related to Electrical machinery like Load characteristics, Load test, Brake test, Parallel Operation ,Loss separation, OC and SC characteristics are done in this Lab.
- To study the characteristics of synchronous motors, induction motors and other special machines.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Various types of DC machines and Transformers which mainly covers experiments with real machines and students gain practical experience in using various DC machines
CO2	Various types of experiments related to Electrical machinery like Load characteristics
CO3	To study the characteristics of synchronous motors
CO4	To study the characteristics of induction motors
CO5	To study single and three phase power measurement

Mapping of Course Outcomes with Program Outcomes (Pos)

Cos/Pos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	H	H	H	H	M	H	M	M	H	H	H	H
CO2	H	H	H	H	M	H	M	M	H	H	H	H
CO3	H	H	H	H	L	H	M	M	H	M	H	H
CO4	H	H	H	H	M	H	M	M	H	H	H	H
CO5	H	H	H	H	L	H	M	M	H	M	H	H

Cos / PSOs	**PSO1**	**PSO2**	**PSO3**	**PSO4**			
CO1				**H**			
CO2				**H**			
CO3				**H**			
CO4				**H**			
CO5				**H**			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical	Soft Skills			
							√					
Approval												

Subject Code: BRE18L02	Subject Name : **ELECTRICAL MACHINES LAB**	**Ty / Lb ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite: Theoretical concepts in Electrical And Electronics Engineering	**Lb**	**0**	**0/0**	**3/0**	**1**

LIST OF EXPERIMENTS

1. Open Circuit and Load Test on DC Shunt Generator
2. Load Test on DC Shunt Motor.
3. Load Test on DC Series Motor.
4. Swinburne's Test
5. Speed Control on DC Shunt Motor
6. O.C. and S.C. test on 1-phaseTransformer
7. Load Test on single phase Transformer
8. Load Test on Alternator.
9. Load Test on 3-phase Squirrel cage Induction Motor.
10. Load Test on 1-phase Induction Motor.
11. Single and three phase power measurement

Total No. of Periods: 45

SEMESTER-IV

DEPARTMENT OF MECHANICAL ENGINEERING

Subject Code:	Subject Name : MICROPROCESSORS AND MICROCONTROLLERS	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
BRE18004	Prerequisite: Electrical and Electronics Engineering	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To study the architecture, addressing modes, and assembly language program of 8085 microprocessor.
- To understand the concepts of different peripherals and their applications
- To learn the functions of 8051 microcontroller and PIC controller and their applications.

COURSE OUTCOMES (COs) :

CO1	The Students will be exposed to different introductory concepts of 8085 microprocessor.
CO2	The students will show their ability with respect to different programming skills in 8085 processor.
CO3	The students will be made aware of different interfacing devices like 8255,8259,8279 etc.
CO4	The students will demonstrate their expertise in writing an ALP in 8051 and PIC to do real time applications
CO5	The students will apply their understanding to do a project to develop an application using these microcontrollers.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	M	M	M	H	L	L	L	M	M	L
CO2	H	H	H	H	H	H	L	M	L	M	M	M
CO3	M	M	M	M	H	H	M	H	L	M	H	M
CO4	H	H	H	H	H	L	M	H	L	M	L	H
CO5	H	M	L	M	M	M	H	L	H	M	H	H

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	H	H	M	H
CO2	H	H	L	H
CO3	M	H	L	H
CO4	H	M	L	H
CO5	L	L	M	H

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								
Approval												

Subject Code: BRE18004	Subject Name : MICROPROCESSORS AND MICROCONTROLLERS	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Electrical and Electronics Engineering	Ty	3	0/0	0/0	3

UNIT I: 8085 PROCESSOR **9**

Hardware Architecture, pin outs – Functional Building Blocks of Processor – Memory organization – I/O ports and data transfer concepts– Timing Diagram – Interrupts.

UNIT II: PROGRAMMING OF 8085 PROCESSOR **9**

Instruction -format and addressing modes – Assembly language format – Data transfer, data manipulation& control instructions – Programming: Loop structure with counting & Indexing – Look up table - Subroutine instructions - stack.

UNIT III: PERIPHERAL INTERFACING **9**

Study on need, Architecture, configuration and interfacing, with ICs: 8255, 8259, 8254, 8237, 8251, 8279, - A/D and D/A converters.

UNIT IV: 8051 AND PIC MICRO CONTROLLER **9**

Hardware Architecture, – Functional Building Blocks of Processor – Memory organization – I/O ports and data transfer concepts– Timing Diagram – Interrupts- Programming concepts with 8051 and PIC.

UNIT V MICRO CONTROLLER PROGRAMMING & APPLICATIONS **9**

Data Transfer, Manipulation, Control Algorithms& I/O instructions – Simple programming exercises key board and display interface – Closed loop control of servo motor- stepper motor control.

Total No. of Periods: 45

TEXT BOOKS

1. Krishna Kant, “Microprocessor and Microcontrollers”, Eastern Company Edition, Prentice Hall of India, New Delhi , 2007.
2. R.S. Gaonkar, “Microprocessor Architecture Programming and Application“, with 8085, Wiley Eastern Ltd., New Delhi, 2013.
3. Soumitra Kumar Mandal, “Microprocessor & Microcontroller Architecture, Programming & Interfacing using 8085, 8086,8051”,McGraw Hill Edu,2013.
4. Muhammed Ali Mazdi,et.al ,”PIC Microcontroller and Embedded Systems”,Pearson ,2014.

REFERENCES:

1. Muhammad Ali Mazidi & Janice Gilli Mazidi, R.D.Kinely „The 8051 Micro Controller and Embedded Systems", PHI Pearson Education, 5th Indian reprint, 2003.
2. N.Senthil Kumar, M.Saravanan, S.Jeevananthan, „Microprocessors and Microcontrollers", Oxford,2013.
3. Valder – Perez, “Microcontroller – Fundamentals and Applications with PIC,” Yeesdee Publishers, Tayler & Francis, 2013.

DEPARTMENT OF MECHANICAL ENGINEERING

Subject Code: BME18006	Subject Name : STRENGTH OF MATERIALS	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Engineering Mechanics	Ty	3	1/0	0/0	4

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE:

- Basic principles of stress, strain and elastic constants
- To draw shear force and bending moment diagrams
- To find deflection of beams

COURSE OUTCOMES (COs) : (3- 5)

CO1	Will learn basic principles of stress, strain and deformation of solids
CO2	Will be able to analyse beams loads and stresses
CO3	Will be able to find torsion of shafts and springs.
CO4	Will be able to find deflection of beams
CO5	Will be able to analyse stresses in two dimensions.

Mapping of Course Outcomes with Program Outcomes (POs)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	H		M		M						
CO2	M	H										
CO3	M	H		M		M						
CO4	M	H										
CO5	M	H		M								

Cos / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	M	H						
CO2	H			M				
CO3	M	H						
CO4	H							
CO5	M	H						

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								
Approval												

Subject Code: BME18006	Subject Name : STRENGTH OF MATERIALS	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Engineering Mechanics	Ty	3	1/0	0/0	4

UNIT –I STRESS, STRAIN AND DEFORMATION OF SOLIDS **12**

Rigid and Deformable bodies – Strength, Stiffness and Stability – Stresses; Tensile, Compressive and Shear – Deformation of simple and compound bars under axial load – Thermal stress – Elastic constants and their relationship – strain energy due to axial load – stress due to suddenly applied load and impact load.

UNIT- II: BEAMS - LOADS AND STRESSES **12**

Types of beams: Supports and Loads – Shear force and Bending Moment in beams – Cantilever, Simply supported beams and Overhanging beams Stresses in beams – Theory of simple bending – Stress variation along the length and in the beam section – Effect of shape of beam section on stress induced – Shear stress distribution in beams of different sections.

UNIT- III: TORSION OF SHAFTS AND SPRINGS **12**

Theory of pure torsion- Torsion of circular and hollow shafts –Stepped shafts – Composite shaft – Stress due to combined bending and torsion. Type of springs - Stiffness- Springs in series-Springs in parallel - Stresses and deflections in helical springs and leaf springs – Design of helical springs- design of buffer springs - leaf springs.

UNIT- IV: DEFLECTION OF BEAMS **12**

Double integration method- Macaulay's Method- Area Moment Theorems for Computations of slope and deflection in Beams. Columns – End conditions – Equivalent length of a column – Euler equation – Slenderness ratio – Rankine formula for columns.

UNIT- V: ANALYSIS OF STRESSES IN TWO DIMENSIONS **12**

Biaxial state of stresses – Thin cylindrical and spherical shells – Deformation in thin cylindrical and spherical shells – Biaxial stresses at a point-Stress as Tension. Stresses on inclined plane – Principal planes and Principal stresses – Mohr's circle for biaxial stresses – Maximum shear stress - Strain energy and Strain Energy Density.

Total No. of Periods: 60

TEXT BOOKS

1. Rajput R.K. "Strength of Materials (Mechanics of Solids)", S.Chand & company Ltd., New Delhi, 2010.
2. S.Ramamruthum and R. Narayan, *"Strength of Materials"*, Dhanpat Rai & Sons,

REFERENCES:

1. *Beer F. P. and Johnston R, (2002) "Mechanics of Materials", McGraw-Hill Book Co, Third Edition*
2. *Egor P. Popov, "Engineering Mechanics of Solids", Prentice Hall of India, New Delhi.*

DEPARTMENT OF MECHANICAL ENGINEERING

Subject Code: BRE18005	Subject Name : **DIGITAL ELECTRONICS**	**Ty / Lb/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite: Electrical and Electronics Circuits	**Ty**	**3**	**1/0**	**0/0**	**4**

L : Lecture T:Tutorial SLr : Supervised Learning P : Project R : Research C:Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE:

- To make the students aware of digital electronics and familiarity with logic design with regard to gates and combinational logic circuits
- To make the students realize the design of sequential logic circuits using flip flops
- To introduce different logic families with respect to digital design.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Students will be introduced to different Boolean algebra concepts.
CO2	Students will be exposed to design of combinational logic circuits.
CO3	Students will be exposed to design of sequential logic circuits using flip flops.
CO4	Students will be made aware of different types of state machines and other concepts.
CO5	Students will be exposed to different logic families with respect to digital design.

Mapping of Course Outcomes with Program Outcomes (POs)

Cos/Pos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**H**	**M**	**M**	**M**	**M**	**H**	**L**	**L**	**L**	**M**	**M**	**L**
CO2	**H**	**H**	**H**	**H**	**H**	**H**	**L**	**M**	**L**	**M**	**M**	**M**
CO3	**M**	**M**	**M**	**M**	**H**	**H**	**M**	**H**	**L**	**M**	**H**	**M**
CO4	**H**	**H**	**H**	**H**	**H**	**L**	**M**	**H**	**L**	**M**	**L**	**H**
CO5	**H**	**M**	**L**	**M**	**M**	**M**	**H**	**L**	**H**	**M**	**H**	**H**
Cos / PSOs	**PSO1**		**PSO2**		**PSO3**		**PSO4**					
CO1	**H**		**H**		**M**		**H**					
CO2	**H**		**H**		**L**		**H**					
CO3	**M**		**H**		**L**		**H**					
CO4	**H**		**M**		**L**		**H**					
CO5	**L**		**L**		**M**		**H**					

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				√								
Approval												

Subject Code: BRE18005	Subject Name : DIGITAL ELECTRONICS	Ty/ Lb/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Electrical and Electronics Circuits	**Ty**	**3**	**1/0**	**0/0**	**4**

UNIT - I: BOOLEAN ALGEBRA **12**

Boolean Algebra – De Morgan's Law - Simplifications of Boolean Expression – Sum of Products and Product of Sums – Karnaugh Map(up to 5 variables) – QuineMcClusky Method of Simplification (Including Don't care conditions)

UNIT - II: COMBINATIONAL LOGIC **12**

Logic gates – AND, OR, NOT, NOR, NAND and EX-OR – Combinational Logic- Arithmetic Circuits – Half adder – Full adder, Half Subtractor - Decimal Adder – Excess 3 Adder – Code Converters – Multiplexer – Demultiplexer- Encoder – Decoder – Design of General Combinational Logic Circuit. PAL, PLA and FPGA.

UNIT- III: SEQUENTIAL LOGIC DESIGN **12**

Building Blocks Of Sequential Logic-Rs, JK, Master-Slave, D And T Flip-Flop, Design of Asynchronous and Synchronous Counters - Binary and BCD Counters - Shift Registers.

UNIT - IV: SEQUENTIAL MACHINES **12**

Basic Models Of Sequential Machines – Concept Of State Diagram - State Table – State Reduction - Design and Implementation of Synchronous Sequential Circuits .Design and Implementation of Asynchronous Sequential Circuits.

UNIT- V: LOGIC FAMILIES AND MEMORY DEVICE **12**

Characteristics of RTL, DTL, TTL, Families – Schottky, Clamped TTL, ECL, IIL –Classification of memories – ROM- ROM organization - PROM – EPROM – EEPROM –EAPROM, RAM

Total no. of Periods: 60

TEXTBOOKS:

1. Charles H. Roth, "*Fundamentals of Logic Design*", Thompson Learning, 5th Edition
2. FLOYD:" *Digital Fundamentals*", 10th Edition Universal Book Stall, New Delhi.1993
3. Morris Mano, "*Digital Electronics and Design*", Prentice Hall of India, 2000

REFERENC::

1. *John F.Wakerly, "Digital Design", Fourth Edition, Pearson/PHI, 2008*
2. *John.M Yarbrough, "Digital Logic Applications and Design", Thomson Learning, 2006.*
3. *Charles H.Roth. "Fundamentals of Logic Design", 6th Edition, Thomson Learning, 2013.*
4. *Donald P.Leach and Albert Paul Malvino, "Digital Principles and Applications", 6th Edition, TMH, 2006.*
5. *Donald D.Givone, "Digital Principles and Design", TMH, 2003*

DEPARTMENT OF MECHANICAL ENGINEERING

Subject Code: BRE18006	Subject Name: **INSTRUMENTATION AND CONTROL FOR ROBOTS**	**Ty / Lb/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite: Basics of Robotics	**Ty**	**3**	**0/0**	**0/0**	**3**

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To introduce the terminologies associated with the measuring system.
- To impart knowledge on sensors and transducer for temperature measurements.
- To understand and calibrate the method of measuring pressure, displacement and velocity.
- To introduce basics of control system
- To mathematically model the physical systems

COURSE OUTCOMES (COs) : (3- 5)
Students will be able to

CO1	To introduce the terminologies associated with the measuring system.
CO2	To impart knowledge on sensors and transducer for temperature measurements.
CO3	To understand and calibrate the method of measuring pressure, displacement and velocity.
CO4	To introduce basics of control system
CO5	To make the students mathematically model the physical systems

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**H**	**H**	**H**	**H**	**M**	**M**	**L**	**M**	**H**	**M**	**H**	**H**
CO2	**H**	**H**	**H**	**H**	**H**	**M**	**L**	**H**	**M**	**M**	**H**	**H**
CO3	**H**	**H**	**H**	**H**	**H**	**L**	**L**	**L**	**H**	**H**	**H**	**M**
CO4	**H**	**H**	**H**	**H**	**H**	**L**	**L**	**L**	**H**	**H**	**M**	**H**
CO5	**H**	**H**	**M**	**H**	**H**	**L**	**L**	**L**	**H**	**M**	**L**	**H**

COs / PSOs	**PSO1**	**PSO2**	**PSO3**	**PSO4**				
CO1	**H**	**M**	**H**	**H**				
CO2	**H**	**L**	**H**	**H**				
CO3	**H**	**L**	**H**	**H**				
CO4	**H**	**M**	**H**	**H**				
CO5	**H**	**H**	**H**	**H**				

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								
Approval												

Subject Code: BRE18006	Subject Name: INSTRUMENTATION AND CONTROL FOR ROBOTS	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Basics of Robotics	Ty	3	0/0	0/0	3

UNIT I: MEASURING SYSTEM **9**

Factors in making the measurements-accuracy, precision, resolution, repeatability, reproducibility, hysteresis, sensitivity, range. International standards for measurement. Errors in Measurement – Gross Errors, Systematic Errors, Mounting and deformation Error – Thermally Induced Error – Interpolation Error – Dynamic Error, Calibration techniques.

UNIT II: TRANSDUCERS FOR TEMPERATURE AND PRESSURE MEASUREMENT **9**

Terminology, principle of operation, Characteristics and signal conditioning- Bimetallic thermostats, Resistance Temperature Detectors, Thermistors, Thermocouples, solid state temperature sensors, Liquid manometers, Capacitance diaphragms, piezoelectric diaphragm.

UNIT III: DISPLACEMENT, VELOCITY & FLOW MEASUREMENT **9**

Principle of operation, Characteristics and signal conditioning-, Venturi flow meters, Magnetic flow meter, float switch, Linear and angular measurement systems, Potentiometer type- resistive- strain gauge, capacitive and inductive, LVDT, Limit switches, inductive and capacitive proximity switches, ultrasonic and photo-electric sensors- linear scales, Laser Interferometers, tachogenerator, Encoders-absolute and incremental ,Synchros and resolvers.

UNIT IV: INTRODUCTION TO CONTROL SYSTEMS **9**

Open-loop and closed –loop systems-comparison, Transfer function; Block diagram reduction, Signal flow graphs, PI, PD and PID control concepts and explanation.

UNIT V MATHEMATICAL MODELS OF PHYSICAL SYSTEMS **9**

Mechanical systems - Translational and rotational systems, Gear trains, Electrical systems, Components of feedback control systems - Potentiometers as error sensing devices, Synchros, Servomotors, Stepper motors.

Total No. of Periods: 45

TEXT BOOKS:

1. Peter Elgar,"Sensors for Measurement and Control", Addison-Wesley Longman Ltd, 1998
2. A.K.Sawhney, "Electrical & Electronic Measurement & Instruments", Dhanpat Rai & Co., 2010
3. I.J.Nagrath, M.Gopal,"Control Systems Engineering", New Age International Publications, 2008

REFERENCES:

1. Patranabis D, "Sensors and Transducers", Prentice-Hall of India Private Limited, New Delhi, 2003.
2. Ernest O Doebelin, "Measurement systems Application and Design", Tata McGraw-Hill Book Company, 2010.

DEPARTMENT OF MECHANICAL ENGINEERING

Subject Code: BHS18NC1	**Subject Name : THE INDIAN CONSTITUTION**	**Ty / Lb/ ETL**	**L**	**T/SLr**	**P/R**	**C**
	Prerequisite: NIL	Ty	2	0/0	0/0	NC

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To provide an overview of the history of the making of Indian Constitution
- To understand the preamble and the basic structures of the Constitution.
- To Know the fundamental rights, duties and the directive principles of state policy
- To understand the functionality of the legislature , the executive and the judiciary

COURSE OUTCOMES (COs) : (3- 5)

The Students will be able to

CO1	To provide an overview of the history of the making of Indian Constitution
CO2	To understand the preamble and the basic structures of the Constitution
CO3	To Know the fundamental rights, duties and the directive principles of state policy

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1						**H**	**L**	**L**	**L**	**L**		
CO2						**H**	**L**	**L**	**L**	**L**		
CO3						**H**	**L**	**L**	**M**	**L**		

COs / PSOs	**PSO1**	**PSO2**	**PSO3**
CO1	**L**	**L**	**M**
CO2	**L**	**L**	**M**
CO3	**L**	**L**	**M**

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engg Sciences	Humanities & Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
			✓									

Subject Code: BHS18NC1	Subject Name: THE INDIAN CONSTITUTION	Ty/Lb/ ETL	L	T/SLr	P/R	C
	Prerequisite: NIL	Ty	2	0/0	0/0	NC

UNIT 1 **3**

The History of the Making of Indian Constitution, Preamble and the Basic Structures

UNIT 2 **3**

Fundamental Rights and Duties , Directive Principles of State Policy

UNIT 3 **3**

Legislature, Executive and Judiciary

UNIT 4 **3**

Emergency Powers

UNIT 5 **3**

Special Provisions for Jammu and Kashmir, Nagaland and Other Regions, Amendments

Total no. of Periods: 15

TEXT BOOKS:

1. D D Basu, Introduction to the Constitution of India, 20th Edn.,LexisnexisButterworths, 2012.

REFERENCE BOOKS:

1. *Rajeev Bhargava (ed), Ethics and Politics of the Indian Constitution, Oxford University Press, New Delhi, 2008.*
2. *Granville Austin, The Indian Constitution: Cornerstone of a Nation, Oxford University Press, Oxford, 1966.*
3. *Zoya Hassan, E. Sridharan and R. Sudarshan (eds), India's Living Constitution: Ideas, Practices, Controversies, Permanent Black, New Delhi, 2002.*
4. *Subhash C. Kashyap, Our Constitution, National Book Trust, New Delhi, 2011.*

Subject Code: BHS18NC2	Subject Name : THE INDIAN TRADITIONAL KNOWLEDGE	Ty / Lb/ ETL	L	T/SLr	P/R	C
	Prerequisite: NIL	Ty	2	0/0	0/0	NC

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To understand the Pre- colonial and Colonial Period, Indian Traditional Knowledge System
- To understand the Traditional Medicine, Traditional Production and Construction Technology
- To Know the History of Physics and Chemistry, Traditional Art and Architecture and Vastu Shashtra, Astronomy and Astrology
- To understand the Origin of Mathematics, Aviation Technology in Ancient India, Crafts and Trade in Ancient India

COURSE OUTCOMES (COs) : (3- 5)

The Students will be able to

CO1	To understand the Pre- colonial and Colonial Period, Indian Traditional Knowledge System
CO2	To understand the Traditional Medicine, Traditional Production and Construction Technology
CO3	To understand the Origin of Mathematics, Aviation Technology in Ancient India, Crafts and Trade in Ancient India

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		H	H	L		M				M		L
CO2		H	H	L		M				M		L
CO3		H	H	L		M				M		L

COs / PSOs	PSO1	PSO2	PSO3
CO1	L	L	M
CO2	L	L	M
CO3	L	L	M

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engg Sciences	Humanities & Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
			✓									

DEPARTMENT OF MECHANICAL ENGINEERING

Subject Code: BHS18NC2	Subject Name : THE INDIAN TRADITIONAL KNOWLEDGE	Ty / Lb/ ETL	L	T/SLr	P/R	C
	Prerequisite: NIL	Ty	2	0/0	0/0	NC

UNIT I **3**

Historical Background: TKS During the Pre- colonial and Colonial Period, Indian Traditional Knowledge System

UNIT II **3**

Traditional Medicine, Traditional Production and Construction Technology

UNIT III **3**

History of Physics and Chemistry, Traditional Art and Architecture and Vastu Shashtra, Astronomy and Astrology

UNIT IV **3**

Origin of Mathematics, Aviation Technology in Ancient India, Crafts and Trade in Ancient India

UNIT V **3**

TKS and the Contemporary World, TKS and the Indian Union, TKS and IT Revolution.

Total no. of Periods: 15

TEXT BOOKS:

1. Amit Jha (2009) , Traditional knowledge system in india, 1st Edition, Delhi University (North Campus)
2. Dr.A.K.Ghosh (2011), Traditional Knowledge of Household Products

Subject Code:	Subject Name : MACHINE DRAWING	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
BME18ET1	**Prerequisite: Basic Engineering Graphics**	**ETL**	**1**	**0/1**	**3/0**	**3**

L : Lecture T : Tutorial S Lr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE: The student will learn

- To impart the knowledge in Machine Drawing fundamentals.
- To impart the knowledge to read, draw and to understand various machine elements and industrial drawing.
- To draw the component and assembly drawing using CAD software.

COURSE OUTCOMES (COs) : (3 - 5)

CO1	To impart the knowledge in Machine Drawing fundamentals.
CO2	To impart knowledge to read, draw and to understand various machine elements and industrial drawing.
CO3	To draw the component and assembly drawing using CAD software.
CO4	To prepare isometric views of the structures.
CO5	To convert part drawing to orthographic views

Mapping of Course Outcomes with Program Outcomes (Pos)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H									M		M
CO2	M		M						M	H		L
CO3	M	H							L	H		L
CO4	M	H							L	H		L
CO5	M	H							L	H		L

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	L	H		L	
CO2	L	M			
CO3		M			
CO4		M			
Co5		M			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills
				✓					
Approval									

		ETL		**S.Lr**		
BME18ET1	**Prerequisite: Basic Engineering Graphics**	**ETL**	**1**	**0/1**	**3/0**	**3**

UNIT- I - DRAWING STANDARDS **5**

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

UNIT- II - INTRODUCTION TO MACHINE DRAWING **10**

Fundamentals of machine drawing: Geometric Dimensioning - Limits, fits, Tolerances – Types – Tolerance Analysis. Isometric to Orthographic conversion of Part drawings and vice versa, Assembly Drawings – Manual drawing.

