GOVERNMENT COLLEGE OF ENGINEERING

AMRAVATI

B. TECH. FIRST YEAR

CURRICULUM

2022-23

Semester I

Teaching Scheme							Evaluation Scheme						
Category	Course Code	Course Title	Theory	Tutorial	Practical		Theory			Practical		Total	Credits
			Hrs/week	Hrs/week	Hrs/week	Total	MSE	TA	ESE	ICA	ESE		
MC	SHU100	Induction Program	Two weeks mandatory audit course										0
BSC	SHU121	Physics	3	1	---	4	30	10	60	---	---	100	4
BSC	SHU122	Calculus and Linear Algebra	3	1	---	4	30	10	60	---	---	100	4
ESC	EEU121	Basic Electrical Engineering	3	---	---	3	30	10	60	---	---	100	3
ESC	CEU121	Engineering Mechanics	3	---	---	3	30	10	60	---	---	100	3
HSMC	SHU123	English	2	---	---	2	---	---	60	---	---	60	2
BSC/LC	SHU124	Physics Lab	---	---	2	2	---	---	---	50	---	50	1
ESC/LC	EEU122	Basic Electrical Engg Lab	---	---	2	2	---	---	---	50	---	50	1
ESC/LC	CEU122	Engineering Mechanics Lab	---	---	2	2	---	---	---	50	---	50	1
HSMC/LC	SHU125	English Lab	---	---	2	2	---	---	---	50	---	50	1
ESC/LC	MEU121	Workshop Practice I	---	---	2	2	---	---	---	50	---	50	1
		Total	14	2	10	26	120	40	300	250	0	710	21

Semester II

Teaching Scheme							Evaluation Scheme						
Category	Course Code	Course Title	Theory	Tutorial	Practical		Theory			Practical		Total	Credits
			Hrs/week	Hrs/week	Hrs/week	Total	MSE	TA	ESE	ICA	ESE		
BSC	SHU221	Chemistry	4	--	---	4	30	10	60	---	---	100	4
BSC	SHU222	Integral calculus and differential equations	3	1	---	4	30	10	60	---	---	100	4
ESC	CSU221	Programming for Problem solving	3	---	---	3	30	10	60	---	---	100	3
ESC	MEU221	Engineering Graphics	2	---	---	2	30	10	60	---	---	100	2
ESC	MEU222/ ETU221	Basic Mechanical Engineering/ Basic Electronics Engineering	2	---	---	2	30	10	60	---	---	100	2
BSC/LC	SHU223	Chemistry Lab	---	---	2	2	---	---	---	50	---	50	1
ESC/LC	CSU222	Programming for Problem solving Lab	---	---	4	4	---	---	---	50	---	50	2
ESC/LC	MEU223	Engineering Graphics Lab	---	---	4	4	---	---	---	50	---	50	2
ESC/LC	MEU224	Workshop Practice II	---	---	2	2	---	---	---	50	---	50	1
		Total	14	1	12	27	150	50	300	200	0	700	21

TA: Teacher Assessment **MSE: Mid Semester Examination** **ESE: End Semester Examination** **ICA: Internal Continuous Assessment**

MSE Duration: 1.30 Hrs all courses **ESE Duration: 2.30 Hrs. all courses, only for MEU221 duration 3.00 Hrs.**

Important Note:

MEU222 for only Electrical, Electronics & TC, Computer Science, Information Technology and Instrumentation Engineering branch
ETU221 for only Civil and Mechanical Engineering branch

In Semester I, the students of Civil, Mechanical, Electrical & Instrumentation Engineering shall be offered group A courses, and that of Electronics & TC, Computer Science and Information Technology shall be offered group B courses. In Semester II, vice versa.

In addition following courses are offered
SHU122 and MEU121 for all students in Semester I. SHU222 and MEU224 for all students in Semester II.
MEU222 shall be offered in Semester I for Electronics & TC, Computer Science, Information Technology branch. And it shall be offered in Semester II for Electrical and Instrumentation Engineering branch
ETU221 shall be offered in Semester II for Civil and Mechanical Engineering branch.

There should be direct correspondence of group A and group B courses.

Sr. No.	Group A Courses		Group B Courses	
	Course Code	Title of Course	Course Code	Title of Course
1	SHU121	Physics	SHU221	Chemistry
2	EEU121	Basic Electrical Engineering	CSU221	Programming for Problem solving

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3	CEU121	Engineering Mechanics	MEU221	Engineering Graphics
4	SHU123	English	SHU223	Chemistry Lab
5	SHU124	Physics Lab	CSU222	Programming for Problem solving Lab
6	EEU122	Basic Electrical Engineering Lab	MEU223	Engineering Graphics Lab
7	CEU122	Engineering Mechanics Lab		
8	SHU125	English Lab		

Category of Course	Definition	Credits
BSC	Basic Science Courses	**18**
ESC	Engineering Science Courses	**21**
HSMC	Humanities and Social Sciences including Mgt.Courses	**3**
	Total Credits	**42**

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SHU100 Induction Program

Teaching Scheme: Two weeks mandatory course Credit : 00

Government College of Engineering, Amravati propose a 2-week long induction program for the UG students entering the institution, right at the beginning of first semester. It will be helpful to students to adjust the new environment and inculcate the spirit of vision and mission of the institution. All students admitted to the B.Tech programme will have to take Induction program as an additional requirement with minimum 75% attendance and be completed within first four semesters.

2 weeks duration
• Physical activity • Creative Arts • Universal Human Values • Literary • Proficiency Modules • Lectures by Eminent People • Visits to local Areas • Familiarization to Dept./Branch & Innovations

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SHU121 PHYSICS

Teaching Scheme : 03 L + 01T Total: 04 Credit : 04
Evaluation Scheme : 30 MSE + 10 TA + 60 ESE Total marks : 100
ESE duration : 2 Hrs 30 min.

Course Objectives:

I. To provide exposure about the basic principles of Physics along with the possible applications.
II. To develop an insight that provide necessary foundation for scientific thinking and innovation.
III. To create awareness about vital role played by science & recent advancements in technology.

Wave Optics: *Interference:* Interference at parallel thin film, interference at wedge shaped film, Newton's rings, application of interference in measurement of refractive index, testing of optical flatness of surface, anti-reflection coating.

Diffraction: Fraunhofer diffraction at single and double slit, the Rayleigh criterion for limit of resolution and its application to vision, diffraction gratings and their resolving power

Polarization: Polarization by double refraction, quarter wave plate and half wave plate, production of circularly and elliptically polarized light.

Lasers: Energy levels in atoms, radiation-matter interaction, absorption of light, spontaneous emission of light, stimulated emission of light, population of energy levels, Einstein A and B coefficients, metastable state, population inversion, resonant cavity, excitation mechanisms, lasing action, properties of laser, characteristics of different types of laser, types of laser - solid state laser (Nd–YAG), gas laser (He-Ne), semiconductor laser, applications of Laser in engineering.

Introduction to Quantum Mechanics: Introduction to quantum mechanics, wave nature of particles, wave packet, Heisenberg's uncertainty principle (its experimental illustration), application (nonexistence of electron in nucleus), wave function, time-dependent and time-independent Schrödinger wave equations, motion of a free particle, solution of stationary-state Schrödinger equation for one dimensional problems–particle in a box.

Semiconductor Physics: Intrinsic and extrinsic semiconductors, dependence of Fermi level on carrier-concentration and temperature (equilibrium carrier statistics), carrier generation and recombination, carrier transport: diffusion and drift, pn-junction, and its working on the basis of energy band diagrams, Hall effect (Hall voltage and coefficient).

Text Books:

1. A Textbook of Engineering Physics, M. N. Avadhanulu, P. G. Kshirsagar, S. Chand, 2016
2. Textbook of Optics, N. Subrahmanyam, Brij Lal, S. Chand, 2006

Reference Books:

1. Optics, A. Ghatak, McGraw Hill Education, 2012.
2. Engineering Physics, Dattu R. Joshi, Mc Graw Hill Education, 2010.
3. Fundamentals of Physics, D. Halliday, R. Resnick, J. Walker, John Wiley & Sons, 2011

Course Outcomes: After completion of course, the student will be able to-

SHU121.1 Demonstrate competency, understanding concepts & working principles of physics.
SHU121.2 Understand the concepts in modern physics and will be able to apply them.

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SHU122 CALCULUS& LINEAR ALGEBRA

Teaching Scheme : 03 L + 01T Total 04 Credit: 04
Evaluation Scheme: 30 MSE + 10 TA + 60 ESE Total marks: 100
ESE duration : 2 hrs 30 min.

Course Objectives:

I. To familiarize the prospective engineers with techniques in calculus, multivariate analysis and linear algebra.

II. To equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.

Infinite Series:

Convergence of series, tests for convergence: Comparision test, D'Alembert's ratio test, Raabe's test Cauchy's root test**,** Power series, Taylor's series, series for exponential, trigonometric and logarithm functions, Fourier series, Half range sine and cosine series.

Partial Differentiation:

Partial derivatives of first and higher orders; total derivative, homogeneous function-Euler"s theorem Tangent plane and normal line, Maxima, minima and saddle points, Jacobian and its properties.

Matrices:

Rank of a matrix; Echelon and normal form of a matrix; Homogeneous and non homogeneous system of linear equations; Eigen values and eigen vectors, Diagonalization of matrices, Cayley-Hamilton theorem(without proof), and orthogonal transformation.

Complex Numbers:

De Moivre's theorem, Roots of equation, Hyperbolic & inverse hyperbolic functions, separation of real & imaginary parts, logarithm of complex numbers.

Special Functions:

Beta and Gamma functions and their properties,
Differentiation under integral sign,
Curve tracing (Cartesian and polar).

Text Books:

1. Higher Engineering Mathematics, B. S. Grewal, 43th edition, Khanna publication,new Delhi 2013.
2. A text book of Applied Mathematics, P. N. Wartikar and J. N. Wartikar (Vol I and II), Pune Vidyarthi Griha Prakashan, Pune, 7th Edition, 2003.

Reference Books:

1. Higher Engineering Mathematics, B. V. Ramana, Tata McGraw Hill Publications, 2007.
2. Advanced Engineering Mathematics, H. K. Dass, S. Chand and Sons, 12th edition, 2002.
3. A Text book of Engineering Mathematics, N.P.Bali, Manish Goyal, Laxmi Publications,7th Edition 2008.
4. Advanced Engineering Mathematics, Erwin kreyszig, 9 Edition, John Wiley & Sons, 2006.
5. Calculus and Analytic geometry, G.B. Thomas and R.L. Finney, 9 Edition, Pearson, Reprint, 2002.

Course Outcomes:-The students will be able:-

SHU122.1 to apply differential and integral calculus to notions of curvature and to improper integrals and shall have a basic understanding of Beta and Gamma functions.
SHU122.2 to use the tool of power series and Fourier series for learning advanced Engg. Mathematics.
SHU122.3 to deal with functions of several variables that are essential in most of engineering branches.

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SHU122.4. to use the essential tool of matrices and linear algebra in a comprehensive manner.

EEU121 BASIC ELECTRICAL ENGINEERING

Teaching Scheme : 03 L **Total: 03** **Credit: 03**
Evaluation Scheme: 30 MSE +10 TA+ 60 ESE **Total Marks: 100**
Duration of ESE : 2 Hrs.30 min.

DC Circuits: Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff's Current and Voltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenin and Norton Theorems. Time-domain analysis of first-order RL and RC circuits.

AC Circuits: Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Three- phase balanced circuits, voltage and current relations in star and delta connections.

Magnetic Circuits and Transformers: Basics of magnetic circuits, Magnetic materials, BH characteristics, ideal and practical transformer, losses, regulation and efficiency by direct loading, Auto-transformer, three-phase transformer connections (Star and Delta)

Electrical Machines: Concept of rotating magnetic fields, Construction, working, starting and speed control of three-phase induction motor, Single-phase induction motor and separately excited dc motor. Construction and working of synchronous generators. [No numericals on this Module]

Electrical Installations: Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries. Elementary calculations for energy consumption, power factor improvement and battery backup.

Suggested Text / Reference Books

1. D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 2010.
2. D. C. Kulshreshtha, "Basic Electrical Engineering", McGraw Hill, 2009.
3. L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press,2011
4. E.Hughes,"Electrical and Electronics Technology", Pearson, 2010.
5. V. D. Toro, "Electrical Engineering Fundamentals", Prentice Hall India, 1989.

Course Outcomes

EEU121.1 To understand and analyze basic electric and magnetic circuits.
EEU121.2 To study the working principles of electrical machines and power converters.
EEU121.3 To introduce the components of low voltage electrical installations.

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CEU121 ENGINEERING MECHANICS

Teaching Scheme : 03 L Total: 03 Credit: 03
Evaluation Scheme : 30 MSE +10 TA+ 60 ESE Total Marks: 100
Duration of ESE : 2 Hrs.30 min.

Course Objectives:

I. To demonstrate applications of principles of mechanics for solutions of various engineering problems.
II. To inculcate in students, problem solving abilities and enhance their analytical abilities.
III. To enhance students' ability to design by solving open ended problems.
IV. To prepare the students for higher level courses such as Strength of Materials, Electrical Machines, Mechanical Design and Structural Analysis.

Vector Mechanics: Introduction to the principles of mechanics, General Force Systems, Moment of a force about a point and about an axis, Couple and couple moment, Couple moment as free vector, Moment of couple about a line, Resolution and composition of coplanar force system, Reduction of system of forces into a force couple system, Simple resultant, wrench. Resultant and Equilibrium of: Two-dimensional force systems and Three-dimensional force systems
Trusses & Cables: Analysis of simple plane trusses, Method of joints, Method of sections, Static analysis of cables for point loads.
Friction: Concept of friction, impending motion, angle of friction, angle of repose, cone of friction, Coulombs laws of dry fiction, wedge blocks, belt friction, Concept of dynamic friction.

Centroid and Centre of Gravity: Centroid of plane areas, second moment of area, and product of inertia, perpendicular and parallel axis theorem, polar moment of inertia, radius of gyration, Principal axes and principal moment of inertia, centre of gravity, mass moment of inertia.
Kinematics: Kinematics of particles: Basic concepts; Rectangular components; Normal and tangential components; Radial and transverse components; motion curves Relative motion; Dependant motion. Kinematics of rigid bodies: Translational motion; Rotation about a fixed axis; General plane motion; Coriolis acceleration, Instantaneous Centre of Rotation.
Kinetics: Kinetics of rectilinear and circular motion of a particle acted upon by a constant and variable force system, Newton's second law; Impulse momentum principle; Central impact; work energy equation for rigid bodies, Energy principles, concept of dynamic equilibrium.
Virtual Work: Work of a force, Principle of Virtual Work and its Engineering Applications.

Text Books:

1. Vector Mechanics for Engineers, Vol. 1 – Statics and Vol. 2 – Dynamics, Beer and Johnston, 8th edition, Tata McGraw Hill International Edition, 2010.
2. Engineering Mechanics, Vol. 1 – Statics 4/e, 1998 and Vol. 2 – Dynamics, Merriam, 5/e, Wiley International, 2001.
3. Engineering Mechanics, by Dr. K. L. Kumar, Tata McGraw Hill Publications, 2011

References Books:

1. Engineering Mechanics, Irving H. Shames, & Rao, Prentice Hall, New Delhi 2010.
2. Engineering Mechanics, Vol. 1 – Statics and Vol. 2 – Dynamics, Mokoshi, V.S., Tata MGH Books, 1996.
3. Engineering Mechanics, F.L.Singer, HarperCollins Publishers India, 2001
4. Engineering Mechanics, McLean, 3rd Edition, SCHAUM Series, 1995.
5. Engineering Mechanics, Timoshenko and Young, McGraw Hill Publication.
6. Engineering Mechnaics, R. C. Hibbeler, Pearson Publishers, 2010
7. NPTEL series of IIT.

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Course Outcomes:

After Completion of the course, students will be able to

CEU121.1 Students shall be able to apply the principles of mechanics for solving the structures like trusses, cables and beams.

CEU121.2 Students shall be equipped with problem solving ability for rigid body mechanics.

CEU121.3 Students shall exhibit various applications of Newtonian Mechanics in their respective engineering disciplines.

CEU121.4 Students shall be clear in fundamentals before going for higher level courses such as Strength of Materials, Electrical Machines, Engineering Thermodynamics, Structural Analysis, Design of Structures, Machine Designs etc.

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SHU123 ENGLISH

Teaching Scheme : 02 L **Total: 02** **Credit: 02**
Evaluation scheme: 60 ESE **Total Marks: 60**
Duration of ESE : 2.30 Hrs

Course Objectives:
I. Improve various types of letters writing skill
II.Improve vocabulary knowledge.

Vocabulary Building: The concept of Word Formation, Root words from foreign languages and their use in English, Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives, Synonyms, antonyms, one word substitute and standard abbreviations.

Basic Writing Skills: Sentence Structures, Use of phrases and clauses in sentences, Importance of proper punctuation, Creating coherence, Organizing principles of paragraphs in documents, Techniques for writing precisely

Identifying Common Errors in Writing: Subject-verb agreement, Noun-pronoun agreement, Misplaced modifiers, Articles, Prepositions, Redundancies, Clichés

Nature and Style of sensible Writing: Describing, Defining, Classifying, Providing examples or evidence, writing introduction and conclusion

Writing Practices: Comprehension, Précis Writing, Essay Writing, business letters and resumes.

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, H yderabad. Oxford University Press.

Course Outcomes:
SHU123.1 The student will acquire basic proficiency in English including reading and listening Comprehension, writing and speaking skills.

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SHU124 PHYSICS LAB

Teaching Scheme : 02 P Total :02 Credit : 01
Evaluation Scheme : Internal Continuous Assessment Total marks : 50

Course Objectives:

I. Practical aspect of applied physics explore the relationships between physical parameters, cultivate the habit of inquiry and acquires skills of observation.

II. Identification of possible errors, analysis and interpretation of data into results.

III. Introduction to modern scientific and technical tools necessary for professional practice.

This is a representative list of practical's. The student is required to perform minimum eight experiments as per his choice so as to cover entire contents of this course.

List of experiments:

1. Determination of radius of curvature of plano-convex lens by using Newton' s rings.
2. Determination of wavelength of spectral lines using diffraction.
3. Determination of grating element-using diffraction of LASER beam.
4. Minimum deviation from a prism.
5. Determination of Specific rotation of optically active liquids.
6. Determination of energy gap in semiconductor.
7. To determine type of semiconductor and Hall coefficient. To determine the carrier concentration and conductivity of a semiconductor using Hall effect.
8. Determination of surface resistivity of given semiconductor by four probes method and study its temperature variation.
9. To determine the Curie temp and relative permittivity of given ferro-electric material.
10. Study of Meissner effect in high TC superconductors and determination of its transition temperature.
11. Study measurement of voltage and frequency using Cathode Ray Oscilloscope.
12. Study characteristics of solar cell at different intensities and determination of maximum workable power.
13. Study of optical fibre characteristics.

Course Outcomes: After completing this course student shall be able to
SHU123.1 Identify probable errors and their rectification.
SHU123.2 Use the techniques, skills and modern engineering tools necessary for professional practice.

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EEU122 BASIC ELECTRICAL ENGINEERING LAB

Teaching Scheme : 02 P Total: 02 Credit: 01
Evaluation Scheme : Internal Continuous Assessment Total Marks: 50

This is a representative list of practicals. The student is required to perform minimum eight experiments as per his choice so as to cover entire contents of this course.

List of experiments/demonstrations:

1 Basic safety precautions. Introduction and use of measuring instruments – voltmeter, ammeter, multi-meter, oscilloscope. Real-life resistors, capacitors and inductors.

2 Measuring the steady-state and transient time-response of R-L, R-C, and R-L-C circuits to a step change in voltage (transient may be observed on a storage oscilloscope). Sinusoidal steady state response of R-L, and R-C circuits – impedance calculation and verification. Observation of phase differences between current and voltage.Resonance in R-L-C circuits.

3 Transformers: Observation of the no-load current waveform on an oscilloscope (non-sinusoidal wave-shape due to B-H curve nonlinearity should be shown along with a discussion about harmonics). Loading of a transformer: measurement of primary and secondary voltages and currents, and power.

4 Three-phase transformers: Star and Delta connections. Voltage and Current relationships (line-line voltage, phase-to-neutral voltage, line and phase currents).Phase-shifts between the primary and secondary side.Cumulative three-phase power in balanced three-phase circuits.

5 Demonstration of cut-out sections of machines: dc machine (commutator-brush arrangement), induction machine (squirrel cage rotor), synchronous machine (field winding - slip ring arrangement) and single-phase induction machine.

6 Torque Speed Characteristic of separately excited dc motor.

7 Synchronous speed of two and four-pole, three-phase induction motors.Direction reversal by change of phase-sequence of connections. Torque-Slip Characteristic of an induction motor.Generator operation of an induction machine driven at super- synchronous speed.

8 Synchronous Machine operating as a generator: stand-alone operation with a load.Control of voltage through field excitation.

9 Demonstration of Components of LT switchgear.

Laboratory Outcomes:

EEU122.1 Get an exposure to common electrical components and their ratings.
EEU122.2 Make electrical connections by wires of appropriate ratings.
EEU122.3 Understand the usage of common electrical measuring instruments.
EEU122.4 Understand the basic characteristics of transformers and electrical machines.

ICA - Internal Continuous Assessment shall be based on the practical record and knowledge /skills acquired. The performance shall assess experiment wise by using continuous assessment formats, A and B.

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CEU122 ENGINEERING MECHANICS LAB

Teaching Scheme : 02 P Total: 02 Credit: 01
Evaluation Scheme : Internal Continuous Assessment Total Marks: 50

Course Objectives

I. To verify the principles of mechanics experimentally.
II. To develop in the students the skill of using graphical methods / Computer programming for the solution of mechanics problems.
III. To describe the motion of a particle / rigid bodies in terms of its position, velocity and acceleration in different frames of reference.

It is a representative list of practical with minimum seven experiments and minimum three graphical solutions using computer programming. The instructor may choose experiments as per his requirements (so as to cover entire contents of the course) from the list or otherwise.

1.Determination of resultant of coplaner concurrent force system by law of polygon of forces.
2. Determination of reactions at the supports of simple supported beam.
3. Determination of forces in the members of Jib crane.
4. Determination of coefficient of friction between inclined glass planes and different blocks.
5. Determination of coefficient of friction between belt and fixed drum.
6. Determination of mechanical advantage, velocity ratio and efficiency of simple screw jack machine.
7. Determination of mechanical advantage, velocity ratio and efficiency of machine. (Any one machine from differential wheel axle machine, single purchase crabs machine, double purchase crabs machine, worm and worm wheel machine)
8. Experiment on Coriolis acceleration
9. Determination of 'g' by compound pendulum.
10. Determination of moment of inertia of flywheel.
11. Verification of Newton's second law of motion by Fletcher's trolley.
12. Demonstration of direct central impact
13. Verification of Virtual Work Principle
14. Determination of Beam Reactions of a compound beam
15. Motion curves for particles / rigid bodies.

Course Outcomes:

After Completion of Course, the student will be able to

CEU122.1 To know when theory applies and when theory is limited by simplifying assumptions.

CEU122.2 identify reasons why actual measurements will differ from theoretical calculations.

CEU122.3 use the laboratory equipments correctly and safely to perform all experiments

CEU122.4 verify the wide field of engineering mechanics in various engineering applications

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SHU125 ENGLISH LAB

Teaching Scheme : 02P **Total: 02** **Credit:01**
Evaluation Scheme: Internal Continuous Assesment **Total Marks: 50**

Oral Communication:

(This unit involves interactive practice sessions in Language Lab)

1. Listening Comprehension
2. Pronunciation, Intonation, Stress and Rhythm
3. Common Everyday Situations: Conversations and Dialogues
4. Communication at Workplace
5. Interviews
6. Formal Presentations

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MEU121 WORKSHOP PRACTICE - I

Teaching Scheme : 02P **Total 02** **Credit : 01**

Evaluation scheme: Internal Continuous Assessment **Total Marks: 50**

Course Objectives:

I. To develop skills to prepare carpentry job
II. To develop skills to prepare gas/arc welding job
III. To develop skills to prepare sheet metal job
IV. To develop skills to prepare black smithy job
V. To develop skills of constructing choke & small transformer windings
VI. To develop skills of repairs & maintenance of domestic electrical appliances
VII. To understand different types of wirings & earthing methods
VIII. To identify all parts of a Personal Computer
IX. To assemble a Personal Computer

Group A

Carpentry: Introduction to wood working, kinds of woods, hand tools & machines, Types of joints, wood turning, Pattern making, types of patterns, Pattern making tools.
One job on wood working joint and demonstration of pattern making on wood working lathe.
Welding: Introduction to various welding equipment and welding joints, Demonstration on Gas welding, Electric arc welding, Spot welding, Resistance welding and TIG/MIG welding
One job on Arc welding
Sheet metal: Introduction to primary technology processes involving bending, punching and drawing, sheet metal tools and equipment, their uses, various sheet metal joints, surface development.
One job on sheet metal joint

Group B

Smithy: Introduction to various smithy tools and equipment, Introduction to forging operation,
One job on upsetting, drawing down, flattening
Electrical Workshop: Transformer and choke winding; repair and maintenance of domestic appliances like mixture, grinder, iron, geyser, electric fan, tube light etc.; MCB, ELCB; Different types of wiring. One job on preparation of extension boards, tube light wiring etc.; demonstration of earthing
Computer Hardware Shop : Introduction of Personal/ Micro Computers, PC Main Parts: CPU Box, Monitor & Peripherals, Inside CPU Box. Various terms used in computer memory. Floppy drives, HDD, CD, and SMPS. Identification of cables of computers; Installation of cards, devices and connecting cables

The shops listed in Group A are common to students of all programs and the shops of Group B are allotted as shown below.

Programme Name	Group B	Group A
Civil Engg.	Smithy	
Mechanical Engg.	Smithy	For all branches

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Electrical Engg.	Electrical Workshop		
Electronics & TC Engg.	Computer Hardware shop	(Carpentry,	
Computer Science & Engg.	Computer Hardware shop	Welding,	Sheet
Information Technology	Computer Hardware shop	Metal)	
Insrumentation Engg.	Electrical Workshop		

Course Outcomes:

After completion of course students will be able to

MEU123.1 Prepare a job on wood working joints.

MEU123.2 Prepare a job using welding operations.

MEU123.3 Prepare a sheet metal job.

MEU123.4 Prepare a job using smithy operation.

MEU123.5 Construct choke & small transformer.

MEU123.6 Perform repairs & maintenance of domestic electrical appliances.

MEU123.7 Assemble different types of wirings & carry out electrical earthing.

MEU123.8 Explain how a PC works and understand the relationship between hardware and software.

MEU123.9 Install, configure, optimize and upgrade personal computers.

MEU123.10 Classify and explain the function of different computer hardware components.

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SHU221 CHEMISTRY

Teaching Scheme : 04 L **Total: 04** **Credit: 04**
Evaluation scheme: 30MSE+10TA+60ESE **Total Marks: 100**
Duration of ESE : 2 hrs 30 min

Course objectives:
I. Have knowledge about engineering materials eg. Refractories, Composite etc.
II. Be aware about Spectroscopic Techniques and Applications.
III. Know Industrial process for softening of water.
IV. Understand the types of Reaction Mechanism.

Spectroscopic techniques and applications: Introduction of Spectroscopy, Principles, Instrumentation and Applications of Fluorescence spectroscopy, AAS (Atomic absorption spectroscopy) and UV-Visible spectroscopy in medicine.
Water treatment: Definition of hardness of water, Types of hardness and softening methods like Lime-Soda, Zeolite and Ion exchange. Units of hardness, Methods of treatment of water for domestic & Industrial purpose, Numerical problems on Lime-soda and Zeolite process. Boiler troubles: Boiler corrosion, Caustic embrittlement, Priming and Foaming, Scale and Sludge formation and internal treatment for Boiler feed water.
Organic reactions and synthesis of a drug molecule: Introduction to reactions involving substitution, addition, elimination, oxidation, reduction etc. Synthesis of a commonly used drug molecule.
Use of free energy in chemical equilibria: Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies. Free energy and emf. Cell potentials, the Nernst equation and applications. Acid base, oxidation reduction and solubility equilibria.
Engineering Chemistry: Corrosion of metals- definition, types and mechanism of Dry and wet corrosion. Design and Material selection, Anodic & cathodic protection, hot dipping: - galvanizing and tinning. Composite Material- definition, classification and applications. Refractories-Definition, types, properties Requisites of good refractory and manufacturing process of refractory.

Fuel: Classification, Calorific value-gross & net Determination of calorific value by Bomb calorimeter & Boy's calorimeter, Proximate & Ultimate Analysis of coal & its significance, Cracking of petroleum fractions, use of gasoline & diesel in internal combustion engines. Working of IC engine, Knocking, Antiknocking agents, there properties with chemical constitution, Octane number and Cetane number.