UNIT- III - PREPARATION OF ASSEMBLY MODELS **15**

Preparing the assembly views (with minimum four components) of various industrial oriented equipments.(E.g. Piston and connection rod, Coupling and shafts, Plummer block, Tail stock, Cotter Joint, Knuckle Joint, Universal Joint and Screw Jack)

UNIT- IV - PREPARATION OF PART MODELS USING MODELING SOFTWARE **15**

Preparing isometric view of various industrial oriented machine components - Selection of machine components from software library - Conversion of part drawing into orthographic views. (Drafting)

(UNIT-s I, II and III should be practiced by drafting equipment- UNIT- IV to be practiced by CAD software)

Total No. of Periods: 45

TEXT BOOKS:

1. N. D. Bhatt and V. M. Panchal, “Machine Drawing”, Charotar Publishing House, Anand, Gujarat, India. 2004.

REFERENCES:

1. *K R Gopalakrishnan, “Machine drawing”, Subhas Stores, Bangalore. 2007*

Subject Code: BME18L11	Subject Name : STRENGTH OF MATERIALS LAB	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Strength of Materials	**Lb**	**0**	**0/0**	**3/0**	**1**

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE: The student will learn

- Experimental methods of finding mechanical properties of materials

COURSE OUTCOMES (COs) : (3- 5)

CO1	Hardness testing and their applications
CO2	Experimental verification of mechanical properties of materials
CO3	Evaluation of stress and strains.
CO4	Estimate spring constant
CO5	Estimate fatigue test.

Mapping of Course Outcomes with Program Outcomes (Pos)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	M	M	M	H	L	L	L	M	M	L
CO2	H	H	H	H	H	H	L	M	L	M	M	M
CO3	M	M	M	M	H	H	M	H	L	M	H	M
CO4	H	H	H	H	H	L	M	H	L	M	L	H
CO5	H	M	L	M	M	M	H	L	H	M	H	H

Cos / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	H		M	H				
CO2	H		M	H				
CO3	M		H	H				
CO4				H				
CO5				H				

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
							✓					
Approval												

Subject Code: BME18L11	Subject Name : STRENGTH OF MATERIALS LAB	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Strength of Materials	Lb	0	0/0	3/0	1

LIST OF EXPERIMENTS

1. Evaluation of Engineering Stress/strain diagram on steel rod.
2. Compression test on Bricks, Concrete blocks
3. Deflection test on beams– Verification of Maxwell Theorem
4. Hardness testing of Steel , Copper and Aluminium using Brinell hardness machines
5. Hardness testing of Steel ,Copper and Aluminium using Rockwell machine
6. Estimation of Spring constant ,under Tension and Compression
7. Estimation of notch toughness of steel using Charpy impact testing machine

Total No. of Periods: 45

Subject Code: BRE18L03	Subject Name: INSTRUMENTATION AND CONTROL LAB	T/ L/ Lb/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Instrumentation and Control for Robots	**Lb**	**0**	**0/0**	**3/0**	**1**

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- Enabling the students practically to know about sensors and the various types used for the measurement of various physical Quantities
- To identify suitable instruments to meet the requirements of industrial applications
- To know practically about the transducer used for the measurement temperature, Resistive, Capacitive and Inductive transducers
- To study the response of the open loop ,closed loop ,first order and second order systems

COURSE OUTCOMES (COs) : (3- 5)

CO1	The students have gained knowledge in sensors and the various types used for the measurement of various physical Quantities
CO2	The students have gained knowledge in instruments to meet the requirements of industrial applications
CO3	The students have gained knowledge about the transducer used for the measurement temperature, Resistive, Capacitive and Inductive transducers
CO4	The students have gained knowledge about the open loop ,closed loop ,first and second order systems
CO5	The students have gained knowledge about speed control of dc motors.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	H	H	H	L	M	H	H	H	M	M
CO2	H	H	M	H	H	L	M	H	H	H	M	M
CO3	H	H	H	H	H	M	L	H	H	H	M	M
CO4	H	M	H	H	H	L	M	H	H	H	M	M
CO5	H	M	H	H	H	L	M	H	H	H	M	M

Cos / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	H	H	M	H				
CO2	H	M	M	H				
CO3	H	H	M	H				
CO4	H	M	H	H				
CO5	H	M	H	H				

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
							√					
Approval												

Subject Code: BRE18L03	Subject Name : INSTRUMENTATION AND CONTROL LAB	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Instrumentation and Control for Robots	Lb	0	0/0	3/0	1

LIST OF EXPERIMENTS

1. Force Measurement using Load Cell
2. Displacement Measurement using LVDT
3. Thermocouple
4. Resistance Temperature Detectors.
5. Strain measurement.
6. Study of thermistors.
7. Study of Open Loop and Closed Loop systems.
8. Speed Control of AC-DC Servomotor using PI/PD/PID Controllers.
9. Modeling and Analysis of first order systems using PI/PD Controller
10. Modeling and Analysis of first order systems using PID Controller
11. Modeling and Analysis of second order systems using PI Controller
12. Modeling and Analysis of second order systems using PID Controller.

Total No. of Periods: 45

DEPARTMENT OF MECHANICAL ENGINEERING

Subject Code: BRE18L04	Subject Name : **DIGITAL ELECTRONICS AND MICROPROCESSOR LAB**	**Ty / Lb/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite: Digital electronics, Microprocessor and Micro controllers	**Lb**	**0**	**0/0**	**3/0**	**1**

L : Lecture T : Tutorial S Lr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE:

- To make students familiar with different types of designs as sequential logic circuits, combinational logic circuits
- Knowledge of basic electronics & digital techniques
- To provide a platform for the students to do multidisciplinary projects using microprocessor and Microcontroller based programming.

COURSE OUTCOMES (COs) : (3 - 5)

CO1	Will be familiarized with different gates and employ them to design combinational logic circuits.
CO2	Will be able to design counters and other sequential logic circuits using flip flops
CO3	Will be able to do programming in 8085 microprocessors
CO4	Will be able to do programming in 8051 microcontrollers
CO5	Will be able to do programming in PIC microcontrollers

Mapping of Course Outcomes with Program Outcomes (Pos)

Cos/Pos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**H**	**M**	**H**	**H**	**H**	**L**	**M**	**H**	**H**	**H**	**M**	**M**
CO2	**H**	**H**	**M**	**H**	**H**	**L**	**M**	**H**	**H**	**H**	**M**	**M**
CO3	**H**	**H**	**H**	**H**	**H**	**M**	**L**	**H**	**H**	**H**	**M**	**M**
CO4	**H**	**H**	**H**	**H**	**H**	**M**	**L**	**H**	**H**	**H**	**M**	**M**
CO5	**H**	**H**	**H**	**H**	**H**	**M**	**L**	**H**	**H**	**H**	**M**	**M**

Cos / PSOs	**PSO1**	**PSO2**	**PSO3**	**PSO4**				
CO1	**L**	**H**	**L**	**H**				
CO2	**L**	**M**	**L**	**H**				
CO3		**M**		**H**				
CO4		**M**		**H**				
CO5		**M**		**H**				

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
							✓					
Approval												

Subject Code: BRE18L04	Subject Name : **DIGITAL ELECTRONICS AND MICROPROCESSOR LAB**	**Ty / Lb/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite: Digital electronics, Microprocessor and Micro controllers	**Lb**	**0**	**0/0**	**3/0**	**1**

DIGITAL ELECTRONICS

1. Adders and Subtractors
2. Multiplexers and Demultiplexers
3. Encoder and Decoders
4. Study of Flip – Flops, Registers/Counters
5. Implementation of any general combinational/sequential logic circuits

MICROPROCESSOR AND MICROCONTROLLER

Experiments Based on ALP for 8085 ,8051

1. Programs on data Transfer Instructions
2. Programs on Arithmetic and Logical Instructions
3. Programs on Branch Instructions
4. Programs on Subroutines
5. Stepper Motor Control

Experiments Based on PIC

1. Programs on data manipulation.
2. Programs on I/O port programming.
3. Serial data programming.
4. LCD and Keyboard programming.
5. ADC, DAC and Sensor programming.
6. Stepper,DC motor programming

Total No. of Periods: 45

DEPARTMENT OF MECHANICAL ENGINEERING

Subject Code:	Subject Name : TECHNICAL SKILL-I (EVALUATION)	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
BRE18TS1	Prerequisite: None	Lb	0	0/0	3/0	1

L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE: The objective is to develop the technical skill of the students.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Develop the technical skills required in the field of study
CO2	Bridge the gap between the skill requirements of the employer or industry and the competency of the students.
CO3	Enhance the employability of the students.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	H	H	M	M	H	M	H	M
CO2	H	H	M	H	H	H	M	M	H	H	H	H
CO3	H	H	H	H	H	H	M	M	H	H	H	H

COs / PSOs	PSO1	PSO2	PSO3	PSO4			
CO1	M	M	H	M			
CO2	M	M	H	M			
CO3	M	M	H	M			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
							✓					
Approval												

Students should undergo training for at least 1 month in any industry/Training center/NPTEL-SWAYAM certification etc for skill development. The report along with certificate in proof of Skill acquired should be submitted during Viva-Voce examination to be conducted by the department.

Subject Code: BEN18SK1	Subject Name: SOFT SKILLS-I (CAREER & CONFIDENCE BUILDING)	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: None	**ETL**	**0**	**0/0**	**3/0**	**1**

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES:

- To create awareness in students, various top companies helping them improve their skill set matrix, leading to develop a positive frame of mind.
- To help students be aware of various techniques of candidate recruitment and help them prepare CV's and resume.
- To help student how to face various types of interview, preparing for HR, technical interviews.
- To help students improve their verbal reading, narration and presentation skills by performs various mock sessions.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Be aware of various top companies leading to improvement in skills amongst them.
CO2	Be aware of various candidate recruitment techniques like group discussion, interviews and be able to prepare CV's and resumes.
CO3	Prepare for different types of interviews and be prepared for HR and technical interviews.
CO4	Improve their verbal, written and other skills by performing mock sessions.
CO4	Able to bring out their entrepreneurial skills
CO5	Able to euip themselves for starting a firm

Mapping of Course Outcomes with Program Outcomes (Pos)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L	L	L	L	L	M	M	H	M	H	M	H
CO2	L	L	L	L	L	M	M	H	M	H	M	H
CO3	L	L	L	L	L	M	M	H	M	H	M	H
CO4	L	L	L	L	L	M	M	H	M	H	M	H
CO5	L	L	L	L	L	M	M	H	M	H	M	H

Cos / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	L	L	L	H
CO2	L	L	L	H
CO3	L	L	L	H
CO4	L	L	L	H
CO5	L	L	L	H

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Interdisciplinary Subject		
									✓			
Approval												

Subject Code:	Subject Name: SOFT SKILLS-I (CAREER & CONFIDENCE BUILDING	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
BEN18SK1	Prerequisite: None	ETL	0	0/0	3/0	1

SUBJECT OBJECTIVES:

- To develop an independent personality
- To be sure of presenting one-self
- To acquire knowledge in specialized sectors

To Improve:

1. Behavioral Pattern and Basic Etiquette,Value System,Inter Personal Skills
2. Behaving in Corporate Culture,Self Awareness / Confidence
3. Managing Self and Personality Styles including Body Language
4. International Culture / Cross Cultural Etiquette, Communication Skill

UNIT- I **6**

Creation of awareness of the top companies / different verticals / Subjects for improving skill set matrix, Industry expectations to enable them to prepare for their career – Development of positive frame of mind – Avoiding inhibitions – Creation of self awareness – Overcoming of inferiority / superiority complex.

UNIT- II **6**

Selection of appropriate field vis-à-vis personality / interest to create awareness of existing industries, Preparation of Curriculum Vitae – OBJECTIVESs, Profiles vis-à-vis companies.

UNIT- III **6**

Group discussions: Do's and Don'ts – handling of group discussions – What evaluators look for! Interpersonal relationships – with colleagues – clients – understanding one's own behaviour – perception by others, How to work with persons whose background, culture, language / work style different from one's, behaviour pattern in multi-national offices.

UNIT- IV **6**

Interview – awareness of facing questions – Do's and Don'ts of personal interview / group interview, Enabling students prepare for different Procedures / levels to enter into any company – books / websites to help for further preparation, Technical interview – how to prepare to face it. Undergoing employability skills test.

UNIT-V **6**

Entrepreneurship development – preparation for tests prior to the interview – Qualities and pre-requisites for launching a firm.

Total No. of Periods: 30

TEXT BOOKS:

1. Agarwal, R.S. Chand, S. (1989) *Quantitative Aptitude*. Publication.
2. ShaliniVerma,(2009) *Soft Skills*. Publication Pearson.

REFERENCES:

1. *Shaliniverma,(2012) Enhancing employability @ SOFT SKILLS. Publication Pearson*
2. Kiranmai Dutt, P. Geetha Rajeevan, C.L. Prakash, N.(2010) *A Subject in Communication Skills.* Publication Foundation Books.
3. Nirakonar,(2011) *English Language Laboratories*.PHI Learning.
4. Anandamurugan, S.(2011) *Placement Interviews*. Publication Tata McGraw Hill Education.

SEMESTER-V

DEPARTMENT OF MECHANICAL ENGINEERING

Subject Code: BRE18007	Subject Name: KINEMATICS AND DYNAMICS OF MACHINERY	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Engineering Mechanics	**Ty**	**3**	**1/0**	**0/0**	**4**

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To understand the basic components and layout of linkages in the assembly of a system machine.
- To understand the principles in analyzing the assembly with respect to the displacement, velocity, and acceleration To understand the motion of a specified set of linkages, design few linkage mechanisms and cam mechanisms
- To understand the basic concepts of toothed gearing and kinematics of gear trains

COURSE OUTCOMES (COs) : (3- 5)
Students will be able to

CO1	To understand the basic components and layout of linkages in the assembly of a system machine.
CO2	To understand the principles in analyzing the assembly
CO3	To understand the motion resulting from a specified set of linkages, design few linkage mechanisms
CO4	To understand the basic concepts of toothed gearing and kinematics of gear trains
CO5	Understand the concept of balancing and vibration.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	M	H	M	M	H	M	H	H
CO2	H	H	H	H	H	M	L	L	M	M	L	H
CO3	H	H	H	H	H	M	L	L	M	M	L	H
CO4	H	H	H	H	H	M	L	L	M	M	L	H
CO5	H	H	H	H	H	M	L	L	M	M	L	H

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	M	M	H	H
CO2	M	M	H	H
CO3	L	H	M	H
CO4	L	H	M	M
CO5	L	H	M	M

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								
Approval												

Subject Code: BRE18007	Subject Name: KINEMATICS AND DYNAMICS OF MACHINERY	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Engineering Mechanics	**Ty**	**3**	**1/0**	**0/0**	**4**

UNIT I: KINEMATICS OF MACHINES **12**

Mechanisms – Terminology and definitions – kinematics inversions of 4 bar and slide crank chain – kinematics analysis in simple mechanisms – velocity and acceleration polygons – Analytical methods – computer approach – cams – classifications – displacement diagrams - layout of plate cam profiles – derivatives of followers motion – circular arc and tangent cams.

UNIT II : GEARS AND GEAR TRAINS **12**

Spur gear – law of toothed gearing – involute gearing – Interchangeable gears – Gear tooth action interference and undercutting – nonstandard teeth – gear trains – parallel axis gears trains – epicyclic gear trains – automotive transmission gear trains.

UNIT III: FRICTION **12**

Sliding and Rolling Friction angle – friction in threads – Friction Drives – Friction clutches– Belt and rope drives – brakes – Tractive resistance.

UNIT IV : FORCE ANALYSIS **12**

Applied and Constrained Forces – Free body diagrams – static Equilibrium conditions – Two, Three and four members – Static Force analysis in simple machine members – Dynamic Force Analysis – Inertia Forces and Inertia Torque – D‟Alembert‟s principle – superposition principle – dynamic Force Analysis in simple machine members.

UNIT V : BALANCING AND VIBRATION **12**

Static and Dynamic balancing – Balancing of revolving and reciprocating masses – Balancing machines – free vibrations – Equations of motion – natural Frequency – Damped Vibration - critical speed of simple shaft – Torsional vibration – Forced vibration – harmonic Forcing – Vibration isolation.

Total No. of Periods : 60

TEXT BOOKS:

1. Ambekar A.G., “Mechanism and Machine Theory” Prentice Hall of India, New Delhi, 2007
2. Shigley J.E., Pennock G.R and Uicker J.J., “Theory of Machines and Mechanisms”, Oxford University Press, 2003

REFERENCES:

1. *Thomas Bevan, “Theory of Machines”, CBS Publishers and Distributors, 1984.*
2. Ghosh. A, and A.K. Mallick, “Theory and Machine”, Affiliated East-West Pvt. Ltd., New Delhi, 1988.
3. Rao.J.S. and Dukkipatti R.V. “Mechanisms and Machines”, Wiley-Eastern Ltd., New Delhi, 1992.
4. John Hannah and Stephens R.C., “Mechanics of Machines”, Viva Low Prices Student Edition, 1999.
5. V.Ramamurthi, Mechanisms of Machine, Narosa Publishing House, 2002.
6. Robert L.Norton, Design of Machinery, McGraw-Hill, 2004.

DEPARTMENT OF MECHANICAL ENGINEERING

Subject Code:	Subject Name : PROGRAMMABLE LOGIC CONTROLLERS	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
BRE18008	Prerequisite: Digital Electronics, C programming	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To be familiar with factory automation
- To be exposed to programmable logic controllers
- To learn to program PLC
- To be exposed to HMI systems
- To learn to install and maintain procedures for PLC and be exposed to applications of PLC

COURSE OUTCOMES (COs) : (3- 5)

CO1	The students have gained knowledge in with factory automation
CO2	The students have gained knowledge in programmable logic controllers.
CO3	The students have gained knowledge to program PLC
CO4	The students have gained knowledge in HMI systems
CO5	The students have gained knowledge to install and maintain procedures for PLC and be exposed to applications of PLC.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	H	L	M	H	H	H	M	M
CO2	H	H	H	H	H	L	M	H	H	H	M	M
CO3	H	H	H	H	H	M	L	H	H	H	M	M
CO4	H	H	H	H	H	M	L	H	H	H	M	M
CO5	H	H	H	H	H	H	H	H	H	H	H	H

COs / PSOs	PSO1	PSO2	PSO3	PSO4				
CO1	H	H	M	H				
CO2	H	M	M	H				
CO3	H	H	M	H				
CO4	H	H	M	H				
CO5	H	H	M	H				

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				√								
Approval												

Subject Code:	Subject Name : PROGRAMMABLE LOGIC CONTROLLERS	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
BRE18008	Prerequisite: Digital Electronics, C programming	Ty	3	0/0	0/0	3

UNIT I : INTRODUCTION TO FACTORY AUTOMATION **9**

History and developments in industrial automation. Vertical integration of industrial automation, Control elements in industrial automation, PLC introduction.

UNIT II : PROGRAMMABLE LOGIC CONTROLLERS **9**

Basics of PLC, Advantages, Capabilities of PLC, Architecture of PLC, Scan cycle, Types of PLC, Types of I/O modules, Configuring a PLC, PLC wiring.

UNIT III: PROGRAMMING OF PLC **9**

Types of Programming - Simple process control programs using Relay Ladder Logic - PLC arithmetic functions - Timers and counters –data transfer-comparison and manipulation instructions, PID instructions, PTO / PWM generation.

UNIT IV HMI SYSTEMS **9**

Necessity and Role in Industrial Automation, Text display - operator panels - Touch panels - Panel PCs - Integrated displays, interfacing PLC to HMI.

UNIT V INSTALLATION **9**

Installation and maintenance procedures for PLC - Troubleshooting of PLC, PLC Networking, Networking standards & IEEE Standard - Protocols - Field bus - Process bus and Ethernet. APPLICATIONS OF PLC Case studies of Machine automation, Process automation, Selection parameters for PLC. Introduction to Programmable Automation Controller.

Total No. of Periods : 45

TEXT BOOKS:

1. John W Webb & Ronald A Reis, “Programmable logic controllers: Principles and Applications”, Prentice Hall India, 2003.
2. Frank D Petruzella “Programmable Logic Controllers ", McGraw Hill Inc, 2005

REFERENCES:

1. Bolton W. , “Mechatronics”, Pearson Education, 2009
2. Kelvin T Erikson, “Programmable Logic Controllers ", Dogwood Valley Press, 2005

Subject Code:	Subject Name : CAD,CAM & CIM	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
BME18014	Prerequisite: Machine Drawing	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE:

- To provide an overview of how computers are being used in design, development of Manufacturing plans and manufacture
- To understand the need for integration of CAD,CAM and CIM

..

COURSE OUTCOMES (COs) : (3- 5)

CO1	Understand the use of various CAD devices.
CO2	Learning various CAD modeling techniques
CO3	Learning CAD/CAM integration and study of CNC Machines
CO4	Learning group Technology and process planning methods
CO5	Learning the FMS concept and functions.

Mapping of Course with Program Outcomes (Pos)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	H	L	M	H	H	H	M	M
CO2	H	H	H	H	H	L	M	H	H	H	M	M
CO3	H	H	H	H	H	M	L	H	H	H	M	M
CO4	H	H	H	H	H	M	L	H	H	H	M	M
CO5	H	H	H	H	H	H	H	H	H	H	H	H

Cos / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	H	H	M	H
CO2	H	M	M	H
CO3	H	H	M	H
CO4	H	H	M	H
CO5	H	H	M	H

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								
Approval												

Subject Code:	Subject Name : CAD,CAM & CIM	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
BME18014	Prerequisite: Machine Drawing	Ty	3	0/0	0/0	3

UNIT- I INTRODUCTION **9**

A typical product cycle, CAD tools for the design process of product cycle, CAD / CAM system evaluation criteria, Input / Output devices;

Graphics Displays: Refresh display, DVST, Raster display, pixel value and lookup table, estimation of graphical memory, LCD, LED fundamentals. Concept of Coordinate Systems: Working Coordinate System, Model Coordinate System, Screen Coordinate System. Graphics exchange standards.

UNIT- II GEOMETRIC TRANSFORMATIONS AND MODELING **9**

Homogeneous representation; Translation, Scaling, Reflection, Rotation, Shearing in 2D and 3D;. Window to View-port transformation. Geometry and Topology, Comparison of wireframe, surface and solid models, Properties of solid model, properties of representation schemes, Concept of Half-spaces, Boolean operations. Schemes: B-rep, CSG, Sweep representation, ASM, Primitive instancing, Cell Decomposition and Octree encoding

UNIT- III COMPUTER AIDED MANUFACTURING **9**

CAM Concepts, Objectives & scope, Nature & Type of manufacturing system, Evolution, Benefits of CAM, Role of management in CAM, Concepts of Computer Integrated Manufacturing, Impact of CIM on personnel, Role of manufacturing engineers, CIM Wheel to understand basic functions.

NC and CNC Technology: Types, Classification, Specification and components, Construction Details-Axis designation, NC/CNC tooling. Fundamentals of Part programming, Types of format, Part Programming for drilling, lathe and milling machine operations.

UNIT- IV GROUP TECHNOLOGY AND CAPP **9**

Introduction, part families, part classification and coding systems: OPITZ, PFA, FFA, Cell design, rank order clustering, composite part concepts, Benefits of group technology. Approaches to Process Planning, Different CAPP system, application and benefits

UNIT- V FLEXIBLE MANUFACTURING SYSTEM **9**

Introduction & Component of FMS, Needs of FMS, general FMS consideration, Objectives, Types of flexibility and FMS, FMS lay out and advantages. Automated material handling system: Types and Application, Automated Storage and Retrieval System, Automated Guided Vehicles, Cellular manufacturing, Tool Management, Tool supply system, Tool Monitoring System, Flexible Fixturing, Flexible Assembly Systems.

Total No. of Periods: 45

TEXT BOOKS

1) Chris McMohan and Jimmie Browne, *"CAD/CAM"*, Addison Wesley Publications, 2nd Ed.
2) HMT, (2000) *"Mechatronics"*, Tata McGraw –Hill Ed.
3) Mikkel. P.Groover, (2007) *"Automation, Production and Computer Integrated Manufacturing"*, PHI., Pvt Ltd.

REFERENCE BOOKS

1. Mikell P Groover, "Automation, Production Systems and Computer Integrated Manufacturing" , Pearson Education
2. Rao, Tewari, Kundra, "Computer Aided Manufacturing", McGraw Hill
3. P. Radhakrishnan , "Computer Numerical Control", New Central Book Agency

Subject Code: BRE18ET2	Subject Name: LINEAR INTEGRATED CIRCUITS	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Electrical and Electronics Circuits	**ETL**	**1**	**0/1**	**3/0**	**3**

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To introduce the basic building blocks of linear integrated circuits.
- To teach the linear and non-linear applications of operational amplifiers.
- To introduce the theory and applications of analog multipliers and PLL.
- To teach the theory of ADC and DAC.
- To introduce the concepts of waveform generation and introduce some special function ICs.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Basics of operational amplifiers
CO2	Applications of operational amplifiers
CO3	Analog multiplier and PLL
CO4	Analog to digital and digital to analog converters
CO5	Waveform generators and special function ICS

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	L	M	M	L	M	H	M	H	M	M	H
CO2	H	L	M	M	L	M	M	M	H	M	M	H
CO3	H	M	L	H	M	H	M	H	M	H	H	M
CO4	H	M	M	H	M	H	H	H	M	H	H	M
CO5	H	L	L	H	L	H	H	H	H	H	H	H

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	H	M	H	M
CO2	H	M	H	M
CO3	H	L	H	L
CO4	H	M	H	M
CO5	H	L	H	L

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Interdisciplinary Subject		
							✓					

Subject Code:	Subject Name: LINEAR INTEGRATED CIRCUITS	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
BRE18ET2	Prerequisite: Electrical and Electronics Circuits	ETL	1	0/1	3/0	3

UNIT I : BASICS OF OPERATIONAL AMPLIFIERS **9**

Current mirror and current sources, Current sources as active loads, Voltage sources, Voltage References, BJT Differential amplifier with active loads, Basic information about op-amps – Ideal Operational Amplifier - General operational amplifier stages -and internal circuit diagrams of IC 741, DC and AC performance characteristics, slew rate, Open and closed loop configurations.

UNIT II : APPLICATIONS OF OPERATIONAL AMPLIFIERS **9**

Sign Changer, Scale Changer, Phase Shift Circuits, Voltage Follower, V-to-I and I-to-V converters, adder, subtractor, Instrumentation amplifier, Integrator, Differentiator, Logarithmic amplifier, Antilogarithmic amplifier, Comparators, Schmitt trigger, Precision rectifier, peak detector, clipper and clamper, Low-pass, high-pass and band-pass Butterworth filters.

UNIT III : ANALOG MULTIPLIER AND PLL **9**

Analog Multiplier using Emitter Coupled Transistor Pair - Gilbert Multiplier cell – Variable transconductance technique, analog multiplier ICs and their applications, Operation of the basic PLL, Closed loop analysis, Voltage controlled oscillator, Monolithic PLL IC 565, application of PLL for AM detection, FM detection, FSK modulation and demodulation and Frequency synthesizing.

UNIT IV : ANALOG TO DIGITAL AND DIGITAL TO ANALOG CONVERTERS **9**

Analog and Digital Data Conversions, D/A converter – specifications - weighted resistor type, R-2R 2R Ladder types - switches for D/A converters,–Ladder type, Voltage Mode and Current-Mode R high speed sample-and-hold circuits, A/D Converters – specifications - Flash type - Successive Approximation type - Single Slope type – Dual Slope type - A/D Converter using Voltage-to-Time Conversion - Over-sampling A/D Converters.

UNIT V : WAVEFORM GENERATORS AND SPECIAL FUNCTION ICS **9**

Sine-wave generators, Multivibrators and Triangular wave generator, Saw-tooth wave generator, ICL8038 function generator, Timer IC 555, IC Voltage regulators – Three terminal fixed and adjustable voltage regulators - IC 723 general purpose regulator - Monolithic switching regulator, Switched capacitor filter IC MF10, Frequency to Voltage and Voltage to Frequency converters, Audio Power amplifier, Video Amplifier, Isolation Amplifier, Opto-couplers and fibre optic IC.

LAB COMPONENTS:

1. Adder
2. Subtractor
3. Inverting amplifier
4. Non-inverting amplifier
5. Voltage follower
6. Square wave generator using 555
7. Sine wave generator using 741
8. A/D & D/A converters

Total No. of Periods : 45

TEXT BOOKS:

1. D.Roy Choudhry, Shail Jain, “Linear Integrated Circuits”, New Age International Pvt. Ltd., 2000.
2. Sergio Franco, “Design with Operational Amplifiers and Analog Integrated Circuits”, 3rd Edition, Tata Mc Graw-Hill, 2007.

REFERENCES:

1. *Ramakant A. Gayakwad, “OP-AMP and Linear ICs”, 4th Edition, Prentice Hall / Pearson Education, 2001.*
2. Robert F.Coughlin, Frederick F.Driscoll, “Operational Amplifiers and Linear Integrated Circuits”, Sixth Edition, PHI, 2001.
3. B.S.Sonde, “System design using Integrated Circuits” , 2nd Edition, New Age Pub, 2001
4. Gray and Meyer, “Analysis and Design of Analog Integrated Circuits”, Wiley International, 2005.
5. Michael Jacob, “Applications and Design with Analog Integrated Circuits”, Prentice Hall of India, 1996.

DEPARTMENT OF MECHANICAL ENGINEERING

Subject Code: BRE18L05	Subject Name : CAD,CAM LAB	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: CAD,CAM &CIM	Lb	0	0/0	3/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE:

- To get practical knowledge in computer aided design and visualizing the real time working conditions
- To get practical knowledge through intensive practice on CNC Machines and related software.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Gain the knowledge of various CAD Software used for modeling.
CO2	Gain the knowledge of modeling of different machine parts.
CO3	Gain the knowledge of CNC Machines and related software.
CO4	Gain the knowledge of writing program for CNC Lathe and Milling operations using CNC Software.
CO5	Gain the knowledge of simulating electronic circuit using CAD software

Mapping of Course with Program Outcomes (Pos)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	M		H							
CO2	H	H	M		H							
CO3	H	H	M		H							
CO4	H	H	M		H							
CO5	H	H	M		H							

Cos / PSOs	PSO1	PSO2	PSO3	PSO4			
CO1	H	H	M	H			
CO2	H	M	M	H			
CO3	H	H	M	H			
CO4	H	H	M	H			
CO5	H	H	M	H			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
							✓					
Approval												

Subject Code:	Subject Name : CAD,CAM LAB	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
BRE18L05	Prerequisite: CAD,CAM &CIM	Lb	0	0/0	3/0	1

1. Shafts subjected to Bending Moment and Twisting Moment
2. Shafts with Axial Load, Bending Moment and Twisting Moment
3. Open and Closed coiled helical springs
4. Leaf Springs
5. Power Screws
6. Wire ropes for various loads
7. Connecting rod
8. Crank shaft
9. Exercises in CNC lathe.
10. Exercises in CNC milling machine.
11. Programming in CAM software
12. Simulation of electrical/electronic circuits using CAD software.

Total No. of Periods : 45

DEPARTMENT OF MECHANICAL ENGINEERING

Subject Code: BRE18L06	Subject Name : PROGRAMMABLE LOGIC CONTROLLERS LAB	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: C programming, Digital Electronics, Instrumentation and Control for Robots	Lb	0	0/0	3/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To do programming in PLC.
- To analyze the operation of SCADA
- To implement applications of PLC

COURSE OUTCOMES (COs) : (3- 5)

CO1	**The students have gained knowledge in** programming with PLC
CO2	**The students have gained knowledge** about the operation of SCADA
CO3	**The students have gained knowledge** about applications of PLC
CO4	**The students have gained knowledge** about designing different control systems
CO5	**The students have gained knowledge** about controlling speed of DC motor

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	H	H	H	H	M	H	H	H	M	M
CO2	H	H	M	H	H	H	M	H	H	H	M	M
CO3	H	H	H	H	H	M	M	H	H	H	M	M
CO4	H	H	H	H	H	M	M	H	H	H	M	M
CO5	H	H	H	H	H	M	M	H	H	H	M	M

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	H	H	M	H
CO2	H	M	M	H
CO3	H	H	M	H
CO4	H	H	M	H
CO5	H	H	M	H

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
							√					

DEPARTMENT OF MECHANICAL ENGINEERING

Subject Code: BRE18L06	Subject Name : PROGRAMMABLE LOGIC CONTROLLERS LAB	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: C programming, Digital Electronics, Instrumentation and Control for Robots	Lb	0	0/0	3/0	1

LIST OF EXPERIMENTS:

1. To study Ladder logic programming of a industrial PLC like SEIMENS/FATEK/MICROLOGIX
2. To write a programme for control of bottling mechanism for soft drinks.
3. To write a Programme for Car Parking.
4. To study step sequence.
5. To write a Programme for Crane Control
6. To write a programme & interface simulated hardware unit of Tank level control.
7. To write a programme & interface & control a traffic light.
8. To write a programme & interface & control a simulated elevator control .
9. To write a programme & interface & control a conveyer belt .
10. To write a programme & interface & control speed of a DC motor .
11. To write a programme & interface & temperature control system using analog outputs.
12. To study the operation of SCADA.

Total No. of Periods: 45

DEPARTMENT OF MECHANICAL ENGINEERING

Subject Code:	Subject Name : TECHNICAL SKILL-II (EVALUATION)	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
BRE18TS2	Prerequisite: None	Lb	0	0/0	3/0	1

L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE: The objective is to develop the technical skill of the students.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Develop the technical skills required in the field of study
CO2	Bridge the gap between the skill requirements of the employer or industry and the competency of the students.
CO3	Enhance the employability of the students.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	H	H	M	M	H	M	H	M
CO2	H	H	M	H	H	H	M	M	H	H	H	H
CO3	H	H	H	H	H	H	M	M	H	H	H	H

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	M	M	H	M
CO2	M	M	H	M
CO3	M	M	H	M

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
								✓				
Approval												

Students should undergo training for at least 1 month in any industry/Training center/SWAYAM-NPTEL Certification etc for skill development. The report along with certificate in proof of Skill acquired should be submitted during Viva-Voce examination to be conducted by the department**.**

DEPARTMENT OF MECHANICAL ENGINEERING

Subject Code: BRE18L07	Subject Name : INDUSTRIAL TRAINING (EVALUATION)	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: None	**Lb**	**0**	**0/0**	**3/0**	**1**

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE : The main objective of the Implant training is to provide a short-term work experience in an Industry/ Company/ Organization

COURSE OUTCOMES (COs) : (3- 5)

CO1	To get an insight of an industry / organization/company pertaining to the domain of study.
CO2	To acquire skills and knowledge for a smooth transition into the career.
CO3	To gain field experience and get linked with the professional network.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	L	L	L	L	H	H	H	H	H	H	H
CO2	H	M	H	H	M	H	H	H	H	H	H	M
CO3	H	H	H	H	M	H	H	H	H	H	H	M

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	M	M	H	M				
CO2	M	M	H	M				
CO3	M	M	H	M				

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
								✓				
Approval												

Students are supposed to undergo industrial training in Robotic related Industries for a minimum period of 15 days during IV/ V semester holidays. They have to prepare a report on the Industrial visit with a certificate in proof of the Industrial visit from competent authority in the industry.

At the end of the Vth semester Viva-Voce examination will be conducted by the internal Examiner duly appointed by the Head of the department and the students will be evaluated.

SEMESTER-VI

DEPARTMENT OF MECHANICAL ENGINEERING

Subject Code: BRE18009	Subject Name : DESIGN OF MACHINE ELEMENTS	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Engineering Mechanics, Strength of Materials, Kinematics and Dynamics of Machinery	Ty	3	1/0	0/0	4

L : Lecture T : Tutorial S Lr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE: The student will learn

- Design principles of various gears and bearings
- Design of various flexible elements, like shaft, couplings ,chain and ropes
- Design of friction clutches

COURSE OUTCOMES (COs) : (3- 5)

CO1	Design principles of various gears and bearings.
CO2	Design process various flexible elements, like shaft, couplings ,chain and ropes
CO3	Design of V belts and chains
CO4	Design rolling contact bearings
CO5	Design friction bearings

Mapping of Course Outcomes with Program Outcomes (POs)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	H	L	M	H	H	H	M	M
CO2	H	H	H	H	H	L	M	H	H	H	M	M
CO3	H	H	H	H	H	M	L	H	H	H	M	M
CO4	H	H	H	H	H	M	L	H	H	H	M	M
CO5	H	H	H	H	H	H	H	H	H	H	H	H

Cos / PSOs	PSO1	PSO2	PSO3	PSO4				
CO1	H	H	M	H				
CO2	H	M	M	H				
CO3	H	H	M	H				
CO4	H	H	M	H				
CO5	H	H	M	H				

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								
Approval												

Subject Code: BRE18009	Subject Name : DESIGN OF MACHINE ELEMENTS	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Engineering Mechanics, Strength of Materials, Kinematics and Dynamics of Machinery	Ty	3	1/0	0/0	4

UNIT I : DESIGN OF GEARS **13**

Review of gear fundamentals, interference, gear forces, determining dimensions of a spur gear pair. Design of helical gears-parallel axis helical gear, normal and transverse planes, helix angles, equivalent number of teeth, determining dimension of helical gear pair, nomenclature of straight and bevel gears.

UNIT II : DESIGN OF SHAFTS AND COUPLINGS **13**

Forces on shafts due to gears, belts and chains, estimation of shaft size based on strength and critical speed. Couplings-types and applications, Design of square keys-use of standards, rigid couplings, flexible flange couplings - selection.

UNIT III : SELECTION OF V BELTS AND CHAINS **13**

V belts for given power and velocity ratio, selection of micro V-belts, timing belts. Selection of roller chain and power speed ratio, silent chain.

UNIT IV : ROLLING CONTACT BEARINGS **8**

Static and dynamic load capacity, cubic mean load, variable load, probability of survival, selection of deep groove and angular contact ball bearings.

UNIT V : FRICTION DRIVES **13**

Clutches - role of clutches, positive and gradually engaged clutches, toothed claw clutches, design of single plate and multiple plate clutches, variable speed drives, types and selection.

Total No. of Periods: 60

TEXT BOOKS:

1. Robert L Mott, "Machine Elements in Mechanical Design", Macmillan Publishing Co., London, 1992.
2. Shigley and Mische, “Mechanical Engineering Design”, McGraw Hill, Inc., New Delhi, 2000.

REFERENCES:

1. Bandari V B, "Design of Machine Elements ", Tata McGraw Hill Publishers Co. Ltd., New Delhi, 2003.
2. Robert L Nortan, “Machine Design-An Integrated Approach”, Pearson Publishers, New Delhi, 2003.
3. Maitra G M, “Handbook of Gear Design”, Tata McGraw Hill, New Delhi, 1998
4. Faculty of Mechanical Engineering, PSG College of Technology, "Design Data Book", M/s. DPV Printers, Coimbatore, 2000

Subject Code:	Subject Name :HYDRAULICS AND PNEUMATICS	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
BRE18010	Prerequisite: Engineering Physics.	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE:

- To understand the basic principles of hydraulics
- To analyse different hydraulic circuits.
- To design different hydraulic circuits.
- To analyse different pneumatic circuits.
- To design different pneumatic circuits.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Will be able to understand the basic principles of hydraulics
CO2	Will be able to analyze different hydraulic circuits
CO3	Will be able to design different hydraulic circuits.
CO4	Will be able to analyse different pneumatic circuits.
CO5	Will be able to design different pneumatic circuits.

Mapping of Course Outcomes with Program Outcomes (POs)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	H	L	M	H	H	H	M	M
CO2	H	H	H	H	H	L	M	H	H	H	M	M
CO3	H	H	H	H	H	M	L	H	H	H	M	M
CO4	H	H	H	H	H	M	L	H	H	H	M	M
CO5	H	H	H	H	H	H	H	H	H	H	H	H

Cos / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	H	H	M	H
CO2	H	M	M	H
CO3	H	H	M	H
CO4	H	H	M	H
CO5	H	H	M	H

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								
Approval												

Subject Code: BRE18010	Subject Name : HYDRAULICS AND PNEUMATICS	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Engineering Physics.	Ty	3	0/0	0/0	3

UNIT I: BASICS OF FLUIDS: 9

Properties of fluids, Units and dimensions, Viscosity, surface tension and capillarity, compressibility and bulk modulus. Flow characteristics, continuity equation, energy equation, Euler and Bernoullis equation, impulse momentum equation and applications.

UNIT II: HYDRAULIC SYSTEM 9

Hydraulic principles – Hydraulic pumps – Characteristics – pump selection – pumping circuits - Hydraulic actuators – Linear and rotary selection – Characteristics – Hydraulic valves –Pressure – Flow – Direction controls – Applications – Hydraulic Fluids – Symbols.

UNIT III: HYDRAULIC CIRCUITS DESIGN AND SELECTION 9

Hydraulic circuits – Reciprocating – Quick-return – sequencing – synchronizing –Accumulators circuits – Safety circuits – Industrial circuits – Press, milling machine, Planner, forklift etc. Design of Hydraulic circuits – selection of components – Installation and maintenance of Hydraulic power packs.

UNIT IV: PNEUMATIC SYSTEMS 9

Fundamentals – Control elements – logic circuits – position – pressure sensing – switching – Electro-pneumatic – Electro-hydraulic circuits.

UNIT V: DESIGN AND SELECTION 9

Design of Pneumatic circuits – classic – cascade – step counter – combination methods – Selection criteria – for pneumatic components – Installation and Maintenance of Hydraulic and Pneumatic power packs.

Total No. of Periods: 45

TEXT BOOKS

1) Anthony Esposito, (2008) *"Fluid power with applications"*, Pearson education Pvt. Ltd, 7th edition.
2) S.K.Bansal(2012) "Fluid Mechanics and Hydraulic Machines" Lakshmi publications Pvt Limited,New Delhi.
3) S.Ilango and V.soundarrajan ,(2011) "*Introduction to Hydraulics and Pneumatics"*,Prentice hall india,2nd Edition.

REFERENCES:

1) W.Bolton, (2012) "Pneumatic and Hydraulic Systems", Butterworth, 3rd edition.

DEPARTMENT OF MECHANICAL ENGINEERING

Subject Code:	Subject Name : POWER ELECTRONICS AND DRIVES	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
BRE18011	Prerequisite: Electrical and Electronics circuits	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial S Lr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- Familiarity to Power Electronic Devices and its characteristics.
- Capable of designing the triggering of firing circuits.
- Familiarization to inverters
- To study about choppers
- To have knowledge in DC & AC Industrial drives.

COURSE OUTCOMES (COs) : (3- 5)

CO1	The students have gained knowledge in Power Electronic Devices and its characteristics
CO2	The students have gained knowledge in design of the triggering of firing circuits
CO3	The students have gained knowledge in inverters
CO4	The students have gained knowledge in choppers
CO5	The students have gained knowledge in DC & AC Industrial drives.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	H	L	M	H	H	H	M	M
CO2	H	H	H	H	H	L	M	H	H	H	M	M
CO3	H	M	H	H	H	M	L	H	H	H	H	M
CO4	H	H	H	H	H	M	L	H	H	H	M	M
CO5	H	H	H	H	H	H	H	H	H	H	H	H

COs / PSOs	PSO1	PSO2	PSO3	PSO4			
CO1	H	H	M	H			
CO2	H	H	M	H			
CO3	H	H	M	H			
CO4	H	H	M	H			
CO5	H	H	M	H			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				√								
Approval												

Subject Code: BRE18011	Subject Name : POWER ELECTRONICS AND DRIVES	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Electrical and Electronics circuits	Ty	3	0/0	0/0	3

UNIT I: REVIEW OF POWER SEMICONDUCTOR DEVICES **9**

Power diodes –power transistors-Characteristics of SCR, TRIAC, Power MOSFET, IGBT-Thyristor protection circuits-thyristor trigeering circuits.

UNIT II CONVERTERS **9**

Single Phase-three Phases-Half controlled –full controlled rectifiers-Dual converters-Effect of source and load inductance-AC regulators (no derivations).

UNIT III INVERTERS AND CONVERTERS **9**

Voltage Source Inverters-bridge inverters-Current Source inverters-Voltage and waveform control of inverters-Dc choppers-Step up and step down –uninterrupted power supplies-introduction to dries-basic elements of drive-load characteristics-selection of drive.

UNIT IV DC DRIVES **9**

Basic characteristic of DC motor-Criteria for Drive selection-Operating modes-quadrant operation of chopper-Closed loop control of DC drives.

UNIT V AC DRIVES **9**

Induction motor-Performance characteristics-Stator and rotor voltage control, frequence and voltage control-Current Control-Introduction to synchronous motor, stepper motor, switched reluctance motor drives-basics of vector control.

.

Total no. of Periods: 45

TEXT BOOKS:

1. Rashid M.H ,"Power Electronics-circuits ,Devices and Applications, PHI, New Delhi.,2004
2Dubey, G.K "Power Semiconductors and Drives", Prentice Hall,1989

REFERENCES:

1. Bimal KBose,"Modern Power Electronics and AC Drives ",Pearson Education ,2002.
2. Joseph Vithyathil,"Power Electronics", Mcgraw Hill,USA,1995.
3Mohan ,Udeland and Robbins,"Power Electronics",John Wiley and sons ,New York ,2003.
4.Vedam Subramaniam ,"Thyristor control of Electrical Drives",Tata McGraw-hill,New Delhi,1998

Subject Code:	Subject Name INDUSTRIAL AUTOMATION LAB	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
BRE18L08	Prerequisite: Hydraulics and Pneumatics	Lb	0	0/0	3/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES:

- To get knowledge on various industrial processes
- To design and implement pneumatic and hydraulic circuits with automation studio software and with kits
- To get Knowledge of industrial robots

COURSE OUTCOMES (COs) : (3- 5) Students

CO1	Will get knowledge on various industrial processes.
CO2	Will design and implement pneumatic and hydraulic circuits with automation studio software and with kits
CO3	Will get Knowledge of different transmitter in industrial process
CO4	Will get knowledge of distributed control system
CO5	Will get knowledge of level control

Mapping of Course Outcomes with Program Outcomes (Pos)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L		H		H							H
CO2	L		H		H							H
CO3	L		L		M							H
CO4	L		L		M							H
CO5	L		L		M							H

Cos / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	H	H	H	H
CO2	H	H	H	H
CO3	H	H	M	H
CO4	H	H	M	H
CO5	H	H	M	H

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
							✓					
Approval												

Subject Code:	Subject Name :INDUSTRIAL AUTOMATION LAB	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
BRE18L08	Prerequisite: Hydraulics and Pneumatics	Lb	0	0/0	3/0	1

3LIST OF EXPERIMENTS:

1. Study of different types of hydraulic and pneumatic components.
2. Study of robotics arm and its configuration.
3. Study of Robotic end effectors
4. Exercises in Pneumatic / Hydraulic Trainer Kit.
5. Design of pneumatic and hydraulic circuits using Automation Studio software.
6. Study of reciprocating movement of double acting cylinder using pneumatic direction control valves.
7. Use of direction control valve and pressure control valve clamping devices for jig and fixture.
8. Study of the characteristics of the pressure transmitter in Industrial Process.
9. Study of the characteristics of the Temperature transmitter in Industrial Process.
10. Study of the characteristics of the Flow transmitter in Industrial Process.
11. Study on Distributed Control System in Industries.
12. Study of Level Control in Industrial Process.

Total No. of Periods: 45

DEPARTMENT OF MECHANICAL ENGINEERING

Subject Code: BRE18L09	Subject Name : POWER ELECTRONICS AND DRIVES LAB	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Power electronics and drives	**Lb**	**0**	**0/0**	**3/0**	**1**

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To provide hands on experience with power electronic converter design and testing

COURSE OUTCOMES (COs) : (3- 5)

CO1	The students have gained knowledge in power electronic converter design and testing
CO2	Would have gained hands on experience with Characteristics of SCR and TRIAC
CO3	Would have gained hands on experience with IGBT based single and Three phase PWM inverter
CO4	Would have gained hands on experience with designing switched mode power converter
CO5	Would have gained hands on experience with designing power electronic based systems

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	H	H	H	H	M	H	H	H	H	H
CO2	H	M	H	H	H	H	M	H	H	H	H	H
CO3	H	M	H	H	H	H	M	H	H	H	H	H
CO4	H	M	H	H	H	H	M	H	H	H	H	H
CO5	H	M	H	H	H	H	M	H	H	H	H	H

COs / PSOs	PSO1	PSO2	PSO3	PSO4			
CO1	H	H	M	H			
CO2	H	H	M	H			
CO3	H	H	M	H			
CO4	H	H	M	H			
CO5	H	H	M	H			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
							√					
Approval												

Subject Code:	Subject Name : POWER ELECTRONICS AND DRIVES LAB	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
BRE18L09	Prerequisite: Power electronics and drives	Lb	0	0/0	3/0	1

LIST OF EXPERIMENTS:

1. Gate Pulse Generation using R, RC and UJT.
2. Characteristics of SCR and TRIAC
3. Characteristics of MOSFET and IGBT
4. AC to DC half controlled converter
5. AC to DC fully controlled Converter
6. Step down and step up MOSFET based choppers
7. IGBT based single phase PWM inverter
8. IGBT based three phase PWM inverter
9. AC Voltage controller
10. Switched mode power converter
11. Simulation of PE circuits (1Φ & 3Φ semi converter, 1Φ & 3Φ full converter, dc-dc converters, ac voltage controllers).