Course outcomes: After studying the course, the students will be able to:
SHU221.1 Have knowledge about spectroscopy.
SHU221.2 Understand the types of hardness of water and softening methods.
SHU221.3 Identify types of reaction mechanism.
SHU221.4 Explain of thermodynamic terms.
SHU221.5 Explain engineering materials.
SHU221.6 Understand the working of IC engine.

Recommended Books:
1. Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane
2. Fundamentals of Molecular Spectroscopy, by C. N. Banwell
3. Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S. Krishnan
4. Physical Chemistry, by P. W. Atkins
5. Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore.

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SHU222 INTEGRAL CALCULUS AND DIFFERENTIAL EQUATIONS

Teaching Scheme : 03 L+01T Total 04 Credit: 04
Evaluation Scheme: 30 MSE + 10 TA + 60 ESE Total marks : 100
Duration of ESE : 2 hrs 30 min.

Course Objectives:

I. To familiarize the prospective engineers with techniques in multivariate integration.
II. To familiarize the techniques in ordinary differential equations.
III. It aims to equip the students to deal with advanced level of mathematics and applications that would be essential for their disciplines.

Multiple Integration:

Double integrals (Cartesian & polar), Change of order of integration in double integrals, Change of variables (Cartesian to polar), Triple integrals, orthogonal curvilinear coordinates, Applications: areas and volumes.

First order ordinary differential equations:

Exact & non exact equations, linear and Bernoulli's equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.

Ordinary differential equations of higher orders:

Linear differential equation with constant coefficient, Second order linear differential equations with variable coefficients: Cauchy-Euler equation, method of variation of parameters, Power series solutions: Legendre polynomials.

Numerical Methods:

Solution of Algebraic and transcendental equations: Bisection method, Newton-Raphson method and Regula-Falsi method.

Finite differences, Relation between operators, Interpolation using Newton's forward and backward difference formulae, Interpolation with unequal intervals: Newton's divided difference and Lagrange's formulae.

Text Books:

1. Higher Engineering Mathematics, B. S. Grewal, 43th edition, Khanna publication, new Delhi 2013.
2. A text book of Applied Mathematics, P. N. Wartikar and J. N. Wartikar (Vol I and II), Pune Vidyarthi Griha Prakashan, Pune, 7thEdition, 2003.

Reference Books:

1. Higher Engineering Mathematics, B. V. Ramana, Tata McGraw Hill Publications, 2007.
2. Advanced Engineering Mathematics, H. K. Dass, S. Chand and Sons,12th edition, 2002.
3. A Text book of Engineering Mathematics, N.P.Bali, Manish Goyal, Laxmi Publications,7th edition 2007.
4. Advanced Engineering Mathematics, Erwin kreyszig, 9 Edition, John Wiley & Sons, 2006.
5. An Introduction to Ordinary Differential Equations, E. A. Coddington, Prentice Hall India, 1995.
6. Engineering Mathematics for first year, Veerarajan T.,Tata McGraw-Hill, New Delhi, 2008.

Course Outcomes: The students will able:

SHU222.1. To use the mathematical tools needed in evaluating multiple integrals and their usage.
SHU222.2. To apply the effective tools of solutions of differential equations that model physical processes.
SHU222.3. To solve mathematical problems using numerical techniques
SHU222.4.To solve various engineering problems with the help of knowledge of differential equations with higher order.

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CSU221 PROGRAMMING FOR PROBLEM SOLVING

Teaching Scheme : 03 L **Total:03** **Credits: 03**
Evaluation Scheme: MSE 30 +10 TA+ 60 ESE **Total Marks: 100**
Duration of ESE : 2Hrs. 30min.

Course Objectives:
I. To introduce basics of programming and develop logical thinking of students.
II. To help students understand how to model real world problems into the software
III. To implement mathematical statistical, applications into programming using C Language.

Introduction to Programming: Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.) Idea of Algorithm: steps to solve logical and numerical problems. Representation of Algorithm: Flowchart/Pseudocode with examples. From algorithms to programs; source code, variables (with data types) variables and memory locations, Syntax and Logical Errors in compilation, object and executable code, Arithmetic expressions and precedence, Conditional Branching and Loops , Writing and evaluation of conditionals and consequent branching ,Iteration and loops
Arrays: Arrays (1-D, 2-D), Character arrays and Strings
Basic Algorithms: Searching, Basic Sorting Algorithms (Bubble, Insertion and Selection), Finding roots of equations, notion of order of complexity through example programs (no formal definition required)
Function: Functions (including using built in libraries), Parameter passing in functions, call by value, Passing arrays to functions: idea of call by reference
Recursion: Recursion, as a different way of solving problems. Example programs, such as Finding Factorial, Fibonacci series, Ackerman function etc. Quick sort or Merge sort.
Structure : Structures, Defining structures and Array of Structures
Pointers: Idea of pointers, Defining pointers, Use of Pointers in self-referential structures, notion of linked list (no implementation)
File handling

Text Books:
1. Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
2. E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill

Reference Books
1. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India

Course Outcomes: The student will able to

CSU221.1 formulate simple algorithms for arithmetic and logical problems and translate the algorithms to programs.
CSU221.2 implement conditional branching, iteration and recursion.
CSU221.3 use arrays, pointers and structures to formulate algorithms and programs.
CSU221.4 apply programming to solve matrix addition and multiplication problems and searching and sorting problems.
CSU221.5 apply programming to solve simple numerical method problems, namely rot finding of function, differentiation of function and simple integration.

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MEU221 ENGINEERING GRAPHICS

Teaching Scheme : 02 L **Total 02** **Credit: 02**

Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **Total marks: 100**

Duration of ESE : 3 Hrs.

Course Objectives:

I. To inculcate imagination and mental visualization capabilities for interpreting the geometrical details of common engineering objects.
II. To impart knowledge about principles/methods related to projections of one, two and three dimensional objects.
III. To develop in students, graphic skills for communication of concepts, ideas and design of engineering products and expose them to existing national standards related to technical drawings.
IV. To be able to read, understand and apply the knowledge of orthographic projections (production related features and instructions) in manufacturing industry, process industry and other allied engineering application.
V. To create the image of three dimensional figures with the help of isometric projections.

All projections in this course are restricted to First Quadrant only.

Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Different types of lines used in drawing practices, dimensioning, Introduction to scale i.e. full size, Reducing scale and enlarging scale.

Conic sections (No focus and directrix method); Cycloid, and Involute; Principles of Orthographic Projections, concepts of four quadrants and conventions used to represent methods of orthographic projection. Projections of Points and lines inclined to both planes (excluding applications of straight lines.)

Projections of Planes: Projection of planes when it is parallel to one & perpendicular to other reference plane, lying in reference plane, inclined to one & perpendicular to other reference plane, inclined to both reference planes. Auxiliary planes - Auxiliary Inclined Plane (AIP) and Auxiliary Vertical Plane (AVP), Use of Auxiliary Plane method for solving the problems.

Projections of Solids: cube, tetrahedron, prism, pyramid, cylinder and cone, projections of above solids when axis perpendicular to one of the reference planes, axis inclined to one & parallel to other reference plane, axis inclined to both the reference planes.

Sections and Sectional Views of Right Angular Solids: Section planes, sectional views, Draw the sectional orthographic views of geometrical solids like Cube, Tetrahedron, Prism, Cylinder, Pyramid, Cone cut by different section planes (when solid is in simple position, when axis is parallel to one & inclined to other reference plane)

Development of surfaces of Regular Solids – Cube, Tetrahedron, Prism, Pyramid, Cylinder and Cone; (No reverse development)

Isometric Projections: Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of Planes, Simple Solids; Conversion of Orthographic projections into Isometric Projections.

Orthographic Projections: Conversion of Pictorial views into Orthographic Projections.

Overview of Computer Graphics: Listing the computer technologies that impact on graphical communication, Demonstrating knowledge of the theory of CAD software [such as: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD, Select

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and erase objects; consisting of set up of the drawing page and the printer, including scale settings, Setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerance; Orthographic constraints, Snap to objects manually and automatically; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles; applying dimensions to objects, applying annotations to drawings; Setting up and use of Layers, layers to create drawings, Create, edit and use customized layers; Changing line lengths through modifying existing lines (extend/lengthen); Printing documents to paper using the print command;

Course Outcomes: After completion of course, student will be able to

MEU221.1 Get acquainted with principles of engineering drawing
MEU221.2 Practice standard conventions to prepare engineering drawings
MEU221.3 Visualize the geometry and shape of the products
MEU221.4 Translate the geometrical information of engineering objects into engineering drawings
MEU221.5 Use computer aided drafting/solid modeling software

Text Book:

1 Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House
2 Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education
3 D.N. Johle, Engineering Drawing, Tata Megraw-hill publishing Co. Ltd
4 Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers
5 (Corresponding set of) CAD Software Theory and User Manuals.

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MEU 222 BASIC MECHANICAL ENGINEERING

Teaching Scheme : 02 L **Total:02** **Credit: 02**
Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **Total Marks: 100**
Duration of ESE : 2 hrs. 30 min.

Course Objective:

I. To demonstrate basic concepts of thermodynamics.
II. To get conversant with basics of heat transfer, refrigeration, internal combustion engines, machine element and machine tools

Thermodynamics Thermodynamic work, p-dV work in various processes, p-V representation of various thermodynamic processes and cycles Ideal gas equations, Properties of pure substance, Statements of I and II laws of thermodynamics and their applications in Mechanical Engineering. Carnot cycle for Heat engine, Refrigerator and Heat pump.

Energy conversion devices (Theoretical study using schematic diagrams only) Package Boiler, Turbine(Impulse & Reaction turbine, Gas turbine, Hydraulic turbines), Working principle and applications of Reciprocating I.C. engines, Air motor. Reciprocating pumps (single acting & double acting), reciprocating compressor, rotary compressors, fans, blowers, Study of household refrigerator, window air conditioner, split air conditioner Ratings and selection criteria of above devices. Refrigerants and their impact on environment.

Heat Transfer Statement and explanation of Fourier's law of heat conduction, Newton;s law of cooling, Stefan Boltzmann's law. Conducting and insulating materials and their properties. Selection of heat sink and heat source. Power Plants (Description with Block Diagrams) Thermal, Hydroelectric, Nuclear and Solar-Wind Hybrid Power Plants.

Machine elements: Power transmission shafts, axles, keys, bush and ball bearings, Flywheel and Governors. Power Transmission Devices Types of Belts and belt drives, Chain drive, Types of gears, Types of Couplings, friction clutch (cone and single plate), brakes (types and applications only) Applications of these devices. Mechanisms:.(Descriptive treatment only) Slider crank mechanism, Four bar chain mechanism, List of various inversions of Four bar chain mechanism, Geneva mechanism, Ratchet and Paul mechanism

Materials Used in Engineering and their Applications Metals – Ferrous and Non-Ferrous, Nonmetallic materials, Material selection criteria Design considerations Steps in Design Introduction to manufacturing processes and Their Applications: Casting, Sheet metal forming, Sheet metal cutting, Forging, Fabrication, Metal joining processes.

Machine Tools (Basic elements, Working principle and types of operations) Lathe Machine – Centre Lathe Drilling Machine – Study of Pillar drilling machine Introduction to NC and CNC machines Grinding machine, Power saw, Milling Machine.

Text Books:

1 P. K Nag "Thermodynamics", Tata McGraw-Hill Publishing Co. Ltd
2 Hajra-Chaudhari " Workshop Technology"

Reference Books:

1 Yunus A. Cengel and Boles," Thermodynamics",Tata McGraw-Hill Publishing Co. Ltd
2 Arora and Domkunwar, "Thermal Engineering", Dhanpat Rai and Sons.
3 R. K. Rajput, "Heat transfer", S Chand Publication, Delhi.
4 V. B. Bhandari "Design of Machine Elements" Tata McGraw-Hill Publishing Co. Ltd

Course Outcomes:

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At the end of the course: Students will be able apply the basics of Mechanical Engineering.

ETU 221 BASIC ELECTRONICS ENGINEERING

Teaching Scheme : 02 L **Total: 02** **Credit: 02**
Evaluation Scheme: 30 MSE +10 TA+ 60 ESE **Total Marks: 100**
Duration of ESE : 2 Hrs.30 min.

Course Objective:

I.Provide foundation of Electronics through study of basic concepts.
II. Study operational principle of diodes and apply the concept in rectifiers, regulators.
III. Understand the operational principle, characteristics of transistors in various configurations and it's usage as an amplifier and switch.
IV. Introduce the students the basic properties of Op-Amp, analysis and design of electronic circuits using Op-Amp.
V. Understand basic working of a communication system.

Diode: PN junction Diode, Rectifiers, Zener Diode, Voltage Regulator.
Transistor: BJT, Types of configurations, Characteristics and Working principle; Transistor as a amplifier; Transistor as a switch.
FET and MOSFET: FET, MOSFET, CS configuration, CS amplifier.
Op-Amp: Block Diagram, IC741, Parameters; Inverting, Non-inverting and Differential amplifier.
Power Semiconductor Devices: Construction, VI Characteristics, Working principle of SCR, DIAC, TRIAC; Applications of Power Electronics.
Communications: Block Diagram, Applications of Communication System.

Text Books:

1. Principles of Electronics, Albert Malvino and David Bates, 8th Edition, McGraw Hill, 2015.
2. Electronic Devices and Circuit Theory, Robert L. Boylestad and Louis. Nashelsky, 11th Edition, Pearson, 2015.
3. Electronics Devices and Circuits An Introduction, Allen Mottershead, 5th Edition, Prentice Hall India, 2003.

Reference Books:

1. Op-amps and Linear Integrated Circuits, R. A. Gaykwad, 4th Edition, Prentice Hall India, 2008.
2. Power Electronics, M. D. Singh and K. B. Khanchandani, 2nd Edition, McGraw Hill , 2008.
3. Electronic Communications, R. Dennis and J. Coolen, 4th Edition, Prentice Hall India, 1995.

Course Outcomes: After Completion of Course, the student will able to
ETU221.1 Characterize diodes, transistors and operational amplifiers.
ETU221.2 Design simple circuits using Op-Amp.
ETU221.3 Understand fundamental principles of electronic communication and construct system model.

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SHU223 CHEMISTRY LAB

Teaching Scheme : 02P **Total:02** **Credit:01**
Evaluation Scheme: Internal Continuous Assessment **Total Marks: 50**

Following is the representative list of experiments. Minimum eight experiments are to be performed

List of experiments:

1. Determination of surface tension and viscosity
2. Thin layer chromatography
3. Ion exchange column for removal of hardness of water
4. Determination of chloride content of water
5. Colligative properties using freezing point depression
6. Determination of the rate constant of a reaction
7. Synthesis of a polymer/drug
8. Saponification/acid value of an oil
9. Chemical analysis of a salt
10. Determination of the partition coefficient of a substance between two immiscible
11. liquids Adsorption of acetic acid by charcoal.
12. Determination of cell constant and conductance of solutions
13. Potentiometry - determination of redox potentials and emfs

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CSU222 PROGRAMMING FOR PROBLEM SOLVING LAB

Teaching Scheme :04P **Total:04** **Credit: 02**

Evaluation scheme: Internal Continuous Assessment **Total Marks: 50**

Course Objective:

I. To introduce basics of programming and develop logical thinking of students.
II. To help students understand how to model real world problems into the software
III. To implement mathematical statistical, applications into programming using C Language.

The sample list of programs is given below. This list can be used as guideline for problem statements but the scope of the laboratory should not be limited to the same.
Aim of the list is to inform about minimum expected outcomes.

[The laboratory should be preceded or followed by a tutorial to explain the approach or algorithm to be implemented for the problem given.]

Tutorial 1: Problem solving using computers:
Lab1: Familiarization with programming environment
Tutorial 2: Variable types and type conversions:
Lab 2: Simple computational problems using arithmetic expressions
Tutorial 3: Branching and logical expressions:
Lab 3: Problems involving if-then-else structures
Tutorial 4: Loops, while and for loops:
Lab 4: Iterative problems e.g., sum of series
Tutorial 5: 1D Arrays: searching, sorting:
Lab 5: 1D Array manipulation
Tutorial 6: 2D arrays and Strings
Lab 6: Matrix problems, String operations
Tutorial 7: Functions, call by value:
Lab 7: Simple functions
Tutorial 8 &9: Numerical methods (Root finding, numerical differentiation, numerical integration):
Lab 8 and 9: Programming for solving Numerical methods problems
Tutorial 10: Recursion, structure of recursive calls
Lab 10: Recursive functions
Tutorial 11: Pointers, structures and dynamic memory allocation
Lab 11: Pointers and structures
Tutorial 12: File handling:
Lab 12: File operations

Course Outcomes: The student will able to-

CSU222.1 formulate the algorithms for simple problems and translate given algorithms to a working and correct program
CSU222.2 correct syntax errors as reported by the compilers
CSU222.3 write iterative as well as recursive programs
CSU222.4 represent data in arrays, strings and structures and manipulate them through a program
CSU222.5 declare pointers of different types and use them in defining self-referential structures.
CSU222.6 create, read and write to and from simple text files.

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MEU223 ENGINEERING GRAPHICS LAB

Teaching Scheme : 04P **Total:04** **Credit: 02**

Evaluation scheme: Internal Continuous Assessment **Total Marks: 50**

Course Objectives:

I. To inculcate imagination and mental visualization capabilities to read, interpret and construct basic geometrical details of common engineering objects using geometrical instruments as well as graphics software

II. To develop graphical skills related to projections of one, two and three dimensional objects/engineering products

III. To expose them to existing national standards related to technical drawings

IV. To apply the knowledge of orthographic projections (production related features and instructions) in manufacturing industry, process industry and other allied engineering application

V. To create the image of three dimensional figures with the help of isometric projections

VI. To develop capability of computer-aided drawing in engineering area using Solid Modelling software

Half imperial (A2-594 mm X 420mm) sheets are to be drawn from the list shown below.

1) Various Engineering Curves (Four Problems)
2) Projections of Lines (Four Problems)
3) Projections of Planes (Four Problems)
4) Projections of Solids (Four Problems)
5) Projections of Sections of Solids (Two Problems)
6) Development of Surfaces (Two Problems)
7) Orthographic Projections (Two problems on sheet and two problems using CAD software)
8) Isometric drawing and Isometric projections (Two problems on sheet and two problems using CAD software)

Course Outcomes: After completion of course, student will be able to:-

MEU223.1 Apply the standard conventions and practices of engineering drawing
MEU223.2 Construct representative drawings of one, two and three dimensional objects/engineering products with geometric details
MEU223.3 Translate the geometrical information of engineering objects into engineering drawings
MEU223.4 Draw orthographic projections of lines, planes and solids
MEU223.5 Prepare sectional and isometric views of simple solids
MEU223.6 Use computer aided drafting/solid modelling software.


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MEU224 WORKSHOP PRACTICE-II

Teaching Scheme : 02P **Total:02** **Credit: 01**

Evaluation scheme: Internal Continuous Assessment **Total Marks: 50**

Course Objectives:

I. To prepare a mould and jobs using casting operation

II. To operate various machines like Lathe, shaper, milling, Drilling machines etc.

III. To prepare a job using various machining operations
IV. To explain the operation of CNC machine
V. To make the students well versed with basic electronic components and PCB designing rules
VI. To learn processes etching, printing, drilling, soldering, testing soldering of electronic components
VII. To be able to set, operate and use survey instruments for Civil Engineering layout.
VIII. To be able to get acquainted with procedure of bar bending, detailing of reinforcements for various structural element
IX. To introduce students with different type of masonry works

Group A

Fitting: Introduction to types of Fits, concepts of interchangeability, different fitting tools & their use, different measuring tools, datum selection, location layout, marking, cutting, shearing, chipping, sizing of metals, drilling and tapping. One job involving fitting to size, male-female fitting with drilling and tapping.
Moulding & Casting: Introduction to moulding tools and equipments; One job on preparation of mould, Demonstration of casting process
Pipe fitting & joints: Introduction to different types of pipefitting and joints; Demonstration of pipe threading and pipe fitting; one job on pipe threading

Group B

Machining processes: Demonstration covering the basic operation on Lathe, Shaper, Drilling and Milling machines, One job on lathe machine covering Turning, Taper Turning and Threading operations, Introduction to CNC operated machines
Electronics Workshop: PCB making, soldering, testing and desoldering of a simple electronic circuit; probe making. One job on above
Civil workshop: Introduction to auto level and theodolite for simple layouts, reinforcement bar bending and tieing, different bonds for brick masonry; preparation of concrete; layout of simple plan, pipe joints making, use of total station, various reinforcement detailing; one job on above

The shops listed in Group A are common to students of all programs and the shops of Group B are allotted as shown below.

Programme Name	Group B	Group A
Civil Engg.	Civil Workshop	For all branches
Mechanical Engg.	Machining Processes	
Electrical Engg.	Electronics Workshop	

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Electronics & TC Engg.	Electronics Workshop	(Fitting, Moulding & Casting, Pipe fitting & Joints)
Computer Science & Engg.	Electronics Workshop	
Information Technology	Electronics Workshop	
Insrumentation Engg.	Electronics Workshop	

Course Outcomes: After completion of course student will be able to-

MEU221.1 Prepare a mould and job using casting process

MEU221.2 Operate various machines like Lathe, shaper, milling, Drilling machines etc.

MEU221.3 Prepare a job using various machining operations

MEU221.4 Explain the operation and working of CNC machines

MEU221.5 Built electronic circuits on PCB

MEU221.6 Handle different basic electronics components and equipments

MEU221.7 Record field book and calculate reduced levels.

MEU221.8 Interpret structural drawings and also should be able to distinguish reinforcements detailing of various structural elements

MEU221.9 Distinguish different masonry bond types and their purposes.

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GOVT. COLLEGE OF ENGINEERING AMRAVATI

DEPARTMENT OF INSTRUMENTATION ENGINEERING

PROPOSED CURRICULUM

For

B. TECH. (III & IV Semester

Instrumentation Engineering)

2020- 2021

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(Prof. S. P. Bijawe)	(Dr. G. G. Bhutada)	(Prof. A.M.Mahalle)

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

The Department of Instrumentation Engineering has developed and maintained a well-defined set of Educational Objectives and desired program outcomes. Educational objectives of the program cater to the requirements of the stakeholders such as students, parents, employers, alumni, faculty members etc.

These objectives will be obvious by professional visibility (publications, presentations, inventions, patents and awards), entrepreneurial activities, and international activities (participation in international conferences, collaborative research and employment abroad).

PEO1: Core Competency: Graduate will be able to solve real world problems appropriate to the discipline using foundation of mathematics, science and Instrumentation Engineering

PEO2: Breadth: Graduate will be competent enough to apply current industry accepted best practices, new and emerging technologies to analyze, design, implement, and maintain the globally acceptable solutions.

PEO3: Learning Environment: Exhibit self- learning capabilities to understand and practice emerging theories and technologies along with effective communication and intra personal skills.

PEO4: Professionalism: Inculcate professional and ethical attitude and ability to relate automation issues to society at large.

PEO5: Preparation: Be successfully employed or accepted into a graduate program / higher studies, and demonstrate a pursuit of lifelong learning.

PROGRAMME OBJECTIVES (POs)

Graduates of Instrumentation Engineering program of Government College of Engineering, Amravati will have the ability to

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

PO2.Problem analysis: An ability to identify, formulate and solve a problem in Instrumentation Engineering with acceptable solution.

PO3. Design/Development of solutions: Design and development solutions for complex engineering and real world problems adhering to safety and regulatory standards as applicable from time to time.

PO4. Investigation: Apply research-based knowledge and research methodologies including design of experiments, analysis and interpretation of data along with synthesis of the information to provide valid conclusions.

PO5. Communication: An ability to communicate effectively with engineering fraternity and society at large in oral and written form while formulating project proposals, reports and other related documents / activities.

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PO6. Team work: Able to work effectively individually and in a various teams (may be multidisciplinary teams).

PO7. Environment and sustainability: The impact of Instrumentation solutions in a global, economic, environmental, and societal context, and demonstrate the knowledge and need for sustainable development.

PO8. Ethics: Apply ethical principles and remain committed to professional ethics and responsibilities and norms of the engineering practices.

PO9. Safety: Understand the social impact of automation, safety aspects of automation, hazards associated with various processes, environmental issues, health, legal and cultural issues etc

PO10. Modern Tools usage: Ability to select and use latest hardware and software tools for various processes and systems including prediction and modeling to complex engineering activities with an understanding of their limitations.

PO11. Project management and finance: Apply knowledge and understanding of the engineering and management fundamentals as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12. Life-long Learning: Recognize the need for independent survival skills and ability to adapt to changes with lifelong learning in the broadest context of technological changes.

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PROGRAMME SPECIFIC OUTCOMES (PSO)

PSO 1: Actively apply technical and professional skills in engineering practices towards the progress of the organization in competitive and dynamic environment.

PSO 2 Inculcate comprehensive education in Instrumentation engineering to ensure core competency in Instrumentation, Control and Automation.

PSO 3: Conduct themselves in a responsible, professional and ethical manner supporting sustainable economic development which enhances the quality of life.

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Internships are educational and career development opportunities which provide practical experience in the relevant field or discipline. They are structured, short-term, supervised programs often focused around particular tasks or projects with defined timescales and placement oriented.

Objective of internship:

• Will expose Technical students to the industrial environment to get a feel of Industry / Corporate culture.

• Provide possible opportunities to learn, understand and sharpen the real time technical / managerial skills required at the job.

• Exposure to the current technological developments

Learn to apply the Technical knowledge in real industrial situations.

• Gain experience in writing Technical reports/projects.

• Expose students to the Engineer's responsibilities and ethics.

• Familiarize with various materials, processes, products and their applications along with relevant aspects of quality control.

• Expose the students to future prospective employers.

Benefits to Students:

• An opportunity to get hired by the reputed Industry/ organization.

• Practical / real life experience in an organizational setting.

• Excellent opportunity to see how the theoretical aspects learned in classes are integrated into the practical world. On-floor experience provides much more professional experience which is often worth more than classroom teaching.

• Helps them decide if the industry and the profession is the best career option to pursue.

• Opportunity to learn new skills and supplement knowledge.

• Opportunity to practice communication and teamwork skills.

• Opportunity to learn strategies like time management, multi-tasking etc in an industrial setup.

• Opportunity to meet new people and learn networking skills.

• Makes a valuable addition to their resume.

• Creating network and social circle and developing relationships with industry people.

• Provides opportunity to evaluate the organization before committing to a full time position.

Benefits to the Institute:

• Enhance the Industry Institute Interaction.

• Makes the placement process easier.

• Improve institutional credibility & branding.

• Helps in retention of the students.

• Curriculum revision can be made based on feedback from Industry/ students.

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• Improvement in teaching learning process.

Considering the above facts and for overall development of student department has propose new scheme for the B.Tech. Instrumentation.

The student shall opt for industrial internship or in house project in 8th semester.

We believe that this scheme will be useful for both type of student and smooth conduct of academics.