Total No. of Periods: 45

DEPARTMENT OF MECHANICAL ENGINEERING

Subject Code: BEN18SK2	Subject Name: SOFT SKILLS-II (QUALITATIVE AND QUANTITATIVE SKILLS)	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: None	**ETL**	**0**	**0/0**	**3/0**	**1**

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES:

- To create awareness in students, various top companies helping them improve their skill set matrix, leading to develop a positive frame of mind.
- To help students be aware of various techniques of candidate recruitment and help them prepare CV's and resume.
- To help student how to face various types of interview, preparing for HR, technical interviews.
- To help students improve their verbal reading, narration and presentation skills by performs various mock sessions.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Be aware of various top companies leading to improvement in skills amongst them.
CO2	Be aware of various candidate recruitment techniques like group discussion, interviews and be able to prepare CV's and resumes.
CO3	Prepare for different types of interviews and be prepared for HR and technical interviews.
CO4	Improve their verbal, written and other skills by performing mock sessions.
CO5	Improve their data interpretation skills

Mapping of Course Outcomes with Program Outcomes (Pos)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L	L	L	L	L	M	M	H	M	H	M	H
CO2	L	L	L	L	L	M	M	H	M	H	M	H
CO3	L	L	L	L	L	M	M	H	M	H	M	H
CO4	L	L	L	L	L	M	M	H	M	H	M	H
CO5	L	L	L	L	L	M	M	H	M	H	M	H

Cos / PSOs	PSO1	PSO2	PSO3	PSO4				
CO1	L	L	H					
CO2	L	L	H					
CO3	L	L	H					
CO4	L	L	H					
CO5	L	L	H					

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Interdisciplinary Subject		
									✓			

DEPARTMENT OF MECHANICAL ENGINEERING

Subject Code: BEN18SK2	Subject Name: SOFT SKILLS-II (QUALITATIVE AND QUANTITATIVE SKILLS)	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: None	**ETL**	**0**	**0/0**	**3/0**	**1**

The purpose of this Subject is to build confidence, inculcate various Soft skills and also helps the students to identify in achieving their personal potential.
At the end of this training program the participant will be able to,
Explain the concept problem solving

- Outline the basic steps in problem solving.
- List out the key elements
- Explain the use of tools and techniques in problem solving.
- Discuss the personality types and problem solving techniques.
- By adapting different thinking styles in group and learn environment.
- Recognizing and removing barriers to thinking in challenging situations.
- Make better decision through critical thinking and creative problem solving.

METHODOLOGY
The entire program is designed in such a way that every student will participate in the class room activities. The activities are planned to bring out the skills and talent of the students which they will be employing during various levels in their real life.

1. Group activities + individual activities
2. Collaborative learning
3. Interactive sessions
4. Ensure Participation
5. Empirical Learning

UNIT I Logical Reasoning I
Logical Statements – Arguments – Assumptions – Courses of Action.

UNIT II Logical Reasoning II
Logical conclusions – Deriving conclusions from passages – Theme detection.

UNIT III Arithmetical Reasoning I
Number system – H.C.F & L.C.M – Problem on ages – Percentage – Profit & Loss – Ratio & Proportion – Partnership.

UNIT IV Arithmetical Reasoning II
Time & Work – Time & Distance – Clocks – Permutations & Combinations – Heights & Distances – Odd man out and Series.

UNIT V Data Interpretation
Tabulation – Bar graphs – Pie graphs – Line graphs.

Total No. of Periods: 30

Reference Book:
1. R.S.Agarwal, A modern approach to Logical Reasoning, S.Chand & Co., (2017).
2. R.S.Agarwal, A modern approach to Verbal and Non verbal Reasoning, S.Chand & Co., (2017).
3. R.S.Agarwal, Quantitative Aptitude for Competitive Examinations, S.Chand & Co., (2017).
4. A.K.Gupta, Logical and Analytical Reasoning, Ramesh Publishing House, (2014).
***5.** B.S.Sijwali, Indu sijwali, A new approach to Reasoning (Verbal and Non verbal), Arihant Publishers, (2014).*

DEPARTMENT OF MECHANICAL ENGINEERING

Subject Code: BRE18L10	Subject Name : MINI-PROJECT	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Knowledge of Interdisciplinary Subjects and Skills.	Lb	0	0/0	3/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE : The main objective of the this course is to bring out the interdisciplinary skills in students by encouraging them to do mini projects, in the field of Mechanical, Electrical, Electronics & Computer science .The project can be a simulation or hardware based.

COURSE OUTCOMES (COs) : (3- 5)

CO1	To apply the interdisciplinary knowledge for carrying out an innovative, industrial application Project.
CO2	To acquire desired technological skills required in the interdisciplinary domain
CO3	To enhance the employability skills of the students.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	L	L	L	L	H	H	H	H	H	H	H
CO2	H	M	H	H	M	H	H	H	H	H	H	M
CO3	H	H	H	H	M	H	H	H	H	H	H	M

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
							✓					
Approval												

Students will have an opportunity to expose their knowledge and talent to make an innovative project. Students are supposed to do innovative projects useful to industries/society in the area of Robotics Engineering and related areas, under the guidance of a staff member of their study. They have to prepare a project report and submit to the department.

At the end of the semester Viva-Voce examination will be conducted by the internal Examiner duly appointed by the Head of the department and the students will be evaluated.

Subject Code: BRE18TS3	Subject Name : TECHNICAL SKILL-3 (EVALUATION)	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: None	**Lb**	**0**	**0/0**	**3/0**	**1**

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE: The objective is to develop the technical skill of the students.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Develop the technical skills required in the field of study
CO2	Bridge the gap between the skill requirements of the employer or industry and the competency of the students.
CO3	Enhance the employability of the students.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	H	H	M	M	H	M	H	M
CO2	H	H	M	H	H	H	M	M	H	H	H	H
CO3	H	H	H	H	H	H	M	M	H	H	H	H

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	M	M	H	M
CO2	M	M	H	M
CO3	M	M	H	M

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
								✓				
Approval												

Students should undergo training for at least 1 month in any **industry/Training Centre/ SWAYAM-NPTEL Certification** etc for skill development. The report along with certificate in proof of Skill acquired should be submitted during viva voce examination to be conducted by the department.

SEMESTER-VII

DEPARTMENT OF MECHANICAL ENGINEERING

Subject Code: BRE18012	Subject Name: KINEMATICS AND DYNAMICS OF ROBOTS	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Kinematics and Dynamics of Machinery	**Ty**	**3**	**1/0**	**0/0**	**4**

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To understand the specifications and kinetics of robotics
- To understand the workspace analysis of Four axis, Five axis and Six axis robots
- To understand the dynamic analysis and forces of robots
- To understand the different motion of robots

COURSE OUTCOMES (COs) : (3- 5)
Students will be able to

CO1	Gain the knowledge of different specifications and kinetics of robotics
CO2	Gain the knowledge of work space analysis of robots
CO3	Gain the knowledge of differential motion and statics
CO4	Gain the knowledge of dynamic analysis and forces
CO5	Gain the knowledge of trajectory planning

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	M	H	M	M	H	M	H	H
CO2	H	H	H	H	H	M	L	L	M	M	L	H
CO3	H	H	H	H	H	M	L	L	M	M	L	H
CO4	H	H	H	H	H	M	L	L	M	M	L	H
CO5	H	H	H	H	H	M	L	L	M	M	L	H

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	M	M	H	H
CO2	M	M	H	H
CO3	L	H	M	H
CO4	L	H	M	M
CO5	L	H	M	M

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								
Approval												

Subject Code: BRE18012	Subject Name: KINEMATICS AND DYNAMICS OF ROBOTS	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Kinematics and Dynamics of Machinery	**Ty**	**3**	**1/0**	**0/0**	**4**

UNIT –I INTRODUCTION 12

Specifications of Robots- – Work envelope - Flexible automation versus Robotic technology –Dot and cross products, Co-ordinate frames, Rotations, Homogeneous Coordinates, Link coordinates, D-H Representation, Arm equation -Two axis, three axis, four axis, five axis and six axis robots. Inverse Kinematic problem, General properties of solutions, Tool configuration, Inverse Kinematics of Two axis Three axis, Four axis and Five axis robots.

UNIT –II WORKSPACE ANALYSIS 12

Workspace analysis of Four axis, Five axis and Six axis robots, Perspective transformation, structured illumination, Camera calibration, Work envelope of Four and Five axis robots, Workspace fixtures.

UNIT –III DIFFERENTIAL MOTION AND STATICS 12

The tool Configuration Jacobian matrix for three axis and, four axis robots, joint space singularities, resolved motion rate control, manipulator Jacobian for three and four axis joint space singularities, induced joint torques and forces.

UNIT –IV DYNAMIC ANALYSIS AND FORCES 12

Introduction, Langrangian mechanics, Effects of moments of Inertia, Dynamic equation for two axis planar articulated robot.

UNIT –V TRAJECTORY PLANNING 12

Trajectory planning Pick and place operations, Continuous path motion, Interpolated motion, Straight line motion.

Total No. of Periods: 60

TEXT BOOKS:

1. Robert J. Schilling, ―Fundamentals of Robotics Analysis and Control‖, PHI Learning, 2009.
2. Niku S B, ―Introduction to Robotics, Analysis, Systems, Applications‖, Prentice Hall, 2001.

REFERENCES:

1. *John J Craig, ―Introduction to Robotics, Pearson, 2009.*
2. *Deb S R and Deb S, ―Robotics Technology and Flexible Automation‖, Tata McGraw Hill Education Pvt. Ltd, 2010.*
3. *Richard D Klafter, Thomas A Chmielewski, Michael Negin, "Robotics Engineering – An Integrated Approach", Eastern Economy Edition, Prentice Hall of India P Ltd., 2006.*
4. *Saha S K, ―Introduction to Robotics‖, Tata McGraw Hill Education Pvt. Ltd, 2010.*

DEPARTMENT OF MECHANICAL ENGINEERING

Subject Code: BRE18013	Subject Name: INDUSTRIAL APPLICATIONS OF ROBOTS	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Basics of robotics	**Ty**	**3**	**0/0**	**0/0**	**3**

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To give a conceptual understanding of usage of robots in manufacturing industries
- To analyse robots for processing operations
- To analyse the robots for assembly ,inspection,selection and select robots based on various design considerations

COURSE OUTCOMES (COs) : (3- 5)
Students will be able to

CO1	Understand the usage of robots for material handling purposes
CO2	Appreciate the significance of robots in processing applications
CO3	Appreciate the role of robots in assembly and inspection
CO4	Appreciate the role of robots in unsafe and safe environments
CO5	Select and design robots based on various considerations

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	M	H	M	M	H	M	H	H
CO2	H	H	H	H	H	M	L	L	M	M	L	H
CO3	H	H	H	H	H	M	L	L	M	M	L	H
CO4	H	H	H	H	H	M	L	L	M	M	L	H
CO5	H	H	H	H	H	M	L	L	M	M	L	H

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	M	M	H	H
CO2	M	M	H	H
CO3	L	H	M	H
CO4	L	H	M	M
CO5	L	H	M	M

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								

Subject Code: BRE18013	Subject Name: INDUSTRIAL APPLICATIONS OF ROBOTS	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Basics of robotics	Ty	3	0/0	0/0	3

UNIT I: MATERIAL TRANSFER AND MACHINE LOADING/UNLOADING 9

General considerations in Robot material handling-material transfer application-machine loading and unloading-robot cell design and control.

UNIT II ROBOT FOR PROCESSING OPERATIONS 9

Applications of Robots in Spot Welding-Continuous Arc welding-Spray coating-Other processing operations using robots-examples and case studies.

UNIT III ASSEMBLY AND INSPECTION 9

Assembly and Robotic Assembly Automation-part presentation Methods-Assembly Operations-Compliance and the Remote Center Compliance (RCC) Device-Assembly System Configurations-Adaptable-programmable Assembly system-Designing for Robotic Assembly-Inspection Automation.

UNIT IV ROBOTS FOR UNSAFE AND SAFE ENVIRONMENTS 9

Robot in hazardous and inaccessible non manufacture environments-construction-underground coal mining-fire fighting operations-under sea operations-Space operations etc.Robots in Service industries-Teaching, security and household robots-case studies

UNIT V SELECTION AND DESIGN CONSIDERATION OF ROBOTS 9

Factors influencing the choice of a robot, robot performance testing-Path/point accuracy and repeatability-maximum working envelop-kinematic and state values-robot safety-considerations-Factors affecting robot safety measures-safety features built into industrial robot-safety barriers and other devices

Total no. of Periods: 45

TEXT BOOKS:

1. Mikell P. Groover,"Industrial Robotics Technology, Programming and Applications", 2nd Edition, John Mcgraw Hill Book Company, 2013
2.Bernard Hodges,"Industrial Robotics",Second Editon,Jaico Publishing House,1993

REFERENCES:

1. *Deb S R and Deb S, —Robotics Technology and Flexible Automation‖, Tata McGraw Hill Education Pvt. Ltd, 2010.*
2. *Saha S K, —Introduction to Robotics, Tata McGraw Hill Education Pvt. Ltd, 2010*

DEPARTMENT OF MECHANICAL ENGINEERING

Subject Code:	Subject Name : ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
BRE18014	Prerequisite: Basics of Robotics, Python Programming	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

Ty/Lb/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- Study the concepts of Artificial Intelligence.
- Learn the methods of solving problems using Artificial Intelligence.
- Introduce the concepts of Expert Systems and machine learning

COURSE OUTCOMES (COs) : Students will:

CO1	Understand different types of AI agents and know various AI search algorithms
CO2	Ability to apply knowledge representation, reasoning, and machine learning techniques to real-world problems in terms of data management
CO3	Ability to use AI for statistical decision making
CO4	Be exposed to introductory concepts in machine learning
CO5	Find the usage of robotics in AI

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	M	H	M	M	H	H	H	H
CO2	H	H	H	H	M	H	M	M	H	H	H	H
CO3	H	H	H	H	L	H	M	M	H	M	H	H
CO4	H	H	H	H	L	H	M	M	H	M	H	H
CO5	H	H	H	H	L	H	M	M	H	M	H	H

COs / PSOs	PSO1	PSO2	PSO3	PSO4		
CO1				H		
CO2				H		
CO3				H		
CO4				H		
CO5				H		

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								
Approval												

DEPARTMENT OF MECHANICAL ENGINEERING

Subject Code:	Subject Name : ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
BRE18014	Prerequisite: Basics of Robotics, Python Programming	Ty	3	0/0	0/0	3

UNIT 1: INTRODUCTION OF AI AND ML **9**

Introduction to data science and AI&ML: Data Science AI & ML, Use Cases in Business and Scope, Scientific Method, Modeling Concepts, CRISP-DM Method, Statistical analysis: Initial Data Analysis, probability, R essentials: Commands and Syntax, Packages and Libraries, Introduction to Data Types, Data Structures in R - Vectors, Matrices, Arrays, Lists, Factors, Data Frames, Importing and Exporting Data, Control structures and Functions.

UNIT 2: DATA MANAGEMENT **9**

Data Acquisition, Data Pre-Processing And Preparation, Data Quality And Transformation, Handling Text Data, Principle Of Big Data, Big Data Framework-Hadoop, Spark, Nosql.

UNIT 3: STATISTICAL DECISION MAKING **9**

Data Visualization, Sampling And Estimation, Inferential Statistics, Linear Regression, Non Linear Regression.

UNIT 4: MACHINE LEARNING **9**

Foundation for ML, Clustering, Classification: Naïve bayes classifier, K-Nearest neighbors, support vector machine, decision tree, ensembles methods, Association rule mining.

UNIT 5 : AI IN ROBOTICS **9**

Robotic perception, localization, mapping- configuring space, planning uncertain movements, dynamics and control of movement, Ethics and risks of artificial intelligence in robotics

Total No. of Periods: 45

TEXT BOOKS:

1. Micheal Negnevitsky, “Artificial Intelligence: A guide to Intelligent Systems”,. Harlow: Addison-Wesley, 2005.

REFERENCES:

1. *Nils J. Nilsson, “Introduction to Machine Learning”, 2005.*
2. *Pang-Ning Tan, Michael Steinbach., Introduction to Data Mining, Pearson, 2019.*

DEPARTMENT OF MECHANICAL ENGINEERING

Subject Code: BRE18L11	Subject Name: ROBOT PROGRAMMING LAB	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Industrial Applications of Robots	**Lb**	**0**	**0/0**	**3/0**	**1**

L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To understand different types of robots based on configuration and application.
- To learn robot programming exercise.
- To learn robot programming and simulation for industrial application.

COURSE OUTCOMES (COs) : (3- 5)
Students will be able to

CO1	To understand different types of robots based on configuration and application
CO2	To learn robot programming exercise
CO3	To learn robot programming and simulation for writing practice
CO4	To learn robot programming and simulation for any industrial process
CO5	To learn robot programming and simulation for multi process

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	M	H	M	M	H	M	H	H
CO2	H	H	H	H	H	M	L	L	M	M	L	H
CO3	H	M	H	H	H	L	M	L	H	H	H	H
CO4	H	M	H	H	H	L	M	L	H	H	H	H
CO5	H	M	H	H	H	L	M	L	H	H	H	H

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	H	M	H	H
CO2	H	M	H	H
CO3	H	H	M	H
CO4	H	H	M	H
CO5	H	H	M	H

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
							✓					
Approval												

Subject Code: BRE18L11	Subject Name: ROBOT PROGRAMMING LAB	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Industrial Applications of Robots	Lb	0	0/0	3/0	1

LIST OF EXPERIMENTS:

- Determination of maximum and minimum position of links.
- Verification of transformation (Position and orientation) with respect to gripper and world coordinate system
- Estimation of accuracy, repeatability and resolution.
- Robot programming and simulation for pick and place
- Robot programming and simulation for Color identification
- Robot programming and simulation for Shape identification
- Robot programming and simulation for machining (cutting, welding)
- Robot programming and simulation for writing practice
- Robot programming and simulation for any industrial process (Packaging, Assembly)
- Robot programming and simulation for multi process.

These programs can be done through proprietary robotic software.

Total No. of Periods : 45

DEPARTMENT OF MECHANICAL ENGINEERING

Subject Code: BRE18L12	Subject Name : PROJECT PHASE -I	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Knowledge of Mechanical Engg & Interdisciplinary fundamental concepts	Lb	0	0/0	3/3	2

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE : The main objective of the Project phase-I is to apply the knowledge gained by the students through their course of study to carry out a socially relevant /Innovative /Interdisciplinary /Research project

COURSE OUTCOMES (COs) : (3- 5)

CO1	Students will start analyzing the previous project works. .
CO2	Students will analyze the various technical tools required for the project work.
CO3	Students will embark upon the necessity of team work.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	L	L	L	L	H	H	H	H	H	H	H
CO2	H	M	H	H	M	H	H	H	H	H	H	M
CO3	H	H	H	H	M	H	H	H	H	H	H	M

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	M	H	H	H
CO2	M	H	H	H
CO3	M	H	H	H

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
							✓					
Approval												

Students should identify the topic of the Project and should collect the literatures and datas, at the end of the semester the students should submit their Project Phase - I report to the Department and Viva -Voce examination will be conducted with external examiners and this carries 6 credits.

DEPARTMENT OF MECHANICAL ENGINEERING

Subject Code:	Subject Name : FOREIGN LANGUAGE	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
BHS18FLX	Prerequisite: None	Lb	0	0/0	3/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE : The main objective of this course is to equip the students with one foreign language which will enable them for higher studies/professional career abroad

COURSE OUTCOMES (COs) : (3- 5)

CO1	Students will have written knowledge in one foreign language.
CO2	Students will have reading knowledge in one foreign language
CO3	Students will have spoken knowledge in one foreign language

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	L	L	L	L	H	H	H	H	H	H	H
CO2	H	M	H	H	M	H	H	H	H	H	H	M
CO3	H	H	H	H	M	H	H	H	H	H	H	M

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1								
CO2								

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
			✓									
Approval												

Students should acquire proficiency in any one foreign language and submit a certificate in proof and submit during examination.

SEMESTER-VIII

DEPARTMENT OF MECHANICAL ENGINEERING

Subject Code:	Subject Name : ENGINEERING ECONOMICS AND INDUSTRIAL MANAGEMENT	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
BMG18008	Prerequisite: None	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab./Embedded Theory and Lab.

OBJECTIVE: The student will learn:

- Concepts of industrial management and economics

COURSE OUTCOMES (COs) :

CO1	Will be introduced to management concepts
CO2	Will be aware of organizational behavior
CO3	Will be aware of demand and supply analysis
CO4	Will be aware of theory of production
CO5	Will be aware of macroeconomic concepts

Mapping of Course Outcomes (COs) with Program Outcomes (POs) & Program Specific Outcomes (PSOs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	H	M	M	M	L				M		M
CO2	M	H	M	M	M	L				M		M
CO3	M				L	M		M	H	H	M	M
CO4	M				L	M		M	H	H	M	M
CO5	M				L	M		M	H	H	M	M

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1			M	L
CO2			M	
CO3			M	
CO4			M	
CO5			M	

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
			✓									
Approval												

Subject Code:	Subject Name : ENGINEERING ECONOMICS AND INDUSTRIAL MANAGEMENT	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
BMG18008	Prerequisite: None	Ty	3	0/0	0/0	3

UNIT - I Introduction to Management **9**

The Nature of Management –Management: Science or Art – Difference between administration and management - Evolution of management thought - Roles of managers– F.W.Taylor and Henri Fayol contribution to the management- Organization and the environmental factors.

UNIT - II Managing Organizational Behavior **9**

Definition- need and Importance of Organizational Behavior – Nature and Scope of Organizational Behavior - Role of managers – Contributing disciplines to Organizational Behavior - Frame work of Organizational Behavior.

UNIT – III Demand & Supply Analysis **9**

Meaning of demand, the demand curve, Elasticity of demand, types of elasticity of demand. **Supply** –Meaning, the supply curve, equilibrium with supply and demand curves.

UNIT IV Theory of Production **9**

Meaning of Production, Basic concepts- total, average, and marginal product, short run and long run production Function, Law of Variable Proportion. Production function with two variable inputs – Isoquants – Meaning, Properties, ISO cost Lines, All variable inputs – Returns to Scale, **Cost Analysis**: Determinants of Costs, types of Cost.

UNIT V Macro Economic Concepts **9**

National income concepts, Inflation, Balance of Payment, Circular flow of income Monetary and Fiscal Policy, Demonization, Exchange Rates

Total no. of Periods: 45

REFERENCE BOOKS:

1. *Meenakshi Gupta - Principles of Management - PHI Learning Pvt. Ltd.-2009.*
2. *L.M.Prasad - Principles and Practice of Management - Sultan Chand & Sons - 7th Edition - 2007.*
3. *Harold Koontz - Principles of Management - Tata McGraw Hill - 2004.*
4. *Mithani, D.M, Managerial Economics- Theory &applications, Himalaya pub.*
5. *Mehta, P, L, Managerial Economics. Analysis, problem & cases, Sultan Chand*

Subject Code:	Subject Name : PROJECT PHASE-II	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
BRE18L13	Prerequisite: Core and interdisciplinary knowledge	Lb	0	0/0	12/12	8

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE : The main objective of the Project phase-II is to apply the knowledge gained by the students through seven semesters of their study to carry out a socially relevant /Innovative /Interdisciplinary /Research project.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Students will gain experience in collecting literature review .
CO2	Students will learn to use various technical tools .
CO3	Students will experience the team work.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	L	L	L	L	H	H	H	H	H	H	H
CO2	H	M	H	H	M	H	H	H	H	H	H	M
CO3	H	H	H	H	M	H	H	H	H	H	H	M

COs / PSOs	PSO1	PSO2	PSO3	PSO4				
CO1	M	H	H	H				
CO2	M	H	H	H				
CO3	M	H	H	H				

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
							✓					
Approval												

Subject Code:	Subject Name : PROJECT PHASE-II	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
BRE18L13	Prerequisite: Core and interdisciplinary knowledge	Lb	0	0/0	12/12	8

GUIDELINES:

- To make the students to make use of the knowledge and skill developed during their four years of study and to apply them for making an innovative product/process for the development of society and industries.

- Students are expected to do a Project work either in an Industry or at the University in the field of Robotics in group, not exceeding 4 students in a group. Each group will be allotted a guide based on the area of Project work.

- Number of reviews will be conducted during the semester to monitor the development of project. Students have to submit the thesis at the end of the semester and appear for the Project Viva-Voce examination conducted by one internal examiner and one external examiner.50% weight age will be given for the internal assessment and 50% weight age for the Project viva a voce examination.

ELECTIVE SUBJECTS

ELECTIVE:
MECHANICAL ENGINEERING

DEPARTMENT OF MECHANICAL ENGINEERING

Subject Code:	Subject Name: MAINTENANCE AND SAFETY ENGINEERING	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
BRE18E01	Prerequisite: Working Principles of Manufacturing Equipments	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE : To impart knowledge on maintenance , fundamentals and Safety Engineering practices

COURSE OUTCOMES (COs) : (3- 5)
Students will be able to

CO1	To gain the knowledge of total productive maintenance
CO2	To gain the knowledge of safety systems analysis
CO3	To gain the knowledge of safety in machine operation
CO4	To gain the knowledge of hazard analysis
CO5	To gain overall knowledge of maintenance

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	M	M	M	M	M	H	M	H	H
CO2	H	H	H	M	M	M	L	M	M	M	L	H
CO3	H	H	H	M	M	M	L	M	M	M	L	H
CO4	H	H	H	M	M	M	L	M	M	M	L	H
CO5	H	H	H	M	M	M	L	M	M	M	L	H

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	L	L	H	H
CO2	L	M	H	M
CO3	L	M	H	M
CO4	L	M	H	M
CO5	L	M	H	M

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							
Approval												

Subject Code: BRE18E01	Subject Name: MAINTENANCE AND SAFETY ENGINEERING	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Working Principles of Manufacturing Equipments	Ty	3	0/0	0/0	3

UNIT I MAINTENANCE: 6

Types – breakdown, preventive, predictive, TPM; elements of preventive maintenance – checklist, schedule, procedure.

UNIT II TOTAL PRODUCTIVE MAINTENANCE: 12

Principles; preparatory stages of implementation – TPM organisation structure, creation; basic TPM policies and aids, master plan. TPM IMPLEMENTATION: Small group activities, autonomous maintenance, establishing planned maintenance, training, developing equipment management program.

UNIT III SAFETY SYSTEMS ANALYSIS: 7

Definitions, safety systems; safety information system: basic concept, safety cost / benefit analysis; industrial safety engineering, OSHA regulations.

UNIT IV HAZARD ANALYSIS: 10

General hazard analysis: electrical, physical and chemical hazard, detailed hazard analysis. Cost effectiveness in hazard elimination. Logical analysis: map method, tabular method, fault tree analysis and hazop studies. FIRE PROTECTION SYSTEM: Chemistry of fire, water sprinkler, fire hydrant, alarm and detection system. Suppression system: CO2 system, foam system, Dry Chemical Powder (DCP) system, halon system, portable extinguisher.

UNIT V SAFETY IN MACHINE OPERATION: 10

Design for safety, lock out system, work permit system, safety in use of power press, cranes. Safety in foundry, forging, welding, hot working and cold working, electroplating and boiler operation. SAFETY AND LAW: Provisions in factory act for safety, explosive act, workmen compensation act, compensation calculation. Boiler act and pollution control act.

Total No. of Periods : 45

TEXT BOOKS:

1. John Ridley, “Safety at Work”, Butter Worth Publisher, Oxford, 1997.
2. Robinson C J and Ginder A P, “Implementing TPM”, Productivity Press, USA, 1995.

REFERENCES:

1. Dhillon B S, “Maintainability, Maintenance and Reliability for Engineers”, CRC Press, 2006.
2. Heinrich H W, “Industrial Accident Prevention”, National Safety Council, Chicago, 1998.
3. National Safety Council, “Personal Protective Equipment”, Bombay, 1998.
4. National Safety Council, “Accident Prevention Manual for Industrial Operations”, Chicago, 1995.
5. Patrick A Michaud, “Accident Prevention and OSHA Compliance”, CRC Press, 1995.
6. Derek James, “Fire Prevention Handbook”, Butter Worth & Co., Oxford, 1991.
7. Dan Peterson, “Techniques of Safety Management”, 1990.

DEPARTMENT OF MECHANICAL ENGINEERING

Subject Code:	Subject Name: MICRO ELECTRO MECHANICAL SYSTEMS	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
BRE18E02	**Prerequisite:** Fundamentals of sensors	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab7

OBJECTIVES:

- To provide knowledge of semiconductors and solid mechanics to fabricate MEMS devices.
- To educate on the rudiments of Micro fabrication techniques
- To introduce various sensors and actuators
- To introduce different materials used for MEMS
- To educate on the applications of MEMS to disciplines beyond Electrical and Mechanical engineering.

COURSE OUTCOMES (COs) : (3- 5)
Students will be able to

CO1	gain the knowledge of semiconductors and solid mechanics to fabricate MEMS devices.
CO2	gain knowledge of different materials used for MEMS
CO3	gain knowledge of applications of MEMS
CO4	gain the knowledge of micromachining techniques
CO5	gain the knowledge of optical and polymer MEMS

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	M	M	M	M	M	H	M	H	H
CO2	H	H	H	M	M	M	M	M	H	M	H	H
CO3	H	H	H	M	M	M	M	M	H	M	H	H
CO4	H	H	H	M	M	M	M	M	H	M	H	H
CO5	H	H	H	M	M	M	M	M	H	M	H	H

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	L	L	H	H
CO2	L	L	H	H
CO3	L	L	H	H
CO4	L	L	H	H
CO5	L	L	H	H

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							
Approval												

Subject Code:	Subject Name: MICRO ELECTRO MECHANICAL SYSTEMS	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
BRE18E02	**Prerequisite:** Fundamentals of sensors	Ty	3	0/0	0/0	3

UNIT I INTRODUCTION **9**

Intrinsic Characteristics of MEMS – Energy Domains and Transducers- Sensors and Actuators – Introduction to Micro fabrication - Silicon based MEMS processes – New Materials – Review of Electrical and Mechanical concepts in MEMS – Semiconductor devices – Stress and strain analysis – Flexural beam bending- Torsional deflection.

UNIT II SENSORS AND ACTUATORS-I **9**

Electrostatic sensors – Parallel plate capacitors – Applications – Interdigitated Finger capacitor – Comb drive devices – Micro Grippers – Micro Motors - Thermal Sensing and Actuation – Thermal expansion – Thermal couples – Thermal resistors – Thermal Bimorph - Applications – Magnetic Actuators – Micromagnetic components – Case studies of MEMS in magnetic actuators- Actuation using Shape Memory Alloys

UNIT III SENSORS AND ACTUATORS-II **9**

Piezoresistive sensors – Piezoresistive sensor materials - Stress analysis of mechanical elements – Applications to Inertia, Pressure, Tactile and Flow sensors – Piezoelectric sensors and actuators – piezoelectric effects – piezoelectric materials – Applications to Inertia , Acoustic, Tactile and Flow sensors.

UNIT IV MICROMACHINING **9**

Silicon Anisotropic Etching – Anisotrophic Wet Etching – Dry Etching of Silicon – Plasma Etching – Deep Reaction Ion Etching (DRIE) – Isotropic Wet Etching – Gas Phase Etchants – Case studies - Basic surface micro machining processes – Structural and Sacrificial Materials – Acceleration of sacrificial Etch – Striction and Antistriction methods – LIGA Process - Assembly of 3D MEMS – Foundry process.

UNIT V POLYMER AND OPTICAL MEMS **9**

Polymers in MEMS– Polimide - SU-8 - Liquid Crystal Polymer (LCP) – PDMS – PMMA – Parylene – Fluorocarbon - Application to Acceleration, Pressure, Flow and Tactile sensors- Optical MEMS – Lenses and Mirrors – Actuators for Active Optical MEMS.

Total No. of Periods : 45

TEXT BOOKS:

1. Chang Liu, „Foundations of MEMS", Pearson Education Inc., 2012.
2. Stephen D Senturia, „Microsystem Design", Springer Publication, 2000.
3. Tai Ran Hsu, "MEMS & Micro systems Design and Manufacture" Tata McGraw Hill, New Delhi, 2002.

REFERENCES:

1. Nadim Maluf," An Introduction to Micro Electro Mechanical System Design", Artech House, 2000.
2. Mohamed Gad-el-Hak, editor, " The MEMS Handbook", CRC press Baco Raton, 2001.
3. Julian w. Gardner, Vijay K. Varadan, Osama O.Awadelkarim, Micro Sensors MEMS and Smart Devices, John Wiley & Son LTD, 2002.
4. James J.Allen, Micro Electro Mechanical System Design, CRC Press Publisher, 2005.

DEPARTMENT OF MECHANICAL ENGINEERING

Subject Code:	Subject Name: ADVANCED STRENGTH OF MATERIALS	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
BRE18E03	Prerequisite: Strength of Materials	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE:

- Basic principles analysis of stress, strain in plates and rotating discs
- To analyze the stresses and deformations through advanced mathematical models.
- To estimate the design strength of various industrial equipments.

COURSE OUTCOMES (COs) : (3- 5)	
CO1	To gain the knowledge of analysis of stresses in plate and rotating discs
CO2	To gain the knowledge of stresses and deformations through advanced mathematical models
CO3	To gain the knowledge of analysis of rotating discs
CO4	To gain the knowledge of beams of elastic foundation
CO5	To analyse curved beams and contact stresses.

Mapping of Course Outcomes with Program Outcomes (POs)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	M	M	M	M	M	H	M	H	H
CO2	H	H	H	M	M	M	L	M	M	M	L	H
CO3	H	H	H	M	M	M	L	M	M	M	L	H
CO4	H	H	H	M	M	M	L	M	M	M	L	H
CO5	H	H	H	M	M	M	L	M	M	M	L	H

Cos / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	M	H	L	L				
CO2	H	L	M	M				
CO3	M	H	M	L				
CO4	M	H	M	L				
CO5	M	H	M	L				

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							
Approval												

Subject Code:	Subject Name: ADVANCED STRENGTH OF MATERIALS	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
BRE18E03	Prerequisite: Strength of Materials	Ty	3	0/0	0/0	3

UNIT I ANALYSIS OF PLATES **8**

Mathematical modeling of plates with normal loads – Point and Distributed Loads – Support conditions – Rectangular plates - Stresses along coordinate axes – Plate deformations – Axisymmetric plates – Radial and tangential stresses – plate deflections.

UNIT II THICK CYLINDERS AND SPHERES **10**

Equilibrium and compatibility conditions – Lame's Theorem – Boundary conditions – distribution of radial and tangential stresses – compound cylinders – Interference fits - Stresses due to temperature distributions.

UNIT III ROTATING DISCS **10**

Lame-Clayperon Theorem – radial and tangential stresses in discs due to centrifugal effects – boundary conditions – solid and hollow discs – Interference fit on shafts –Strengthening of the hub – residual stresses – Auto frettege – Discs of variable thickness – Disc profile for uniform strength.

UNIT IV BEAMS ON ELASTIC FOUNDATION **8**

Infinite beam subjected to concentrated load – Boundary Conditions – Infinite beam subjected to a distributed load segment – Triangular load – Semi infinite beam subjected to loads at the ends and concentrated load near the ends – Short beams.

UNIT V CURVED BEAMS AND CONTACT STRESSES **9**

Analysis of stresses in beams with large curvature – Stress distribution in curved beams – Stresses in crane hooks and C clamps – Contact Stresses – Hertz equation for contact stresses – applications to rolling contact elements.

Total No. of Periods : 45

TEXT BOOKS:

1. Boresi A.P., Schmidt R.J., "Advanced Mechanics of Materials", John Wiley and Sons, Sixth edition, 2003.
2. Dally J.W. and Riley W.F, "Experimental Stress Analysis", John Wiley and Sons 2003

REFERENCES:

1. Burr A. H., Cheatham J.B., "Mechanical Analysis and Design", Prentice Hall of India, Second Edition, 2001.
2. Den-Hartog J.P., "Strength of Materials", John Wiley and Sons.

DEPARTMENT OF MECHANICAL ENGINEERING

Subject Code:	Subject Name : COMPUTER INTEGERATED MANUFACTURING	Ty / Lb/ETL	L	T / S.Lr	P/ R	C
BRE18E04	Prerequisite: CAD,CAM & CIM	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES: Students will learn

- To understand the application of computers in various aspects of Manufacturing viz., Design, Process planning, Manufacturing cost, Layout & Material Handling system
- To understand the Modern manufacturing systems
- To understand the concepts and applications of flexible manufacturing systems

COURSE OUTCOMES (COs) : (3- 5)

CO1	To gain the knowledge of CAD/ CAM used in modern manufacturing system
CO2	To gain the knowledge of computerized process planning
CO3	To gain the knowledge of cellular manufacturing system
CO4	To gain the knowledge of FMS and AGVs
CO5	To gain the knowledge of industrial robotics

Mapping of Course Outcomes with Program Outcomes (Pos)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	M	H	M	H	M	H	H	M	H	H	M
CO2	M	M	M	M	H	M	H	H	M	M	H	M
CO3	M	M	M	M	H	M	H	H	M	M	H	M
CO4	M	M	M	M	H	M	H	H	M	M	H	M
CO5	M	M	M	M	H	M	H	H	M	M	H	M

Cos / PSOs	PSO1	PSO2	PSO3	PSO4				
CO1	M	H	H	H				
CO2	M	H	H	H				
CO3	H	H	H	H				
CO4	H	H	H	H				
CO5	H	H	H	H				

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							
Approval												

Subject Code:	Subject Name : COMPUTER INTEGERATED MANUFACTURING	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
BRE18E04	Prerequisite: CAD,CAM & CIM	Ty	3	0/0	0/0	3

UNIT I INTRODUCTION **10**

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

UNIT II PRODUCTION PLANNING AND CONTROL AND COMPUTERISED PROCESS PLANNING **10**

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

UNIT III CELLULAR MANUFACTURING **9**

Group Technology(GT), Part Families – Parts Classification and coding – Simple Problems in Opitz Part Coding system – Production flow Analysis – Cellular Manufacturing – Composite part concept – Machine cell design and layout – Quantitative analysis in Cellular Manufacturing – Rank Order Clustering Method - Arranging Machines in a GT cell – Hollier Method – Simple Problems.

UNIT IV FLEXIBLE MANUFACTURING SYSTEM (FMS) AND AUTOMATED GUIDED VEHICLE SYSTEM (AGVS) **8**

Types of Flexibility - FMS – FMS Components – FMS Application & Benefits – FMS Planning and Control– Quantitative analysis in FMS – Simple Problems. Automated Guided Vehicle System (AGVS) – AGVS Application – Vehicle Guidance technology – Vehicle Management & Safety.

UNIT V INDUSTRIAL ROBOTICS **8**

Robot Anatomy and Related Attributes – Classification of Robots- Robot Control systems – End Effectors – Sensors in Robotics – Robot Accuracy and Repeatability - Industrial Robot Applications – Robot Part Programming – Robot Accuracy and Repeatability – Simple Problems.

Total No. of Periods : 45

TEXT BOOKS:

1. Mikell.P.Groover "Automation, Production Systems and Computer Integrated Manufacturing", Prentice Hall of India, 2008.
2. Radhakrishnan P, Subramanyan S.and Raju V., "CAD/CAM/CIM", 2nd Edition, New Age International (P) Ltd, New Delhi, 2000.

REFERENCES:

1. Kant Vajpayee S, "Principles of Computer Integrated Manufacturing", Prentice Hall India, 2003. 105
2. Gideon Halevi and Roland Weill, "Principles of Process Planning – A Logical Approach" Chapman & Hall, London, 1995.

Subject Code:	Subject Name : FINITE ELEMENT ANALYSIS	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
BRE18E05	Prerequisite: Strength of Materials, Design of Machine Elements	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES: Students will learn

- Fundamentals of Finite Element Analysis and their applications

COURSE OUTCOMES (COs) : (3- 5)

CO1	Will able to model field problems in engineering and analyze various equations
CO2	Will be able to solve problems governing one dimensional equations
CO3	Will be able to solve problems governing two dimensional scalar equations
CO4	Will be able to solve problems governing two dimensional vector equations
CO5	Will be able to formulate shape functions for isometric elements

Mapping of Course Outcomes with Program Outcomes (Pos)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	M	H	M	H	M	H	H	M	H	H	M
CO2	M	M	M	M	H	M	H	H	M	M	H	M
CO3	M	M	M	M	H	M	H	H	M	M	H	M
CO4	M	M	M	M	H	M	H	H	M	M	H	M
CO5	M	M	M	M	H	M	H	H	M	M	H	M

Cos / PSOs	PSO1	PSO2	PSO3	PSO4				
CO1	M	H	H	H				
CO2	M	H	H	H				
CO3	H	H	H	H				
CO4	H	H	H	H				
CO5	H	H	H	H				

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skills	Soft Skills			
					✓							
Approval												

Subject Code: BRE18E05	Subject Name : FINITE ELEMENT ANALYSIS	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Strength of Materials, Design of Machine Elements	Ty	3	0/0	0/0	3

UNIT I INTRODUCTION **9**

Historical background-mathematical modeling of field problems in engineering-governing equations-discrete and continuous models-boundary-initial and Eigen value problems-weighed Residual methods-variational formulation of boundary value problems-Ritz technique-basic concepts of finite element method.

UNIT II ONE DIMENSIONAL PROBLEMS **9**

One Dimensional Second Order Equations-Discretization-Element types-Linear and Higher order Elements-Derivation of shape functions and stiffness matrices and force vectors-Assembly of matrices-Solutions of problems from solid mechanics including thermal stresses-heat transfer ,Natural frequencies of longitudinal vibration and mode shapes –fourth order beam equation-Transverse deflections and Transverse Natural frequencies of beams

UNIT III TWO DIMENSIONAL SCALAR VARIABLE PROBLEMS **9**

Second Order 2D Equations involving Scalar Variable Functions-Variable formulation-finite element formulation-Triangular Elements and Quadrilateral Elements-Shape functions and element matrices and vectors. Application to field problems-Thermal problems-Torsion of non circular shafts

UNIT IV TWO DIMENSIONAL VECTOR VARIABLE PROBLEMS **9**

Equations of Elasticity-Plane Stress, plane strain and axisymmetric problems-Constitutive matrices and Strain displacement matrices-Stiffness matrix-Stress calculations-Plate and Shell elements.

UNIT V ISOPARAMETRIC FORMULATION AND ADVANCED TOPICS **9**

Natural co-ordinate systems-Isoparametric elements-shape functions for isoparametric elements-One and two dimensions-Serendipity elements-Numerical integration-Matrix solution techniques-Solutions Techniques to Dynamic problems-Introduction to Analysis Software-Introduction to Non-Linearity.

Total No. of Periods : 45

TEXT BOOKS:

1. J.N Reddy "An Introduction to the Finite element Method",3rd Edition ,Tata McGraw Hill, 2005.
2. Seshu P., "Text Book of Finite Element Analysis", Prentice-Hall of India Pvt.Ltd, New Delhi, 2007.

REFERENCES:

1. Logan ,D.L, "A first Subject in Finite Element Method", Thomson Asia Pvt.Ltd,, 2002.
2. Robert D.Cook,David S.Malkus et.al, "Concepts and Applications of Finite Element Analysis" 4th Edition,Wiley Student Edition,2002
3.Rao, S.S.,"The Finite Elelent Method in Engineering",3rd Edition,3rd Edition ,Butter worth Heinemann,2004

ELECTIVE:

ROBOTICS

DEPARTMENT OF MECHANICAL ENGINEERING

Subject Code: BRE18E06	Subject Name: AUTOMATION SYSTEM DESIGN	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Hydraulics and Pneumatics, Programmable Logic controllers	**Ty**	**3**	**0/0**	**0/0**	**3**

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To know about the pneumatics and hydraulics in automation of Mechanical operations.
- To know about the electric and electronic systems in automation of Mechanical operations.

COURSE OUTCOMES (COs) : (3- 5)
Students will be able to

CO1	To know about the fundamental concepts of industrial automation.
CO2	Appreciate the significance of transfer lines and automated assembly
CO3	Analyze pneumatic controls of a system
CO4	Appreciate the significant features of automation
CO5	Analyse elements of hydraulic system

Mapping of Course Outcomes with Program Outcomes (POs)

COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	M	M	M	M	M	H	M	H	H
CO2	H	H	H	M	M	M	L	M	M	M	L	H
CO3	H	H	H	M	M	M	L	M	M	M	L	H
CO4	H	H	H	M	M	M	L	M	M	M	L	H
CO5	H	H	H	M	M	M	L	M	M	M	L	H

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	L	L	H	H
CO2	L	M	H	M
CO3	L	M	H	M
CO4	L	M	H	M
CO5	L	M	H	M

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							
Approval												

DEPARTMENT OF MECHANICAL ENGINEERING

Subject Code: BRE18E06	Subject Name: AUTOMATION SYSTEM DESIGN	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite Hydraulics and Pneumatics, Programmable Logic controllers	Ty	3	0/0	0/0	3

UNIT I FUNDAMENTAL CONCEPTS OF INDUSTRIAL AUTOMATION 9

Fundamental concepts in manufacturing and automation, definition of automation, reasons for automating. Types of production and types of automation, automation strategies, levels of automation.

UNIT II TRANSFER LINES AND AUTOMATED ASSEMBLY 9

General terminology and analysis, analysis of transfer lines without storage, partial automation. Automated flow lines with storage buffers. Automated assembly-design for automated assembly, types of automated assembly systems, part feeding devices, analysis of multi-station assembly machines. AS/RS, RFID system, AGVs, modular fixturing. Flow line balancing.

UNIT III PNEUMATIC CONTROL 9

Components, constructional details, filter, lubricator, regulator, constructional features, types of cylinders, control valves for direction, pressure and flow, air motors, air hydraulic equipments. PNEUMATIC CONTROL SYSTEM DESIGN: General approach to control system design, symbols and drawings, schematic layout, travel step diagram, circuit, control modes, program control, sequence control, cascade method, Karnaugh-Veitch mapping.

UNIT IV PROGRAMMABLE AUTOMATION 9

Special design features of CNC systems and features for lathes and machining centers. Drive system for CNC machine tools. Introduction to CIM; condition monitoring of manufacturing systems. DESIGN FOR HIGH SPEED AUTOMATIC ASSEMBLY: Introduction, Design of parts for high speed feeding and orienting, high speed automatic insertion. Analysis of an assembly. General rules for product design for automation. DESIGN OF MECHATRONIC SYSTEMS: Stages in design, traditional and mechatronic design, possible design solutions. Case studies-pick and place robot, engine management system.

UNIT V ELEMENTS OF HYDRAULIC SYSTEMS 9

Pumps and motors- types, characteristics. Cylinders, types, typical construction details. Valves for control of direction, flow and pressure, types, typical construction details. HYDRAULIC SYSTEM DESIGN: Power pack–elements, design. Pipes- material, pipe fittings. seals and packing. maintenance of hydraulic systems. Selection criteria for cylinders, valves, pipes. Heat generation in hydraulic system ADVANCED TOPICS IN HYDRAULICS AND PNEUMATICS: Electro pneumatics, ladder diagram. Servo and Proportional valves - types, operation, application. Hydro-Mechanical servo systems. PLCconstruction, types, operation, programming

Total No. of Periods : 45

TEXT BOOKS:

1. Mikell P Groover, “Automation Production Systems and Computer- Integrated Manufacturing” Pearson Education, New Delhi, 2001.
2. Wemer Depper and Kurt Stoll, “Pneumatic Application”, Kemprath Reihe, Vogel Buch Verlag Wurzbutg, 1987.
3. Bolton W, “Mechatronics“, Pearson Education, 1999.

REFERENCES:

1. Mikell P Groover, "Industrial Robots – Technology Programmes and Applications” , McGraw Hill , New York, USA. 2000.
2. Wemer Deppert and Kurt Stoll, “Pneumatic Application”, Kemprath Reihe, Vovel Verlag , Wurzburg, 1976.
3. Steve F Krar, “Computer Numerical Control Simplified“, Industrial Press, 2001.

DEPARTMENT OF MECHANICAL ENGINEERING

Subject Code: BRE18E07	Subject Name: INDUSTRIAL NETWORKING	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Instrumentation and Control for Robots, Programmable Logic Controllers	Ty	3	0/0	0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To understand the evolution of computer networks using the layered network architecture.
- Understand the concepts of modbus.
- Be familiar with different Ethernet systems
- Be familiar with wireless communications and its applications.