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Semester I

Teaching Scheme							Evaluation Scheme						
Category	**Course**	**Course Title**	**Theory**	**Tutorial**	**Practical**		**Theory**			**Practical**		**Total**	**Credits**
			Hrs/week	**Hrs/week**	**Hrs/week**	**Total**	**MSE**	**TA**	**ESE**	**ICA**	**ESE**		
MC	SHU100	Induction Program	Two weeks mandatory audit course										0
BSC	SHU121	Physics	**3**	**1**	**---**	**4**	**30**	**10**	**60**	**---**	**---**	**100**	**4**
BSC	SHU122	Calculus and Linear Algebra	**3**	**1**	**---**	**4**	**30**	**10**	**60**	**---**	**---**	**100**	**4**
ESC	EEU121	Basic Electrical Engineering	**3**	**---**	**---**	**3**	**30**	**10**	**60**	**---**	**---**	**100**	**3**
ESC	CEU121	Engineering Mechanics	**3**	**---**	**---**	**3**	**30**	**10**	**60**	**---**	**---**	**100**	**3**
HSMC	SHU123	English	**2**	**---**	**---**	**2**	**---**	**---**	**60**	**---**	**---**	**60**	**2**
BSC/LC	SHU124	Physics Lab	**---**	**---**	**2**	**2**	**---**	**---**	**---**	**50**	**---**	**50**	**1**
ESC/LC	EEU122	Basic Electrical Engg Lab	**---**	**---**	**2**	**2**	**---**	**---**	**---**	**50**	**---**	**50**	**1**
ESC/LC	CEU122	Engineering Mechanics Lab	**---**	**---**	**2**	**2**	**---**	**---**	**---**	**50**	**---**	**50**	**1**
HSMC/LC	SHU125	English Lab	**---**	**---**	**2**	**2**	**---**	**---**	**---**	**50**	**---**	**50**	**1**
ESC/LC	MEU121	Workshop Practice I	**---**	**---**	**2**	**2**	**---**	**---**	**---**	**50**	**---**	**50**	**1**
		Total	**14**	**2**	**10**	**26**	**120**	**40**	**300**	**250**	**0**	**710**	**21**

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Semester II

Teaching Scheme							Evaluation Scheme						
Category	**Course**	**Course Title**	**Theory**	**Tutorial**	**Practical**		**Theory**			**Practical**		**Total**	**Credits**
			Hrs/week	**Hrs/week**	**Hrs/week**	**Total**	**MSE**	**TA**	**ESE**	**ICA**	**ESE**		
BSC	SHU221	Chemistry	**4**	**--**	**---**	**4**	**30**	**10**	**60**	**---**	**---**	**100**	**4**
BSC	SHU222	Integral calculus and differential equations	**3**	**1**	**---**	**4**	**30**	**10**	**60**	**---**	**---**	**100**	**4**
ESC	CSU221	Programming for Problem solving	**3**	**---**	**---**	**3**	**30**	**10**	**60**	**---**	**---**	**100**	**3**
ESC	MEU221	Engineering Graphics	**2**	**---**	**---**	**2**	**30**	**10**	**60**	**---**	**---**	**100**	**2**
ESC	MEU222/ ETU221	Basic Mechanical Engineering/ Basic Electronics Engineering	**2**	**---**	**---**	**2**	**30**	**10**	**60**	**---**	**---**	**100**	**2**
BSC/LC	SHU223	Chemistry Lab	**---**	**---**	**2**	**2**	**---**	**---**	**---**	**50**	**---**	**50**	**1**
ESC/LC	CSU222	Programming for Problem solving Lab	**---**	**---**	**4**	**4**	**---**	**---**	**---**	**50**	**---**	**50**	**2**
ESC/LC	MEU223	Engineering Graphics Lab	**---**	**---**	**4**	**4**	**---**	**---**	**---**	**50**	**---**	**50**	**2**
ESC/LC	MEU224	Workshop Practice II	**---**	**---**	**2**	**2**	**---**	**---**	**---**	**50**	**---**	**50**	**1**
		Total	**14**	**1**	**12**	**27**	**150**	**50**	**300**	**200**	**0**	**700**	**21**

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TA: Teacher Assessment MSE: Mid Semester Examination ESE: End Semester Examination ICA: Internal Continuous Assessment

MSE Duration: 1.30 Hrs all courses

Important Note:

MEU222 for only Electrical, Electronics and TC, Computer Science, Information Technology and Instrumentation Engineering branch

ETU221 for only Civil and Mechanical Engineering branch

In Semester I, the students of Civil, Mechanical, Electrical and Instrumentation Engineering shall be offered group A courses, and that of

There should be direct correspondence of group A and group B courses.

Sr. No.	Group A Courses		Group B Courses	
	Course Code	Title of Course	Course	Title of Course
1	SHU121	Physics	SHU221	Chemistry
2	EEU121	Basic Electrical	CSU221	Programming for Problem solving
3	CEU121	Engineering Mechanics	MEU221	Engineering Graphics
4	SHU123	English	SHU223	Chemistry Lab
5	SHU124	Physics Lab	CSU222	Programming for Problem solving Lab
6	EEU122	Basic Electrical	MEU223	Engineering Graphics Lab
7	CEU122	Engineering Mechanics		
8	SHU125	English Lab		

Category of Course	Definition	Credits
BSC	Basic Science Courses	**18**
ESC	Engineering Science Courses	**21**
HSMC	Humanities and Social Sciences including Mgt.Courses	**3**
	Total Credits	**42**

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SEM III													
Category	**Course Code**	**Name of the Course**	**Teaching Scheme**				**Evaluation Scheme Total**						**Credits**
							Theory			**Practical**			
			Theory Hrs /Week	**Tutorial Hrs/ Week**	**Practical Hrs/Week**	**Total**	**MSE**	**TA**	**ESE**	**ICA**	**ESE**	**Total**	
BSC	SHU321C SHU322C	Transform and Statistical Methods Integral Calculus And Probability	**3**	**1**	**--**	**4**	**30**	**10**	**60**	**--**	**--**	**100**	**4**
PCC	INU321	Sensors and transducers I	**3**	**--**	**--**	**3**	**30**	**10**	**60**	**--**	**--**	**100**	**3**
PCC	INU322	Electrical Measurement and Instrumentation	**3**	**--**	**--**	**3**	**30**	**10**	**60**	**--**	**--**	**100**	**3**
PCC	INU323	Electronics Devices and Circuits	**3**	**--**	**--**	**3**	**30**	**10**	**60**	**--**	**--**	**100**	**3**
BSC	SHU325	Human values and ethics	**1**	**--**	**--**	**1**	**30**	**20**	**--**	**--**	**--**	**50**	**0**
PCC-LC	INU324	Sensors and transducers-I Lab	**--**	**--**	**2**	**2**	**---**	**--**	**--**	**25**	**25**	**50**	**1**
PCC-LC	INU325	Electrical Measurement	**--**	**--**	**2**	**2**	**---**	**--**	**--**	**25**	**25**	**50**	**1**

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		and Instrumentation Lab											
PCC-LC	INU326	Electronics Devices and Circuits Lab	--	--	**2**	**2**	---	--	--	**25**	**25**	**50**	**1**
PCC-LC	INU327	Computational Methods Lab	--	--	**2**	**2**	---	--	--	**50**	--	**50**	**1**
BSC	SHU323	Introduction to Constitution of India	**1**	--	--	**1**	**30**	**20**	--	--	--	**50**	**0**
	Total		**14**	**01**	**08**	**23**	**180**	**80**	**240**	**125**	**75**	**700**	**17**

***SHU322C For Direct Second year students**

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SEM IV													
Category	**Course Code**	**Name of the Course**	**Teaching Scheme**				**Evaluation Scheme**						**Credits**
							Theory			**Practical**			
			Theory Hrs /Week	**Tutorial Hrs/ Week**	**Practical Hrs/Week**	**Total**	**MSE**	**TA**	**ESE**	**ICA**	**ESE**	**Total**	
PCC	INU421	Sensors and Transducers-II	**3**	--	--	**3**	**30**	**10**	**60**	--	--	**100**	**3**
OEC	INU422	Linear Integrated Circuits	**3**	**1**	--	**3**	**30**	**10**	**60**	--	--	**100**	**4**
PCC	INU423	Control System Engineering	**3**	**1**	--	**3**	**30**	**10**	**60**	--	--	**100**	**4**
OEC	INU424	Signals and Systems	**3**	--	--	**3**	**30**	**10**	**60**	--	--	**100**	**3**
PCC	INU425	Digital Electronics	**3**	--	--	**3**	**30**	**10**	**60**	--	--	**100**	**3**
MC	SHU422	Environmental Studies	**1**	--	--	**1**	**30**	**20**	--	--	--	**50**	**0**
PCC-LC	INU426	Sensors and Transducers-II Lab	--	--	**2**	**2**	--	--	--	**25**	**25**	**50**	**1**
OEC-LC	INU427	Linear Integrated Circuits Lab	--	--	**2**	**2**	--	--	--	**25**	**25**	**50**	**1**
PCC-LC	INU428	Control System Engineering Lab	--	--	**2**	**2**	--	--	--	**50**	--	**50**	**1**
OEC-LC	INU429	Signals and Systems Lab	--	--	**2**	**2**	--	--	--	**25**	**25**	**50**	**1**
PCC-LC	INU430	Digital Electronics Lab	--	--	**2**	**2**	--	--	--	**25**	**25**	**50**	**1**
	Total		**16**	**02**	**10**	**26**	**180**	**70**	**300**	**150**	**100**	**800**	**22**

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SEM V													
Category	**Course Code**	**Name of the Course**	**Teaching Scheme**				**Evaluation Scheme**						**Credits**
							Theory			**Practical**			
			Theory Hrs /Week	**Tutorial Hrs/ Week**	**Practical Hrs/Week**	**Total**	**MSE**	**TA**	**ESE**	**ICA**	**ESE**	**Total**	
PEC	INU521	Control System Design	**3**	**1**	**--**	**4**	**30**	**10**	**60**	**--**	**--**	**100**	**4**
PCC	INU522	Unit Operations	**3**	**--**	**--**	**3**	**30**	**10**	**60**	**--**	**--**	**100**	**3**
OEC	INU523	Power Electronics	**3**	**--**	**--**	**3**	**30**	**10**	**60**	**--**	**--**	**100**	**3**
OEC	INU524	Digital Signal Processing	**3**	**--**	**--**	**3**	**30**	**10**	**60**	**--**	**--**	**100**	**3**
PCC	INU525	Analytical Instrumentation	**3**	**--**	**--**	**3**	**30**	**10**	**60**	**--**	**--**	**100**	**3**
OEC	INU526	Programme Elective-I	**3**	**--**	**--**	**3**	**30**	**10**	**60**	**--**	**--**	**100**	**3**
OEC-LC	INU527	Power Electronics Lab	**--**	**--**	**2**	**2**	**--**	**--**	**--**	**25**	**25**	**50**	**1**
OEC-LC	INU528	Digital Signal Processing Lab	**--**	**--**	**2**	**2**	**--**	**--**	**--**	**25**	**25**	**50**	**1**
PCC-LC	INU529	Analytical Instrumentation Lab	**--**	**--**	**2**	**2**	**--**	**--**	**--**	**25**	**25**	**50**	**1**
		Total	**18**	**01**	**6**	**25**	**180**	**60**	**360**	**75**	**75**	**750**	**22**

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SEM VI														
Category	**Course Code**	**Name of the Course**	**Teaching Scheme**				**Examination Scheme**					**Total**	**Credits**
							Theory			**Practical**			
			Theory Hrs /Week	**Tutorial Hrs/ Week**	**Practical Hrs/Week**	**Total**	**MSE**	**TA**	**ESE**	**ICA**	**ESE**		
PCC	INU621	Process Control	**3**	**1**	**--**	**4**	**30**	**10**	**60**	**--**	**--**	**100**	**4**
PCC	INU622	Industrial Automation	**3**	**--**	**--**	**3**	**30**	**10**	**60**	**--**	**--**	**100**	**3**
OEC	INU623	Internet of Things	**3**	**--**	**--**	**3**	**30**	**10**	**60**	**--**	**--**	**100**	**3**
OEC	INU624	Electrical Machines and Drives	**3**	**--**	**--**	**3**	**30**	**10**	**60**	**--**	**--**	**100**	**3**
OEC	INU633	Open Elective-I	**3**	**--**	**--**	**3**	**30**	**10**	**60**	**--**	**--**	**100**	**3**
PEC	INU626	Programme Elective II	**3**	**--**	**--**	**3**	**30**	**10**	**60**	**--**	**--**	**100**	**3**
PCC-LC	INU627	Process Control Lab	**--**	**--**	**2**	**2**	**--**	**--**	**--**	**25**	**25**	**50**	**1**
PCC-LC	INU628	Industrial Automation Lab	**--**	**--**	**2**	**2**	**--**	**--**	**--**	**25**	**25**	**50**	**1**
OEC-LC	INU629	Internet of Things Lab	**--**	**--**	**2**	**2**	**--**	**--**	**--**	**25**	**25**	**50**	**1**
PCC-LC	INU630	Minor Project	**--**	**--**	**4**	**4**	**--**	**--**	**--**	**25**	**25**	**50**	**2**
	Total		**18**	**1**	**10**	**29**	**180**	**60**	**360**	**100**	**100**	**800**	**24**

Note: INU 633 - Open Elective-I – This subject will be offered as interdisciplinary elective.

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SEM VII														
Category	**Course Code**	**Name of the Course**	**Teaching Scheme**				**Examination Scheme**					**Total**	**Credits**
							Theory			**Practical**			
			TH Hrs /Week	**Tut Hrs/ Week**	**Practical Hrs/Week**	**Total**	**MSE**	**TA**	**ESE**	**ICA**	**ESE**		
PCC	INU721	Project engineering Management	**3**	--	--	**3**	**30**	**10**	**60**	--	--	**100**	**3**
PCC	INU722	Biomedical Instrumentation	**3**	--	--	**3**	**30**	**10**	**60**	--	--	**100**	**3**
PEC	INU723	Programme Elective – III	**3**	--	--	**3**	**30**	**10**	**60**	--	--	**100**	**3**
PEC	INU724	Programme Elective – IV	**3**	--	--	**3**	**30**	**10**	**60**	--	--	**100**	**3**
PEC	INU725	Programme Elective – V	**3**	--	--	**3**	**30**	**10**	**60**	--	--	**100**	**3**
OEC	INU733	Open Elective-II	**3**	--	--	**3**	**30**	**10**	**60**	--	--	**100**	**3**
PCC-LC	INU727	Project engineering Management Lab	--	--	**2**	**2**	--	--	--	**25**	**25**	**50**	**1**
PCC-LC	INU728	Biomedical Instrumentation-Lab	--	--	**2**	**2**	--	--	--	**25**	**25**	**50**	**1**
	Total		**18**	--	**4**	**22**	**180**	**60**	**360**	**50**	**50**	**700**	**20**

Note: INU 733 - Open Elective-II – This subject will be offered as interdisciplinary elective.

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SEMESTER VIII														
Category	**Course Code**	**Name of the Course**	**Teaching Scheme**				**Examination Scheme**					**Total**	**Credits**
							Theory			**Practical**			
			Theory Hrs /Week	**Tutorial Hrs/ Week**	**Practical Hrs/Week**	**Total**	**MSE**	**TA**	**ESE**	**ICA**	**ESE**		
PEC	INU821	*Programme Elective-VI	**3**	**--**	**--**	**3**	**30**	**10**	**60**	**--**	**--**	**100**	**3**
PROJ	INU822	A) Project and Seminar **OR** B) Industry Internship Project	**--**	**--**	**28**	**28**	**--**	**--**	**--**	**200**	**200**	**400**	**14**
	Total		**3**	**0**	**28**	**31**	**30**	**10**	**60**	**200**	**200**	**500**	**17**

***Students going for Industrial Project/Thesis will complete above course through online platform such as MOOCs. , NPTEL etc or by self-study mode and will directly appear for ESE only. (Total internal marks (MSE+TA) will be awarded proportional to ESE marks secure)**

BSC	Basic Science Courses
ESC	Engineering Science Courses
HSMC	Humanities and Social Sciences including Management courses
PCC	Programme core courses
PEC	Programme Elective courses
OEC	Open Elective courses
LC	Laboratory course
MC	Mandatory courses
SI	Summer Industry Internship
PROJ	Project

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Programme Elective Courses

	PE-I	PE-II	PE-III	PE-IV	PE-V	PE-VI
A.	Automotive Instrumentation	Digital Control	Process Modeling and Optimization	Neural and Fuzzy Based Control	Communication Protocols	Smart Material
B.	Instrument System Design	Advance Sensors	Environment Instrumentation	Batch Process Control	Robotics	Artificial Intelligence
C.	Hydraulic and Pneumatic Components	Power Plant Instrumentation	Modern Control Theory	Building Automation	Speech Signal Processing	Process Equipment Design
D.	Optical Fiber Communication	Mechatronics				
E.	Biomedical Signal Processing	Biomedical Image Processing				
F.	Microcontroller and its applications	Measurement Data Analysis				

Open Elective Courses

Open Elective-I	Open Elective-II
Basic Instrumentation	Industrial Automation
Biomedical Instrumentation	Introduction to Machine Learning
Automatic Control System	Mechatronics

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Department of Instrumentation Engineering

List of Equivalent Subjects from SWAYAM/NPTEL for Credit Transfer

SN	Course Code	Course	Details of equivalent course from SWAYAM/ NPTEL	Date of Registration	Link/ Platform	% Syllabus Matching
SY BTech (III Semester)						
	INU321	Sensors and transducers I	Mechanical Measurement Systems, Prof. Ravi Kumar, IIT Roorkee	July-Oct 2020	https://swayam.gov.in/nd1_noc20_me57/preview	50%
			Industrial Instrumentation, Prof. Alok Barua, IIT Kharagpur	Online lecture series is available but not for registration. Content matches with our course.	https://nptel.ac.in/courses/108/105/108105064/	70%

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	INU322	Electrical Measurement and Instrumentation	Electrical Measurement and Electronic Instruments Prof. Avishek Chatterjee, IIT Kharagpur	Online lecture series is available but not for registration. Content matches with our course.	https://swayam.gov.in/nd1_noc19_ee44/preview https://nptel.ac.in/courses/108/105/108105153/	70%
	INU323	Electronics Devices and Circuits	Semiconductor Devices and Circuits, Prof. Sanjiv Sambandan, IISc Banglore	July-Oct 2020	https://swayam.gov.in/nd1_noc20_ee77/preview	60%
			Microelectronics: Devices To Circuits, Prof. Sudeb Dasgupta, IIT Roorkee	July-Oct 2020	https://swayam.gov.in/nd1_noc20_ee85/preview	80%
			Analog Electronic Circuit Prof. Shouribrata Chatterjee	July-Oct 2020	https://swayam.gov.in/nd1_noc20_ee89/preview	60%
SY BTech (IV Semester)						
	INU421	Sensors and	Principles of Mechanical	Online lecture series is	https://nptel.ac.in/courses/112/103/112103261/	70%

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		Transducers-II	Measurement, Prof. Dipankar N. Basu, IIT Guwahati	available but not for registration. Content matches with our course.		
			Mechanical Measurements and Metrology, Prof. Shunmugam M. S Prof. S.P. Venkateshan, IIT Madras	Online lecture series is available but not for registration. Content matches with our course.	https://nptel.ac.in/courses/112/106/112106138/#	50%
	INU422	Linear Integrated Circuits	Op-Amp Practical Applications: Design, Simulation and Implementation Prof. Hardik Jeetendra Pandya, IISc Banglore	July-Oct 2020	https://swayam.gov.in/nd1_noc19_ee39/preview	50%
	INU423	Control System Engineering	Control engineering Prof. Ramkrishna Pasumarthy, IIT	July-Oct 2020	https://swayam.gov.in/nd1_noc20_ee62/preview	80%

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			Madras			
			Control systems Prof. Shankar Raman, IIT Madras	July-Oct 2020	https://swayam.gov.in/nd1_noc20_ee90/preview	80%
	INU424	Signals and Systems	Principles of Signals and Systems, Prof. Aditya K. Jagannatham, IIT Kanpur	Online lecture series is available but not for registration. Content matches with our course.	https://swayam.gov.in/nd1_noc20_ee15/preview https://nptel.ac.in/courses/108/104/108104100/	80%
	INU425	Digital Electronics	Digital Circuits Prof. Santanu Chattopadhyay, IIT Kharagpur	July-Oct 2020	https://swayam.gov.in/nd1_noc20_ee70/preview	75%
			Digital Electronic Circuits Prof. Goutam Saha, IIT Kharagpur	Online lecture series is available but not for registration. Content matches with our course.	https://swayam.gov.in/nd1_noc20_ee32/preview https://nptel.ac.in/courses/108/105/108105132/	80%

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TY BTech (V Semeter)						
	INU501	Microprocessor and Interfacing	Microprocessor and Microcontroller Prof. Santanu Chattopadhyay, IIT Kharagpur.	Online lecture series is availablebut not for registration. Content matches with our course.	https://swayam.gov.in/nd1_noc20_ee42/preview https://nptel.ac.in/courses/108/105/108105102/	60%
	INU502	Instrumental Methods of Analysis	Spectroscopic Techniques for Pharmaceutical and Biopharmaceutical Industries Prof. Shashank Deep, IIT Delhi	July-Oct 2020	https://swayam.gov.in/nd1_noc20_cy32/preview	
	INU503	Digital Signal Processing	Discrete-Time Signal Processing Prof. Mrityunjay Chakraborty, IIT Kharagpur	Online lecture series is available but not for registration. Content matches with our course	https://nptel.ac.in/courses/117/105/117105134/	50%

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	INU504	Electronic Instrumentation	Electrical Measurement and Electronic Instruments Prof. Avishek Chatterjee, IIT Kharagpur	Online lecture series is available but not for registration. Content matches with our course.	https://swayam.gov.in/nd1_noc19_ee44/preview https://nptel.ac.in/courses/108/105/108105153/	70%
	INU505	Control System Engineering	Control engineering Prof. Ramkrishna Pasumarthy, IIT Madras	July-Oct 2020	https://swayam.gov.in/nd1_noc20_ee62/preview	80%
			Control systems Prof. Shankar Raman, IIT Madras	July-Oct 2020	https://swayam.gov.in/nd1_noc20_ee90/preview	80%
TY BTech (VI Semeter)						
	INU601	Microcontroller and It's Application	Microprocessor and Microcontroller Prof. Santanu Chattopadhyay, IIT Kharagpur.	Online lecture series is availablebut not for registration. Content matches with our course.	https://swayam.gov.in/nd1_noc20_ee42/preview https://nptel.ac.in/courses/108/105/108105102/	70%

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	INU602	Power Electronics	Power Electronics Prof. G. Bhuvaneshwari, IIT Delhi	July-Oct 2020	https://swayam.gov.in/nd1_noc20_ee97/preview	60%
	INU603	Material Science and Process				
	INU604	Process Control	Industrial Automation and Control Prof. S. Mukhopadhyay, IIT Kharagpur	Online lecture series is available but not for registration. Content matches with our course.	https://nptel.ac.in/courses/108/105/108105088/	60%
			Chemical Process Control Prof. Sujit Jogwar, IIT Bombay	Aug-Oct 2020	https://swayam.gov.in/nd1_noc20_ch28/preview	65%
	INU605	Project Engineering and Management	Project Planning and Control Prof. Koshy Varghese, IIT Madras	July-Sept 2020	https://swayam.gov.in/nd1_noc20_ce44/preview	
			Project Management for Managers Prof. Mukesh Kumar Barua, IIT Roorkee	July- Oct 2020	https://swayam.gov.in/nd1_noc20_mg48/preview	

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Final Year BTech (VII Semeter)						
	INU701	Industrial Automation	Industrial Automation and Control Prof. S. Mukhopadhyay, IIT Kharagpur Prof. S. Sen, IIT Kharagpur	Online lecture series is available but not for registration. Content matches with our course.	https://swayam.gov.in/nd1_noc20_me39/preview https://nptel.ac.in/courses/108/105/108105063/	60%
	INU702	Biomedical Engineering	Introduction to Biomedical Engineering Dr. Kirill Aristovich Peter, The great St. Petersburg Polytechnic University	5 July 2020 (5 week course on Coursera)	https://www.coursera.org/learn/bioengineering	
	INU703	**Elective-I**				
		Building Automation				
		Instrumentation for Agriculture and Food Processing				

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		System Identification	System (Process) Identification, Dr. Arun K.Tangirala Department of Chemical EngineeringIIT Madras	Online lecture series is available but not for registration. Content matches with our course.	https://nptel.ac.in/courses/103/106/103106149/	70%
		Embedded Systems	Embedded Systems Design, Prof.Anupam Basu, IIT Kgp	Online lecture series is available but not for registration. Content matches with our course.	https://nptel.ac.in/courses/106/105/106105159/	
		Power Plant Instrumentation	Power Plant Engineering By Prof. Ravi Kumar , IIT Roorkee	Online lecture series is available but not for registration. Content matches with our course	https://swayam.gov.in/nd1_noc20_me10/preview https://nptel.ac.in/courses/112/107/112107291/	
Final Year BTech (VIII Semeter)						
	INU801	Instrumentation				

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		System Design				
	INU802	Modern Control Theory	Advanced linear continuous control systems: Applications with MATLAB programming and simulink Prof. Yogesh Vijay Hote, IIT Roorkee	Online lecture series is available but not for registration. Content matches with our course.	https://swayam.gov.in/nd1_noc19_ee45/preview https://nptel.ac.in/courses/108/107/108107115/	70%
	INU803	**Elective -II**				
		Optoelectronics Instrumentation				
		Neural Network and Fuzzy logic Control	Introduction to Fuzzy set Theory, Arithmetic and logic Prof. Niladri Chatterjee, IIT Delhi	July-Oct 2020	https://swayam.gov.in/nd1_noc20_ma48/preview	
		Advance Sensors	Industrial Instrumentation Prof. Alok Barua, IIT Kharagpur	Online lecture series is available but not for registration. Content matches with	https://nptel.ac.in/courses/108/105/108105064/	

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				our course.		
		Digital Control System	Digital Control System - Web course, Dr. Indrani Kar, Prof. S. Majhi,IIT Guwahati	Online web content is available but not for registration. Content matches with our course	https://nptel.ac.in/courses/108/103/108103008/	50%
		Virtual Instrumentation				
	INU804	**Elective-III**				
		Image Processing	Digital Image Processing By Prof. Prabir Kumar Biswas, IIT Kharagpur	July-Oct 2020	https://swayam.gov.in/nd1_noc20_ee75/preview	
		Optimal and Robust Control	Optimal Control Prof. Barjeev Tyagi IIT Roorkee	Online lecture series is available but not for registration. Content matches with	https://nptel.ac.in/courses/108/107/108107098/	40%

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				our course.		
			Optimal Control, Prof. G.D. Ray ,IIT Kharagpur	Online lecture series is available but not for registration. Content matches with our course	https://nptel.ac.in/courses/108/105/108105019/	40%
		Biomedical Signal Processing	Biomedical Signal Processing Prof.Sudipta Mukhopadhyay , IIT Kharagpur	Online lecture series is available but not for registration. Content matches with our course.	https://nptel.ac.in/courses/108/105/108105101/	
		Nonlinear Control System	Nonlinear System Analysis, Prof. Arunkumar D Mahindrakar And Prof. Ramkrishna Pasumarthy	Online lecture series is available but not for registration. Content matches with our course.	https://swayam.gov.in/nd1_noc20_ee54/preview https://nptel.ac.in/courses/108/106/108106162/	60%

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Credit Distribution of Department of Instrumentation

S. No.		Credit Breakup for INST (Proposed)	Credit Breakup for INST (Existing)	Credit Breakup for INST in % (Proposed)	Credit Breakup for INST in % (Existing)
1.	Humanities and Social Sciences including Management courses	7	7	4.26	3.89
2.	Basic Science courses	18	25	10.9	13.58
3.	Engineering Science courses including workshop, drawing, basics of electrical/mechanical/computer etc	21	23	12.8	12.5
4.	Professional core courses	54	102	32.9	55.43
5.	Professional Elective courses relevant to chosen specialization/branch	15	10	9.14	5.4
6.	Open subjects – Electives from other technical and /or emerging subjects	33	3	20	1.6
7.	Project work, seminar and internship in industry or elsewhere	16	14	9.75	7.6
8.	Mandatory Courses [Environmental Sciences, Induction Program, Indian Constitution, Essence of Indian Traditional Knowledge]	(non-credit)	(non-credit)	(non-credit)	(non-credit)
9.	Total	164	184	100	100.00

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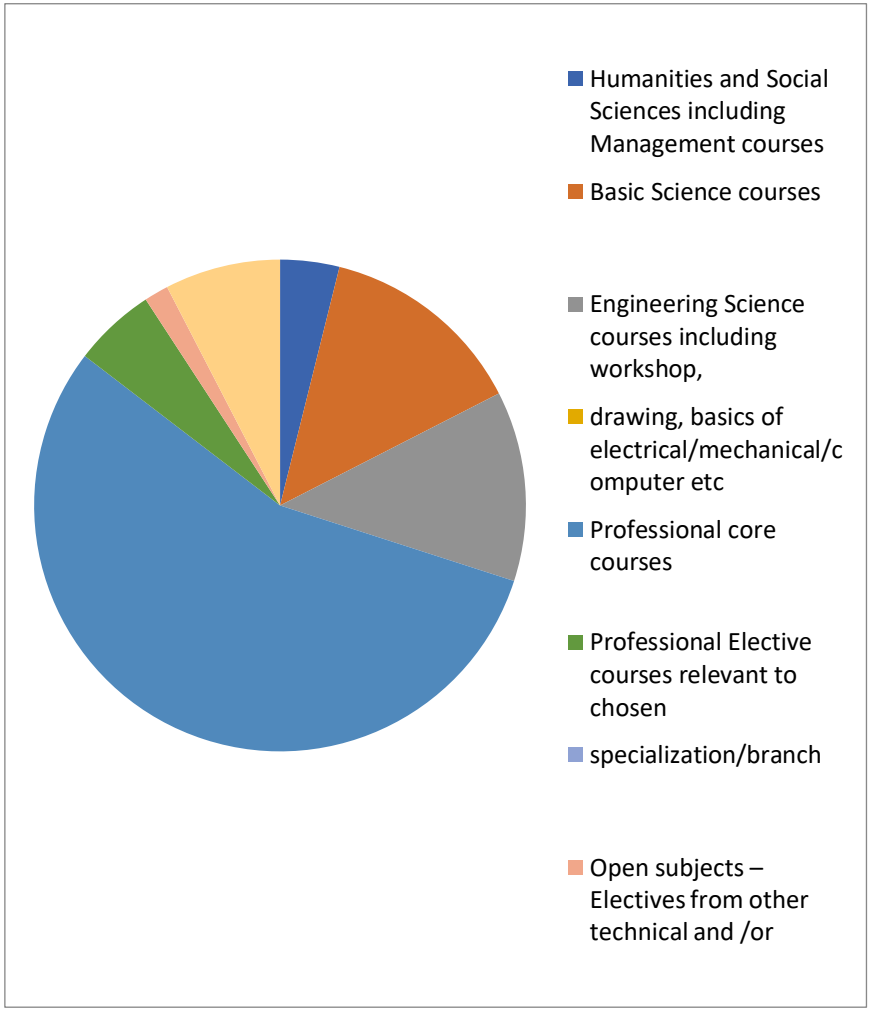
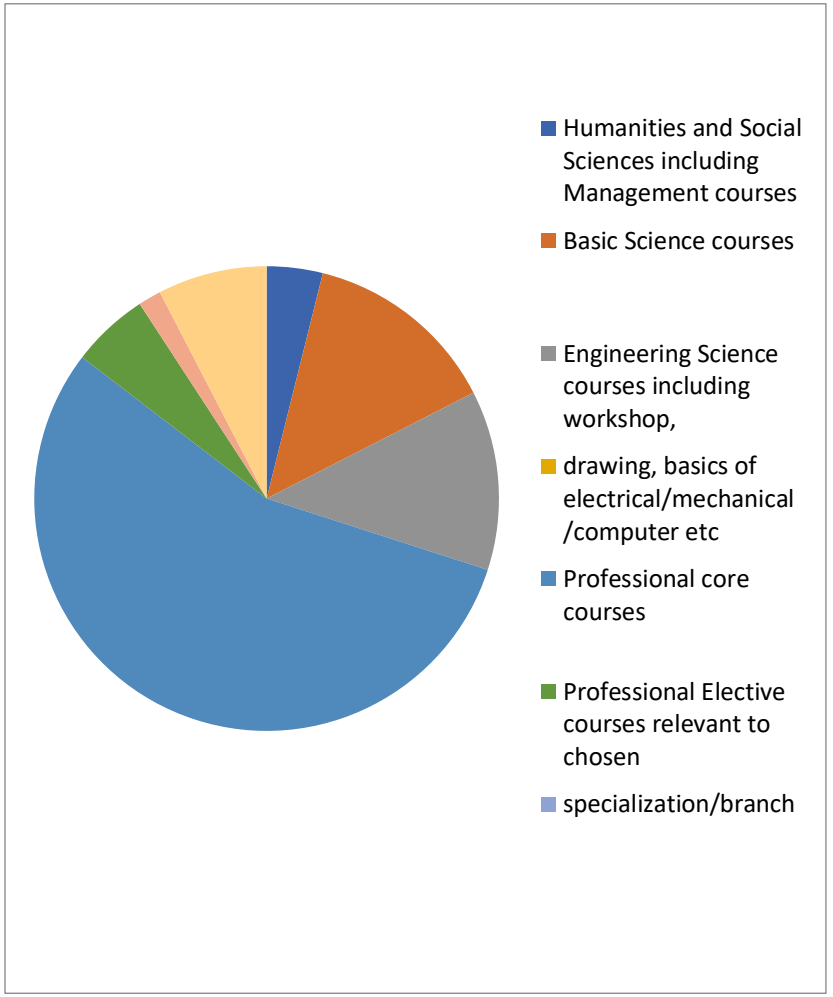


Credit Distribution Chart (Existing)



Credit Distribution Chart (Proposed)

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GOVT. COLLEGE OF ENGINEERING AMRAVATI

DEPARTMENT OF INSTRUMENTATION ENGINEERING

PROPOSED CURRICULUM

For

B. TECH. (III and IV Semester

Instrumentation Engineering)

2020- 2021

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SHU321C TRANSFORM AND STATISTICAL METHODS

Teaching Scheme: 03Th+ 01Tut = 04 Total **Total Credits: 04**
Evaluation Scheme: 30MSE+60ESE+10TA **Total Marks: 100**
ESE duration: 2:30 hr

Course Objectives:

I. To study solution of partial differential equations and apply it to solve wave and heat equations.
II. To learn Laplace transform and its properties. Apply it to solve differential equation and to calculate stability of LTI system.
III. To equip students with the foundations of probabilistic and statistical analysis mostly used in varied applications in engineering and science.