COURSE OUTCOMES (COs) : (3- 5)
Students will be able to

CO1	To understand the evolution of computer networks using the layered network architecture.
CO2	Understand the concepts of modbus.
CO3	Be familiar with the different Ethernet systems.
CO4	Familiarize with wireless communications.
CO5	Familiarize with various applications of networks

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	M	M	M	M	M	H	M	H	H
CO2	H	H	H	M	M	M	L	M	M	M	L	H
CO3	H	H	H	M	M	H	L	M	M	M	H	H
CO4	H	H	H	M	M	H	L	M	M	M	H	H
CO5	H	H	H	M	M	H	L	M	M	M	H	H

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1			H	H
CO2			H	H
CO3			H	M
CO4			H	H
CO5			H	H

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							
Approval												

Subject Code: BRE18E07	Subject Name: INDUSTRIAL NETWORKING	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Instrumentation and Control for Robots, Programmable Logic Controllers	Ty	3	0/0	0	3

UNIT I INTRODUCTION **10**

Modern instrumentation and control systems – OSI model – Protocols – Standards – Common problems and solutions – Grounding/shielding and noise - EIA-232 interface standard – EIA-485 interface standard – Current loop and EIA-485 converters. FIBRE OPTICS: Introduction – Fibre optic cable components and parameters – Basic cable types – Connection fibres – troubleshooting.

UNIT II MODBUS CONCEPTS **8**

Overview – Protocol structure – Function codes – Modbus plus protocol –Data Highway – AS interface (AS-i) – Device Net: Physical layer – Topology – Device taps – Profibus PA/DP/FMS: Protocol stack – System operation.

UNIT III ETHERNET SYSTEMS **12**

IEEE/ISO standards – Medium access control – frames – Reducing collisions – Auto negotiation – LAN system components – Structured cabling – Industrial Ethernet – Troubleshooting Ethernet. 99 CAN BUS: Concepts of bus access and arbitration – CAN: Protocol-Errors: Properties – detection – processing – Introduction to CAN 2.0B

UNIT IV WIRELESS COMMUNICATIONS **9**

Radio spectrum – Frequency allocation – Radio modem – Intermodulation – Implementing a radio link – RFID: Basic principles of radio frequency identification – Transponders - Interrogators

UNIT V APPLICATIONS **6**

Automotive communication technologies – Design of automotive X-by-Wire systems, - The LIN standard – The IEC/IEEE Train communication network: Applying train communication network for data communications in electrical substations.

Total No. of Periods: 45

TEXT BOOKS:

1. Steve Mackay, Edwin Wright, Deon Reynders and John Park, “Practical Industrial Data Networks: Design, Installation and Troubleshooting”, Newnes (Elsevier), 2004
2. “Practical Filebus, Device Net and Ethernet for Industry”, IDC Technology, 2006

REFERENCES:

1. Richard Zurawski, “The Industrial Communication Technology Handbook”, Taylor and Francis, 2005
2. Dominique Paret, “Multiplexed Networks for Embedded Systems”, John Wiley & Sons, 2007
3. Albert Lozano-Nieto, “RFID Design Fundamentals and Applications”, CRC Press, 2011

DEPARTMENT OF MECHANICAL ENGINEERING

Subject Code: BRE18E08	Subject Name: TOTAL INTEGERATED AUTOMATION	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Hydraulics and Pneumatics , Programmable Logic Controllers	**Ty**	**3**	**0/0**	**0/0**	**3**

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To gain knowledge in various electrical and electronic programmable automations and their applications.

COURSE OUTCOMES (COs) : (3- 5)
Students will be able to

CO1	Analyze the concepts of total integrated automation
CO2	Analyze the role of human machine interface systems.
CO3	Analyse the role of SCADA
CO4	Analyse the different roles of communication protocols involving SCADA
CO5	Analyse distributed control systems

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	M	M	M	M	M	H	M	H	H
CO2	H	H	H	M	M	M	M	M	H	M	H	H
CO3	H	H	H	M	M	M	M	M	H	M	H	H
CO4	H	H	H	M	M	M	M	M	H	M	H	H
CO5	H	H	H	M	M	M	M	M	H	M	H	H

COs / PSOs	PSO1	PSO2	PSO3	PSO4			
CO1	L	L	H	H			
CO2	L	L	H	H			
CO3	L	L	H	H			
CO4	L	L	H	H			
CO5	L	L	H	H			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							
Approval												

Subject Code:	Subject Name: TOTAL INTEGERATED AUTOMATION	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
BRE18E08	Prerequisite: Hydraulics and Pneumatics , Programmable Logic Controllers	Ty	3	0/0	0/0	3

UNIT I TOTALLY INTEGRATED AUTOMATION: 9

Need, components of TIA systems, advantages, Programmable Automation Controllers (PAC), Vertical Integration structure.

UNIT II HMI SYSTEMS: 9

Necessity and Role in Industrial Automation, Need for HMI systems. Types of HMI- Text display - operator panels - Touch panels - Panel PCs - Integrated displays (PLC & HMI). Check with PLC 502 and remove

UNIT III SUPERVISORY CONTROL AND DATA ACQUISITION (SCADA) 9

Overview – Developer and runtime packages – architecture – Tools – Tag – Internal &External graphics, Alarm logging – Tag logging – structured tags– Trends – history– Report generation, VB & C Scripts for SCADA application.

UNIT IV COMMUNICATION PROTOCOLS OF SCADA 9

Proprietary and open Protocols – OLE/OPC – DDE – Server/Client Configuration – Messaging – Recipe – User administration – Interfacing of SCADA with PLC, drive, and other field device

UNIT V DISTRIBUTED CONTROL SYSTEMS (DCS) : 9

DCS – architecture – local control unit- programming language – communication facilities – operator interface – engineering interfaces. APPLICATIONS OF PLC & DCS: Case studies of Machine automation, Process automation, Introduction to SCADA Comparison between SCADA and DCS.

Total No. of Periods: 45

TEXT BOOKS:

1. John.W.Webb & Ronald A. Reis, “Programmable logic controllers: Principles and Applications”, Prentice Hall India, 2003.
2. Michael P. Lukas, “Distributed Control systems”, “Van Nostrand Reinfold Company”1995

REFERENCES:

1. Win C C Software Manual, Siemens, 2003
2. RS VIEW 32 Software Manual, Allen Bradly, 2005
3. CIMPLICITY SCADA Packages Manual, Fanuc India Ltd, 2004

Subject Code:	Subject Name: MICRO ROBOTICS	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
BRE18E09	Prerequisite: Basics of Robotics	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To gain knowledge in micro robot working principle and applications

COURSE OUTCOMES (COs) : (3- 5)
Students will be able to

CO1	Get aware of the introductory concepts of MST
CO2	Appreciate scaling laws and materials for MEMS
CO3	Appreciate the working of flexures, actuators and sensors
CO4	Appreciate the concept of microrobotics
CO5	Implement microrobotics

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	M	M	M	M	M	H	M	H	H
CO2	H	H	H	M	M	M	M	M	H	M	H	H
CO3	H	H	H	M	M	M	M	M	H	M	H	H
CO4	H	H	H	M	M	M	M	M	H	M	H	H
CO5	H	H	H	M	M	M	M	M	H	M	H	H

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	L	L	H	H
CO2	L	L	H	H
CO3	L	L	H	H
CO4	L	L	H	H
CO5	L	L	H	H

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships /	Soft Skills			
					✓							
Approval												

Subject Code: BRE18E09	Subject Name: MICRO ROBOTICS	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Basics of Robotics	Ty	3	0/0	0/0	3

UNIT I INTRODUCTION: **5**

MST (Micro System Technology) – Micromachining - Working principles of Microsystems - Applications of Microsystems.

UNIT II SCALING LAWS AND MATERIALS FOR MEMS: **10**

Introduction - Scaling laws - Scaling effect on physical properties, scaling effects on Electrical properties, scaling effect on physical forces. Physics of Adhesion - Silicon-compatible material system - Shape memory alloys - Material properties: Piezo resistivity, Piezoelectricity and Thermoelectricity.

UNIT III FLEXURES, ACTUATORS AND SENSORS: **10**

Elemental flexures - Flexure systems - Mathematical formalism for flexures. Electrostatic actuators, Piezo-electric actuators, Magneto-strictive actuators. Electromagnetic sensors, Optical-based displacement sensors, Motion tracking with microscopes.

UNIT IV MICRO ROBOTICS: **9**

Introduction, Task specific definition of micro-robots - Size and Fabrication Technology based definition of micro robots - Mobility and Functional-based definition of micro-robots - Applications for MEMS based micro-robots.

UNI V IMPLEMENTATION OF MICROROBOTS: **11**

Arrayed actuator principles for micro-robotic applications – Micro-robotic actuators - Design of locomotive micro-robot devices based on arrayed actuators. Micro-robotics devices: Micro-grippers and other micro-tools - Micro-conveyors - Walking MEMS Micro-robots – Multi-robot system: Micro-robot powering, Micro-robot communication.

Micro-fabrication principles - Design selection criteria for micromachining - Packaging and Integration aspects – Micro-assembly platforms and manipulators.

Total No. of Periods : 45

TEXT BOOKS:

1. Mohamed Gad-el-Hak, ―The MEMS Handbook, CRC Press, New York, 2002.
2. Yves Bellouard, ―Microrobotics Methods and Applications‖, CRC Press, Massachusetts, 2011.

REFERENCES:

1. Nadim Maluf and Kirt Williams, _‖An Introduction to Microelectromechanical systems Engineering‖, Artech House, MA, 2002.
2. Julian W Gardner, ―Microsensors: Principles and Applications‖, John Wiley & Sons, 1994.

Subject Code: BRE18E10	Subject Name: COGNITIVE ROBOTICS	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Basics of Robotics	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- Basic knowledge in cognitive robot working principle and applications

COURSE OUTCOMES (COs) : (3- 5)
Students will be able to

CO1	Appreciate the robot cognition and perception
CO2	Build maps
CO3	Analyse randomized path planning
CO4	Understand the SLAM concepts
CO5	Analyse different robot packages

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	M	M	M	M	M	H	M	H	H
CO2	H	H	H	M	M	M	M	M	H	M	H	H
CO3	H	H	H	M	M	M	M	M	H	M	H	H
CO4	H	H	H	M	M	M	M	M	H	M	H	H
CO5	H	H	H	M	M	M	M	M	H	M	H	H

COs / PSOs	PSO1	PSO2	PSO3	PSO4			
CO1	L	L	H	H			
CO2	L	L	H	H			
CO3	L	L	H	H			
CO4	L	L	H	H			
CO5	L	L	H	H			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							
Approval												

Subject Code: BRE18E10	Subject Name: COGNITIVE ROBOTICS	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Basics of Robotics	Ty	3	0/0	0	3

UNIT I CYBERNETIC VIEW OF ROBOT COGNITION AND PERCEPTION: 6

Introduction to the Model of Cognition, Visual Perception, Visual Recognition, Machine Learning, Soft Computing Tools and Robot Cognition.

UNITII MAP BUILDING: 12

Introduction, Constructing a 2D World Map, Data Structure for Map Building, Explanation of the Algorithm, An Illustration of Procedure Traverse Boundary, An Illustration of Procedure Map Building ,Robot Simulation, Execution of the Map Building Program.

UNIT III RANDOMIZED PATH PLANNING: 9

Introduction, Representation of the Robot‘s Environment, Review of configuration spaces, Visibility Graphs, Voronoi diagrams, Potential Fields and Cell Decomposition, Planning with moving obstacles, Probabilistic Roadmaps, Rapidly exploring random trees, Execution of the Quadtree-Based Path Planner Program.

UNIT IV SIMULTANEOUS LOCALIZATION AND MAPPING (SLAM): 12

Problem Definition, Mathematical Basis, Example: SLAM in Landmark Worlds, Taxonomy of the SLAM Problem, Extended Kalman filter, Graph-Based Optimization Techniques, Particle Methods Relation of Paradigms.

UNIT V ROBOT PROGRAMMING PACKAGES: 6

Robot Parameter Display, Program for BotSpeak,Program for Sonar Reading Display, Program for Wandering Within the Workspace, Program for Tele-operation, A Complete Program for Autonomous Navigation.

Total No. of Periods : 45

TEXT BOOKS:

1. Patnaik, Srikanta, "Robot Cognition and Navigation An Experiment with Mobile Robots", Springer-Verlag Berlin and Heidelberg, 2007.
2. Howie Choset, Kevin LynchSeth Hutchinson, George Kantor, Wolfram Burgard, Lydia Kavraki, and Sebastian Thrun, ―Principles of Robot Motion-Theory, Algorithms, and Implementation‖, MIT Press, Cambridge, 2005.

REFERENCES:

1. Sebastian Thrun, Wolfram Burgard, Dieter Fox, ―Probabilistic Robotics‖, MIT Press, 2005.
2. Margaret E. Jefferies and Wai-Kiang Yeap, "Robotics and Cognitive Approaches to Spatial Mapping", Springer-Verlag Berlin Heidelberg 2008. 15

DEPARTMENT OF MECHANICAL ENGINEERING

Subject Code: BRE18E11	Subject Name: CLOUD ROBOTICS	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Basics of Robotics	**Ty**	**3**	**0/0**	**0/0**	**3**

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- Basic knowledge in cloud robot working principle and applications

COURSE OUTCOMES (COs) : (3- 5)
Students will be able to

CO1	Be aware of introductory concepts of telerobotics
CO2	Appreciate the concept of networked robotics
CO3	Appreciate the working of online robotics
CO4	Design software architecture of online robots
CO5	Analyse different case studies for the same

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	M	M	M	M	M	H	M	H	H
CO2	H	H	H	M	M	M	M	M	H	M	H	H
CO3	H	H	H	M	M	M	M	M	H	M	H	H
CO4	H	H	H	M	M	M	M	M	H	M	H	H
CO5	H	H	H	M	M	M	M	M	H	M	H	H

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	L	L	H	H
CO2	L	L	H	H
CO3	L	L	H	H
CO4	L	L	H	H
CO5	L	L	H	H

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							
Approval												

Subject Code: BRE18E11	Subject Name: CLOUD ROBOTICS	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Basics of Robotics	Ty	3	0/0	0/0	3

UNIT I INTRODUCTION: **5**

Telerobotics: Overview and background – Brief history.

UNIT II COMMUNICATIONS AND NETWORKING: **13**

The Internet – Wired Communication Links – Wireless Links – Properties of Networked Telerobotics – Building a Networked Telerobotic system – State command Presentation – Command Execution/ State Generation – Collaborative Control

UNIT III FUNDAMENTALS OF ONLINE ROBOTS: **10**

Introduction – Robot Manipulators – Teleoperation – Teleoperation on a local network – Teleoperation via a constrained link.

UNIT IV ONLINE ROBOTS: **10**

Introduction to networked robot system on the Web – Software Architecture and design – Interface design.

UNIT V CASE STUDY: **7**

Performance of mobile robots controlled through the web – System Description – Software Architecture.

Total No. of Periods: 45

TEXT BOOKS:

1. Bruno Siciliano, Oussama Khatib, ―Springer Handbook of Robotics‖, Springer Science and Business, 2010.
2. Ken Goldberg, Roland Siegwart, ―Beyond Webcams – An Introduction to Online Robots‖, MIT Press, 2010.

REFERENCES:

1. Borko Furht, Armando Escalante, ―Handbook of Cloud Computing‖, Springer Science & Business, 2010.
2. Peter Sinčák, Pitoyo Hartono, Mária Virčíková, Ján Vaščák, Rudolf Jakša , ―Emergent Trends in Robotics and Intelligent Systems‖, Springer, 2014.

DEPARTMENT OF MECHANICAL ENGINEERING

Subject Code:	Subject Name: MEDICAL ROBOTICS	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
BRE18E12	Prerequisite: Basics of Robotics	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- Basic knowledge in medical robot working principle and applications

COURSE OUTCOMES (COs) : (3- 5)
Students will be able to

CO1	To categorize different types of medical robots
CO2	To gain knowledge with respect to performing localization and tracking methods using robots
CO3	To gain knowledge with respect to different types of surgical robots
CO4	Appreciate the working of robots with respect to rehabilitation
CO5	Design robots for medical care.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	M	M	M	M	M	H	M	H	H
CO2	H	H	H	M	M	M	M	M	H	M	H	H
CO3	H	H	H	M	M	M	M	M	H	M	H	H
CO4	H	H	H	M	M	M	M	M	H	M	H	H
CO5	H	H	H	M	M	M	M	M	H	M	H	H

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	L	L	H	H
CO2	L	L	H	H
CO3	L	L	H	H
CO4	L	L	H	H
CO5	L	L	H	H

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							
Approval												

DEPARTMENT OF MECHANICAL ENGINEERING

Subject Code:	Subject Name: MEDICAL ROBOTICS	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
BRE18E12	Prerequisite: Basics of Robotics	Ty	3	0/0	0/0	3

UNIT I INTRODUCTION: **7**

Types of medical robots - Navigation - Motion Replication - Imaging - Rehabilitation and Prosthetics - State of art of robotics in the field of healthcare.

UNIT II LOCALIZATION AND TRACKING: **8**

Position sensors requirements - Tracking - Mechanical linkages - Optical - Sound-based - Electromagnetic - Impedance-based - In-bore MRI tracking - Video matching - Fiber optic tracking systems - Hybrid systems.

UNIT III SURGICAL ROBOTICS: **10**

Minimally invasive surgery and robotic integration – surgical robotic sub systems - synergistic control. Control Modes - Radiosurgery - Orthopedic Surgery - Urologic Surgery and Robotic Imaging - Cardiac Surgery – Neurosurgery – case studies.

UNIT IV REHABILITATION and ROBOTS IN MEDICAL CARE: **12**

Rehabilitation for Limbs - Brain-Machine Interfaces - Steerable Needles – case studies.
Assistive robots –types of assistive robots – case studies.

UNIT V ROBOTS IN MEDICAL CARE: **8**

DESIGN OF MEDICAL ROBOTS: Characterization of gestures to the design of robots- Design methodologies- Technological choices- Security.

Total No. of Periods : 45

TEXT BOOKS:

1. Mark W. Spong, Seth Hutchinson, and M. Vidyasagar, ―Robot Modeling and Control‖, Wiley Publishers, 2006.
2. Paula Gomes, "Medical robotics Minimally invasive surgery", Wood head, 2012.

REFERENCES:

1. Achim Schweikard, Floris Ernst, ―Medical Robotics‖, Springer, 2015.
2. Jocelyne Troccaz, ―Medical Robotics‖, Wiley-ISTE, 2012. 3. Vanja Bonzovic, ‖Medical Robotics‖, I-tech Education publishing,Austria,2008.

DEPARTMENT OF MECHANICAL ENGINEERING

Subject Code: BRE18E13	Subject Name: PRECISION EQUIPMENT DESIGN	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Design of Machine Elements, Kinematics and Dynamics of Machinery	**Ty**	**3**	**0/0**	**0/0**	**3**

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To impart knowledge in the increasing quality concepts of parts, accuracy requirement of machine tools and also to introduce latest topics in Manufacturing like micro machining and smart materials so as to equip them to join core electronic manufacturing industries.

COURSE OUTCOMES (COs) : (3- 5)
Students will be able to

CO1	Understand the concepts of precision engineering concepts
CO2	Understand different categories of motion errors.
CO3	Design different design strategies for machine tools
CO4	Analyse parallel kinematic machines
CO5	Undertstand precision control techniques

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	M	H	M	L	H	H	H	H
CO2	H	H	H	H	H	M	L	L	M	H	H	H
CO3	H	H	H	H	M	H	M	L	H	H	H	H
CO4	H	H	H	H	M	H	M	L	H	H	H	H
CO5	H	H	H	H	M	H	M	L	H	H	H	H

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	H	M	H	H
CO2	M	M	M	H
CO3	H	M	M	H
CO4	H	M	M	H
CO5	H	M	M	H

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							
Approval												

Subject Code: BRE18E13	Subject Name: PRECISION EQUIPMENT DESIGN	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Design of Machine Elements, Kinematics and Dynamics of Machinery	Ty	3	0/0	0/0	3

UNITI: INTRODUCTION TO PRECISION ENGINEERING: 3

Precision manufacturing, Intelligent manufacturing – objectives, Reconfigurable systems.

UNIT II : MOTION ERRORS: 6

Errors and error measurements, Model of measurement, Statistical measurements, Propagation of errors, Motion errors principle –translational body, rotational body, geometric and kinematic errors, Other types of errors in machines – thermal, cutting force induced, environmental, common geometric errors – cosine, abbe, dead path errors, Methodologies of error elimination.

UNIT III : DESIGN STRATEGIES FOR MACHINE TOOLS 12

Standard sizes, Precision engineering principles –design, modeling and simulation , Design roadmap – conceptual analysis, materials selection, kinematic design of bearing and guide ways, Structural analysis – static and dynamic analysis , Micro machines – design approach, design challenges – kinematics, interactive forces, actuators

UNIT IV : PARALLEL KINEMATIC MACHINES (PKM) 12

Serial and parallel systems, Precision design of PKM – need of PKM ,low cost, degrees of freedom, workspace volume, high stiffness and agility, repeatability in movement, low inertia, Configurations and characteristic issues – degrees of calculation, Design principles – Kinematic modeling.

UNIT V: PRECISION CONTROL 12

Fundamentals of motion control , system modeling and performance assessment, linear dynamics, nonlinear dynamics – force ripple, friction, hysteresis, incorporating nonlinear dynamics, Control design strategies – PID feedback, feed forward control, ripple, RBF compensation, internal model control , Case study: Design of piezoelectric actuator – piezoelectric actuator, LVDT, adaptive controller.
.

Total No. of Periods: 45

REFERENCES:

1. Samir Mekid, "Introduction to Precision Machine Design and Error Assessment", CRC-Press, Taylor and Francis Group, New York, 2009.
2. Alexander H Slocum, "Precision Machine Design", Prentice Hall Publishers, 1992.
3. Moore W R, "Foundations of Mechanical Accuracy", The Moore Special Tool Company, Bridgeport, Connecticut, 1970.
4. Nakazawa H, "Principles of Precision Engineering", Oxford University Press, Oxford, 1994.
5. Smith S.T, Chetwynd D.G, "Foundations of Ultra – Precision Mechanism Design", Gordon and Breach Publishers, Switzerland, 1992.

ELECTIVE:
ELECTRICAL AND ELECTRONICS ENGINEERING

Subject Code:	Subject Name : VIRTUAL INSTRUMENTATION	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
BRE18E14	Prerequisite: Instrumentation and Control for Robots	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To study the basics of virtual instrumentation
- To study the programming techniques
- To study the data acquisition systems
- To study the instrument interfaces
- To know about the applications of virtual instruments are introduced in mechatronics systems.

COURSE OUTCOMES (COs) : (3- 5)

CO1	The students have gained knowledge in basics of VIRTUAL INSTRUMENTATION
CO2	The students have gained knowledge in PROGRAMMING TECHNIQUES
CO3	The students have gained knowledge in DATA ACQUISTION Systems
CO4	The students have gained knowledge in INSTRUMENT INTERFACES
CO5	The students have gained knowledge about the applications of virtual instruments are introduced in mechatronics systems.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	H	L	M	H	H	H	M	H
CO2	H	H	H	H	H	L	M	H	H	H	M	H
CO3	H	M	H	H	H	M	L	H	H	H	H	H
CO4	H	H	H	H	H	M	L	H	H	H	M	M
CO5	H	H	H	H	H	H	H	H	H	H	H	H

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	H	H	M	H
CO2	H	H	M	H
CO3	H	H	H	H
CO4	H	H	H	H
CO5	H	H	H	H

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					√							
Approval												

Subject Code: BRE18E14	Subject Name : VIRTUAL INSTRUMENTATION	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Instrumentation and Control for Robots	Ty	3	0/0	0/0	3

UNIT I : REVIEW OF VIRTUAL INSTRUMENTATION **9**

Historical perspectives, advantages, block diagram and architecture of a virtual instrument, data -flow techniques, graphical programming in data flow, comparison with conventional programming.

UNIT II : PROGRAMMING TECHNIQUES **9**

VIS and sub-VIS loops and charts, arrays, clusters and graphs, case and sequence structures, formula nodes, local and global variables, string and file I/O.

UNIT III : DATA ACQUISTION BASICS **9**

AOC.OAC. 010. Counters & timers. PC Hardware structure, timing. Interrupts OMA, software and hardware installation.

UNIT IV : COMMON INSTRUMENT INTERFACES **9**

Current loop, RS.232C/RS.485, GPIB, System buses, interface buses: USB, PCMCIA, VXI, SCXI, PXI, etc., networking basics for office &.Industrial applications, Visa and IVI, image acquisition and processing. Motion control.

UNIT V :USE OF ANALYSIS TOOLS **9**

Fourier transforms, power spectrum correlation methods, windowing & filtering, VI application in various fields.