Partial differential equations:

Definition, order, degree, classification, formation of partial differential equation, method of separation of variables, first and second order one dimensional wave equation, heat equation and two dimensional Laplace equation.

Laplace Transform:

Laplace Transform, Properties of Laplace Transform, Laplace transform of causal periodic signals, Analysis and Characterization of LTI systems using the Laplace Transform, The transfer function and differential equation, Impulse response and Step response, Causality, Stability, Stability of a causal LTI system

Random variables and Probability Distributions :

Basic concepts of probability and its properties; Conditional probability and independent events; Random variables, discrete and continuous random variables, Mean and variance of Binomial, Poisson and Normal distributions and applications**.**

Sampling Distributions and Interval of Estimation :

Sampling Distributions: t-distribution, Chi-square distribution, Interval of estimation.

Text books:

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1. Higher Engineering Mathematics, B.S. Grewal, Khanna Publishers,2020, 44th edition.
2. Advanced Engineering Mathematics, H.K.Das, S.Chand & Company Pvt.Ltd,2014.
3. A text book of Engineering Mathematics,N.P. Bali and Manish Goyal, Laxmi Publications, Reprint, 2010.

Reference books:

1. Advanced Engineering Mathematics,Erwin Kreyszig, 9th Edition, John Wiley & Sons, 2006.
2. Higher Engineering Mathematics, B.V,Ramana,Tata Mc Graw Hill Publishing company Ltd.,New Delhi,2008, 6th edition.
3. A First Course in Probability, S. Ross, 6th Ed., Pearson Education India, 2002.
4. An Introduction to Probability and Statistics,V. K. Rohatgi and A.K. Md. Ehsanes Saleh, 2nd Edition.
5. Applied Statistics and Probability for Engineers, D. C. Montgomery and G.C. Runger, 5th edition, John Wiley & Sons, (2009).
6. Introductory Statistics, P. S. Mann, Wiley Publications, 7th edition (2013).
7. I. N. Sneddon, Elements of Partial Differential Equations, Dover Publications, Inc. Mineola New York.

Course Outcomes:

After the successfully completion of the course the student will able to

SHU321C.1 To solve partial differential equations and also to solve wave and heat equations.

SHU321C.2 To use knowledge of Laplace Transform and to solve differential equation and to calculate stability of LTI system.

SHU321C.3 Tackle problems related to continuous and discrete probability distributions.

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SHU322C INTEGRAL CALCULUS AND PROBABILITY

Teaching Scheme: 03Th+ 01Tut = 04 **Total Credits: 04**
Evaluation Scheme: 30MSE+60ESE+10TA **Total Marks: 100**
ESE duration: 2:30 hr

Course Objectives:

I. To familiarize the prospective engineers with techniques in integral calculus.
II. To familiarize about ordinary differential equation and develop problem solving skills.
III. To study solution of partial differential equations and apply it to solve wave and heat equations.
IV. To learn Laplace transform and its properties. Apply it to solve differential equation and to calculate stability of LTI system.
V. To equip students with the foundations of probabilistic and statistical analysis mostly used in varied applications in engineering and science.

Ordinary differential equations of higher orders:
Linear differential equation with constant coefficient, complementary function, particular integral, complete solution; method of variation of parameters.

Integral Calculus :
Beta and Gamma functions and their properties; Evaluation of double integrals (Cartesian & polar),change of order of integration.

Partial differential equations:
Definition, order, degree, classification, formation of partial differential equation, method of separation of variables, first and second order one dimensional wave equation, heat equation

Laplace Transform:
Laplace Transform, Properties of Laplace Transform, Laplace transform of causal periodic signals, Analysis and Characterization of LTI systems using the Laplace Transform, The transfer function and differential equation, Impulse response and Step response,

Random variables and Probability Distributions:

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Basic concepts of probability and its properties; Conditional probability and independent events; Random variables, discrete and continuous random variables, Mean and variance of Binomial, Poisson and Normal distributions and applications**.**

Text books:

1. Higher Engineering Mathematics, B.S. Grewal, Khanna Publishers,2020, 44th edition.
2. Advanced Engineering Mathematics, H.K.Das, S.Chand & Company Pvt.Ltd,2014.
3. A text book of Engineering Mathematics,N.P. Bali and Manish Goyal, Laxmi Publications, Reprint, 2010.

Reference books:

1. Advanced Engineering Mathematics,Erwin Kreyszig, 9th Edition, John Wiley & Sons, 2006.
2. Higher Engineering Mathematics, B.V,Ramana,Tata Mc Graw Hill Publishing company Ltd.,New Delhi,2008, 6th edition.
3. A First Course in Probability, S. Ross, 6th Ed., Pearson Education India, 2002.
4. An Introduction to Probability and Statistics,V. K. Rohatgi and A.K. Md. Ehsanes Saleh, 2nd Edition.
5. Applied Statistics and Probability for Engineers , D. C. Montgomery and G.C. Runger, 5th edition, John Wiley & Sons, (2009).
6. Introductory Statistics, P. S. Mann, Wiley Publications, 7th edition (2013).
7. I. N. Sneddon, Elements of Partial Differential Equations, Dover Publications, Inc. Mineola New York.

Course Outcomes:

After the successfully completion of the course the student will able to

SHU322C.1 Solve partial differential equations and also to solve wave and heat equations.

SHU322C.2 Use knowledge of Laplace Transform and to solve differential equation and to calculate stability of LTI system.

SHU322C.3 Tackle problems related to continuous and discrete probability distributions.

SHU322C.4 Use the mathematical tools needed in evaluating multiple integrals and their usage.

SHU322C.5 Equip the students with different techniques of solving ordinary differential equations.

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INU321 SENSORS AND TRANSDUCERS-I

Teaching Scheme : 03 L + 0 T **Total 03** **Credit: 03**
Evaluation Scheme: 30MSE +10 TA+ 60 ESE
Total Marks: 100 **Duration of ESE : 2hrs 30min**

Course Objectives:

I. To Understand basic principles of sensing various parameters
II. To select sensors for typical applications
III. To compare different sensors

Introduction Measurement and measurement system: industrial measuring parameters and their units, definitions of sensors and transducers, classification of transducers, static and dynamic characteristics, selection criteria, importance.

Temperature measurement: Temperature scales, classification of temperature sensors, standards, , SAMA classifications, working principle, types, materials, design criterion: Non electrical sensors (thermometer, thermostat), electrical sensors (RTD, thermocouple- laws of thermoelectricity, terminologies, types (B, E, J, K, R/, S, T), characteristics, , lead wire compensation, cold junction compensation techniques, thermistor- their types (NTC, PTC) and comparison, measuring circuits, , Protection (Thermo well), Thermopiles), radiation sensors (pyrometers), Temperature switch, Temperature IC sensors (AD590 and LM35), problem based on electrical sensors

Pressure measurement: Definition, pressure scale, units and relations, standards, working principle, types, materials, Design criterion: Manometers- U tube, well type, inclined tube, Elastic pressure sensors- bourdon, diaphragm, bellows and their types, secondary pressure sensors. Differential pressure sensors, force balance type, motion balance type, capacitive (delta cell), ring balance, vibrating cylinder type, High-pressure sensors- Dead weight tester, Bulk modulus cell, Bridge man type (Pressure sensitive wires), Low-pressure sensors- McLeod gauge, thermal conductivity (Pirani Gauge, Thermocouple gauge), Calibrating Instruments – Dead Weight Tester (Pressure, Vacuum) ionization types, Pressure switch, problem based on elastic and differential pressure sensors

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Level measurement: Standards, working principle, types, materials, design criterion: Direct (Gauges): Hook type, sight glass: tubular, transparent and reflex, float and tape. Indirect: Hydrostatic pressure, bubbler. Electrical : Float, displacer (torque tube unit), ultrasonic, radioactive, radar (contact, non-contact – TDR / PDS), thermal. Solid level detectors electronic Load cell Float type: float & wire, float & board, capacitive and resistive types, Level switches, problems based on indirect and electrical type level sensors.

Flow measurement: Standards, Newtonian and non-newtonian fluids, Reynolds‟s number, laminar and turbulent flows, velocity profile, Bernoulli‟s equation for incompressible flow, density, Beta ratio, Reynolds‟s number correction, square root relation, working principle, types, materials, and design criterion: primary or quantity meters (positive displacement flow meter, Differential pressure type flow meters: Orifice (eccentric, segmental, concentric), different pressure taps, venture-meter, pitot tube , Variable area type: Rotameter, electrical flow sensors (Turbine type, Electromagnetic type, ultrasonic type (Doppler, transit time), Vortex shedding type, mass flow meters, anemometers), flow tantalizers and solid flow measurement, Flow switches.

Chemical sensors: Standards, working principle, types, materials, and design criterion: Chemical sensors (pH and conductivity, humidity).

Text Books:

1. Arun Ghosh, Introduction to Measurements and Instrumentation, PHI Learning Pvt. Ltd.
2. B. C. Nakra and K. K. Choudhari, “Instrumentation Measurements and Analysis” by, Tata McGraw Hill Education, Second ed., 2004.

Reference Books:

1. A. K. Sawhney, “Electrical and Electronic Measurements and Instrumentation”, Dhanpat Rai and Sons, Eleventh ed., 2000.
2. D.V.S. Murthi, “Instrumentation and Measurement Principles”, PHI, New Delhi, Second ed. 2003.
3. B. C. Nakra and K. K. Choudhari, “Instrumentation Measurements and Analysis” by, Tata McGraw Hill Education, Second ed., 2004.
4. E.O. Doebelin, “Measurement Systems”, McGraw Hill.
5. Bentley J. P., Principles of measurement systems, Third Edition, Pearson education Asia pvt.ltd, 2000

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6. D. Patranabis, “Principle of Industrial Instrumentation”, Tata McGraw Hill, Second ed., 1999.

Course Outcomes: Upon Completion of this course, students will able to

INU321.1: Select transducers and sensors for specific applications
INU321.2: Use concepts in common methods for converting a physical parameter into an electrical quantity
INU321.3: Narrate working principles of various transducers and sensors with their sketches.
INU321.4: Interpret the characteristics of the transducers and sensors
INU321.5: Compare various criterions used for selection of transducers/sensors

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INU322 ELECTRICAL MEASUREMENT AND INSTRUMENTATION

Teaching Scheme : 03 L + 0 T Total 03 Credit: 03
Evaluation Scheme: 30MSE +10 TA+ 60 ESE
Total Marks: 100 Duration of ESE : 2hrs 30min.

Course Objectives:

I. The course intends provide an overview and understand the internal structure of various types of laboratory Measuring Instruments
II. To study different bridge circuits used for measurement of electrical parameters such as R, L, C.
III. To learn the operation of Signal Generators and analyzers, Analog and Digital instruments and Recorders
IV. To teach methods of phase & frequency measurement.

Experimental data and errors: fundamentals of measurements, measurement recording and reporting, graphical presentation of data, Static and Dynamic characteristics of instruments, input & output impedance, loading effects of series and shunt connected instruments, Types of Errors, Statistical Analysis, Probability of Errors, Limiting Errors calibration of instruments.

Analog and digital meters: Classification, deflecting, controlling, damping, breaking torques Electromechanical meters, PMMC type, galvanometer, DC ammeter, DC voltmeter, calibration, selection and performance of measuring instruments, multi-range meters, extension of range, loading effect in instruments. DMM, true RMS meter, Universal Counter
Electrostatic type instruments: construction, Principle of operation,
EDM type instruments: EDM Wattmeter (single phase) and errors present, single phase induction type energy meter, measurement of power in ac circuits and dc circuits, DC potentiometers along with its standardization and applications

DC bridges: low, medium and precise resistance measurement, Wheatstone bridge, bridge sensitivity, errors in bridge circuits, null type and deflection type bridges, current sensitive and voltage sensitive bridges, Kelvin bridge, Kelvin double bridge, applications of DC bridges

AC Bridges: General equations for bridge balance, detectors for AC bridges, Quality factor (Q) and dissipation factor(D), Maxwell bridge, Hay bridge, Schering bridge, Wien bridge, applications of AC bridges, digital RCL meter, Q meter

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Time and frequency measurement: Universal counter and its mode – totalizing, frequency, period, time interval, ratio, measurement errors, application of counters for frequency meter, phase measurement, automation in digital instruments, Tan-Delta measurement, Dielectric loss measurement.

Signal generators and analyzers: function generator, arbitrary waveform generators, total harmonic distortion analyzer, Spectrum Analyzers, Wave analyzers, Logic Analyzer
Recording Instruments: Principle and working of strip chart and X-Y recorder

Text Books:

1. A. K. Sawhney, "Electrical and Electronic Measurements and Instrumentation", Dhanpat Rai and Sons, Eleventh ed., 2000.
2. H S Kalsi, "Electronic Instrumentation", Tata McGraw-Hill, Third ed., 2010

Reference Books:

1. Albert D. Helfrick, William David Cooper, "Modern electronic Instrumentation and Measurement Techniques" Prentice Hall, Second ed., 1990
2. Clyde F. Coombs, "Electronic Instrument Handbook", McGraw-Hill, Third ed., 2000.
3. Electronic Instruments and Instrumentation Technology by Anand M. M. S., PHI
4. J. B. Gupta, Electrical and Electronic Measurements & Instrumentation, S. K. Katariya & Sons, 1969.

Course Outcomes: Upon Completion of this course, students will able to

INU322.1: Distinguish the static & dynamic characteristics of an instrument along with their error types
INU322.2: Use the common electrical and electronic measuring instruments
INU322.3: Identify and evaluate AC and DC bridges for measurement of R, L and C
INU322.4: Categorize instruments based on power, energy and signal analyzers

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INU323 ELECTRONIC DEVICES & CIRCUITS

Teaching Scheme : 03 L **Total : 03** **Credit : 03**
Evaluation Scheme: 30 MSE +10 TA+ 60 ESE **Total Marks: 100**
Duration of ESE : 2hrs 30min.

Course objective:

I. Understand the structure of basic electronic devices.
II. Be exposed to active and passive circuit elements.
III. Familiarize the operation and applications of transistor like BJT and FET.
IV. Explore the characteristics of amplifier gain and frequency response.
V. Learn the required functionality of positive and negative feedback systems.

Bipolar Junction Transistor: Transistor characteristics, Transistor amplifier characteristics, transistor biasing, thermal stability, thermal runway. Amplifier configurations and comparison , multistage amplifier, amplifier noise and distortion, two stage RC Coupled amplifier, high input resistance transistor circuit.

Large signal amplifiers: Class A, B, AB, and C operations and their performance characteristics, push pull, complimentary symmetry amplifier.

Feedback amplifiers: Feedback concept, transfer gain, general characteristics of negative feedback amplifier, methods of feedback and their effects.

Oscillators: Sinusoidal oscillator, resonant circuit, phase shift oscillator, wein bridge oscillator, crystal oscillator and frequency stability, collpitts oscillator, Hartley oscillator. Transistor switch multivibrators of different types, Schmitt trigger.

Introduction to Unipolar Devices: Ideal M/S diode, Si-SiO2 MOS diode, MOSFET, MOSFET structures, Basic device characteristics, FET, Comparison of BJT and FET amplifier.
Multistage Amplifiers and Differential Amplifier

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BIMOS cascade amplifier, Differential amplifier – Common mode and Difference mode analysis – FET input stages – Single tuned amplifiers – Gain and frequency response – Neutralization methods, power amplifiers –Types (Qualitative analysis).

Text Books:

1. Integrated Electronics, Analog and Digital Circuits and Systems, Millman J.and Halkias C. C, 27th Edition, McGraw Hill, 1972
2. Electronics Principles, Malvino A.P, 6th Edition, Tata McGraw Hill New Delhi, 2001.

Reference Books:

1. Electronic Devices and Circuit Theory, Boylestad and Nishelsky, 9th Edition, Prentice Hall of India, 2005
2. Electronics Devices, T. Floyd, 6th edition, Pearson.

Course Outcomes: Upon Completion of this course, students will able to

INU323.1: Illustrate the structure and working operation of basic electronic devices.
INU323.2: Able to identify and differentiate both active and passive elements
INU323.3: Analyze the characteristics of different electronic devices
INU323.4: Choose and adapt the required components to construct an amplifier circuit.
INU323.5: Design and analysis of oscillators

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SHU325 HUMAN VALUES AND ETHICS

Teaching Scheme: 1 Th **Credit: 00**

Evaluation scheme: 20TA+30MSE **Total Marks: 50**

MSE Duration: 1Hr 30 Min.

Objectives:

I. To develop the importance of moral virtue through spiritual and yoga activities which leads to professional experience of students

II. To understand the dimension of professional ethics.

III. To learn engineering ethics through theories which develop moral judgment among technical students.

IV. To understand the global ethical issues and its dimension this leads to moral leadership

Human Values

Morals, values and Ethics, Integrity, Work ethic, Service learning, Civic virtue, Respect for others, Living peacefully, Caring, Sharing, Honesty, Courage, Valuing time, Cooperation, Commitment, Empathy, Self-confidence, Character, Spirituality, Introduction to yoga and meditation for professional excellence and stress management.

Professional Ethics

Definition of Ethics, Professional Ethics, Business Ethics, Corporate Ethics, Engineering Ethics, Personal Ethics; Profession, Professionalism, Professional Responsibility, Professional Ethics; Conflict of Interest, Gift Vs Bribery, Environmental breaches, Negligence, Deficiencies in state-of-the-art; Vigil Mechanism, Whistleblowing, protected disclosures.

Engineering Ethics

Senses of 'Engineering Ethics', Variety of moral issues, Types of inquiry, Moral dilemmas, Moral Autonomy, Kohlberg's theory, Gilligan's theory, Consensus and Controversy, Models of professional roles, Theories about right action, Self-interest, Customs and Religion, Uses of Ethical Theories

Global Issues

Multinational Corporations, Environmental Ethics, Computer Ethics, Weapons Development, Engineers as Managers, Consulting Engineers, Engineers as Expert Witnesses and Advisors, Moral Leadership, Code of Conduct, Corporate Social Responsibility

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Text books:

1. “Ethics in Engineering”, Mike W. Martin and Roland Schinzinger, Tata McGraw Hill, New Delhi, 2003.
2. “Engineering Ethics”, Govindarajan M, Natarajan S, Senthil Kumar V. S, Prentice Hall of India, New Delhi, 2004.

Reference books:

1. “Engineering Ethics”, Charles B. Fleddermann, Pearson Prentice Hall, New Jersey, 2004.
3. “Engineering Ethics – Concepts and Cases”, Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, Cengage Learning, 2009
4. “Ethics and the Conduct of Business”, John R Boatright, Pearson Education, New Delhi,2003
5. “Fundametals of Ethics for Scientists and Engineers”, Edmund G Seebauer and Robert L Barry, Oxford University Press, Oxford, 2001
6. “Business Ethics: Decision Making for Personal Integrity and Social Responsibility” Laura P. Hartman and Joe Desjardins, Mc Graw Hill education, India Pvt. Ltd.,New Delhi 2013.
7. " Value Education", World Community Service Centre, Vethathiri publications, Erode, 2011

Outcomes:

After the successful completion of the course the student shall be able to

SHU325.1	Make work life balance and found himself or herself with sound mindset at workplace.
SHU325.2	Incorporate professional ethics at work place.
SHU325.3	Manage moral dilemmas and conflicts at workplace.
SHU325.4	Develop global perspective for ethical issues.

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INU324 SENSORS AND TRANSDUCERS-I LAB

Teaching Scheme : 02 P **Total : 02** **Credit:01**
Evaluation Scheme: 25 ICA + 25 ESE **Total Marks: 50**
Duration of ESE : 3 hrs.

Course Objectives:

I. To measure different physical parameters
II. To calibrate different type of transducers
III. To apply different methods of measurements

Minimum Eight Experiments to be performed covering the entire Syllabus of **INU321 SENSORS AND TRANSDUCERS-I**. Representative list is as follows.

1. To determine RTD, thermister and thermocouple characteristics.
2. Measurement of Pressure using Bellows, Bourdon gauge, Diaphragm.
3. To determine performance of C-type bourdon gauge
4. Calibration of pressure gauge using dead weight pressure tester
5. To determine Load cell characteristics
6. Characterization and calibration of level measurement system. (Capacitive and resistive)
7. To determine the LVDT characteristics
8. To determine Rotameter characteristics
9. To determine flow using orifice or venturimeter or rotameter and compare the accuracy
10. Measurement of pH and conductivity of given solutions
11. Compare performance of electromagnetic flow meter and Rotameter
12. Select a pressure sensor for the application which needs highest accuracy

Course Outcomes: Upon Completion of this course, students will able to

INU324.1: To plot characteristics of various transducers and sensors
INU324.2: Analyze and interpret data of various measurement
INU324.3: Calibrate various type of transducers

Note:

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ICA- The Internal Continuous Assessment shall be based on the practical record and Knowledge/skill acquired. The performance shall be assessed experiment wise by using continuous assessment formats A and B.

ESE – The End Semester Exam for Practical shall be based on performance in one of the experiments and may be followed by sample questions.

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INU325 ELECTRICAL MEASUREMENT AND INSTRUMENTATION LAB

Teaching Scheme : 02 P **Total : 02** **Credit: 01**
Evaluation Scheme: 25 ICA + 25 ESE **Total Marks: 50**
Duration of ESE : 3 hrs.

Course Objective:

I. Providing fair knowledge on the working of various electrical and electronic meters
II. Design and Evaluation of different bridges
III. Use of DSO for different signal measurement

Minimum Eight Experiments to be performed covering the Entire Syllabus of **INU322 ELECTRICAL MEASUREMENT AND INSTRUMENTATION.** Representative list is as follows.

1. Usage of DSO for steady state periodic waveforms produced by a function generator. Selection of trigger source and trigger level, selection of time-scale and voltage scale. Bandwidth of measurement and sampling rate
2. Measurement of a batch of resistors and estimating statistical parameters
3. Measurement of L using a bridge technique as well as LCR meter
4. Measurement of C using a bridge technique as well as LCR meter
5. Design and implementation of resistance measurement using Wheatstone bridge
6. Measurement of Low Resistance using Kelvin's double bridge
7. Measurement of High resistance and Insulation resistance using Megger
8. Phase and frequency measurement on DSO using Lissajous pattern
9. Usage of DSO to capture transients like a step change in R-L-C circuit
10. Study of Arbitrary Waveform Generator
11. Study of digital voltmeter, digital multimeter
12. Study and verify different modes of Universal Counter

Course Outcomes: Upon Completion of this course, students will able to

INU325.1: Design and validate DC and AC bridges
INU325.2: Learn about various measurement devices, their characteristics, their operation and their limitations.
INU325.3: Design and implement experimental setup for measurement of electrical quantities.

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INU325.4: Demonstrate the usage of energy, power meters and signal analyzers.

Note: ICA – The Internal Continuous Assessment shall be based on the practical record and knowledge/skill acquired. The performance shall be assessed experiment wise by using continuous assessment formats, A and B.

ESE – The End Semester Exam for Practical shall be based on performance in one of the experiments and may be followed by sample questions.

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INU326 ELECTRONIC DEVICES & CIRCUITS LAB

Teaching Scheme : 02 P **Total : 02** **Credit: 01**
Evaluation Scheme: 25 ICA + 25 ESE **Total Marks: 50**
Duration of ESE : 3 hrs.

Objectives

I. To identify and test various electronic components
II. To plot the characteristics of diode and transistor
III. To design and implement amplifier and oscillator circuits

Minimum Eight Experiments to be performed covering the entire Syllabus of **INU323 ELECTRONIC DEVICES & CIRCUITS**. Representative list is as follows.
Students perform and observe waveform for all experiments on software (multisim).

1. Obtain V-I characteristic of diode and zener diode.
2. To measure ripple factor at the output of
    a. Half wave rectifier with and without filter capacitor
    b. Full Wave rectifier with and without filter capacitor
    c. Bridge rectifier with and without filter capacitor.
3. To verify performance of various Clipper circuits.
4. To verify performance of various Clamper circuits
5. To obtain characteristic of transistor as a switch circuit.
6. To obtain input and output characteristics and calculate gain of CE amplifier circuit.
7. To obtain input and output characteristics and calculate gain of CB amplifier circuit.
8. To obtain frequency response of single stage transistor amplifier.
9. To obtain the transfer characteristics of FET.
10. Test performance parameters of voltage regulator using IC LM317,78XX series, IC 723
11. To study the effect of
    a. voltage series feedback on two stage amplifie
    b. current series feedback on single stage CE amplifier.
12. Determine the efficiency of push pull power amplifier

Course Outcomes : Upon Completion of this course, students will able to

INU326.1: Analyze the diode and transistor characteristics.

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INU326.2: Design the biasing circuits
INU326.3: Design and implement various amplifiers and analyze frequency responses
INU326.4: Interpret the construction, operation and characteristics of JFET and MOSFET

Note : ICA – The Internal Continuous Assessment shall be based on the practical record and knowledge/skill acquired. The performance shall be assessed experiment wise by using continuous assessment formats, A and B.

ESE – The End Semester Exam for Practical shall be based on performance in one of the experiments and may be followed by sample questions.

The course coordinator may assign the following problems to students for better understanding

1. Design a Half wave rectifier which has low ripple value.
2. Design a Full wave rectifier which has low ripple value.
3. Design a Full wave bridge rectifier which has low ripple value.
4. Design a regulated power supply using Zener diode.
5. Make a mini project on automatic washroom light on-off.
6. ON/OFF light bulb at 230V using relay and transistor as a switch.
7. Design a CE, CC, and CB amplifier.
8. Design any application using Darlington pair.
9. Design audio amplifier using any type of power amplifier.
10. Design an inverter with n-type enhancement MOSFET and draw its VTC characteristics using NgSpice.
11. Simulate experiments using available Electronic Design Automation Tools like Circuit maker, Tina, Multisim, Electronic work bench etc.
12. Seminar/Mini Project

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INU 327 COMPUTATIONAL METHODS LAB

Teaching Scheme: 02 P Total: 02 **Credit: 01**
Evaluation Scheme: 50 ICA **Total Marks: 50**

Course Objectives:

I. To Provide sound knowledge of various MATLAB tools.
II. To Plot appropriately labelled graph using MATLAB.
III. To Prepare computer program for solving linear and ODE equations.
IV. To impart skills to develop programming using MATLAB.

List of Experiment

1. Introduction to the MATLAB Interface.
2. Working with Matrices: creation and manipulation.
3. Working with plots and subplots, 2D and 3D plotting.
4. Programming using Script and function files.
5. Programming using Conditional statements and Loops.
6. Solving Linear Systems in MATLAB
7. Determination of roots of a polynomial and polynomial Curve Fitting.
8. Finding Solution of ordinary differential equations.
9. Simulation using MATLAB.
10. Creating a simple GUI in MATLAB.

Text Books:

1. MATLAB: A practical Introduction to Programming and Problem solving, Stormy Attaway, 5th Edition, Butterworth- Heinemann, 2019.
2. MATLAB programming for Engineers, Stephan J. Chapman, 2nd Edition, Pearson Education, 2004.

Reference Books:

1. Numerical Methods Using MATLAB, Mathews. J. H. and Fink K.D., 4th Edition, PHI New Delhi, 2005.
2. Mastering MATLAB-7, Hanselman and Littlefield, Prentice Hall, 2005.

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3. MATLAB and It's applications in Engineering, R. K. Bansal, A. K. Goel, and M. K. Sharma, Pearson's Educations India, 2009.
4. Getting Started with MATLAB: A Quick Introduction for Scientists and Engineers; Rudra Pratap, Oxford University Press, 2010.

Course Outcomes: Upon Completion of this course, students will able to

INU327.1: Develop an algorithm for solving linear, nonlinear and ODE equations.
INU327.2: Demonstrate the types of plotting and analysis techniques
INU327.3: Create simulation or GUI for simple application.

Note:
ICA – The Internal Continuous Assessment shall be based on the practical record and knowledge/skill acquired. The performance shall be assessed experiment wise by using continuous assessment formats, A and B.

ESE – The End Semester Exam for Practical shall be based on performance in one of the experiments and may be followed by sample questions.

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SHU 323 INTRODUCTION TO CONSTITUTION OF INDIA

Teaching Scheme: 1 Th **Credit: 00**
Evaluation scheme: 20TA+30MSE **Total Marks: 50**
MSE Duration: 1Hr30 Min.

Course Objectives:

- To acquaint students about constitution of India, Fundamental rights, fundamental duties, electoral process and role of central, state and local government and its administration.

Course Content

Unit I: Introduction to Constitution of India
Salient features of the Constitution of India, Preamble of the Constitution, fundamental rights and fundamental duties, Directive Principles of State Policy and relevance of directive principles. Parliamentary Form of Government in India- President, Vice-President, Prime Minister along with council of Minister, Parliament, Supreme court, Electoral process in India. Amendment Procedure.

Unit II: State executives Governor, chief minister, state legislature, high courts of state.

Unit III: Role and functions of local self government- Municipalities in India, with special reference to 73rd amendment. Panchayat Raj in India with special reference to 74th amendment.

Course outcomes:

On the successful completion of this course, Students shall be able to-

- Understand and remember the knowledge of basic information about Indian Constitution.
- Apply the knowledge of fundamental rights and fundamental duties.

Reference Books:-

1. An Introduction to Constitution of India, M.V.Pylee, Vikas Publishing, 2002
2. Constitution of India, Dr. B. R. Ambedkar, Government of India Publication
3. Latest Publications of Indian Institute of Human Rights, New Delhi

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INU421 SENSORS AND TRANSDUCERS-II

Teaching Scheme : 03 L + 0 T **Total: 03** **Credit: 03**
Evaluation Scheme: 30MSE +10 TA+ 60 ESE
Total Marks: 100 **Duration of ESE : 2hrs 30min.**

Course Objectives:

I. To Understand basic principles of sensing various parameters
II. To design signal conditioning circuits
III. To select of sensors for typical applications

Displacement Measurement : Working principles, types, measuring circuits and applications of: Resistive transducers (Potentiometer, Linear and rotary, Loading Effect types of strain gauges, derivation of gauge factor, bridge configurations, compensation, applications of strain gauges), Inductive transducers (LVDT and Eddy current type), Capacitive transducers (Capacitance principles, capacitive displacement transducers, capacitive level transducers, capacitive hygrometer), Piezoelectric transducers, Ultrasonic transducers and Hall effect transducers. Problems based on resistive, capacitive and inductive type of transducers.

Velocity and speed measurement: Standards, working principle, types, materials, design criterion: Electromagnetic tachometer, Photoelectric tachometer, Toothed rotor variable reluctance tachometer. Magnetic pickups, Encoders, Photoelectric pickups, Shaft speed measurement. Applications of velocity measurement sensors. Problems based on velocity nad speed measurement

Vibration and acceleration measurement: Standards, working principle, types, materials, design criterion: Eddy current type, piezoelectric type, Seismic Transducer, Accelerometer: Potentiometric type, LVDT type, Piezo-electric type. Applications of Acceleration and vibration sensors.

Force and torque measurement: Basic methods of force measurement, elastic force traducers, strain gauge, load cells, shear web, piezoelectric force transducers, vibrating wire force transducers, Strain gauge torque meter, Inductive torque meter, Magneto-strictive transducers, torsion bar dynamometer, etc. Dynamometer (servo control and absorption) instantaneous power measurement and alternator power measurement. Applications of Force and Torque sensors.

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Design of signal conditioning circuit : Thermocouple, RTD, Thermister, load cell, potentiometric sensors, Capacitive level sensor, LVDT, Optical sensors (LDR, photodiode, photo transistor, photo cell).

Advances in sensors technology: Working Principle, types, Materials: Smart sensors, MEMS, Nano sensors, Semiconductor sensors, Optical fiber sensors. Applications of these technologies in various industry sectors.

Course Outcomes: Upon Completion of this course, students will able to

INU421.1: Apply different methods for measurement of various parameters
INU421.2: Analyze, formulate and select suitable sensor for given industrial application
INU421.3: Use of smart transducer

Text Books:

1. D.V.S. Murthi, "Instrumentation and Measurement Principles", PHI, New Delhi, Second ed. 2003.
2. B. C. Nakra and K. K. Choudhari, "Instrumentation Measurements and Analysis" by, Tata McGraw Hill Education, Second ed., 2004.

Reference Books:

1. D. Patranabis, "Principle of Industrial Instrumentation", Tata McGraw Hill, Second ed., 1999.
2. B.G. Liptak, "Process Measurement & Analysis", Chilton Book Company, Fourth ed., 2003.
3. E.O. Doebelin, "Measurement Systems", McGraw Hill, Fifth ed., 2003.
4. Sabrie Soloman, "Sensors Handbook" ,McGraw Hill Publication, First ed., 1998.
5. A.K. Sawhney, "Electrical & Electronic Instruments & Measurement", Dhanpat Rai and Sons, Eleventh ed., 2000.
6. R.K.Jain, "Engineering Metrology", Khanna Publisher, Delhi,Eighteenth ed.,2002.
7. Neubert, H.K.P., Instrument Transducers, Clarenden Press, Oxford, 1988.
8. C. S. Rangan, G. R. Sharma and V. S. Mani, 'Instrumentation Devices and Systems', Tata McGraw-Hill Publishing Company Ltd.

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INU422 LINEAR INTEGRATED CIRCUITS

Teaching Scheme : 03 L+1T **Total:04** **Credit : 04**
Evaluation Scheme: 30MSE+10 TA+ 60 ESE **Total Marks: 100**
Duration of ESE : 2hrs 30min.

Course Objectives:

I. Understand fundamental concepts of linear integrated circuits.
II. Demonstrate different applications of linear and non-linear operational amplifiers.
III. Identify different configurations of OPAMP
IV. To perform analysis of circuits based on linear integrated circuits
V. Design circuits & system for a particular application using linear integrated circuits

Operational Amplifiers Fundamentals: Characteristics of Op Amp, Noise figure, Types of Noise, Causes of Slew Rate, Concept of dB and dBm, Frequency response, Frequency / Phase Compensation Techniques. SR, CMRR, PSRR/SVRR. Offset adjustment techniques, Comparative study of different amplifier ICs such as LM 741, LM 324,OP 07

Feedback amplifiers. Positive and negative feedback amplifiers, voltage series feedback amplifier, Voltage shunt feedback amplifier and differential amplifier configuration and their special cases.

Linear Applications of op amp: Voltage Summing with averager, Voltage subtractor, voltage follower, peak amplifier, analog adder, Current booster, Integrator and practical integrator, Differentiator and practical differentiator, Instrumentation Amplifier with three op-amp, Current to voltage and voltage to current converter, analog multipliers, dividers, log/antilog amplifiers.

Non-linear Applications of Op-amp: Comparator characteristics, peak detectors, waveform generation circuits viz Schmitt's trigger, pulse generators, ZCD and its use, Schmitt trigger with external bias, window detector. Precision half wave and full wave rectifiers with IC 741. wave shaping circuits - clippers and clampers, precision rectifiers.

Timers and Voltage regulators: Timers: Triggerable and retriggerable, IC 555 monostable multivibrators and astable multivibrators. Designs and Applications.

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Voltage regulators : Linear and Switching DC Voltage regulators: Basic 78XX and 79XX voltage regulators, voltage regulator IC723.

Active filters and oscillators: First order and Second order active low pass, high pass filter, band pass filter, band stop or band reject Notch filter, all pass filters, Introduction of butterworth, chebyshev , elliptic and Bessel filters. Sinusoidal oscillators using Op amp: Barkhausen criteria, Wein Bridge oscillator, RC phase shift oscillator.

Text Books:

1. Op-amp and Integrated circuits, Ramakant A. Gaikwad, 3rd Edition, PHI Publication, 2002
2. Integrated Circuits, K.R. Botkar, 9th Edition , Khanna Publisher, 2003
3. Operational Amplifiers and Linear ICs, D. A. Bell, Oxford University Press, 3rd edition, 2011

Reference Books:

1. Design with Op-amp and Analog Integrated circuits, Sergio Franco, Tata McGraw Hill Edition, New Delhi, 1998
2. Analog Electronics, L. K. Maheshwari and M.M.S. Anand, Prentice Hall of India, New Delhi.
3. Physics of Semiconductor Devices, S. M. Sze, 5th edition, John Wiley Publications.
4. Op-amp and Linear Integrated Circuits Theory and Applications, J. Fiore, Delmar Thompson Learning, 1st edition, 2001.
5. Operational Amplifiers and Linear Integrated Circuits, R. Coughlin, F. Driscoll, PHI, 6th edition, 2001

Course Outcomes: Upon Completion of this course, students will able to

INU422.1: Analyze the concepts of linear integrated circuits
INU422.2: Design circuit using operational amplifier for various applications.
INU422.3: Apply linear and non linear applications of operational amplifier.
INU422.4: Demonstrate the factions of timer, voltage regulator, filter and oscillators.

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INU 423 CONTROL SYSTEM ENGINEERING

Teaching Scheme: 03 L+1T **Total: 04** **Credit: 04**
Evaluation Scheme: 30 MSE +10 TA+ 60 ESE **Total Marks: 100**
Duration of ESE: 2 Hrs.30 min.

Course Objectives:

I. Introduce the elements, needs and application of control system and it's modeling.
II. Understand the concept of stability, time domain specifications and it's methods
III. To learn various methods of frequency domain analysis for linear system.
IV. Illustrate basic concepts of state variable analysis.

Fundamentals of control systems: Introduction to need for automation and automatic control, Basic Components of a Control System, Concept of open loop and closed loop Systems, Examples of control system, Effects of Feedback, Types of Feedback Control Systems. Review of Laplace and inverse Laplace transform, Transfer functions.

Mathematical modeling: Mathematical modeling of: electrical systems, mechanical systems, electro-mechanical systems, Electrical analogues of dynamical systems, Block diagrams, Block diagram reductions, Signal flow graph, Mason's gain formula, Application of gain formula to block diagrams.

Time response analysis: Time response of system, Standard test signals, Analysis of first order and second order systems, Time response specifications, Steady state errors and error constants.

Stability analysis: Stability of open loop and closed loop systems, Routh-Hurwitz criterion, Stability and Performance analysis, Root locus techniques, Root locus construction rules, Sketching of Root Locus.

Frequency response analysis: Frequency domain specifications, Correlation between time and frequency responses, Bode plots, Relative stability, Phase margin and Gain margin, Minimum and non-minimum phase systems, Introduction to polar plots, Nyquist plot, and Nyquist stability criterion.

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Text Books:

1. Norman Nise, Control System Engineering, Wiley International, sixth edition, 2011.
2. Nagrath and Gopal, Control System Engineering-, New Age International Publication, fifth edition, 2003.

Reference Books:

1. C.H. Houpis, S.N. Sheldon, Linear Control System Analysis and Design with MATLAB, CRC Press; 6 edition.
2. G. Goodwin, S.Graebe, Mario Salgado, Control System Design, Pearson Education, edition.
3. G. Franklin, J.Powell, A. Naeini, Feedback Control of Dynamic Systems, Pearson, 6th edition.
4. K. Ogata, Modern Control Engineering, Prentice Hall Publications, fifth edition.
5. Dorf and Bishop, Modern Control Systems:, Addison Wesley, LPE, 9th Edition.
6. B. C. Kuo, Automatic control system, Prentice Hall of India, 7th Edition, 1995

Course Outcomes:

INU423.1: Identify the Need of control system and its applications.

INU423.2: Apply control system to complex real world problems in order to obtain mathematical models.

INU423.3: Analyze the given control system for different input signals.

INU423.4: Test the stability of the given system and draw the root locus for the system.

INU423.5: Analysis behavior of closed loop systems of using Bode plot, Polar plot, Nyquist plot.

INU423.6: Represent various systems transfer function in state variable form and check its controllability and observability.

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INU424 SIGNALS AND SYSTEMS

Teaching Scheme : 03 L **Total:03** **Credit: 03**
Evaluation Scheme : 30 MSE + 10 TA + 60 ESE **Total marks : 100**
ESE duration : 2 Hrs 30 min.

Course Objectives:

I. Understand the fundamental characteristics of continuous time and discrete time signals and systems.
II. Understand signals and systems in terms of both the time and transform domains, taking advantage of the complementary insights and tools that these different perspectives provide.
III. Design and analyze linear time-invariant systems and compute its response.
IV. Analyze the spectral characteristics of signals using Fourier analysis.
V. Analyze the systems using Z-transform.

Introduction to Signals and Systems: Introduction to Signals, Classification of Signals, Continuous Time and Discrete Time Signals, Step and Impulse Functions, Transformation of Independent Variable, Introduction to Systems, Classification of Systems, Properties of Systems, Normal Form of System Equation, Initial Conditions, Impulse Response of a Physical System, system Impulse Response.

Analysis of Systems: System characteristics, Introduction to Convolution, Convolution Sum, Linear and Circular Convolution, Sampling theorem, reconstruction, aliasing, sampling in the frequency domain, sampling of discrete time signals, decimation and interpolation

Fourier Transform Analysis: Fourier analysis for Continuous time signals and systems, Continuous time Fourier series and its convergence, Continuous time Fourier Transform, its properties, frequency response

Discrete Fourier Transform: Discrete time Fourier series and its convergence, discrete time Fourier Transform, its properties, frequency response.

Z-Transform: Definition, properties of z-transform, z-transform of standard sequences, inverse Z-transform, relationship of z-transform with Fourier transform applications of Z-transform to solutions of difference equations, Properties and applications of Z transform.

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FIR and IIR system:
Introduction to FIR and IIR system, block diagram representation, cascade, parallel, and feedback interconnections,
FIR and IIR system realization, Direct Form I, Direct Form II, cascade, parallel and transposed realization.

Text Books:

1. Tarun Kumar Rawat "Signals and Systems", Oxford University Press, first edition 2010.
2. Michael J. Robert, "Introduction to Signals and Systems", TMH, Second ed., 2003.

Reference Books:

1 Alan V Oppenhein, Alan S Wiilsky, "Signals and systems" PHI, Second ed. 2009
2 S.Haykin and B. VanVeen "Signals and Systems, Wiley, 1998.
3 M. Mandal and A. Asif, "Continuous and Discrete Time Signals and Systems, Cambridge, 2007.

Course Outcomes: Upon Completion of this course, students will able to

INU424.1: Classify systems based on their properties and determines the response of LSI system using convolution
INU424.2: Analyze system properties based on impulse response and Fourier analysis.
INU424.3: Apply the Z- transform for analyze of continuous-time and discrete-time signals and systems.
INU424.4: Understand the process of sampling and the effects of under sampling.
INU424.5: Design and analyze linear time-invariant systems and compute its response.
INU424.6: Analyze the spectral characteristics of signals using Fourier analysis.
INU424.7: Analyze the systems using Laplace transform and Z-transform.

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INU425 DIGITAL ELECTRONICS

Teaching Scheme : 03 L **Total : 03** **Credit : 03**
Evaluation Scheme: 30 MSE +10 TA+ 60 ESE **Total Marks: 100**
Duration of ESE : 2hrs 30min.

Course objectives:

I. To analyze logic processes and implement logical operations using combinational logic circuits
II. To understand characteristics of memory and their classification
III. To understand concepts of sequential circuits and to analyze sequential systems in terms of state machines
IV. To understand concept of Programmable Devices, PLA, PAL, CPLD and FPGA

Digital Logic Families: Digital IC specification terminology, different types of logic families, complementary metal oxide semiconductor logic, logic families interfacing - TTL driving CMOS, CMOS driving TTL, measurement of specification parameters of IC's, 5400 / 7400 series ICs, Tristate Logic, Comparison of Different logic families.

Combinational logic design: Switching algebra, combinational circuit analysis, combinational circuit synthesis, and combinational circuit minimization, K-Map of three, four, five variable functions, minimizing SOP and POS expressions. Quine McClusky minimization, design of encoders, decoders, tri-state devices, multiplexers, demultiplexers, comparators, arithmetic circuits– half and full adders, ripple adders, subtractors, carry look ahead adders, combinational multipliers, examples- barrel shifter, floating point encoder etc.

Sequential logic design: Latches and flip flops, edge triggered and master slave flip flops (SR, JK, D, T etc), feedback sequential circuit design, sequential PLDs, Counters and shift registers, synchronous design methodology, clock skew, gating the clock, asynchronous inputs.

A/D and D/A Converters: Single slope, dual slope tracking and successive approximation type, Introduction to flash A/D converter, comparison of commercial IC's and Criteria for judging the performance. Binary weighted resister type D/A converter, R-2-R ladder type D/A converter.

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Programmable Logic Devices I: Introduction to memories, Types of memories, Memory specification, Introduction to PAL, PLA, Configurable Programmable Logic Devices, Various types of CPLD's.

Programmable Logic Devices II: Introduction to FPGA and its various architectures. PLD Programming concepts, Introduction to PLD Programming languages

Text Books:

1. Ronald J. Toccii, "Digital Systems: Principles and Applications", Pearson LPE, Fourth ed. 2009.
2. R. P. Jain, "Modern Digital Electronics", McGraw Hill Higher Education, Fourth ed., 2010.

Reference Books:

1. Mano M.M, "Digital Logic and Computer Design", Pearson LPE, Fourth, ed., 2009.
2. Boyce J. C., "Digital Logic: Operation and Analysis", Prentice Hall, Second ed., 1982.

Course outcomes: Upon Completion of this course, students will able to

INU425.1: Develop a digital logic and apply it to solve real life problems
INU425.2: Apply Boolean algebra and other minimization techniques to digital circuits
INU425.3: Design combinational and sequential circuits for a given problem / case studies related to digital circuits
INU425.4: Evaluate appropriate hardware and software tools for combinational and sequential circuit design, implementation and verification
INU425.5: Analyze digital system design using PLD

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SHU422 ENVIRONMENTAL STUDIES

Teaching Scheme: 01 L **Total: 01** **Credit: 00**
Evaluation scheme: 20TA+30MSE **ESE Duration: 1:30 hrs**
Total Marks: 50

Course objectives: The objectives of offering this course are to

- Be aware of various environmental factors and there preservation.
- Teach them how to protect Environment and natural resources.
- How to make equitable use of energy resources.

The Multidisciplinary Nature of Environmental Studies: Definition, scope and importance, Need for public awareness.

Social issues and Environment: From Unsustainable to sustainable development, urban problems related to energy, Water conservation, rainwater harvesting, and watershed management Resettlement and rehabilitation of people, problems.
Environmental ethics: Issues and possible solution, Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, Wasteland reclamation. Consumerism and Waste products, Environment protection act, Air (prevention & control) act, Water (prevention and control) act, Wildlife protection act, Forest conservation act, Issues involved in enforcement of environmental legislation.
Human population and environment: Environment and human health, Human rights, Role of Information Technology in Environment and human health, Public awareness.

Natural Recourses: Conventional energy resources: definition, classification, composition, energy content types: coal, petroleum, natural gases, hydrogeothermal, nuclear, environmental implication of energy uses. Non conventional energy resources: solar energy, wind energy, tidal energy, geothermal energy, hydropowers and biogas.

Ecosystem and Biodiversity: Concept of ecosystem, Structure and function of ecosystem, Producer, consumer, decomposers. Energy flow in the ecosystem. Ecological succession. Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of following ecosystem: Forest ecosystem, Grass land ecosystem, Desert ecosystem Aquatic ecosystem (Rivers and ocean).

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Introduction- definition: genetics, species and ecosystem, diversity.
Biogeographically classification of India. Conservation of biodiversity- In-situ and Ex-situ conservation of Biodiversity. Threats to biodiversity: habitat loss, poaching of wildlife, man wildlife conflicts. Endangered and endemic species of India. Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values. Biodiversity at global, national and local level. India as mega diversity nation. Hot spot of biodiversity.

Environmental Pollution: Definition, Causes, effects and control measures of Air pollution, Water pollution, Soil pollution, Noise pollution, Thermal pollution, Nuclear hazards, Solid waste, Management, Causes effects and control measures, Role of individual in prevention of pollution, Hazardous waste management, Biomedical waste management, Disaster management: floods, earthquake, cyclone and landslides.

Course outcomes: After studying the course, the students will be able to:-

SHU422.1 Convey the Environmental awareness among peoples.
SHU422.2 Apply Conservation of various natural resources and environmental factors.
SHU422.3 Aware about social and environmental issues.

Recommended Books:

1) The Biodiversity of India, Bharucha Erach ,Marin Publishing Pvt. Ltd., Ahmedabad
2) Brunner R.C., 1989,Hazardous Waste Incineration, McGraw Hill Inc.
3) Marine pollution, Clark R.S., Clanderson Press Oxford (TB)
4) Environmental Chemistry, De A.K. Wiley Estern Lmt.
5) Environmental Chemistry, Sharma B.K., 2001 Goel Publ., House, Meerat.
6) Environmental Management, Wagner K.D., 1998, W.B. Saunders Co., Philadel phia, USA
7) Environmental Studies, Benny Joseph, 1st edition,2005,Tata Mcgraw-Hill Publ.

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INU426 SENSOR & TRANSDUCER-II LAB

Teaching Scheme: 02 P **Total : 02** **Credit : 01**
Evaluation Scheme: 25 ICA+ 25 ESE **Total Marks: 50**
Duration of ESE : 3 hrs.

Course Objectives:

I. Acquire the knowledge of the constructions and working principle of different types of sensors and transducers
II. Understand different techniques of measurement for physical parameters.
III. Design signal conditioning circuits for different sensors

Minimum Eight Experiments to be performed covering the Entire Syllabus of **INU421 SENSORS AND TRANSDUCERS-II.** Representative list is as follows.

1. To determine the LVDT characteristics
2. Measurement of strain using strain gauge.
3. Loading effect of Potentiometer
4. Characteristics of Piezo-electric Transducer
5. Study of distance measurement using ultrasonic transducer.
6. Measurement of Displacement by (a) Piezoelectric pickup and (b) Light dependent resistor
7. Measurement of speed and torque using Opto Electronic Sensor
8. Characteristics of Hall effect sensor
9. Measurement of level using capacitive transducer.
10. Study of Differential Pressure Transducer & signal conditioning of output signal
11. To study characteristics of temperature transducer like thermocouple, thermistor and RTD with implementation of a small project using signal conditioning circuits like instrumentation amplifier.

Course Outcomes: Upon Completion of this course, students will able to

INU426.1: Examine the characteristics of different transducer
INU426.2: Identify suitable instruments to meet the requirements of industrial applications

Note:
ICA- The Internal Continuous Assessment shall be based on the practical record and

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Knowledge/skill acquired. The performance shall be assessed experiment wise by using continuous assessment formats A and B.

ESE – The End Semester Exam for Practical shall be based on performance in one of the experiments and may be followed by sample questions.

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INU427 LINEAR INTEGRATED CIRCUITS LAB

Teaching Scheme: 02 P **Total : 02** **Credit : 01**
Evaluation Scheme: 25 ICA+ 25 ESE **Total Marks: 50**
Duration of ESE : 3 hrs.

Course Objectives:

I. Acquire fundamental concepts of linear integrated circuits.
II. Design Inverting-Non inverting and differential circuits with op-amp.
III. Gain basic knowledge for obtaining linear and non-linear applications of operational amplifiers.
IV. Become familiar with the applications of timers, Voltage regulators, filters and oscillators

Minimum Eight Experiments to be performed covering the Entire Syllabus of **INU422 LINEAR INTEGRATED CIRCUIT.** Representative list is as follows.

1. Measurement of op-amp parameters and comparison with op-amp data sheets.
2. Assembling of op-amp Inverting, Non inverting and differential circuits to measure an input in the range of mill volts to few volts.
3. Design of signal conditioning circuit to operate a relay or to generate timing delays (e.g.10 sec., or 20 or 20 sec. or 1 minute) using IC 555.
4. Design of a circuit to work as voltage regulator of 10 or 20 volts using IC 723. Use of 565 PLL as a frequency multiplier.
5. Design of Oscillators using op-amp. and testing.
6. Design of single stage differential amplifier and testing.
7. Design of low and high pass filters with a cut off frequency of 1 kHz or 2 kHz and testing for frequency response.
8. Design of instrumentation amplifier using 3 op-amps and testing for gain, frequency response.
9. Design of cascade amplifier system using op-amp and testing for gain and frequency response.
10. Design of attenuator circuit using amplifier and testing for gain.
11. Design of band pass filter using op-amp and testing for frequency response.
12. Design of Clippers and Clampers .

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13. Design Monostable and bistable multivibrator using timer IC 555.

Course Outcomes: Upon Completion of this course, students will able to

INU427.1: Design and analyze concepts of linear integrated circuits.
INU427.2: Design circuit using operational amplifier for various applications.
INU427.3: Develop linear and non linear applications of operational amplifier.
INU427.4: Perform the basic operations of timer, voltage regulator, filter and oscillators.

Note :

ICA – The Internal Continuous Assessment shall be based on the practical record and knowledge/skill acquired. The performance shall be assessed experiment wise by using continuous assessment formats, A and B.

ESE – The End Semester Exam for Practical shall be based on performance in one of the experiments and may be followed by sample questions.

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INU428 CONTROL SYSTEM ENGINEERING LAB

Teaching Scheme: 02 P **Total:02** **Credit: 01**
Evaluation Scheme: Internal Continuous Assessment (ICA) **Total Marks: 50**

Course Objectives:

I. To introduce the MATLAB software from control systems point of view.
II. To provide adequate knowledge in the time response of systems and steady state error analysis using Software.
III. To Show the Effect of addition of poles and zeros to forward path of an open loop and closed loop system using software.
IV. To give basic knowledge for obtaining the open loop and closed–loop frequency responses of systems and analysis of system using software.
V. To become familiar with the Simulink toolbox in MATLAB and the functions of different blocks available in the library.