Total No. of Periods : 45

TEXT BOOK

1. Gupta ," Virtual Instrumentation Using Lab view 2E" Tata McGraw-Hill Education, 2010

REFERENCES:

1. Gary Jonson, Labview Graphical Programming, Second Edition, McGraw Hill, New York, 1997
2. Sokoloff; Basic concepts of Labview 4, Prentice Hall Inc., New Jersey 1998.
3. Gupta S., Gupta J.P: , PC interfacing for Data Acquisition & Process Control, Second Edition, Instrument Society of America, 1994.

DEPARTMENT OF MECHANICAL ENGINEERING

Subject Code:	Subject Name : ADVANCED MICROPROCESSORS AND MICRO CONTROLLERS	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
BRE18E15	Prerequisite: Microprocessors and Microcontrollers	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- The student should be made to: Study the Architecture of 8085 microprocessor
- Study the Architecture of 8086 microprocessor.
- Learn the design aspects of I/O and Memory Interfacing circuits.
- Study about communication and bus interfacing.
- Study the Architecture of 8051 microcontroller.

COURSE OUTCOMES (COs) : (3- 5)

CO1	The student should be made to: Study the Architecture of 8085 microprocessor
CO2	Study the Architecture of 8086 microprocessor.
CO3	Learn the design aspects of I/O and Memory Interfacing circuits.
CO4	Study about communication and bus interfacing.
CO5	Study the Architecture of 8051 microcontroller

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	H	H	M	H	H	H	M	H
CO2	H	H	H	H	H	H	M	H	H	H	M	H
CO3	H	M	H	H	H	M	H	H	H	H	H	H
CO4	H	H	H	H	H	M	H	H	H	H	M	M
CO5	H	H	H	H	H	H	H	H	H	H	H	H

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	H	H	M	H
CO2	H	H	M	H
CO3	H	H	H	H
CO4	H	H	H	H
CO5	H	H	H	H

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					√							
Approval												

Subject Code:	Subject Name : ADVANCED MICROPROCESSORS AND MICRO CONTROLLERS	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
BRE18E15	Prerequisite: Microprocessors and Microcontrollers	Ty	3	0/0	0/0	3

UNIT I 8086 MICROPROCESSOR **8**

Architecture – Pin description – Operating modes – Registers – Interrupts – Bus cycle – Addressing modes – Typical configuration of 8086 system – Overview of Instruction set.

UNIT II 80286 MICROPROCESSOR **8**

Functional block diagram - Modes of operation – Real and protected mode – Memory management and protection features.

UNIT III 80386, 80486 PROCESSORS **8**

80386: Functional block diagram - Programming model - Addressing modes and instruction set overview – Address translation - Modes of operation - 80486 processor - Functional block diagram - Comparison of 80386 and 80486 processors.

UNIT IV PENTIUM MICROPROCESSOR **6**

Introduction – Architecture – Special Pentium registers – Memory management.

UNIT V PIC MICROCONTROLLER **15**

Architecture – Memory structure – Register File – Addressing modes – Interrupts – Timers: Modes of operation PIC PERIPHERAL FUNCTIONS AND SPECIAL FEATURES: PWM output – Analog to Digital converter – UART – Watchdog timer – RESET Alternatives – Power Down mode – I 2C Bus operation

Total No. of Periods : 45

TEXT BOOKS:

1. Barry B Brey, "The Intel Microprocessor 8086/8088, 80186/80188, 80286, 80386, 80486 Pentium and Pentium processor, Pentium II,III,4 , Prentice Hall of India, New Delhi, 2005.
2. Douglas V Hall, "Microprocessors and Interfacing: Programming and Hardware", McGraw Hill, New Delhi, 2005.
3. John B Peatman, “Design with PIC Microcontroller, McGraw Hill, Singapore, 1st Reprint, 2001

REFERENCES:

1. Mohammed Rafiquzzaman, "Microprocessors and microcomputer based system design", CRC Press, 2005.
2. Walter A Triebel, Avtar Singh .”The 8088 and 8086 microprocessors Programming Interfacing software, Hardware and Applications”,Pearson Education ,2009
3. Myke Pred ko, “Programming and Customising the PIC Microcontroller, “McGraw Hill, USA, 1998

Subject Code:	Subject Name : DIGITAL CONTROL SYSTEM	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
BRE18E16	Prerequisite: Instrumentation and Control for Robots	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To understand the concept of Z – Transform
- To understand the sampled data systems
- To understand the state space analysis and stability analysis
- To study the state space analysis
- To gain knowledge in pole placement and observer gain

COURSE OUTCOMES (COs) : (3- 5)

CO1	To understand the concept of Z – Transform
CO2	To understand the sampled data systems
CO3	To understand the state space analysis and stability analysis
CO4	To study the state space analysis
CO5	To gain knowledge in pole placement and observer gain

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	H	H	M	H	H	H	M	H
CO2	H	H	H	H	H	H	M	H	H	H	M	H
CO3	H	M	H	H	H	M	H	H	H	H	H	H
CO4	H	H	H	H	H	H	H	H	H	H	M	H
CO5	H	H	H	H	H	H	H	H	H	H	H	H

COs / PSOs	PSO1	PSO2	PSO3	PSO4				
CO1	H	H	H	H				
CO2	H	H	M	H				
CO3	H	H	H	M				
CO4	H	H	H	H				
CO5	H	H	H	H				

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					√							
Approval												

Subject Code:	Subject Name : DIGITAL CONTROL SYSTEM	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
BRE18E16	Prerequisite: Instrumentation and Control for Robots	Ty	3	0/0	0/0	3

UNIT I Z TRANSFORM: 6

Sampled data theory – Sampling process – Sampling theorem – Signal reconstruction – Sample and hold circuits – Z Transform – Theorems on Z Transforms – Inverse Z Transforms.

UNIT II SAMPLED DATA SYSTEMS: 8

Pulse transfer function – Response of sampled data system to step and ramp inputs – mapping between s-plane and z-plane: Primary strips and Complementary Strips.

UNIT III STATE SPACE ANALYSIS: 11

State Space Representation of discrete time systems, Solving discrete time- state- space equations, Pulse Transfer Function Matrix, Discretization of continuous time state–space equations.

UNIT IV STABILITY ANALYSIS: 11

Stability Analysis of closed loop systems in the Z-Plane. Jury stability test – Stability Analysis by use of the Bilinear Transformation and Routh Stability criterion. Stability analysis using Liapunov theorems.

UNIT V POLE PLACEMENT AND OBSERVER DESIGN: 9

Controllability, Observability, Useful Transformations in State-Space analysis and Design, Design via Pole Placement, State Observers, Servo Systems.

Total No. of Periods : 45

TEXT BOOKS:

1. Ogata K., ―Discrete-Time Control systems‖, 2nd Edition, PHI Learning Pvt. Ltd, 2009.
2. Kuo B.C., ―Digital Control Systems‖, 2nd Edition, Oxford University Press, 2007.

REFERENCES:

1. Gopal M., ―Modern Control Systems Theory‖, 3 rd Edition, New Age International Publications, 2014.
2. Gopal M., ―Digital Control Engineering‖, New Age International Publications, 2003.
3. Gopal M., ―Digital Control and State Variable Methods‖, 3rd Edition, TMH, 2008.
4. Richard C. Dorf and Robert H. Bishop, ―Modern Control Systems‖, 12th Edition, Pearson Education, 2004.

Subject Code:	Subject Name: SPECIAL MACHINES AND CONTROLLERS	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
BRE18E17	Prerequisite: Electrical Machines	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES:

- To know about special types of electrical motors, their characteristics and applications.

COURSE OUTCOMES (COs) : (3- 5)
Students will be able to

CO1	gain the knowledge working principle of stepper motors.
CO2	gain the knowledge of switched reluctance motors
CO3	gain the knowledge of working principle of permanent magnet brushless DC motors
CO4	gain the knowledge of working principle of permanent magnet synchronous motors
CO5	Gain the working knowledge of linear motors.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	M	M	M	M	M	H	M	H	H
CO2	H	H	H	M	M	M	L	M	M	M	L	H
CO3	H	H	H	M	M	M	L	M	M	M	L	H
CO4	H	H	H	M	M	M	L	M	M	M	L	H
CO5	H	H	H	M	M	M	L	M	M	M	L	H

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	L	L	H	H
CO2	L	M	H	M
CO3	L	M	H	M
CO4	L	M	H	M
CO5	L	M	H	M

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical	Soft Skills			
					✓							
Approval												

Subject Code:	Subject Name: SPECIAL MACHINES AND CONTROLLERS	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
BRE18E17	Prerequisite: Electrical Machines	Ty	3	0/0	0/0	3

UNIT I STEPPER MOTORS **9**

Types - Constructional features – principle of operation – variable reluctance motor – single and Multi stack configurations – Permanent Magnet Stepper motor – Hybrid stepper motor. Different modes of Excitation - theory of torque predictions – Drive systems and circuit for open loop and closed loop control of stepper motor.

UNIT II SWITCHED RELUCTANCE MOTORS **9**

Constructional features – principle of operation –Torque Equation - Power Converters for SR Motor – Rotor Sensing Mechanism & Logic Controller – Sensor less Control of SR motor - Applications.

UNIT III PERMANENT MAGNET BRUSHLESS D.C. MOTORS **8**

Principle of operation – Types – Magnetic circuit analysis – EMF and torque equations – Power controllers – Motor characteristics and control – Applications.

UNIT IV PERMANENT MAGNET SYNCHRONOUS MOTORS **8**

Principle of operation, EMF, power input and torque expressions, Phasor diagram, Power Controllers, Torque speed characteristics, Self control, Vector control, Current control Schemes – Applications.

UNIT V LINEAR MOTORS: **11**

Linear Induction motor (LIM) classification – construction – Principle of operation – Concept of current sheet – goodness factor – DC Linear motor (DCLM) types – circuit equation - DCLM control applications – Linear Synchronous motor(LSM) – Types–Applications SERVOMOTORS: Servomotor – Types – Constructional features, principle of operation - control applications

Total No. of Periods : 45

TEXT BOOKS:

1. K. Venkataratnam," Special Electrical Machines", Universities Press (India) Private Limited, India, 2009.
2. Kenjo, T and Naganori, S "Permanent Magnet and brushless DC motors", Clarendon Press, Oxford, 1989

REFERENCES:

1. Kenjo T, "Stepping Motors and their Microprocessor Controls", Clarendon Press London, 2003.
2. Miller T J E, "Brushless Permanent Magnet and Reluctance Motor Drives", Clarendon Press, Oxford, 1989 .
3 Naser A and Boldea L,"Linear Electric Motors: Theory Design and Practical Applications", Prentice Hall Inc., New Jersey 1987.
4. Floyd E Saner," Servo Motor Applications", Pittman USA, 1993.
5. WILLIAM H YEADON, ALAN W YEADON, Handbook of Small Electric Motors, McGraw Hill, INC, 2001

ELECTIVE:
ELECTRONICS AND COMMUNICATION ENGINEERING

Subject Code: BRE18E18	Subject Name : DIGITAL SIGNAL PROCESSING	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Digital Electronics, Microprocessors and Microcontrollers	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To learn the concepts of Signals and systems and their applications in digital signal Processing

COURSE OUTCOMES (COs) : (3- 5)

CO1	Will be able to learn the concepts of signal and systems
CO2	Will be able to perform Z-Transforms and its realizations.
CO3	Will have the ability to perform DFT and FFT techniques.
CO4	Will be able to design digital filters in FIR and IIR mode
CO5	Describe the modules in the architecture of digital signal processor.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	H	M	L	L	L	L	L	M
CO2	H	H	H	H	H	M	M	L	M	M	L	M
CO3	H	H	H	H	H	L	L	L	L	L	M	L
CO4	H	H	H	H	H	H	L	L	M	L	L	L
CO5	H	H	M	M	M	M	M	M	M	M	M	M

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	H	H	L	H
CO2	H	H	L	H
CO3	H	H	L	H
CO4	H	H	L	H
CO5	H	H	L	H

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					√							
Approval												

Subject Code: BRE18E18	Subject Name : DIGITAL SIGNAL PROCESSING	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Digital Electronics, Microprocessors and Microcontrollers	Ty	3	0/0	0/0	3

Unit I SIGNALS & SYSTEMS 9

Signal classifications – Signal Representation – Classification of Discrete time signals – Typical Discrete time signals – operation on signals – Discrete time system – Classification of Discrete time systems – solution of difference Equations.

Unit II Z TRANSFORM & REALISATIONS 9

Z Transform – Properties – System function – Inverse Z Transform – Realization of Digital filters – Direct Form-I, Direct Form-II, Transposed, parallel, cascade, Lattice- Ladder structure

Unit III DFT & FFT 9

Discrete Fourier Transform (DFT) – Definition – Properties – Convolution of sequences – Linear convolution - circular convolution. Introduction to Radix – 2 FFT – Properties – DIT (FFT) – DIF (FFT) – Algorithms of Radix – 2FFT – Computing Inverse DFT by doing a direct DFT

Unit IV DESIGN OF DIGITAL FILTER 9

Review of design techniques for analog low pass filters –Frequency transformation – Properties of IIR filter design – Characteristics of FIR filters with linear phase - Fourier series Method – frequency sampling Method – Design of FIR filters using windows.

Unit V OVERVIEW OF DIGITAL SIGNAL PROCESSOR 9

Overview of Digital Signal Processors – Application of Digital Signal Processor – Memory Architecture of DSP Processor – Von Neumann Architecture – Harvard Architecture - Architecture of TMS320C5X Processor – Addressing modes – Pipelining .

Total No. of Periods : 45

Textbooks:

1.Sanjit k. Mitra "Digital signal processing", A Computer Based Approach, Tata McGraw Hill, NewDelhi
2.B.Venkataramani, M.Bhaskar, “Digital Signal Processors, Architecture, Programming and Application”, Tata McGraw Hill, New Delhi, 2003.
3.Alan V Oppenheim, "Signals and Systems", Prentice Hall of India Pvt. Ltd, 2nd Edition, 1997
Hwei P. Hsu, Schaum’s Outline Series, “Signals and Systems”, Mc Graw Hill Companies, 2nd Edition

References:

1.A.V.Oppenheim, R.W. Schafer and J.R. Buck, “Discrete – Time Signal Processing”, 8th Indian reprint, Pearson 2004.
2.Simon Haykin and Barry Van Veen ," Signals and Systems", John Wiley and Sons, Inc., 1999.

DEPARTMENT OF MECHANICAL ENGINEERING

Subject Code:	Subject Name : EMBEDDED SYSTEMS DESIGN	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
BRE18E19	Prerequisite: Digital Electronics	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To give an understanding of working of embedded system and its applications

COURSE OUTCOMES (COs) : (3- 5)

CO1	Understand the introductory concepts of embedded system
CO2	Analyze the architecture of a typical embedded system.
CO3	Aware of the different Operating system of embedded system.
CO4	Analyse the different performance issues of embedded system
CO5	Design and implement embedded systems for real time purpose

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO1	PO1	PO1	PO1	PO1	PO1	PO1	PO1	PO1	PO1	PO1
CO1	H	H	H	H	H	H	H	L	H	H	H	H
CO2	H	H	H	M	H	H	H	H	M	H	M	M
CO3	H	H	H	H	M	H	L	M	H	L	H	H
CO4	H	H	H	H	H	H	H	L	H	H	H	H
CO5	H	H	H	M	H	H	H	H	M	H	M	M

COs / PSOs	PSO1	PSO2	PSO3	PSO4			
CO1	H	H	H	H			
CO2		M	L				
CO3	M		H				
CO4		H		H			
CO5	H		H				

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					√							
Approval												

Subject Code: BRE18E19	Subject Name : EMBEDDED SYSTEMS DESIGN	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Digital Electronics	Ty	3	0/0	0/0	3

UNIT I INTRODUCTION TO EMBEDDED SYSTEM **7**

Embedded system, Functional building block of embedded system, Characteristics of embedded system applications, Challenges in embedded system design, Embedded system design processes.

UNIT II ARCHITECTURE OF EMBEDDED SYSTEM **10**

Computer architecture taxonomy, CPUs – Programming input and output, Supervisor mode, Exceptions & Traps, Co - processors, Memory system mechanisms - CPU bus - Memory devices - I/O devices - Component interfacing - Assembly and linking - Basic compilation techniques – Program optimization.

UNIT III OS FOR EMBEDDED SYSTEMS **10**

Introduction to RTOS, Multiple tasks and multiple processes, Context switching, Operating system, Scheduling policies, Interprocess communication mechanisms. Introduction to µC/ OS II.

UNIT IV PERFORMANCE ISSUES OF EMBEDDED SYSTEMS **8**

CPU Performance, CPU power consumption, Program level performance analysis, Analysis and optimization of program size, energy and power, Evaluating operating system performance, Power management and optimization strategies for processes, Multiprocessors – CPUs and accelerators, Multiprocessor performance analysis.

UNIT V DESIGN & IMPLEMENTATION **10**

Development and debugging, Manufacturing Testing, Program validation and Testing, Distributed embedded architecture, Networks for Embedded Systems - I 2 C Bus, CAN Bus, Design examples: Cell phones, Digital Still Cameras, Elevator Controller.

Total No. of Periods: 45

TEXT BOOKS:

1. Wayne Wolf, "Computers as Components: Principles of Embedded Computer Systems Design", The Morgan Kaufmann Series in Computer Architecture and Design, Elsevier Publications, 2008.
2. Rajkamal, "Embedded Systems – Architecture, Programming and Design", Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2010.

REFERENCES:

1. David E Simon, "An Embedded software primer", Pearson education India, New Delhi, 2004.
2. Sriram V Iyer, Pankaj Gupta, "Embedded Real-time Systems Programming", Tata McGrawHill Publishing Company Ltd, New Delhi, 2008

Subject Code:	Subject Name : WIRELESS COMMUNICATION	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
BRE18E20	Prerequisite: Basics of Electronics	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES:

- The student should be made to Be familiar with the characteristic of wireless channel
- Understand the design of a cellular system
- Learn the various digital signaling techniques and multipath mitigation techniques
- Be exposed to the concepts of multiple antenna techniques

COURSE OUTCOMES (COs) : (3- 5)

CO1	Will gain the knowledge of wireless channels
CO2	Will gain the knowledge of cellular architecture
CO3	Will gain the knowledge of digital signaling for fading channels
CO4	Will analyze multipath mitigation techniques
CO5	Will analyze different antenna techniques

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	H	H	H	L	H	H	H	H
CO2	H	H	H	M	H	H	H	H	M	H	M	M
CO3	H	H	H	H	M	H	L	M	H	L	H	H
CO4	H	H	H	M	H	H	H	H	M	H	M	M
CO5	H	H	H	H	M	H	L	M	H	L	H	H

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	H		M	
CO2		L		M
CO3	L	M		M
CO4	L	M		M
CO5	L	M		M

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					√							

Approval												

Subject Code: BRE18E20	Subject Name : WIRELESS COMMUNICATION	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Basics of Electronics	**Ty**	**3**	**0/0**	**0/0**	**3**

UNIT I WIRELESS CHANNELS **9**

Large scale path loss – Path loss models: Free Space and Two-Ray models -Link Budget design – Small scale fading- Parameters of mobile multipath channels – Time dispersion parameters Coherence bandwidth – Doppler spread & Coherence time, Fading due to Multipath time delay spread – flat fading – frequency selective fading – Fading due to Doppler spread – fast fading – slow fading.

UNIT II CELLULAR ARCHITECTURE **9**

Multiple Access techniques - FDMA, TDMA, CDMA – Capacity calculations–Cellular concept Frequency reuse - channel assignment- hand off- interference & system capacity- trunking & grade of service – Coverage and capacity improvement.

UNIT III DIGITAL SIGNALING FOR FADING CHANNELS **9**

Structure of a wireless communication link, Principles of Offset-QPSK, p/4-DQPSK, Minimum Shift Keying, Gaussian Minimum Shift Keying, Error performance in fading channels, OFDM principle – Cyclic prefix, Windowing, PAPR.

UNIT IV MULTIPATH MITIGATION TECHNIQUES **9**

Equalisation – Adaptive equalization, Linear and Non-Linear equalization, Zero forcing and LMS Algorithms. Diversity – Micro and Macrodiversity, Diversity combining techniques, Error probability in fading channels with diversity reception, Rake receiver,

UNIT V MULTIPLE ANTENNA TECHNIQUES **9**

MIMO systems – spatial multiplexing -System model -Pre-coding - Beam forming - transmitter diversity, receiver diversity- Channel state information-capacity in fading and non-fading channels.

Total No. of Periods : 45

TEXTBOOKS:

1. Rappaport,T.S., “Wireless communications”, Second Edition, Pearson Education, 2010.
2. Andreas.F. Molisch, “Wireless Communications”, John Wiley – India, 2006.

REFERENCES:

1.David Tse and Pramod Viswanath, “Fundamentals of Wireless Communication”, Cambridge University Press, 2005.
2. Upena Dalal, “ Wireless Communication”, Oxford University Press, 2009.
3. Van Nee, R. and Ramji Prasad, “OFDM for wireless multimedia communications”, Artech House, 2000.

DEPARTMENT OF MECHANICAL ENGINEERING

Subject Code:	Subject Name : VLSI DESIGN	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
BRE18E21	Prerequisite: Digital Electronics	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To learn the basics of MOS Transistors.
- To study the design of combinational logic circuit using CMOS.
- To learn CMOS sequential logic circuits design.
- To learn the concepts of modeling a digital system using HDL.
- To study the basics of PIC microcontroller.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Will be able to understand the basics of MOS Transistor.
CO2	Will be able to design combinational circuits using CMOS logic.
CO3	Will be able to design sequential circuits using CMOS.
CO4	Will be able to design arithmetic building blocks
CO5	Will be able to implement different implementation strategies for VLSI Design.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO1	PO1	PO1	PO1	PO1	PO1	PO1	PO1	PO1	PO1	PO1
CO1	H	H	H	H	H	H	H	L	H	H	H	H
CO2	H	H	H	M	H	H	H	H	M	H	M	M
CO3	H	H	H	H	M	H	L	M	H	L	H	H
CO4	H	H	M	M	H	H	H	L	H	H	L	L
CO5	H	H	M	H	M	H	H	L	H	H	H	L

COs / PSOs	PSO1	PSO2	PSO3	PSO4				
CO1	H	H	H	L				
CO2		M		H				
CO3	M		L					
CO4	M			H				
CO5	H	M	L	L				

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					√							
Approval												

Subject Code:	Subject Name : VLSI DESIGN	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
BRE18E21	Prerequisite: Digital Electronics	Ty	3	0/0	0/0	3

UNIT I MOS TRANSISTOR PRINCIPLE **9**

NMOS and PMOS transistors, Process parameters for MOS and CMOS, Electrical properties of CMOS circuits and device modeling, Scaling principles and fundamental limits, CMOS inverter scaling, propagation delays, Stick diagram, Layout diagrams

UNIT II COMBINATIONAL LOGIC CIRCUITS **9**

Examples of Combinational Logic Design, Elmore's constant, Pass transistor Logic, Transmission gates, static and dynamic CMOS design, Power dissipation – Low power design principles

UNIT III SEQUENTIAL LOGIC CIRCUITS **9**

Static and Dynamic Latches and Registers, Timing issues, pipelines, clock strategies, Memory architecture and memory control circuits, Low power memory circuits, Synchronous and Asynchronous design

UNIT IV DESIGNING ARITHMETIC BUILDING BLOCKS **9**

Data path circuits, Architectures for ripple carry adders, carry look ahead adders, High speed adders, accumulators, Multipliers, dividers, Barrel shifters, speed and area tradeoff

UNIT V IMPLEMENTATION STRATEGIES **9**

Full custom and Semi custom design, Standard cell design and cell libraries, FPGA building block architectures, FPGA interconnect routing procedures.