Minimum Eight Experiments to be performed covering the Entire Syllabus of **INU423 CONTROL SYSTEM ENGINEERING. Any four from Group A and any four from Group B.**

Group A:

1. Use R-C circuit to analyze the response of a first order system for standard test inputs.
2. Use R-L-C circuit to analyze the response of a second order system for standard test inputs.
3. Develop a Simulink model to find steady state error for a type 0, type 1 and type 2 systems.
4. Modeling of Physical Systems using Simulink.
5. To obtain the model of the Inverted pendulum and study the closed loop performance using experiments or using Software.
6. Physical Modeling of Inverted Pendulum/ Cruse Control using Simscape.

Group B:

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1. Introduction to MATLAB, MATLAB's Simulink and control systems toolbox (with some examples) or any other control system related software package.
2. Study of time response characteristics of second order control system using Software.
3. Study and plot the unit step responses of addition of a pole and a zero to the closed loop transfer function
4. Use software to plot the Bode diagram of given transfer functions and analyze the stability.
5. Use software to draw the polar plot and Nyquist plot of given transfer functions and analyze the stability.
6. Transient Response Analysis in State-Space using software.

Course Outcomes: Upon Completion of this course, students will able to

INU428.1: Analyze the given systems using time domain analysis with the help of software.
INU428.2: Analyze the given systems using frequency domain analysis with the help of software.
INU428.3: Develop mathematical model for electrical systems.

Note:
ICA- The Internal Continuous Assessment shall be based on the practical record and Knowledge/skill acquired. The performance shall be assessed experiment wise by using continuous assessment formats A and B.

ESE – The End Semester Exam for Practical shall be based on performance in one of the experiments and may be followed by sample questions.

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INU429 SIGNALS AND SYSTEMS LAB

Teaching Scheme : 02 P **Total : 02** **Credit: 01**
Evaluation Scheme: 25 ICA + 25 ESE **Total Marks: 50**
Duration of ESE : 3 hrs.

Course objectives:

The primary objective of this course is to provide a thorough understanding and analysis of signals and systems using MATLAB.

Following Experiments to be performed covering the entire Syllabus of **INU424 SIGNALS AND SYSTEMS**. Representative list is as follows.

1. Program for addition and multiplication of two continuous time signals
2. Triangular wave by simple method
3. Saw tooth waveform and Triangular waveform
4. Generate the discrete time sequences
   Unit step, Sinusoidal, exponential,
5. Program to plot signum function
6. program for folding of given signal
7. program for Time shifting of two of given signal
8. program to find the convolution of two sequences
9. program to plot the frequency response of first order system
10. program to plot the frequency response of higher order system
11. Fourier Transform of Rectangular pulse
12. Fourier transform of sinc function
13. Program to find DFT of given sequence
14. Program to find inverse DFT of the given sequence
15. To compute and plot the impulse response and pole-zero diagram of transfer function using Laplace transform.
16. To compute and plot the impulse response and pole-zero diagram of transfer function using Z-transform.

Course outcomes: Upon Completion of this course, students will able to

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INU429.1: Understand basics of MATLAB syntax, functions and programming.
INU429.2: Generate and characterize various continuous and discrete time signals.
INU429.3: Perform the basic operations on the signals.
INU429.4: Design and analyze linear time-invariant systems and compute its response.
INU429.5: Analyze the spectral characteristics of signals using Fourier analysis.
INU429.6: Analyze the systems using Z-transform.

Note:
ICA- The Internal Continuous Assessment shall be based on the practical record and Knowledge/skill acquired. The performance shall be assessed experiment wise by using continuous assessment formats A and B.

ESE – The End Semester Exam for Practical shall be based on performance in one of the experiments and may be followed by sample questions.

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INU430 DIGITAL ELECTRONICS LAB

Teaching Scheme : 02 P **Total : 02** **Credit: 01**
Evaluation Scheme: 25 ICA + 25 ESE **Total Marks: 50**
Duration of ESE : 3 hrs.

Course objective:

I. To know the concepts of Combinational circuits.
II. To understand the concepts of flip-flops, registers and counters

Minimum Eight Experiments to be performed covering the entire Syllabus of **INU425 DIGITAL ELECTRONICS**. Representative list is as follows.

1. Measurement of IC's parameters like rise time, fall time, propagation delays, and current and voltage parameters.
2. Design and implementation of arithmetic circuits
3. Design and implementation of various code converters and its applications
4. Design and implementation of multiplexer and demultiplexer and its applications
5. Design and implementation of encoders and decoders and its applications
6. Design and implementation of synchronous and asynchronous counters and its applications
7. Design and implementation of non sequential counters
8. Design and implementation of shift registers and its applications
9. Implementation and verifications of Combinational circuits on programmable logic devices
10. Implementation and verifications of sequential circuits on programmable logic devices

Course outcome: Upon Completion of this course, students will able to

INU430.1: Design experimental setup for measurement of digital IC parameters & its verification.
INU430.2: Design, realize and analyze various combinational and sequential circuits
INU430.3: Select and use latest hardware and software tools for digital system realization

Note:
ICA- The Internal Continuous Assessment shall be based on the practical record and

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Knowledge/skill acquired. The performance shall be assessed experiment wise by using continuous assessment formats A and B.

ESE – The End Semester Exam for Practical shall be based on performance in one of the experiments and may be followed by sample question.

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GOVT. COLLEGE OF ENGINEERING AMRAVATI

DEPARTMENT OF INSTRUMENTATION ENGINEERING

PROPOSED CURRICULUM

For

B. TECH. (V and VI Semester

Instrumentation Engineering)

2021- 2022

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INU521 CONTROL SYSTEM DESIGN

Teaching Scheme : 03 L+1 T **Total: 04** **Credit: 04**
Evaluation Scheme: 30 MSE +10TA+ 60 ESE **Total Marks: 100**
Duration of ESE : 2hrs.30min.

Course objectives:

I. To introduce the elements of control system design and it's modeling.
II. To understand the concept of Time response analysis and it's design Specifications**.**
III. To understand design concept of compensators using root locus approach.
IV. To design compensators for feedback control systems given the performance specifications such as the phase margin, gain margin and the static velocity error constant using Bode diagrams.
V. To design PID controllers for practical processes.

Introduction:

Steps in control system design process, Transfer function, electrical network transfer function, translational and rotational mechanical systems transfer function, electro-mechanical systems Transfer function.

Time response analysis and design Specifications :

Review to time response of first order system, Second order System and Higher order system, Steady state error and error constant, Effect of adding Zero to system, Design Specification of First order system, Design Specification of second order system, Design specification of Higher order System

Compensator design (root locus approach):

Need of compensators, types of compensators (series, parallel), Preliminary design considerations, Types of series compensators (lead, lag, lag-lead) ,their transfer functions, Implementation of lead, lag, lead-lag compensators, Design of compensators using root locus approach, Basic Principle for designing parallel compensated system.

Compensator design (Frequency response approach):

Frequency response approach to control system design (Polar Plot approach and Bode Diagram approach), Basic characteristics of Lead, Lag, Lead-Lag compensation, Compensator design using Bode plot approach: Lead, lag and lag-lead compensator, comparison of Lead, Lag, Lead-Lag compensation.

PID Controller Design and Two degree of Freedom control :

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Different type of control mode as PI, PD, PID controller, Design of PI, PD, PID Controller in frequency domain approach (Gain and Phase margin), Modifications of PID Control Schemes PI-D Control , I-PD Control , Two degree of Freedom control, Zero-Placement Approach to Improve Response Characteristics.

Text Book:

1. Control System Engineering, Nagrath and Gopal, New Age International Publication, 5th edition, 2003
2. Control System Engineering , Norman Nise, Wiley International, 6th edition, 2011.
3. Modern Control Engineering, K. Ogata, 3rd edition, Prentice Hall of India Pvt. Ltd.

Reference Books:

1. Modern Control Systems, Richard C. Dorf, Robert H. Bishop, 11th edition, Pearson.
2. Control System Design , Graham C. Goodwin, Stefan F. Graebe, Mario E. Salgado, PHI Publication, 2001
3. Advanced control theory , Nagoorkani, 2nd edition, RBA publication
4. Control System Design, A. S. Mandke, 1st edition, Khanna Publishers, New Delhi, 2007.
5. Process Control, Modeling, Design and Simulation, B. W. Bequette, Trow/Argosy (Series Editor), Trow/Argosy (Series Editor) Prentice Hall of India Pvt. Ltd

Course Outcomes:

On completion of the course, students will be able to:

INU521.1 Describe the basic elements of control system design and System.

INU521.2 Understand the concept of Time response analysis and it's design Specifications.

INU521.3 Design lead compensators, lag compensators and lag lead compensators using root locus approach.

INU521.4 Design compensators for feedback control systems given the performance specifications such as the phase margin, gain margin using Bode diagrams.

INU521.5 Design PID controllers for processes.

CO – PO –PSO Mapping:

CO	PO/PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	0	0	0	1	0	0	0	0	0	1	0	0
CO2	2	3	2	1	1	0	0	0	0	0	2	0	0	2	1
CO3	3	2	3	0	0	2	0	0	0	1	0	1	1	3	0
CO4	2	2	1	2	0	0	1	0	0	0	2	0	1	1	0
CO5	1	2	1	1	0	0	0	1	1	2	0	1	1	2	1

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

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INU522 UNIT OPERATIONS

Teaching Scheme : 03 L + 0 T **Total 03** **Credit: 03**
Evaluation Scheme: 30MSE +10 TA+ 60 ESE **Total Marks: 100**
Duration of ESE : 2hrs.30min.

Course Objectives:

I. To get knowledge of different heat exchanger equipments and effect of other parameters on them
II. To understand concepts of fluid transportation
III. To demonstrate an understanding of Distillation and Extraction process
IV. To study and Understand the principles of various size reduction methods, conveying equipments, sedimentation
V. To propose the unit operation sequence and equipment required in different industries

Heat exchangers: heat transfer fundamentals. General design requirements, shell and tube type, plate type heat exchangers, fundamental principal, application, fabrication, condensers: type, working, application.

Boilers: types, working, application, components, fabrication. evaporators: types, working, application, components, fabrication and heat transfer coefficient. Parameters associated in design.

Distillation Columns: types, continues and batch, sieve plate and packed column, height and diameter relation of distillation column. Overall design aspect: material, fabrication, mass transfer calculations, energy balance and material balance. Rectification, striping, fractionating column and application.

Extraction Methods: Leaching and extraction, gas absorption, batch and continuous drying, drying of solids, batch and continuous drying, crystallization: equipment setup requirements, working, fabrication, mass transfer calculations, and applications.

Size reduction Methods: Mixing of solids, size reduction Crushing and grinding and screening: types, equipment setup, working principal. Selection criteria and considerations for equipment used for size reduction and mechanical separation.

Unit operations in different industries: Identification and justification of unit operations used in different industries like sugar, cement, fertilizer industry with help of process flow diagram

Text Books:

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1. Unit Operation in Chemical Engineering, Warren L. McCabe, Julian C. Smith, Peter Harroitt, McGraw Hill. 5th edition, 2005.
2. Unit operations and chemical engineering, W.L. Mccav and J.C. Smith, Tata Mcgraw Hill publications

Reference Books:

1. Mass transfer operations , R.E. Treybl , 3rd edition, Mcgraw Hill publication
2. Perry's Chemical Engineers handbook, D. W. Green, 9th edition, Mcgraw Hill publications.
3. Mass transfer, Thomas K. Sherwood, Robert L. Pigford, and Charles R. Wilke, McGraw-Hill Book Company, 1975
4. Process equipment designing, Brownell Young, Wiley publication, 2009

Course Outcomes:

On completion of the course, students will be able to:

INU522.1 Knowledge of different heat exchanger equipments and effect of other parameters on them.
INU522.2 Understand concepts of fluid transportation
INU522.3 Demonstrate an understanding of Distillation and Extraction process
INU522.4 Study and Understand the principles of various size reduction methods, conveying equipments, sedimentation
INU522.5 Propose the unit operation sequence and equipment required in different industries

CO – PO –PSO Mapping:

CO	PO/PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	0	1	0	0	0	0	0	0	0	0	0	0	3	0
CO2	3	0	0	0	0	0	0	0	0	0	0	0	0	2	0
CO3	2	0	1	1	0	0	0	0	0	0	0	0	1	2	0
CO4	3	0	2	2	0	0	0	0	0	0	0	2	2	3	0
CO5	0	2	3	0	0	0	0	2	0	0	2	0	3	3	2

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

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INU523 POWER ELECTRONICS

Teaching Scheme : 03 L + 0 T **Total 03** **Credit: 03**
Evaluation Scheme: 30MSE +10 TA+ 60 ESE **Total Marks: 100**
Duration of ESE : 2hrs.30min.

Course Objectives:-

I. Familiarize with principles of thyristors and thyristor Commutation Techniques.
II. Acquiring an understanding of Phase Controlled Rectifiers.
III. Understand the working principles of DC Chopper and Inverters.
IV. Analyze the characteristics of Speed control of DC motors.
V. Study some Application of Power Electronics

Introduction: Introduction to basic thyristors, Design of gate triggering circuits using thyristor, thyristor protection circuits, thyristor Commutation Techniques: Principles of Natural commutation, Design of Forced commutation circuits: Self commutation, Impulse commutation, Resonant pulse commutation, Complementary commutation, External pulse commutation.

Phase Controlled Rectifiers: Single phase rectifiers: Half wave, Center tapped, Bridge (half controlled and fully controlled) with R and RL load, Introduction to Three phase rectifiers, dual converters, Power factor improvement methods.

DC Chopper: Basic chopper, continuous and discontinuous current conduction, TRC, CLC methods, Classification of choppers, step-up chopper.

Inverters: Single phase inverters: series, parallel and bridge configurations with R load, PWM inverters. Three phase inverters with 120^0 and 180^0 conduction with R and RL load, voltage control.

Speed control of DC motors: Basic machine equation, Schemes for DC motor Speed Control, DC chopper drives, control using multiphase choppers, microprocessor control of DC drives.

Application of Power Electronics: Battery charging, High Voltage DC transmission, Electronic Lamp ballast, Emergency Light System.

Text Books:

1. An Introduction to Thyristor and Their Application M. Ramamurty, 2nd Edition, Affiliated East-West Press Private Limited, New Delhi-110 020(India), 1991.

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2. Electronics: Circuits, Devices, and Applications, M. H. Rashid, 2nd Edition, Prentice Hall of India Private Limited, New Delhi-110 001(India),1994.

Reference Books:

1. Power Electronics, Singh M. D., Khanchandani K. B, 2nd Edition, McGraw- Hill Publishing Company Limited, New Delhi (India), 1998.
2. Power Electronics, P. S. Bimbhra, 2nd Edition, Khanna Publishers, Delhi- 110 006 (India), 1998.
3. Electric Drives, P. K. Sen and N. K. De, 5th Edition, Prentice Hall of India Private Limited, New Delhi-110001(India), 1999.
4. Principles of Thyristorised Converters, De G. Oxford, IBH Publications, 1982.

Course Outcomes:

On completion of the course, students will be able to:

INU523.1 Familiarize with thyristors and thyristor Commutation Techniques.
INU523.2 Understanding of Phase Controlled Rectifiers.
INU523.3 Understand the working principles of DC Chopper and Inverters.
INU523.4 Analyze the characteristics of Speed control of DC motors.
INU523.5 Design and implement industrial applications of power electronic circuits.

CO – PO –PSO Mapping:

CO	PO/PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	0	0	0	1	0	0	0	0	0	1	0	0
CO2	2	3	2	1	0	0	0	0	0	0	2	0	2	2	1
CO3	2	0	3	0	0	2	0	0	0	1	0	0	1	3	0
CO4	1	2	3	2	2	0	1	0	1	0	2	2	0	1	2
CO5	2	2	1	1	0	0	0	0	0	2	0	1	1	0	0

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

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INU 524 DIGITAL SIGNAL PROCESSING

Teaching Scheme: 03 L+00 T **Total: 03** **Credit: 03**
Evaluation Scheme: 30 MSE +10TA+ 60 ESE **Total Marks: 100**
Duration of ESE : 2hrs.30min.

Course objectives:

I. Understand of basic structures of IIR and FIR systems design,.
II. Learn the computation techniques and computation complexity of DSP algorithms
III. Learn the digital filter design techniques
IV. Understand the concept of wavelet transform technique in DSP
V. Study of Design, Implementation and analysis DSP systems

Introduction to signal processing: Introduction to DSP, Typical signal processing operations, typical signal processing applications, advantages of digital signal processing.
Algorithm implementation: properties of DFT**,** Computation of DFT, FFT algorithms, Decimation in time, Decimation in Frequency, Different algorithms of FFT such as DIT and DIF where input and output is in order, radix-n algorithms.
FIR Filter design techniques: FIR filter specifications, Linear phase in FIR filters ,Linear phase FIR filter design using windowing technique, Linear phase FIR filter design using frequency sampling method
IIR Filter design techniques: Introduction, Design of IIR filters from analog filters-Impulse invariant transformation, Bilinear transformation, Design of digital low pass butterworth filter, chebyshev filter ,Design of IIR filters from normalized Low pass IIR filters
Fundamentals of Multirate DSP and Filter Bank : Introduction to decimation, interpolation process, digital filter banks, DFT filter banks .
Introduction to Wavelet Transform: Introduction to Short time Fourier Transform (STFT), continuous wavelet transform (CWT), discrete wavelet transform (DWT)
Introduction to DSP Processors: Introduction to fixed point and floating point DSP processors, architectural features of TMS320C67XX, applications of DSP processors

Text Books:

1. Discrete time signal processing, A. V. Oppenheim, R. W. Schafer, 3rd Edition, Prentice-Hall of India, 2001.

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2. Digital signal processing- A computer based approach, S. K. Mitra, 2nd Edition, Tata McGraw Hill, 2002.
3. Modern Digital signal processing , V Udayashankara, 2nd edition, Prentice-Hall of India, 2012

Reference Books:

1. Digital Signal Processing- A Practical Approach, E. C. Ifeachor, B. W. Jarvis, 2nd Edition, Pearson Education, New Delhi, 2002.
2. Digital signal processing –Principles, algorithms and applications, J. G. Proakis, D. G. Manolakis, 3rd Edition, Prentice Hall of India, 2002.
3. Understanding Digital Signal Processing, R. G. Lyons, Pearson Education, New Delhi, 1999.
4. http://www.nptel.iitm.ac.in

Course Outcomes:

On completion of the course, students will be able to:

INU 524.1 Represent system in direct form I, direct form II, cascade and parallel form
INU 524.2 Implement decimation in time and decimation in frequency FFT algorithms
INU 524.3 Understand and able to design IIR Filter and linear phase FIR filter using rectangular, hamming and hanning windows
INU 524.4 Describe the concept of wavelet transform in digital signal processing
INU 524.5 Explain the various features of DSP processors

CO – PO –PSO Mapping:

CO	PO/PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	0	0	0	0	0	0	0	0	0	0	0	0	3	0
CO2	2	0	1	0	2	0	0	0	0	0	0	0	2	1	0
CO3	2	1	1	0	1	0	0	0	0	0	0	0	3	2	0
CO4	3	2	0	0	1	0	0	0	0	0	0	0	2	2	0
CO5	2	0	0	0	1	0	0	0	0	0	0	0	0	3	0

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

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INU525 ANALYTICAL INSTRUMENTATION

Teaching Scheme : 03 L + 0 T **Total 03** **Credit: 03**
Evaluation Scheme: 30MSE +10 TA+ 60 ESE **Total Marks: 100**
Duration of ESE : 2hrs.30min

Course Objectives:

I. To identify, understand and define the fundamentals of Analytical instruments
II. To sketch various types of flame photometry
III. To Illustrate the elements of Absorption Spectroscopy
IV. To discuss the terms, principle, instrumentation, operation and applications of Molecular spectroscopic techniques.
V. To describe and articulate various aspects of Gas and Liquid Chromatography

Introduction to Chemical instrumental analysis: advantages over classical methods, classification: Spectral, electro analytical and separative methods, Laws of photometry (Beer and Lambert's law), Basic Components of analytical instruments, Electromagnetic radiation and its interaction with matter

Colourimeters and spectrophotometers (UV-Visible): monochromators, filters, grating, prism, dual wavelength and double monochromator systems, rapid scanning spectrophotometers, IR spectrophotometers

Flame Photometry: Principle, constructional details, flue gases, atomizer, burner, optical system, recording system. Atomic absorption spectrophotometers: Theoretical concepts, instrumentation: hollow cathode lamps, burners and flames, plasma excitation sources, optical and electronic system

Atomic Spectroscopy: An introduction to spectrometric methods. Atomic absorption Spectrometer: Theoretical concept and Instrumentation, hollow cathode lamp, Burner and flames, Plasma excitation sources

Mass Spectrometer (MS): Principle, ionization methods, mass analyzer types - magnetic deflection type, time of flight, quadruple, double focusing, detectors for MS, applications X-ray spectrometry: Instrumentation for X-ray spectrometry, X-ray diffractometer

Chromatography: Classification, Gas chromatography: principle, constructional details, GC detectors, Liquid Chromatography, High Performance Liquid Chromatography (HPLC): principle, constructional details, HPLC

Text Books:

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1. Instrumental Methods of Analysis, Willard, H H; Merritt, Jr, L L; Dean, J A; Settle, Jr, F A., CBS Publishers and Distributors, 7th edition, New Delhi.
2. Handbook of Analytical Instruments, R. S. Khandpur, , 3rd edition, Tata McGraw–Hill Publications

Reference Books:

1. Instrumental Methods of Chemical Analysis, Galen W. Ewing, 5th edition, McGraw-Hill Book Company.
2. Introduction to Instrumental Analysis, Robert D. Braun, 2nd edition, McGraw-Hill Book Company
3. Principles of Instrumental Analysis, Skoog, Holler, Nieman, 5th edition, Thomson books-cole publications.

Course Outcomes:

On completion of the course, students will be able to:

INU525.1 Identify, understand and define the fundamentals of Analytical instruments
INU525.2 Sketch various types of flame photometry
INU525.3 Illustrate the elements of Absorption Spectroscopy
INU525.4 Discuss the terms, principle, instrumentation, operation and applications of Molecular spectroscopic techniques.
INU525.5 Describe and articulate various aspects of Gas and Liquid Chromatography

CO – PO –PSO Mapping:

CO	PO/PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	0	0	0	0	0	0	0	0	0	0	0	1	2	0
CO2	2	0	0	0	0	0	0	0	0	0	0	0	2	2	0
CO3	3	1	0	0	0	0	0	0	0	0	0	0	2	1	0
CO4	2	1	0	0	0	0	0	0	0	0	0	0	1	2	0
CO5	2	0	0	0	0	0	0	0	0	0	0	0	1	2	0

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

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Programme Elective-I

INU526 (A) AUTOMOTIVE INSTRUMENTATION

Teaching Scheme : 03 L **Total: 03** **Credit: 03**
Evaluation Scheme: 30 MSE +10TA+ 60 ESE **Total Marks: 100**
Duration of ESE : 2hrs.30min

Course objectives:

I. To understand the concepts of automotive electronics and its evolution and trends.
II. To learn Electronic fuel injection and ignition systems
III. To understand the various automotive control systems using Model based development technique.
IV. To understand concept of hybrid electric
V. To develop the ability to understand safety standards advances in towards autonomous vehicles.

Fundamentals and automotive electronics: Introduction to Automobile industry and plant. Open loop and closed loop system component for electronic engine management, Vehicle motion control, current trends in modern automobiles, overview of typical automotive systems and components, AUTOSAR.

Electronic fuel injection and ignition systems: Introduction, carburettor control system, throttle body ignition and multi-port and point fuel injection, advantages of electronic ignition system, types of solid state ignition system and their principle of operation, electronic spark timing control system.

Engine control system: Engine cranking and warm up control, acceleration enrichment De-acceleration leaning and idle speed control, integrated engine control system, exhaust emission control system, engine performance testing automobile chassis electronic control system, principle of electronic braking, automatic transmission electronic control circuit, cruise control circuit, the electronic steering control theory, ABS, ASR, ESP and other electronic control method.

Hybrid Electric Vehicles : Concept of Hybrid Electric Drive Trains , Architectures of Hybrid Electric Drive Trains , Series Hybrid Electric Drive Trains , Parallel Hybrid Electric Drive Trains, Torque-Coupling Parallel Hybrid Electric Drive Trains, Speed-Coupling Parallel Hybrid Electric Drive Trains, Torque-Coupling and Speed-Coupling Parallel Hybrid Electric Drive Trains

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Active and passive safety system : Body electronics including lighting control, remote keyless entry, immobilizers etc., electronic instrument clusters and dashboard electronics, aspects of hardware design for automotive including electro-magnetic interference suppression, electromagnetic compatibility etc., (ABS) antilock braking system, (ESP) electronic stability program, air bags.

Text Books:

1. Understanding Automotive Electronics, William B. Ribbens, 6th Edition, Butterworth-Heinemann Publication, 2003.
2. Automobile Engineering Volume-IandII , Dr. Kirpal Singh Gill, Standard Publishers Distributors

Reference Books:

1. Automotive Electrical Equipment , Young A.P., Griffiths, ELBS and New Press, 1999.
2. Automotive computers and control system, Tom Weather Jr. andCland c. Ilunter, Prentice Hall Inc., New Jersey.
3. Automobile Engineering Volume-IandII, Dr. Kirpal Singh, Publication
4. Understanding Automotive Electronics, William B. Riddens, 5th Edition, 1998
5. Automotive Hand Book , Robert Boshe, Bentely Publishers, 5th Edition, Germany,2005.
6. Computers and Control system, Tom Weather Jr and Cland C. Hutter, Prentice Hall Inc. NewJeresy
7. Modern electric, hybrid electric and fuel cell vehicles fundamentals, theory and design Mehrdad Ehsani, Yimin Gao, Ali Emadi, by CRC Press.

Course outcomes:

On completion of the course, students will be able to:

INU526 (A).1 Describe knowledge of various of automotive electronics and its evolution.
INU526 (A).2 Understand the basic knowledge of Electronic fuel injection and ignition systems.
INU526 (A).3 Ability to understand automotive control unit.
INU526 (A).4Understand the overview of Hybrid Electric Vehicle and safety systems employed in today's automotive industry
INU526(A).5 Select the basic modelling and control scheme for automotive systems.

CO – PO –PSO Mapping:

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CO	PO/PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	0	0	0	1	0	0	0	0	0	1	0	0
CO2	2	3	2	1	0	0	0	0	0	0	2	0	2	2	1
CO3	3	1	3	0	0	2	0	0	0	1	0	1	1	3	0
CO4	1	2	1	2	2	0	1	0	0	0	2	0	1	1	0
CO5	1	2	1	1	0	0	0	1	1	2	0	1	1	2	1

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

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Programme Elective-I

INU526 (B) INSTRUMENT SYSTEM DESIGN

Teaching Scheme : 03 L **Total: 03** **Credit: 03**
Evaluation Scheme: 30 MSE +10TA+ 60 ESE **Total Marks: 100**
Duration of ESE : 2hrs.30min

Course objectives:

I. To understand the basic design procedure and electronic design guidelines
II. To design temperature, flow instrumentation system
III. To understand the basic need and procedure of reliability engineering
IV. To summarize the selection criteria of different sensors according to its applications
V. To describe the hazardous area classification

Basic concepts of design: Design procedure, Basic concepts of instrument design, Functional requirements and specifications of instrumentation component. SMART transmitterand its features, SMART transmitter using HART protocol

Electronic design guidelines: Noise in electronic circuit, the design of low noise Circuits, Component limits for intrinsic safe design, The Zener Barrier, Grounding and shielding techniques, protection against electromagnetic interference and electrostatic discharge, Packaging for various operational environment including IP-51, IP-54, IP65, IP67 and IP68.

Design of temperature instrumentation system: using RTD, thermocouple, thermistor, Selection criteria, Self heating effects in resistive temperature transducers, Power-dissipation constant and its calculations, Thermocouple with thermowell assembly, time-constant calculation, Protection-tubes, types, materials, Design considerations for thermowell

Design of flow instrumentation system: using orifice, rotameter, venturimeter, different flow coefficient like Cd, Cc, and Cv and their calculation. Types of orifice designs, Types of pressure taps to measure Δp, Different design considerations in orifice, venturimeter and rotameter design.

Reliability engineering: Reliability concepts, causes of failures, bath tub curve, Quality and reliability, MTTF, MTBF, and MTTR. Availability and Maintainability. Redundancy and redundant systems

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Hazardous Area Classification: Classification of hazardous Area. Protection Principle, Explosion and Flame proof Protection, Type of Protection-Oil or Liquid Emersion, Increase Safety. Intrinsic Safety, Safety Integrity Level.

Text Books:

1. Noise Reduction Techniques, Ott, 2nd edition, A Wiley-Interscience publication
2. Measurement and Instrumentation Theory and Applications Morris and Langari, 3rd edition, Academic Press, 2020.
3. Measurement Systems , Doeblin E. O. and D. Mannik, 5th Edition, Application and Design, McGraw Hill International Edition, 2006.

Reference Books:

1. Process Instrumentation, and Control Handbook Considine D. M., 3rd Edition, McGraw Hill International
2. Process Control Instrument Engineers Handbook, Bela G. Liptak, 3rd Edition, Butterworth Heinemann Company, 1999
3. Principles of Measurement Systems Bentley J. P., 3rd edition, Pearson Education, New Delhi, 2000.
4. Warren Boxleitner, IEEE press: Electrostatic Discharge and Electronic Equipment
5. Printed Circuit Boards , Walter C Bosshart, 31st reprint, CEDT Series-Tata McGraw Hill publications, 2001
6. Applications of Analog Integrated Circuit, S. Soclof, Prentice Hall of India, 2004
7. Applied Instrumentation in the Process Industries, Andrew Williams, 2nd Edition, Vol. I and Vol. II, GWF Publishing Company, 2002
8. Process Control Instrumentation Technology, Johnson C. D., 7th Edition, Pearson Education, New Delhi, 2003.
9. A Course in Mechanical Measurements and Instrumentation, Sawhney A. K. and Puneet Sawhney, 26th edition, Dhanpat Rai and Co. (P) Ltd., New Delhi, 1998

Course Outcomes:

On completion of the course, students will be able to:

INU526(A).1 Understand the basic design procedure and electronic design guidelines
INU526(A).2 Design temperature, flow instrumentation system

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INU526(A).3 Understand the basic need and procedure of reliability engineering
INU526(A).4 Summarize the selection criteria of different sensors according to its applications
INU526(A).5 Describe the hazardous area classification

CO – PO –PSO Mapping:

CO	PO/PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	0	0	0	1	0	0	0	0	0	0	0	0
CO2	2	3	2	1	1	0	0	0	0	0	2	0	0	2	0
CO3	3	2	3	0	0	0	0	0	0	1	0	1	0	1	0
CO4	3	2	3	2	0	0	1	0	2	2	2	0	2	3	3
CO5	3	2	3	1	0	0	0	1	2	2	0	1	2	3	3

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Programme Elective-I

INU526(C) HYDRAULIC AND PNEUMATICS COMPONENTS

Teaching Scheme : 03 L **Total: 03** **Credit: 03**
Evaluation Scheme: 30 MSE +10TA+ 60 ESE **Total Marks: 100**
Duration of ESE : 2hrs.30min

Course Objectives:

I. To explain the Fluid power and operation of different types of pumps.
II. To summarize the features and functions of Hydraulic motors, actuators and Flow control valves
III. To understand the functions of hydraulic and pneumatic Controllers
IV. To develop different types of Hydraulic circuits and systems
V. To understand the functions of hydraulic and pneumatic Controllers

Introduction of fluid power: Incompressible Fluids, Advantages and Applications – Fluid power systems – Types of fluids - Properties of fluids and selection – Basics of Hydraulics – Pascal's Law – Principles of flow - Friction loss, Functional requirements of a power transmission systems like mechanical, oil hydraulic, pneumatic, electrical or their combinations
Basic Accessories of Hydraulic System: Construction, Working, Design, Advantages, Disadvantages of rotary and reciprocating pumps like and their characteristics, Specifications, sizing and selection of pumps, Linear actuators like ram type, telescopic and single acting/double acting, types of their constructions, cylinder materials, cushioning of hydraulic cylinders, Sequencing of cylinders,
Hydraulic Circuits and Systems: Standard Symbols for developing hydraulic circuits, Accumulators, Intensifiers, Industrial hydraulic circuits – Regenerative, Pump Unloading, Double Pump, Pressure Intensifier, Air-over oil, Sequence, Reciprocation, quick return, Synchronization, Fail-Safe, Direction control, Flow Control, Speed Control, design and selection of components.
Basic Accessories of Pneumatic System: Pneumatic fundamentals, Construction, working principle and operation of pneumatic power transmission system components like Power source, FRL unit, Actuators and control valves like DCV, FCV, PCV, time delay, quick exhaust, twin pressure, shuttle;
Pneumatic control circuits and systems- Standard Symbols used for developing pneumatic circuits, Pneumatic circuits like reciprocating circuits, switching circuits, sequential circuits,

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hydro pneumatic circuits, solenoid operated circuits, simple logic circuits, Selection, sizing and specifications of pneumatic components.

Hydraulic and Pneumatic Controllers used in Feedback Control systems: Construction, working principle and operation of proportional and servo control valves including servo-type DCV like nozzle valve, flapper type valve, mechanical servo valve, single and double stage servo valves; Applications of servomotor systems in feedback control systems.

Text Books:

1. Industrial Hydraulics, John Pippenger, Tyler Hicks, McGraw Hill.
2. Oil Hydraulic Systems, Principle and Maintenance, Majumdar S R, McGraw-Hill.
3. Fluid Power with Applications, Esposito Anthony, Pearson.

Reference Books:

1. Fluid Power: Generation, Transmission and Contro, Jagadeesha T. and Thammaiah Gowda, 1st edition, Wiley publication
2. The Analysis and Design of Pneumatic Systems , B. W. Anderson, John Wiley.
3. Control of Fluid Power Analysis and Design , Mc Clay Donaldson, Ellis Horwood Ltd.
4. Hydraulic and Pneumatic Controls: Understanding made Easy, K.Shanmuga Sundaram, S.Chand and Co Book publishers, New Delhi, 2006 (Reprint 2009)
5. Basic Pneumatic Systems, Principle and Maintenance , S R Majumdar, McGraw-Hill.
6. Basic Fluid Power Dudley, A. Pease and John J. Pippenger, Prentice Hall, 1987
7. Fluid Power Circuits and Controls: Fundamentals and Applications, John S. Cundiff, CRC Press, 2002.
8. Fluid Power: Theory and Applications , James A. Sullivan, 3rd Edition, Prentice Hall, 1989

Course Outcomes:

On completion of the course, students will be able to:

INU526(C).1	Explain the Fluid power and operation of different types of pumps.
INU526(C).2	Summarize the features and functions of Hydraulic motors, actuators and Flow control valves
INU526(C).3	Develop different types of Hydraulic circuits and systems
INU526(C).4	Design the different pneumatic circuits and systems

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INU526(C).5 Understand the functions of hydraulic and pneumatic Controllers

CO – PO –PSO Mapping:

CO	PO/PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	0	0	0	1	0	0	0	0	0	0	0	0
CO2	2	3	2	1	1	0	0	0	0	0	2	0	0	2	0
CO3	3	2	3	0	0	0	0	0	0	1	0	1	0	1	0
CO4	3	2	3	2	0	0	1	0	2	2	2	0	2	3	3
CO5	3	2	3	1	0	0	0	1	2	2	0	1	2	3	3

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Programe Elective-I

INU526 (D) OPTICAL FIBER COMMUNICATION

Teaching Scheme : 03 L + 0 T **Total 03** **Credit: 03**
Evaluation Scheme: 30MSE +10 TA+ 60 ESE **Total Marks: 100**
Duration of ESE : 2hrs.30min

Course Objectives:

I. To explain the basic principles of optical fiber, types of optical fiber, optical sources and optical fiber fabrication. Understand
II. To describe the working of fiber optic sensors Understand
III. To attain deep knowledge about the Interferometers Knowledge
IV. To understand and apply knowledge of LASERS
V. To apply the knowledge of Wavelength Division Multiplexing Concepts and Components

Principle of Optical fiber: Acceptance angle and acceptance cone – Numerical aperture – V-number – Types of optical fibers (Material, Refractive index and mode) – properties- Optical sources-Optical detectors. Optical fiber production and fabrication.
Fiber optic sensors: Fiber optic instrumentation system for measurement of fiber characteristics – Different types of modulators – Interferometric method for measurement of length – Moire fringes – Measurement of pressure, temperature, current, voltage, liquid level and strain – fiber optic gyroscope. Source coupling- Fiber connection-Splicing Techniques.
Interferometers: Fabry – perot and Michelson interferometers – Interference filters – Interferometeric method of measurement – Interference filters – Interferometeric method of measurement of optical components – Optical spectrum analyzer.
Lasers: Principles of operation – Einstein relations – Population inversion – Optical feedback – laser modes – Classes of laser – Solid state, gas and liquid dye lasers– Semiconductor lasers – Q-switching and mode locking – Properties of laser light, Applications: measurement of distance, length, atmospheric effect and pollutants using Laser
Wavelength Division Multiplexing: Introduction to WDM, operation principles, WDM standards, Mach-Zehender interferometer, multiplexer, Isolators and circulators, direct thin film filters, active optical components, variable optical attenuators, tunable optical fibers, dynamic gain equalizers, optical drop multiplexers, polarization controllers, chromatic dispersion compensators

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Text Books:

1. Optical Fiber Communication, G. Keiser, McGraw Hill, 1995.
2. Optoelectronics: An Introduction, J.Wilson and J.F.B.Hawkes , Prentice Hall of India.

Reference Books:

1. Industrial Applications of Lasers, John F. Ready, Academic Press, 1978.
2. Optical Fiber Communications-Principles and Practice, John M. Senior, Pearson Education Limited.
3. Lasers: Theory and Applications, K.Thygarajan and A.K.Ghatak , Plenum Press.
4. Principles of Lasers, O.Svelto , Plenum Press.

Course Outcomes:

On completion of the course, students will be able to**:**

INU526(D).1	Explain the basic principles of optical fiber, types of optical fiber, optical sources and optical fiber fabrication.
INU526(D).2	Able to describe the working of fiber optic sensors
INU526(D).3	Attain deep knowledge about the Interferometers
INU526(D).4	Understand and apply knowledge of LASERS
INU526(D).5	Apply the knowledge of Wavelength Division Multiplexing Concepts and Components

CO – PO –PSO Mapping:

CO	PO/PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	0	0	0	0	0	0	0	0	0	0	0	3	0
CO2	2	0	0	0	1	0	0	0	0	0	0	0	1	2	0
CO3	3	2	0	2	2	0	0	0	0	0	0	0	2	2	0
CO4	2	0	0	2	0	0	0	0	0	0	1	1	1	3	2
CO5	0	1	0	2	0	0	0	0	0	0	2	0	1	2	3

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Programme Elective-I

INU526 (E) BIOMEDICAL SIGNAL PROCESSING

Teaching Scheme : 03 L **Total: 03** **Credit: 03**
Evaluation Scheme: 30 MSE +10TA+ 60 ESE **Total Marks: 100**
Duration of ESE : 2hrs.30min

Course Objectives:

I To introduce the biomedical signal origin and dynamics
II To give the basic knowledge of signal processing on biomedical signals
III To give the knowledge about events detection (viz. P, QRS and T wave in ECG)
IV To study the filtering techniques, Neurological Signal Processing techniques
V To study the various biomedical signal Data compression techniques

Introduction to biomedical signals: The nature of biomedical signals, Examples of Biomedical signals, objectives of biomedical signal analysis, Sources of noise in biomedical signal recordings, Difficulties in biomedical signal analysis

Cardiological signal processing: Basic electrocardiography, ECG signal characteristics, Powers spectrum of ECG, Band pass filtering technique, Differentiation technique, Template matching, approaches for QRS Detection Pan Tompkins Algorithm for QRS Detection, Dicrotic Notch Detection, Correlation coefficients.

Neurological Signal Processing: The brain and its potentials, the electrophysiological origin of brain waves, The EEG signal and its characteristics, EEG analysis Auto Regressive (A.R.)modeling, Sleep Stage analysis

Signal Averaging: Basics of signal averaging, signal averaging as a digital filter, software for signal averaging, limitation of signal averaging.

Adaptive Filters: Principal noise canceller model, 60 Hz adaptive cancelling using sine wave model, applications of adaptive filtering removal of artifacts of one signal embedded in another - Maternal-Fetal ECG.

Data Reduction Techniques: Lossy and Lossless data reduction Algorithms, Direct ECG data compression techniques, Turning point algorithm, AZTEC Algorithm, Fan algorithm, Huffman coding.

Text Books:

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1. Biomedical Signal Processing Principles and Techniques, D. C. Reddy, Tata McGraw-Hill, 2005.
2. Biomedical Signal Analysis A case study approach, Rangaraj M. Rangayyan, JohnWiley, 2002.

Reference Books:

1. Biomedical Digital Signal Processing, Willis J. Tompkins, Prentice Hall of India publications/ Eastern Economy Edition, Print, 2000.
2. Biomedical Instrumentation and Measurements, F. Weibell , L. Cromwell, Prentice Hall of India Pvt. Ltd publication, 1979.
3. Hand book of Biomedical Instrumentation, Khandpur R. S., 2nd edition, Prentice Hall of India Pvt. Ltd, New Delhi, India, 1999

Course Outcomes:

On completion of the course, students will be able to:

INU526(E).1	Describe the origin, source and characteristics of biomedical signals,
INU526(E).2	Differentiate, apply the basics of signal processing techniques on biomedical signals
INU526(E).3	Demonstrate proficiency in using the QRS detection algorithm
INU526(E).4	Demonstrate the techniques for EEG waveform signal analysis
INU526(E).5	Discuss, categorize the data reduction techniques

CO – PO –PSO Mapping:

CO	PO/PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	0	3	-
CO2	3	1	-	-	2	-	-	-	-	-	-	-	3	2	-
CO3	2	1	-	1	2	-	-	-	-	-	-	-	2	2	1
CO4	2	1	-	1	1	-	-	-	-	-	-	-	1	2	1
CO5	2	1	-	-	2	-		-	-	-	-	-	2	2	0

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Programme Elective-I

INU526 (F) MICROCONTROLLER AND ITS APPLICATION

Teaching Scheme: 03 L **Total: 03** **Credit: 03**
Evaluation Scheme: 30MSE +10 TA+ 60 ESE **Total Marks: 100**
Duration of ESE: 2hrs.30min.

Course Objective:-

I. To learn the fundamentals of microcontrollers
II. To understand the concepts of Assembly Language Programming of 8051
III. To understand the basic hardware interfacing
IV. To learn the basic serial communication modes of microcontroller and basics of embedded system.
V. To develop application based systems using microcontrollers with efficient programming

Introduction to microcontrollers: Comparison of microprocessor and microcontrollers, architecture of 8051 and study of SFR, Overview and features, On chip and external memory map, Interrupt Structure, Timers and Counters, Generating Software and Hardware Delays, Serial Communication, Power Down and Idle mode .

Assembly language programming for 8051: Architecture and operation, pin out diagram microcontroller instruction classification, instruction set Arithmetic and logical operations, jump and call instructions etc., Writing assembly language programming based on instruction set, stacks and subroutines.

Interrupts of 8051: Serial data I/P and O/P, serial data transmission and communication counters and timers, timer modes timer/counter programming.

8051 microcontroller interfacing with: 8255, Keyboard and Display devices like LED, LCD, Stepper motor interfacing, A/D and D/A chips external memories (RAM and EPROM), Memory interfacing concepts, I/O interfacing concepts, I/O expansion.

Serial data communication: Introduction to serial data communication, network configuration, 8051 data communication mode (Mode 0 –Shift register mode, Mode1- Standard 8-bit UART Mode, Mode 2 and 3- Multiprocessor).

Introduction ofEmbedded systems : Define Embedded systems, Main Components of Embedded system, Classification, Different Processor used in system, application of embedded system Introduction of PIC microcontroller.

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Text Books:

1. The 8051 Microcontroller and Embedded System, M.A. Mazidi, PearsonEducation, 2004.

2. The 8051 microcontroller, Kenneth Ayala, 3rd edition, Delmar Cengage Learning, 2005.

Reference Books:

1. 8051 Microcontroller-Internals,Instructions,Programming and Interfacing by Subrata Ghoshal
2. Microcontroller Basics, Muhammad Ali Mazidi, Rolin McKinlay, Davies J H Publisher: Elsevier Year: 2011
3. Programming and customizing the 8051 Microcontroller, Myke Predko, McGraw-Hill, New Delhi, 1999.
4. Microcontroller, Sampath K. Venkatesh, Publisher: S. K. Kataria and Son

Course Outcomes:

On completion of the course, students will be able to:

INU526(F).1 Understand Microcontrollers basics
INU526(F).2 Develop and implement Assembly language programs
INU526(F).3 Understand the hardware Interfacing with 8051 to develop a simple microcomputer system
INU526(F).4 Understand the basic serial communication modes of microcontroller and embedded system basics.
INU526(F).5 Develop simple application based projects.

CO – PO –PSO Mapping:

CO	PO/PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	0	0	0	1	0	0	0	0	0	1	0	0
CO2	2	1	2	1	0	0	0	0	0	0	2	0	2	2	1
CO3	2	0	3	0	0	2	0	0	0	1	0	1	1	3	0
CO4	1	2	2	2	2	2	1	0	1	0	0	2	0	1	2
CO5	2	2	1	1	0	0	0	0	0	2	0	1	1	0	0

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INU527 POWER ELECTRONICS LAB

Teaching Scheme: 02 P **Total: 02** **Credit: 01**
Evaluation Scheme: 25 ICA +25 ESE **Total Marks: 50**
Duration of ESE: 3hrs

Course Objectives:

I. To familiarize with principles and characteristics of SCR
II. To acquiring an understanding of Phase Controlled Rectifiers, DC Chopper and Inverters.
III. To analyze the characteristics of Speed control of DC motors.

Minimum Eight Experiments should be conducted from the sample list given below.
(Students perform and observe waveform for all experiments on software (multisim).**)**

1. Observe characteristics of SCR
2. RC triggering circuit of SCR
3. Observe characteristics UJT Relaxation oscillator.
4. Single phase controlled Rectifiers.
5. Single phase half controlled with R Load.
6. Single phase half controlled with RL Load.
7. Single phase full bridge Rectifiers.
8. Three phase rectifier circuit.
9. Basic step-down chopper.
10. Basic step-up chopper.
11. Speed control of D.C. motor using controlled rectifiers.
12. Speed control of D.C. motor using choppers.
13. Speed control of A.C. motor using inverter.

Course Outcomes:

On completion of the course, students will be able to:

INU527.1 Understanding of Phase Controlled Rectifiers, Chopper, SCR and Inverters.

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INU527.2 Analyze the characteristics of Speed control of DC motors.

INU527.3 Design and implement industrial applications of power electronic circuits.

Note:

ICA- The Internal Continuous Assessment shall be based on the practical record and Knowledge/skill acquired. The performance shall be assessed experiment wise by using continuous assessment formats A and B.

ESE- The End Semester Exam shall be based on performance in one of the experiments and may be followed by sample questions.

CO – PO –PSO Mapping:

CO	PO/PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	0	0	0	1	0	0	0	0	0	1	0	0
CO2	2	1	3	0	0	2	0	1	0	1	0	1	1	2	0
CO3	1	2	3	2	2	2	1	0	1	0	2	2	0	0	2

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INU528 DIGITAL SIGNAL PROCESSING LAB

Teaching Scheme: 02 P **Total: 02** **Credit: 01**
Evaluation Scheme: 25 ICA + 25 ESE **Total Marks: 50**
Duration of ESE: 3hrs

Students are supposed to write the programs (at least eight) on general-purpose computer using any development environment (MATLAB/ C/C++) or on any DSP processor and development environment

Course objectives:

I. Knowledge of MATLAB or any other resources/tool to explain the classification of signals and basic operations on the signals
II. Explore the MATLAB for various filter design and implementation
III. Explore the architecture and features of DSP processors

List of the Experiments

1 Write a Matlab Program to generate the ramp, exponential, sine, cosine sequence (Digital signal generation)
2 To compute the convolution of two sequences and coorelation of two sequences
3 Determine the DFT and IDFT of the given sequence
4 To compute the circular convolution using FFT
5 To compute the linear convolution using FFT
6 To compute correlation using FFT
7 Design a low pass and High pass FIR filter using hamming window
8 Design a low pass FIR filter using frequency sampling method
9 Design a low pass Butterworth IIR filter using bilinear transformation method
10 Design Lowpass, Highpass IIR Chebyshev filter

Note:

ICA- The Internal Continuous Assessment shall be based on the practical record and Knowledge/skill acquired. The performance shall be assessed experiment wise by using continuous assessment formats A and B.

ESE- The End Semester Exam shall be based on performance in one of the experiments and may be followed by sample questions.

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Course Outcome:

On completion of the course, students will be able to:

INU528.1 Use the Matlab programming efficiently for any DSP signal generation and operations
INU528.2 Design the filters as per the applications
INU528.3 Analyse the signals by using various DSP filtering techniques

CO – PO –PSO Mapping:

CO	PO/PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	0	2	0	0	0	0	0	0	0	2	1	-
CO2	1	1	2	0	2	0	0	0	0	0	0	0	2	1	0
CO3	1	3	0	0	2	0	0	0	0	0	0	0	2	1	0

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INU529 ANALYTICAL INSTRUMENTATION LAB

Teaching Scheme: 02 P **Total: 02** **Credit: 01**
Evaluation Scheme: 25 ICA + 25 ESE **Total Marks: 50**
Duration of ESE: 3 hrs.

Course Objectives:

I. To have a practical hands on experience on Absoprtion Spectroscopic methods
II. To acquire experience in the purification by performing chromatography
III. To validate and analysis using spectrometric and microscopic techniques

Minimum Eight Experiments to be performed covering the entire Syllabus of **INU525 ANALYTICAL INSTRUMENTATION**. Representative list is as follows. (Virtual labs of various IITs can be refer for practical conduction)

1. To study principle, working and various elements of colorimeter and to find out the transmittance and absorbance of a given sample
2. To check the response of source sensor assembly
3. Design one application of log amplifier
4. Verification of pH values for temperature ranges
5. To study principle, working and various elements of densitometer
6. To study UV-Visible spectrophotometer
7. To study Flame Photometer
8. To study principle, working and various elements of Atomic Absorption spectrophotometer

Course Outcomes:

On completion of the course, students will be able to:

INU529.1 Have a practical hands on experience on Absoprtion Spectroscopic methods
INU529.2 Acquire experience in the purification by performing chromatography
INU529.3 Validate and analysis using spectrometric and microscopic techniques

Note:

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ICA- The Internal Continuous Assessment shall be based on the practical record and Knowledge/skill acquired. The performance shall be assessed experiment wise by using continuous assessment formats A and B.

ESE – The End Semester Exam for Practical shall be based on performance in one of the experiments and may be followed by sample questions.

CO – PO –PSO Mapping:

CO	PO/PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	0	2	0	0	0	0	0	0	0	0	0	2	0
CO2	2	1	0	2	0	0	0	0	0	0	0	0	2	2	0
CO3	2	2	0	3	0	0	0	0	0	0	0	0	2	3	1

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INU621 PROCESS CONTROL

Teaching Scheme: 03 L + 1 T **Total: 04** **Credit: 04**

Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **Total Marks: 100**

Duration of ESE: 2hrs.30min.

Course Objective:-

I. To learn the fundamentals of Process.
II. To study the concepts of Dynamic Behavior of systems.
III. To understand the basic construction of Final Control Element and Controller
IV. To learn the Concept of feedback control.
V. To analyze and Design of Advanced Control systems

Introduction to Process control: Process characteristics, Types of processes, process characteristics and controllability, self regulating and non self regulating. Processes, interacting and non-interacting processes. Relative gain array and it's analysis.

Dynamic Behavior of systems: Dynamic Behavior of First Order, second order and higher order systems, Dynamic response of first order lag system, First order system with variable time constant and gain, Dynamic systems with Dead Time, Dynamic systems with Inverse Response.

Control Valve as Final Control Element : Introduction of control valve, Main components of valve, Valve types, Valve characteristics, selection of control valves, concept of Cv, calculation of Cv and trim size, cavitations and flashing, noise in control valves, testing of control valve, valve positioners, necessity of positioners.

Controllers: Open Loop and Closed Loop Control System, .Multi-loop and Multivariable Process control system, Design consideration for P, PI, PID, ON OFF Controller, Tuning of PID controller using Cohen-Coon method, Ziegler-Nichols Turning Technique, frequency response method.

Introduction to Feed Back control: Concept of feedback control, Types of feedback controller, measuring devices, Transmission lines, FCE, Outline of design problems; simple performance criteria, time integral performance content, selection of a feedback controller.

Analysis of Advanced Control systems: Feedback control systems with large dead time or inverse response, feed forward control, Cascade control, ratio control, auto selective control, Split range Control, adaptive control system, inferential control system

Text Books:

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1. Process Control System, F. G. Shinskey, 2nd Edition, McGraw Hill, 1979.
2. Chemical process control, George Stephanopoulos, Prentice-Hall of India, 2003.

Reference Books:

1. Process Control Handbook, Bela G. Liptak, Chilton Book Company, 2001.
2. Computer Based Industrial Control Krishnakant, Prentice-Hall of India, 1997
3. Process Instrumentation and Control Handbook Considine, 5th Edition, McGraw Hill, 1995.
4. Instrumentation for Process Measurement and Control, Norman A. Anderson, 3rd Edition.
5. Process Systems analysis and Control, D. R. Coughanour, 2nd Edition, McGraw Hill publications.
6. Process Dynamics and Control, D. E. Seborg, T. F. Edger, and D. A. Millichamp, 2nd Edition, John Wiley and Sons, 2004.
7. Shreve's Chemical Process Industries George Austin, 5th edition, McGraw hill Publication 1990.
8. Automatic Process Control, D. Eckman, Wiley Eastern Publication

Course Outcomes:

On completion of the course, students will be able to:

INU621.1 Learn the fundamentals of Process characteristics
INU621.2 Understand the concepts of Dynamic Behavior of systems.
INU621.3 Draw and Explain the basic construction of Controller and Control valve
INU621.4 Learn the Concept of feedback control.
INU621.5 Analyze and Design of Advanced Control systems

CO – PO –PSO Mapping:

CO	PO/PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	0	0	0	1	0	0	0	0	0	1	0	0
CO2	2	3	2	0	0	0	0	0	0	0	1	0	2	2	1
CO3	3	1	3	1	0	2	0	0	0	1	0	1	1	3	1
CO4	1	2	0	2	2	0	1	0	1	0	2	0	0	1	0
CO5	1	2	1	1	0	0	0	0	0	2	0	1	1	2	0

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INU622 INDUSTRIAL AUTOMATION

Teaching Scheme: 03 L+00 T **Total: 03** **Credit: 03**
Evaluation Scheme: 30 MSE +10TA+ 60 ESE **Total Marks: 100**
Duration: 2hrs.30min.

Course objectives:

I. To give knowledge of fundamentals and current trends in Industrial automation
II. To give knowledge of PLC components ,configuration and programming concepts
III. To Explore and understand the DCS and SCADA systems in plants
IV. To explore and understand industry grade virtual automation software
V. To Understand the integration and communication of PLC, DCS SCADA systems

Industrial Automation Basics Fundamentals of industrial automation, need role of automation, current trends, automation strategy evolution

Programmable logic controllers: PLC architecture, operation, definition of discrete process control, ladder diagrams, ladder diagram elements, ladder programming and its features, programming examples of typical processes. Introduction to PLC programming, languages like STL, FBD, CFC, SFC.

DCS Configurations: Hierarchical control , concept of direct digital control, distributed process control, Functional block diagram of DCS, supervisory computer displays, Software configurations in DCS, control technique, Communication between components of DCS, DCS algorithm, attributes. Study of any one DCS such as TDC-3000.

Introduction to Supervisory control and data acquisition (SCADA): Basic architecture of SCADA system, applications to process control systems.

Introduction to virtual automation software for different types of PLC controller, SCADA and pneumatic, hydraulic technology (Autom Gen,Autosim gen), programming examples of typical processes

Introduction to Data highways: Field buses, Multiplexers and remote sensing terminal units.

System integration: With PLC and computer (Hybrid control system), I/O hardware, set point stations, Network protocols, MAP/TOP, HART protocol

Computer integrating process: communication hierarchy, ISO/OSI reference model, MAP, TOP application. Study of YOKOGAWA, Rosemount Distributed Control Systems.

Text Books:

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1. Process Control Instrument Engineers Handbook, D. Eckman, 3rd edition, Butterworth Heinemann Company, 1999
2. Introduction to Programmable Logic Controllers, Gary Dunning, 2nd edition, Thomson Delmar learning, 2002.