Total No. of Periods : 45

TEXTBOOKS:

1. Jan Rabaey, Anantha Chandrakasan, B.Nikolic, "Digital Integrated Circuits: A Design Perspective", Second Edition, Prentice Hall of India, 2003.
2. M.J. Smith, "Application Specific Integrated Circuits", Addisson Wesley, 1997

REFERENCES:

1. N.Weste, K.Eshraghian, "Principles of CMOS VLSI Design", Second Edition, Addision Wesley 1993
2. R.Jacob Baker, Harry W.LI., David E.Boyee, "CMOS Circuit Design, Layout and Simulation", Prentice Hall of India 2005 3. A.Pucknell, Kamran Eshraghian, "BASIC VLSI Design", Third Edition, Prentice Hall of India, 2007

DEPARTMENT OF MECHANICAL ENGINEERING

Subject Code:	Subject Name : INTERNET OF THINGS FOR ROBOT	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
BRE18E22	Prerequisite: Instrumentation and Control for Robots, Microprocessors and Microcontrollers and Python Programming	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

Ty/Lb/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To study basic of IoT and M2M.
- To study IoT with Cloud Environment.
- To design IoT systems with Python and Study physical Devices

COURSE OUTCOMES (COs) : (3- 5)

CO1	Will be able to get overview of IoT
CO2	Will be able to implement new approach based on IoT and M2M
CO3	Will be able to design IoT systems with cloud environment.
CO4	Will be able to use python software to configure IoT devices.
C05	Will be able to implement new applications based on Raspberry PI and Intel Galileo Arduino board

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	M	M	M	M	M	L	L	H	M	H	H
CO2	M	M	H	H	H	L	H	L	H	M	H	H
CO3	H	H	H	H	H	H	H	M	H	M	H	M
CO4	H	H	H	H	H	H	H	M	H	H	H	H
CO5	H	H	H	H	H	H	H	M	H	H	H	H

COs / PSOs	PSO1	PSO2	PSO3	PSO4		
CO1	H	H	H	H		
CO2	H	H	M	H		
CO3	H	H	M	H		
CO4	H	H		H		
CO5	H	H		H		

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							
Approval												

Subject Code:	Subject Name : INTERNET OF THINGS FOR ROBOT	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
BRE18E22	**Prerequisite: Instrumentation and Control for Robots, Microprocessors and Microcontrollers and Python Programming**	**Ty**	**3**	**0/0**	**0/0**	**3**

UNIT I: INTRODUCTION TO IoT **9**

Definition and Characteristics of IoT-Things in IoT-IoT protocols-Logical Design of IoT-IoT enabling technologies-IoT levels

UNIT II: DOMAIN SPECIFIC IoT AND M2M **9**

Home Automation-Cities-Environment-Energy-Retail-Logistics-Agriculture-Health and Lifestyle-Introduction to M2M-Difference between IoT and M2M-SDN and NFV for IoT

UNIT III :IoT SYSTEM MANAGEMENT AND CLOUD **9**

Need for IoT system management-SNMP-NETCONF-YANG-NETOPEER-IoT design methodology-Case Study for IoT System-WAMP-AutoBahn for IoT-Xively-Django-Amazon Web for IoT-SkyNet IoT.

UNIT IV: IoT SYSTEMS-LOGICAL DESIGN USING PYTHON **9**

Introduction-Installing Python-Python data types and data structures-Control flow-Functions-Modules-Packages-File Handling-Data/Time Operations-Classes-Python packages of Interest for IoT

UNIT V :IoT PHYSICAL DEVICES **9**

Raspberry Pi-Linux on Raspberry Pi-Raspberry Pi Interfaces-Programmig Raspbeery Pi with Python-Arduino boards-Other IoT devices-Data analytics for IoT-Intel Galileo Arduino board specification(With simple programs)

Total No. of Periods : 45

TEXTBOOKS:

1. Arshadeep Bahaga,Vijay Madisetti,"Internet of things-A hands –on approach", Universities press,First Edition 2015
2. Adrian McEwen and Hakim Cassimally,"Designing the Internet of Things",Wiley,First Edition,2014
3.C Hillar Gastn,"Internet of Things with Python",Packt publishing,first edition ,2016

REFERENCES:

1. Dominique DGuinard and Vlad M.Trifa,"Building the Web of things with examples in Node.js and Raspberry Pi",Manning Publications Co,2016
2. Marco Schwartz,"Internet of Things with the Raspberry Pi:Build Internet of Things Projects Using the Raspberry Pi Platform",Kindle Edition

ELECTIVE:
COMPUTER SCIENCE AND ENGINEERING

DEPARTMENT OF MECHANICAL ENGINEERING

Subject Code:	Subject Name : HUMAN COMPUTER INTERACTION	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
BRE18E23	Prerequisite: Basics of Computers and applications	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

Ty/Lb/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- Learn the foundations of Human Computer Interaction
- Be familiar with the design technologies for individuals and persons with disabilities
- Manage HCI

COURSE OUTCOMES (COs) : (3- 5)

CO1	Will get an idea on involvement of humans in HCI
CO2	Will get an idea on involvement of computers in HCI
CO3	Will have an conceptual idea of application and domain specific design
CO4	How HCI can be used for diverse population
CO5	How to manage HCI in the current scenario

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	M	H	M	H	H	M	H	H	H	H
CO2	H	H	H	H	H	H	M	M	H	H	H	M
CO3	H	H	H	H	M	M	H	H	H	M	H	L
CO4	H	H	H	H	M	M	H	H	H	M	H	L
CO5	H	H	H	H	M	M	H	H	H	M	H	L

COs / PSOs	PSO1	PSO2	PSO3	PSO4		
CO1	H	H	H	H		
CO2	H	H	M	H		
CO3	H	H	M	H		
CO4	H	H		H		
CO5	H	H		H		

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							
Approval												

Subject Code: BRE18E23	Subject Name : HUMAN COMPUTER INTERACTION	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Basics of Computers and applications	Ty	3	0/0	0/0	3

UNIT I: HUMANS IN HCI **9**

Introduction-implications for HCI-overview of HCI-Mentor models in HCI-emotions in HCI- cognitive architecture –task loading and stress in HCI-theoretical framework and mitigation strategies-motivating ,influencing and persuading users – human error identification in HCI

UNIT II :COMPUTERS IN HCI **9**

Input technologies and techniques – sensor and recognition based input for interaction-visual displays-haptic interfaces-nonspeech auditory output-network based interaction-wearable computers-design of computer workstation

UNIT III: APPLICATION/DOMAIN SPECIFIC DESIGN **9**

HCI in health care-designing emotions for games, entertainment interfaces and interactive products-motor vehicle driver interfaces-HCI in aerospace-user centered design in games

UNIT IV: DESIGNING FOR DIVERSITY **9**

The digital divide-the role of gender in HCI-IT and older adults-HCI for kids-IT for cognitive support-physical disabilities and computing technologies – an analysis of impairments-computing technologies for deaf and hard of hearing users

UNIT V: MANAGING HCI AND EMERGING ISSUES **9**

Technology transfer-augmenting cognition in HCI-human values, ethics and design, cost justification-future trends in HCI

Total No. of Periods : 45

TEXT BOOKS:

1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, “Human Computer Interaction”, 3rd Edition, Pearson Education, 2004.
2. Preece J., Rogers Y.,Sharp H.,Baniyon D., Holland S. and Carey T. Human Computer Interaction, Addison-Wesley, 1994.

REFERENCES:

1. *Brian Fling, “Mobile Design and Development”, First Edition , O"Reilly Media Inc., 2009.*
2. *Bill Scott and Theresa Neil, “Designing Web Interfaces”, First Edition, O"Reilly, 2009.*
3. *B.Shneiderman; Designing the User Interface, Addison Wesley 2000 (Indian Reprint).*

DEPARTMENT OF MECHANICAL ENGINEERING

Subject Code:	Subject Name : ADVANCED MACHINE LEARNING	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
BRE18E24	Prerequisite: Artificial Intelligence and Machine Learning	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

Ty/Lb/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To learn machine learning techniques
- To acquire knowledge about clustering and nonparametric methods
- To understand multilayer perceptrons and dimensionality reduction
- To design and analyze machine learning experiments.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Understand the concept of Machine Learning
CO2	Recognize the importance and relevance of parametric and multivariate methods
CO3	Recognize the importance and relevance of clustering and non parametric methods
CO4	Understand the concept of linear discrimination and multilayer perceptrons
CO5	Understand the concept kernel machines and graphical models

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	M	H	H	M	M	M	H	M	H	H
CO2	M	H	M	H	H	M	M	H	M	H	M	H
CO3	H	H	M	H	H	M	H	M	H	M	H	M
CO4	H	H	M	H	H	M	H	M	H	M	H	M
CO5	H	H	M	H	H	M	H	M	H	M	H	M

COs / PSOs	PSO1	PSO2	PSO3	PSO4		
CO1	M	H	L	M		
CO2	M	H	L	M		
CO3	M	H	L	M		
CO4	M	H	L	M		
CO5	M	H	L	M		

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							
Approval												

Subject Code:	Subject Name : ADVANCED MACHINE LEARNING	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
BRE18E24	Prerequisite: Artificial Intelligence and Machine Learning	Ty	3	0/0	0/0	3

UNIT I: INTRODUCTION TO MACHINE LEARNING 9

Machine Learning – Machine learning applications – learning association – supervised learning – learning a class from examples – learning multiple classes – regression – model selection and generation – Bayestan decision theory – losses and risk – discriminate functions – association rules.

UNIT II: PARAMETRIC AND MULTIVARIATE METHODS 9

Parametric methods – maximum likelihood estimation – Baye's estimator – parametric classification –regression – tuning model – multivariate methods – multivariate data – multivariate normal distribution – multivariate regression – dimensionality reduction – subset selection – factor analysis – multidimensional scaling – Isomap.

UNIT III: CLUSTERING AND NONPARAMETRIC METHODS 9

Clustering - Mixtures densities – k mean clustering – special and hierarchal clustering – Nonparametric density estimation – generalization to multivariate data – nonparametric classification – outlier data – decision trees – univariate trees – pruning – rule extraction from trees – multivariate trees.

UNIT IV: LINEAR DISCRIMINATION AND MULTILAYER PERCEPTRONS 9

Linear discrimination – generalizing the linear model – pair wise separation – logistic discrimination – discrimination by regression – multilayer preceptrons – MLP – back propagation algorithms – training procedures – tuning – dimensionality reduction – deep learning – local models – competitive learning – radial basis – normalized basis – learning vector quantization - mixture of experts.

UNIT V: KERNEL MACHINES AND GRAPHICAL MODELS 9

Kernel machine – optimal separating hyper plane – v SVM – multiple kernel learning – large margin nearest neighbour classifier – graphical models – generative models – d Separation - belief propagation – Hidden morkov models – Bayesten estimation – combining multiple learners – reinforcement learning.

Total No. of Periods : 45

TEXT BOOKS:

1. Ethem Alpaydin, "Introduction to Machine Learning" 3rd Edition PHI- 2014
2. Snila Gollapudi, "Practical Machine Learning" PACKT – 2016

REFERENCES:

1. *Tom M Mitchell, "Machine Learning" McGraw-Hill – 2013*
2. *David Barber "Bayesian Reasoning and Machine Learning" Cambridge University Press – 2015.*

DEPARTMENT OF MECHANICAL ENGINEERING

Subject Code:	Subject Name : RANDOMIZED ALGORITHMS	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
BRE18E25	Prerequisite: Programming and Mathematical knowledge	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

Ty/Lb/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To understand the mathematical foundations needed for understanding and designing randomized algorithms
- To appreciate the need for randomized algorithms
- To expose the students to probabilistic methods
- To understand the concept of random walk
- To expose the students to different types of applications of randomized algorithms

COURSE OUTCOMES (COs) : (3- 5)

CO1	Will be introduced to different randomized algorithms
CO2	Will be able to analyze different probabilistic methods
CO3	Will be able to apply different algebraic techniques and applications
CO4	Will be able to apply geometric and graph algorithms
CO5	Will be able to apply hashing and online algorithms

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	M	H	H	M	M	M	H	M	H	H
CO2	M	H	M	H	H	M	M	H	M	H	M	H
CO3	H	H	M	H	H	M	H	M	H	M	H	M
CO4	H	H	M	H	H	M	H	M	H	M	H	M
CO5	H	H	M	H	H	M	H	M	H	M	H	M

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	M	H	L	M		
CO2	M	H	L	M		
CO3	M	H	L	M		
CO4	M	H	L	M		
CO5	M	H	L	M		

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							
Approval												

Subject Code:	Subject Name : RANDOMIZED ALGORITHMS	Ty/ Lb/ ETL	L	T / S.Lr	P/ R	C
BRE18E25	Prerequisite Programming and Mathematical knowledge	Ty	3	0/0	0/0	3

UNIT I :INTRODUCTION TO RANDOMIZED ALGORITHMS **9**

Introduction to Randomized Algorithms - Min-cut – Elementary Probability Theory – Models of Randomized Algorithms – Classification of Randomized Algorithms – Paradigms of the Design of Randomized Algorithms - Game Theoretic Techniques – Game Tree Evaluation – Minimax Principle – Randomness and Non Uniformity.

UNIT II :PROBABILISTIC METHODS **9**

Moments and Deviations – occupancy Problems – Markov and Chebyshev Inequalities – Randomized Selection – Two Point Sampling – The Stable Marriage Problem – The Probabilistic Method – Maximum Satisfiability – Expanding Graphs – Method of Conditional Probabilities – Markov Chains and Random Walks – 2-SAT Example – Random Walks on Graphs – Random Connectivity

UNIT III: ALGEBRAIC TECHNIQUES AND APPLICATIONS **9**

Fingerprinting Techniques – Verifying Polynomial Identities – Perfect Matching in Graphs – Pattern Matching – Verification of Matrix Multiplication Structuring Problems – Ra- Data ndom Treaps – Skip Lists – Hash Tables.

UNIT IV :GEOMETRIC AND GRAPH ALGORITHMS **9**

Randomized Incremental Construction – Convex Hulls – Duality – Trapezoidal Decompositions – Linear Programming – Graph Algorithms – Min-cut – Minimum Spanning Trees.

UNIT V: HASHING AND ONLINE ALGORITHMS **9**

Hashing – Universal Hashing - Online Algorithms – Randomized Online Algorithms - Online Paging – Adversary Models – Relating the Adversaries – The k-server Problem.

Total No. of Periods : 45

TEXT BOOKS:

1.Rajeev Motwani and Prabhakar Raghavan, “Randomized Algorithms”, Cambridge University Press, 1995.

REFERENCES:

1. Juraj Hromkovic,”Design and Analysis of Randomized Algorithms”, Springer, 2010.
2. Michael Mitzenmacher and Eli Upfal, “Probabilty and Computing – Randomized Algorithms and Probabilistic Analysis”, Cambridge University Press, 2005.

DEPARTMENT OF MECHANICAL ENGINEERING

Subject Code:	Subject Name : GRAPH ALGORITHMS	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
BRE18E26	Prerequisite: Programming and Mathematical knowledge	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

Ty/Lb/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To understand the concept and need of graphs
- To understand various graph algorithms
- To understand the various applications of graph in real world problems

COURSE OUTCOMES (COs) : (3- 5)

CO1	Analyse the concept of graphs
CO2	Analyse the concept of path and tree algorithms
CO3	Analyse the concept of matching
CO4	Analyse the eulerian and Hamiltonian graphs
CO5	Analyse graph isomorphism

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	H	H	M	M	H	H	H	H
CO2	H	H	H	H	M	H	M	M	H	M	H	H
CO3	M	H	H	H	L	H	M	M	H	M	H	H
CO4	M	H	H	H	L	H	M	M	H	M	H	H
CO5	M	H	H	H	L	H	M	M	H	M	H	H

COs / PSOs	PSO1	PSO2	PSO3	PSO4		
CO1	M	H	L	M		
CO2	M	H	L	M		
CO3	M	H	L	M		
CO4	M	H	L	M		
CO5	M	H	L	M		

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							
Approval												

Subject Code:	Subject Name : GRAPH ALGORITHMS	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
BRE18E26	Prerequisite: Programming and Mathematical knowledge	Ty	3	0/0	0/0	3

UNIT I: INTRODUCTION: **6**

Graphs, subgraphs, matrix representations, degree sequence, connected graphs, vertex and edge connectivity, distance in graphs, weighted graphs, graph classes, interval graphs, clique, independent set, vertex cover. Trees – characterizations, rooted, unrooted, spanning tree, matrix tree theorem, Cayley‘s formula. Graph operations – union, intersection, product. Digraphs – connectivity, tournament, transitive closure, topological order. Algorithms – time and space complexities.

UNIT II: PATH AND TREE ALGORITHMS: **7**

Shortest path problem, Dijkstra‘s algorithm, Floyd‘s algorithm for all pair shortest path, BellmanFord-Moore shortest path algorithm for graphs with negative length edges. Minimum weight spanning tree – fundamental cycles, cotrees and bonds, Prim‘s and Kruskals‘s algorithms, Cheriton-Tarjan algorithm. Depth-first and breadth-first algorithms for finding blocks.

UNIT III: MATCHING: **11**

Maximum and perfect matchings, augmenting path, Berge‘s, Konig‘s and Tutte‘s theorems, Hall‘s theorem, Hungarian algorithm, Edmond-Blossom algorithm. Kuhn-Munkre‘s algorithm for optimal assignment. NETWORK FLOW: Maximum flow in a network, minimum cut, Ford-Fulkerson algorithm, Max-flow min-cut theorem. Similarity between matching and flow theories.

UNIT IV: EULERIAN AND HAMILTONIAN GRAPHS: **11**

Eulerian trails and tours. Optimal Chinese Postman Tour – Edmond‘s and Johnson algorithm, Eulerian trail - Fleury‘s algorithm. Hamiltonian cycles – Ore‘s and Dirac‘s conditions. Gray codes, Traveling Salesman problem – Christofide‘s algorithm. VERTEX COLORING: Vertex coloring and bounds. Sequential coloring, largest degree first algorithms. Maximum clique and vertex coloring. Mycielski‘s construction for large chromatic number.

UNIT V:GRAPH ISOMORPHISM: **10**

Isomorphism, subgraph isomorphism, László Babai‘s quasi-polynomial time solution for graph isomorphism problem. PLANAR GRAPHS: Euler‘s formula, dual graph, Kuratowski‘s theorem, 4-color problem, Wagner‘s theorem. Planarity testing – Hopcraft-Tarjan algorithm.

Total No. of Periods : 45

TEXT BOOKS:

1. Willian Kocay, Donald L. Kreher, Graphs, Algorithms, and Optimization, CRC Press, 2013.
2. Jonathan Gross and Jay Yellen, Graph Theory and its Applications, CRC Press, 2006.

REFERENCES:

1. Douglas B West, Introduction to Graph Theory, PHI Learning Pvt. Ltd., 2012.
2. Naveed Sherwani, Algorithms for VLSI Physical Design Automation, Springer, 2013.
3. Bang-Jensen, Jørgen, Gutin, Gregory Z., Diagraphs: Theory, Algorithms and Applications, Springer-Verlag, 2010.

DEPARTMENT OF MECHANICAL ENGINEERING

Subject Code: BRE18E27	Subject Name : VISION SYSTEM AND IMAGE PROCESSING	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite:Programming and Mathematical knowledge,Basics of Robotics	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To study and analyze vision system, algorithms and robotic vision.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Will be introduced to vision system concepts
CO2	Will analyse different vision algorithms
CO3	Will analyse and understand object recognition
CO4	Will be aware of different applications with regard to image processing
CO5	Will be introduced to robotic vision concepts.

Mapping of Course Outcomes with Program Outcomes (POs)

Cos/Ps	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	M	H	L	H	M	H	M	H	H
CO2	H	H	M	M	H	H	M	M	H	M	H	L
CO3	H	M	H	M	M	H	M	M	M	H	H	H
CO4	M	H	H	H	H	M	M	L	M	L	M	H
CO5	L	M	H	H	H	M	M	L	M	M	H	H

Cos / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	H	H	M					
CO2	M	H	L					
CO3	M	H	H					
CO4	M	H	H					
CO5	H	H	M					

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							
Approval												

Subject Code: BRE18E27	Subject Name : VISION SYSTEM AND IMAGE PROCESSING	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Programming and Mathematical knowledge, Basics of Robotics	**Ty**	**3**	**0/0**	**0/0**	**3**

UNIT I : VISION SYSTEM **9**

Basic Components – Elements of visual perception, Lenses: Pinhole cameras, Gaussian Optics – Cameras – Camera-Computer interfaces.

UNIT II : VISION ALGORITHMS **9**

Fundamental Data Structures: Images, Regions, Sub-pixel Precise Contours – Image Enhancement : Gray value transformations, image smoothing, Fourier Transform – Geometric Transformation - Image segmentation – Segmentation of contours, lines, circles and ellipses – Camera calibration – Stereo Reconstruction.

UNIT III: OBJECT RECOGNITION **9**

Object recognition, Approaches to Object Recognition, Recognition by combination of views – objects with sharp edges, using two views only, using a single view, use of dept values.

UNIT IV : APPLICATIONS **9**

Transforming sensor reading, Mapping Sonar Data, Aligning laser scan measurements - Vision and Tracking: Following the road, Iconic image processing, Multiscale image processing, Video Tracking - Learning landmarks: Landmark spatiograms, K-means Clustering, EM Clustering.

UNIT V ROBOT VISION **9**

Basic introduction to Robotic operating System (ROS) - Real and Simulated Robots - Introduction to Open CV, Open NI and PCL, installing and testing ROS camera Drivers, ROS to Open CV - The cv_bridge Package.

Total No. of Periods : 45

TEXT BOOKS:

1. Carsten Steger, Markus Ulrich, Christian Wiedemann, “Machine Vision Algorithms and Applications”, WILEY-VCH, Weinheim,2008.
2. Damian m Lyons,“Cluster Computing for Robotics and Computer Vision”, World Scientific, Singapore, 2011.

REFERENCES:

1. Rafael C. Gonzalez and Richard E.woods, “Digital Image Processing”, Addition - Wesley Publishing Company, New Delhi, 2007.
2. Shimon Ullman, “High-Level Vision: Object recognition and Visual Cognition”, A Bradford Book, USA, 2000.
3. R.Patrick Goebel, “ ROS by Example: A Do-It-Yourself Guide to Robot Operating System – Volume I”, A Pi Robot Production, 2012.

DEPARTMENT OF MECHANICAL ENGINEERING

Subject Code:	Subject Name : SYSTEM SOFTWARE	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
BRE18E28	Prerequisite: Basics of computer software and hardware	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES

- To understand the concept of assemblers, loaders, and linkers.
- Understand fundamental concepts of macroprocessing and emulators.
- Understand the concept of virtual machines.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Will gain the knowledge of assemblers
CO2	Will gain the knowledge of loaders and linkers
CO3	Will gain the knowledge of macro processors and emulators
CO4	Will Understand the concept of virtual machines
CO5	Will Understand the concept of code optimizing techniques, garbage collections and real world implementation of the same.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	H	H	H	L	H	H	H	H
CO2	H	H	H	M	H	H	H	H	M	H	M	M
CO3	H	H	H	H	M	H	L	M	H	L	H	H
CO4	H	H	H	H	M	H	L	M	H	L	H	H
CO5	H	H	H	H	M	H	L	M	H	L	H	H

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	H	H	M	H
CO2	H	L	H	L
CO3	M	L	M	H
CO4	M	L	M	H
CO5	M	L	M	H

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					√							
Approval												

Subject Code: BRE18E28	Subject Name : SYSTEM SOFTWARE	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Basics of computer software and hardware	Ty	3	0/0	0/0	3

UNIT I ASSEMBLERS **16**

Review of Computer Architecture – Machine Instructions and Programs – Assemblers –Basic Assembler Functions – Assembler Features – Assembler Design Options

UNIT II LOADERS AND LINKERS **8**

Loaders and Linkers – Basic Loader Functions – Machine-Dependent Loader Features – Machine-Independent Loader Features– Loader Design Options-Dynamic Linking and Loading- Object files- Contents of an object file – designing an object format – Null object formats- Code sections- Relocation – Symbols and Relocation – Relocatable a.out- ELF.

UNIT III MACROPROCESSORS AND EMULATORS **10**

Macroprocessors – Basic Macro Processor Functions – Machine-Independent Macro Processor Features – Macro Processor Design Options - - Emulation - basic Interpretation – Threaded Interpretation – Interpreting a complex instruction set – binary translation.

UNIT IV VIRTUAL MACHINES **6**

Pascal P-Code VM – Object-Oriented VMs – Java VM Architecture – Common Language Infrastructure – Dynamic Class Loading.

UNIT V ADVANCED FEATURES **5**

Instruction Set Issues – Profiling – Migration – Grids – Code optimizations- Garbage Collection- Examples of real world implementations of system software

Total No. of Periods : 45

TEXT BOOKS:

1. Leland L. Beck, “System Software”, 3rd ed., Pearson Education, 1997.
2. John R. Levine, “Linkers & Loaders”, Morgan Kauffman, 2003.

REFERENCES:

1. John J Donovan, “ Systems Programming”, McGraw Hill , 1999.
2. Dhamdhere D M, “Systems Programming”, Tata McGraw Hill, 2001.
3. Aho A V, Sethi R and Ullman J D, “Compilers: Principles, Techniques and Tools”, Addison Wesley, Longman, 1999.
4. Dhamdhere D M, “Compiler Construction Principles and Practice”, Macmillan Company, 1997.
5. Holub Allen I, “Compiler Design in C”, Prentice Hall, 2001.