Reference Books:

1. Process Control Instrumentation Technology, Johnson C. D., 7th edition, Pearson Education, New Delhi, 2003.
2. Programmable Controllers: Principles and Applications, Webb J. W., Mergy/publishing co. 1988
3. Computer Based Industrial Control, Krishankant, 7th edition, PHI, 2005,
4. Programmable logic controllers and Industrial Automation An introduction, Madhuchandra Mitra, Samarjit Sen Gupta, Penram publishing (India) Pvt Ltd,2009
5. http://www.nptel.iitm.ac.in

Course Outcomes:

On completion of the course, students will be able to:

INU622.1 Describe various blocks, need of Industrial automation
INU622.2 Demonstrate the various functions of PLC and write small programs using PLC
INU622.3 Summarize DCS and SCADA systems
INU622.4 Describe various functions, programming features of Virtual Automation software and Distributed control system
INU622.5 Explore and use the industry grade virtual automation software for small industrial application

CO – PO –PSO Mapping:

CO	PO/PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	0	0	0	0	0	0	0	0	0	0	0	0	2	0
CO2	1	2	3	0	2	0	0	0	0	0	0	0	2	1	1
CO3	3	0	0	0	2	0	0	0	0	0	0	0	0	3	0
CO4	2	0	1	0	3	0	0	0	0	0	0	0	2	1	2
CO5	2	0	2	0	3	0	0	0	0	0	0	0	3	0	1

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INU623 INTERNET OF THINGS

Teaching Scheme: 03 L **Total 03** **Credits: 03**
Evaluation Scheme: 30MSE +10TA+ 60ESE **Total Marks: 100**
Duration of ESE: 2hrs.30min

Course Objectives

I. To understand the structure, function and characteristics of Internet of Things.
II. To develop fundamentals of Arduino Uno
III. To recognize various devices, sensors and applications
IV. To explain the design of the various IoT Applications.
V. To identify the communication protocols

Introduction to IoT: Sensing, Actuation, Networking basics, Communication Protocols, Sensor Networks, Machine-to-Machine Communications, IoT Definition, Characteristics. IoT Functional Blocks, Physical design of IoT, Logical design of IoT, Communication models and APIs, Challenges in IOT

Arduino Simulation Environment Arduino Uno Architecture: Setup the IDE, Writing Arduino Software, Arduino Libraries, Basics of Embedded C programming for Arduino, Interfacing LED, push button and buzzer with Arduino, Interfacing Arduino with LCD

Sensor and Actuators with Arduino: Overview of Sensors working, Analog and Digital Sensors, Interfacing of Temperature, Humidity, Motion, Light and Gas Sensor with, Arduino Interfacing of Actuators with Arduino, Interfacing of Relay Switch and Servo Motor with Arduino

IoT Applications: Healthcare Environmental Transportation Smart Home, City Automation, Tracking (Following and Monitoring Mobile Objects), Control Application Examples

Communication Protocol: IoT and M2M, Introduction to communication architecture- Network protocol stack, IoT protocols: MQTT/MQTTS, CoAP, 6LoWPAN, like TCP, UDP, HTTP/S., Comparison of the different IoT protocols, advantages and disadvantages (limitations) of these IoT protocols. IPv4 addressing problem for IoT and introduction to IPv6 is required to address more devices.

Internet of Things Privacy, Security and Governance- power consumption, LOS, reliability, Standardization, Scalability , Addressing Issues , traffic characterization , Security aspects, Privacy, IoT security tomography and layered attacker model

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Text Books:

1. Internet of Things: A Hands-on Approach, Arshdeep Bahga, Vijay Madisetti, Universities Press, 2015.
2. Getting Started with Intel Edison, Stephanie Moyerman, Published by Maker Media, Inc., San Francisco, 2016. CA 94111.
3. Internet of Things (A Hands-onApproach)Vijay Madisetti and Arshdeep Bahga, 1st Edition, VPT, 2014

Reference Books:

1. ArduinoUno:A Hands-On Guide for Beginner, Agus Kurniawan , 1st edition
2. Getting Started with the Internet of Things, Cuno Pfister, O"Reilly Media, 2011, ISBN: 978-1-4493- 9357-1
3. Internet sources: Arduino site, Intel IoT site, Raspberry pi site.

Supplementary Resources: References Web

a) https://www.udemy.com/internet-of-things-iot-for-beginners-getting-started/
b) http://playground.arduino.cc/Projects/Ideas
c) http://runtimeprojects.com
d) http://www.megunolink.com/articles/arduino-garage-door-opener
e) http://www.willward1.com/arduino-wifi-tutorial
f) http://www.makeuseof.com/tag/pi-overdose-heres-5-raspberry-pi-alternatives
g) http://www.electronicshub.org/arduino-project-ideas
h) http://homeautomationserver.com
i) http://www.toptechboy.com/arduino-lessons
j) https://www.eprolabs.com

YouTube

a) https://www.youtube.com/watch?v=kLd_JyvKV4Y
b) https://www.youtube.com/watch?v=TkA2LJctU1c

Course outcomes:

On completion of the course, student will be able to

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INU623.1 To explain the structure, function and characteristics of Internet of Things.
INU623.2 To develop fundamentals of Arduino Uno
INU623.3 To recognize various devices, sensors and applications
INU623.4 To understand the design of the various IoT Applications.
INU623.5 To identify the communication protocols

CO – PO –PSO Mapping:

CO	PO/PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	0	0	0	0	0	0	0	0	0	0	0	0	1	0
CO2	2	2	3	0	1	0	0	0	0	2	0	0	0	2	0
CO3	0	3	1	0	0	0	2	0	0	1	0	0	0	2	2
CO4	2	2	0	1	0	2	2	0	0	0	2	0	2	1	2
CO5	1	3	2	2	3	0	0	0	0	0	0	0	2	2	0

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INU624 ELECTRICAL MACHINES AND DRIVES

Teaching Scheme: 03 L + 0 T **Total: 03** **Credit: 03**
Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **Total Marks: 100**
Duration of ESE: 2hrs.30min.

Course Objectives:

I. To acquire basic principles, operation, performance and control of DC and AC machine.
II. To study construction and design issues associated with electrical machines.
III. To understand the basic principles, operation and construction of Synchronous Machines.
IV. To gain the knowledge about operation of DC and AC drivers.
V. To make able the students to identify the need and choice for various drives.

DC Machines :D.C. motor principle, comparison of generator and motor action significance of back emf, voltage equation of a motor, torque - armature torque of a motor, shaft torque, speed of d. c. motor, speed regulation, motor characteristics, characteristics of shunt motors, speed control of d. c. shunt motor and applications of DC motors.
AC Machines : Induction motor: General principle, construction, rotor: squirrel cage rotor, Rotor rotation, slip, frequency of rotor current, starting torque for squirrel cage motor, slip-ring motors, condition for maximum starting torque, relation between torque and slip, full load torque and maximum torque, equivalent circuits of rotor, and an induction motor, single phase I.M. revolving theory, equivalent circuit of a single-phase motor, types of single phase motors, DOL and Star Delta Starter.
Synchronous Machines : Basic principles, construction, star and delta connection, equation of induced EMF, synchronous motor principle of operation, method of starting, motor on load, effect of increase in load.
DC drives: DC drives System model, motor rating, motor mechanism dynamics, drive transfer function, effect of armature current waveform, torque pulsations, adjustable speed drives, chopper fed and 1 phase converter fed drives, effect of field weakening.
AC Drives: Induction Motor drives Basic Principle of operation, stator voltage control of induction motor, torque-slip characteristics, operation with different types of load, speed control by varying stator frequency and voltage. Circuit protection devices for motor.

Text Books:

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1. A Textbook of Electrical Technology Vol II , B.L.Theraja, A.K. Theraja, S.Chand and Co. 2nd edition New Delhi
2. Electric Machines and Drives, Ned Mohan, Wiley India Pvt. Ltd., 2013

Reference Books:

1. Electrical Machines, Ashfaq Husain, 3rd edition, Dhanpat Rai and Co. 2000,
2. Electric motor drives, R. Krishnan, PHI, 2001
3. Modern Power Electronics and Ac drives, B.K. Bose, PHI, 2002
4. Electric motors and drives, Fundamentals types And applications, Austin Hughes, 5th edition, 2019
5. Fundamentals of Electrical Drive, G. K. Dubey, 2nd edition, Narosa Publishing House, 2018

Course Outcomes:

On completion of the course, student will be able to

INU624.1 Understand the working principles, classifications of DC and AC electrical machines.

INU624.2 Analyze the characteristics, controls, power stages and applications of Dc machine and AC machines.

INU624.3 Understand the basic principles, operation and construction of Synchronous Machines.

INU624.4 Understand different speed control methods in DC and AC motors using drivers.

INU624.5 Understand the characteristic of load and selection of drive in industrial sectors.

CO – PO –PSO Mapping:

CO	PO/PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	0	0	0	1	0	0	0	0	0	1	0	0
CO2	2	0	2	1	0	0	0	0	0	0	2	0	2	2	1
CO3	3	1	1	0	0	2	0	0	0	1	0	1	1	3	0
CO4	1	2	3	0	2	0	1	0	1	0	2	1	0	1	2
CO5	2	2	1	1	0	0	0	0	0	2	0	1	1	1	0

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

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Open Elective-I

INU633 (A) BASIC INSTRUMENTATION

Teaching Scheme: 03 L **Total: 03** **Credit: 03**
Evaluation Scheme: 30 MSE +10 TA+ 60 ESE **Total Marks: 100**
Duration of ESE: 2hrs.30min.

Course Objectives:

I. To analyze static and dynamic characteristics of a measurement system
II. To explain the principle and working with schematic diagrams of pressure sensors and transducers.
III. To describe the principle and working with schematic diagrams of level sensors and transducers.
IV. To understand the principle and working with schematic diagrams of flow sensors and transducers.
V. To solve preliminary design problems based on various sensors and transducers

General concepts and terminology of measurement systems, transducer classification, general input-output configuration, static and dynamic characteristics of a measurement system, Statistical analysis of measurement data.

Temperature measurement: Introduction to temperature measurements, Thermocouple, Resistance Temperature Detector, Thermistor and its measuring circuits, Radiation pyrometers and thermal imaging.

Pressure measurement: Introduction, definition and units, Mechanical, Electro-mechanical pressure measuring instruments. Low pressure measurement, Transmitter definition types, I/P and P/I Converters.

Level measurement: Introduction, Mechanical and electrical methods of level measurement.

Flow measurement: Introduction, definition and units, classification of flow meters, differential pressure and variable area flow meters, Positive displacement flow meters, Electro Magnetic flow meters, Hot wire anemometer and ultrasonic flow meters. Calibration and selection of Flow meters

Text Books:

1. Measurement Systems - Application and Design, Doebelin E.O., Tata McGraw Hill publishing company, 5th Edition, 2008.

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2. Principles of Industrial Instrumentation, Patranabis D, Tata McGraw Hill, 3rd Edition, 2010.

Reference Books:

1. Instrumentation Reference Book, B.E.Noltingk, 2nd Edition, Butterworth Heinemann, 1995.
2. Process Measurement and Analysis, B.G.Liptak, 4th Edition, Chilton Book Company, Radnor, Pennsylvania, 2003.
3. Process / Industrial Instruments and Controls Handbook, Douglas M. Considine, 5th Edition, McGraw Hill, Singapore, 1999.
4. Applied Instrumentation in Process Industries – A survey, Vol I and Vol II, Andrew W.G, Gulf Publishing Company, Houston, 2001
5. Industrial Flow measurement, Spitzer D. W., ISA press, 3rd Edition, 2005

Course Outcomes:

On completion of the course, student will be able to

INU633(A).1 Analyze static and dynamic characteristics of a measurement system

INU633(A).2 Explain the principle and working with schematic diagrams of pressure sensors and transducers.

INU633(A).3 Describe the principle and working with schematic diagrams of level sensors and transducers.

INU633(A).4 Understand the principle and working with schematic diagrams of flow sensors and transducers.

INU633(A).5 Solve preliminary design problems based on various sensors and transducers

CO – PO –PSO Mapping:

CO	PO/PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	0	2	0	0	0	0	0	0	0	0	0	2	0
CO2	3	0	0	1	0	0	0	0	0	0	0	0	0	3	0
CO3	2	0	0	1	0	0	0	0	0	0	0	0	0	3	0
CO4	3	0	0	1	0	0	0	0	0	0	0	0	0	3	0
CO5	2	3	2	2	0	0	0	0	0	0	0	0	1	2	0

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Open Elective-I

INU633 (B) BIOMEDICAL INSTRUMENTATION

Teaching Scheme : 03 L **Total: 03** **Credit: 03**
Evaluation Scheme: 30 MSE +10 TA+ 60 ESE **Total Marks: 100**
Duration of ESE : 2hrs.30min

Course Objectives:

I. To Introduce the Mechanisms, Anatomy and Physiology of Human body systems
II. To give the knowledge of engineering principles applied to biomedical systems
III. To give the knowledge of the bio potentials, bioelectric signals and electrode systems
IV. To study the characteristics of the ECG, EMG, EEG Waveforms
V. To Introduce electrical parameters measurement, Safety aspects in BME, Imaging techniques CT, MRI

Introduction: Biomedical Instrumentation system, generalized medical measurement systems, classification of biomedical Instruments, scope for Biomedical Engineers.

Physiology and Bio potential Electrodes: Electro-Physiology of cardiovascular system, respiratory system, nervous system, Resting and Action Potential, Electrode electrolyte interface, half-cell potential, Electrodes Limb electrodes, floating electrodes, pregelled disposable electrodes, needle and surface electrodes

Instrumentation in Cardiovascular System (ECG) : Cardiological system, cardiac cycle of the heart, Einthoven triangle, ECG leads Measurement and analysis of EGG waveform. Block schematic of ECG system, Introduction of defibrillators, Phonocardiograph, Pacemakers

Instrumentation in Nervous system (EEG) : Sources of brain potential, generation of brain signals, EEG component waves, EEG -10-20 electrode system, Block schematic of EEG system

Instrumentation in Muscular system (EMG): muscular system, electrical signals of motor unit and gross muscle, human motor coordination system, Block schematic of EMG system

Instrumentation in Non-Electrical Parameter Measurements: Measurement of blood pressure, pulmonary function measurements, Blood Gas analyzers

Safety aspects in BME Safety aspects in biomedical engineering, ground loops and currents, shielding methods of accident prevention

Introduction to Imaging systems – Introduction of X-ray ,Computer tomography, Magnetic resonance imaging system and applications in biomedical engineering

Text Books:

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1. Hand book of Biomedical Instrumentation, Khandpur R. S., 2nd edition, McGraw Hill, New Delhi, India, 2003.
2. Biomedical Instrumentation and measurement, Leslie Cromwell, 3rd edition, Prentice Hall of India, New Delhi, 1997.

Reference Books:

1. Medical Instrumentation, Leslie Cromwell, 5th edition, John Wiley and Sons, Hoboken, NJ, 2010.
2. Introduction to Biomedical Equipment Technology, Carr Joseph J., and Brown J., 4thedition, Pearson Education, 2000.
3. Biomedical Digital Signal Processing, Willis J. Tompkins, Prentice Hall of India publications/ Eastern Economy Edition, 2nd Print, 2000

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

INU633(B).1 Define and apply the engineering principles to Medical engineering
INU633(B).2 Describe mechanisms, anatomy and physiology of various systems of the Human body
INU633(B).3 Demonstrate the measurements on and interpretation of data from ECG,EMG, EEG waveform
INU633(B).4 Categorize different biomedical imaging systems and summarize the safety aspects in biomedical instrumentation
INU633(B).5 Work in interdisciplinary team as per scope of their respective program/branch specific applications in Biomedical Engineering

CO – PO –PSO Mapping:

CO	PO/PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	0	0	0	0	0	0	0	0	0	0	0	3	0
CO2	2	0	0	0	0	0	0	0	0	0	0	0	0	3	0
CO3	1	2	0	1	2	0	0	0	0	0	0	0	2	2	1
CO4	2	0	0	0	0	2	0	0	0	0	0	0	1	2	1
CO5	0	0	0	0	1	2	0	1	2	0	0	0	0	0	2

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Open Elective-I

INU633(C) AUTOMATIC CONTROL SYSTEM

Teaching Scheme : 03 L **Total: 03** **Credit: 03**
Evaluation Scheme: 30 MSE +10 TA+ 60 ESE **Total Marks: 100**
Duration of ESE : 2hrs.30min

Course Objectives:

I. To understand basic concepts, operation and performance of feedback control systems.
II. To design mathematical model of a system and simplify it.
III. To study and analysis of control systems in time domain.
IV. To conduct stability analysis and apply compensators to control System.
V. To learn various methods of frequency domain analysis for linear system.

Introduction to Control System: Introduction to need for automation and automatic control, Basic Components of a Control System, Open loop and closed loop control system, types of feedback control systems-linear v/s non linear systems. Time invariant v/s time varying, effect of feedback on gain, sensitivity, noise.

Mathematical modelling: Mathematical modelling of electrical systems, mechanical systems, electro-mechanical systems, Electrical analogues of dynamical systems, Block diagrams, Block diagram reductions, Signal flow graph, Mason's gain formula, Application of gain formula to block diagrams.

Time Domain Analysis: Standard test signals, transient response, steady state error and error constants, dynamic error series, time response of first and second order systems and transient response specifications, effect of adding poles and zeros to transfer functions.

Stability of Linear Control System: Concept of stability, Necessary conditions for stability, methods of determining stability of linear control systems, Routh-Hurwitz criterion, relative stability analysis.

The Root–Locus technique: Introduction, basic properties of the root loci, rules for construction of the root loci, root loci for systems with transportation lag. sensitivity of the roots of the characteristics equation.

Frequency response analysis: Frequency domain specifications, Correlation between time and frequency responses, Bode plots, Relative stability, Phase margin and Gain margin, Minimum and non-minimum phase systems.

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Text Books:

1. Automatic control systems Benjamin C. Kuo, 5th Edition, Prentice-Hall of India.
2. Control Systems Engineering, I.J. Nagrath and M. Gopal , 3rd Edition, New age International Publishers, India, 2001.

Reference Books:

1. Control Systems: Principles And Design, M. Gopal, 2nd edition Tata MC-Graw-Hill.2002
2. Modern control engineering, K. Ogata, 5th edition.
3. Control Systems Engineering, Norman S. Nise, 3rd Edition, John Wiley and Sons.Inc, Singapore,2001.
4. Modern Control Systems, R. C. Dorf and R.H. Bishop, 8th edition, Addison-Wesley.
5. Control System Design, Mario Salgado, G. Goodwin, S. Graebe, Pearson Education

Course Outcomes:

On Completion of this course, students will able to

INU633(C).1 Understand control system concept, basic control configurations and types of control systems.

INU633(C).2 Review of Laplace transform and learn how to represent system using mathematical model.

INU633(C).3 Perform Time domain analysis of control systems

INU633(C).4 Give comment about stability of control systems.

INU633 (C).5 Analyze frequency response analyses of control systems.

CO – PO –PSO Mapping:

CO	PO/PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	0	0	0	1	0	0	0	0	0	1	0	0
CO2	2	3	2	0	0	0	0	0	0	0	1	0	2	2	1
CO3	3	1	3	1	0	2	0	0	0	1	0	1	1	3	1
CO4	1	2	1	2	2	0	1	0	1	0	2	0	0	1	0
CO5	1	2	1	1	0	0	0	0	0	2	0	1	1	2	0

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Program Elective-II

INU626 (A) DIGITAL CONTROL

Teaching Scheme : 03 L + 0 T **Total 03** **Credit: 03**
Evaluation Scheme: 30MSE +10 TA+ 60 ESE **Total Marks: 100**
Duration of ESE : 2hrs.30min

Course Objective:-

I. To understand fundamental concepts of discrete time control system.
II. To get familiarize the Pulse Transfer Function, digital PID Controllers and filter.
III. To design the Discrete Time Control System.
IV. To learn the concept of state space analysis of Discrete Time Control System.
V. To explore the concept of Pole Placement.

Introduction to Discrete Time Control System: Basic building blocks of Discrete time Control system, Sampling Theorem, Z transform and Inverse Z transform for applications for solving differential equations, Mapping between the S-plane and the Z-plane, Impulse sampling ,Data Hold, zero order and first order hold.

Pulse Transfer Function and Digital PID Controllers: The pulse transfer function, pulse transfer function of Closed Loop systems, Pulse transfer function of Digital PID controller, Velocity forms of Digital PID Controller, Realization of Digital Controllers and digital filter, Infinite filter response filter and finite filter response filter.

Design of Discrete Time Control System: Stability analysis of close loop system in Z-plane, Jury stability criterion, Bi linear transformations, Design based on the root locus method, Design based on frequency response method ,Analytical Design Method.

State Space Analysis of Discrete Time Control System: State space representation of discrete time systems, Solution of discrete time state space equations, Pulse transfer function matrix, Eigen Values, Eigen Vectors and Matrix Diagonalization, Discretization of continuous time state space equations, Liapunov stability analysis

Pole Placement and Observer Design: Concept of controllability and Observability, Useful transformations in state space analysis and design, Stability improvement by state feedback, Design via pole placement, State observers.

Text Books:

1. Discrete Time Control systems K. Ogata, 2nd edition, Prentice Hall, January 2005.

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2. Digital Control and State Variable Methods , M. Gopal, 2nd edition, Tata McGraw Hill, 2008.

Reference Books:

1. Digital control of Dynamic Systems, G. F. Franklin, J. David Powell, Michael Workman, 3rd Edition, Addison Wesley, 2000.
2. Digital Control Engineering, M. Gopal, 3rd edition, Wiley Eastern Ltd.
3. Digital Control, Kannan Moudgalya, 2nd edition, John Wiley and Sons, 2007.
4. Digital Control , Forsythe and W. and Goodall R.N McMillan, 1993
5. Digital Control Systems, Contantine H. Houpis and Gary B. Lamont, 2nd edition, McGraw-Hill.

Course Outcomes:

On Completion of this course, students will able to

INU626 (A).1 Illustrate the fundamental concepts of discrete time control system.
INU626 (A).2 Understand the Pulse Transfer Function , digital PID Controllers and digital filter.
INU626 (A).3 Design the Discrete Time Control System.
INU626 (A).4 Analyze the concept of state space analysis of Discrete Time Control System.
INU626 (A).5 Understand the concept of Pole Placement.

CO – PO –PSO Mapping:

CO	PO/PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	1	0	0	0	1	0	0	0	0	0	1	0	0
CO2	2	3	2	1	0	0	0	0	0	0	2	0	2	2	1
CO3	3	1	3	0	0	2	0	0	0	1	0	1	1	3	0
CO4	1	2	1	2	2	0	1	0	0	0	2	0	0	1	0
CO5	2	2	1	1	0	0	0	0	0	2	0	1	1	2	0

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INU626(B) Program Elective-II

ADVANCE SENSORS

Teaching Scheme : 03 L + 0 T **Total: 03** **Credit: 03**
Evaluation Scheme: 30MSE +10 TA+ 60 ESE **Total Marks: 100**
Duration of ESE : 2hrs.30min

Course Objectives:

I. To describe the fabrication processes including surface micromachining, bulk micromachining, and LIGA.(understand)
II. To understand the Precision Manufacturing Applications
III. To apply the knowledge of different semiconductor gas and biosensors for various application
IV. To understand the working of MEMS systems including their applications and advantages
V. To demonstrate the various methods of synthesis of nanoparticles and use of nanoparticles in various fields.

IC technology used in micro sensor system: Crystal growth and wafer making, oxidation lithography, masking, pattern generation and transfer, resist profiles, ion implantation, diffusion, and vacuum evaporation oxidation, RIE , CVD and PVD techniques, deposition by epitaxy, bulk and surface micromachining, types of etching, LIGA process, packaging, use of polysilicon materials, bonding of different types etc.

Semiconductor Gas Sensors: Classification of semiconductor gas sensors, Conduction mechanism in semiconducting metal oxide sensing films, blocks cheme description, Study of MOS type, Catalytic type, elctromechanical type and NDIR type gas sensors, tin oxide–based sensors

Advanced Sensor Technology In Precision Manufacturing Applications: Bar-Code Identification Systems, Sensors Detecting Faults in Dynamic Machine Parts (Bearings), Fuzzy Logic for Optoelectronic Color Sensors in Manufacturing, Position Encoder Sensors in Manufacturing,

Biosensors: Electrochemical Biosensors- Amperometric Sensors, Potentiometric Sensor, Conductometric Sensors, Nanomaterial-based Biosensors - Carbon Nanotube-based Biosensor, Graphene-based Biosensors, Applications of Biosensors- Defense Industries, Clinical Diagnostics, Environmental Monitoring, Challenges in Biosensing

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MEMS:-Polymeric MEMS Fabrication Techniques microsensing and microactuation for mems, Fabrication Examples of Smart Microsystems- SAW-based smart tongue, CNT-based glucose sensor, Vibration and Noise-Control Applications- Active vibration control in a thin-walled box beam, Active noise control of structure-borne vibration and noise in a helicopter cabin, Bulk Micromachined Accelerometers, Surface Micromachined Microspectrometers

Networking of Smart Sensor System: Overview of distributed measurements, Prototype system, Smart node architecture, Applications of the prototype system, system models, Two chip approach of smart sensor

Text Books:

1. Smart Material Systems and MEMS: Design and Development Methodologies, Vijay K. Varadan,K. J. Vinoy,S. Gopalakrishnan, Willey Publications, 2006
2. Sensors Handbook, Sabrie Soloman, McGraw-Hill Companies,2010

Reference Books:

1. Biosensors: Fundamentals and Applications , Bansi Dhar Malhotra and Chandra Mouli Pandey, A Smithers Group Company
2. Medical Instrumentation Application and Design , J. Webster, 4th edition, John Willey and Sons Publications
3. Physics of Semiconductor Devices, S. M. Sze and Kwok K. Ng , 3rd Edition, Willy publication,2007
4. Handbook of Optical Sensors, José Luís Santos, Faramarz Farahi, CRC Press 2014
5. Semiconductor Gas Sensors, Raivo Jaaniso and Ooi Kiang Tan, Wodhead Publishing(ELSVIER),2020

Web recourses:
http://ndl.iitkgp.ac.in/document/Z2JzN0ZmU2VhdW5kODBJdWRCTmg3SEVSeE95TDM5WTUrNlFXdE42UlNJRFJuUzN0YjJUM3c3aUF1U1VoRDJldQ

Course Outcomes:
Upon Completion of this course, students will able to

INU626(B).1: Describe the fabrication processes including surface micromachining, bulk micromachining, and LIGA.(understand)
INU626(B).2 : Understand the Precision Manufacturing Applications

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INU626(B).3 : Apply the knowledge of different semiconductor gas and biosensors for various application

INU626(B).4 : Understand the working of MEMS systems including their applications and advantages

INU626(B).5 **:** Demonstrate the Networking of Smart Sensor System

CO – PO –PSO Mapping:

CO	PO/PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	0	0	0	0	0	2	0	0	3	0	0	3	1	3
CO2	2	0	2	1	0	0	2	2	2	2	0	0	2	0	1
CO3	3	3	0	3	0	0	2	0	0	1	0	0	2	3	0
CO4	3	0	0	2	0	0	0	0	1	3	0	0	0	2	2
CO5	2	0	2	0	3	0	0	0	0	0	0	0	0	0	0

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Programme Elective-II

INU626(C) POWER PLANT INSTRUMENTATION

Teaching Scheme: 03 L **Total: 03** **Credit : 03**
Evaluation Scheme: 30 MSE +10 TA+ 60 ESE **Total Marks: 100**
Duration of ESE: 2hrs.30min.

Course Objectives:

I. To describe the power generation scenario
II. To analyze the steam turbines and condensers along with their working principles and types
III. To recognize the layout, component details of hydroelectric power plant and nuclear power plant
IV. To emphasize the fundaments of solar and wind power plants
V. To realize different method of energy conversion and importance of Instrumentation in power plants

Energy scenario and basic concepts of Thermal Power Plant: Law of thermodynamics, renewable and nonrenewable energy sources, ,

Thermal Power Plant: fossil fuel steam generator, steam and water cycle, boiler and its classification, different types boilers and its mountings and fittings, various controls of boilers, properties and classification of coal, outside and inside plant coal handling, pulverization of coal, Burning of fuel, different methods of feed water treatment, Steam turbines-Impulse and Reaction type: Working principle and efficiencies, energy losses in steam turbine, Steam condenser: working principles and its types,

Hydroelectric power Plant: Site selection, hydrology, elements of hydroelectric power plant, Hydro Turbines: radial flow impulse turbine, Fransis turbine and Kalpan Turbine

Principle of Nuclear energy: Chemical and nuclear reactions, nuclear fission, chain reaction, advantages and limitations of NPP, Nuclear reactor and its classification, essential components of NPP, Combined operations: advantages of combined operations, coordination between different plants,

Solar and Wind power plant: Solar radiations, solar constants, solar angles, collectors and their classifications, types of solar plants according to temperature, Wind Energy: Classification of wind machines, performance calculation, Wave and geothermal energy: devices for wave energy conversion, tidal energy, Photovoltaic conversion: Description and principle of working

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Instrumentation in power plants: Different methods of energy conversion, pressure, temperature and flow measurements in power plants, Environmental aspects of power generation: pollution from TPS, gaseous emission and control, pollution from NPP, effects of hydro and solar plants

Text Books:

1. Boiler Control Systems Engineering, G.F. Gilman, 2nd edition, ISA Publication, 2005.
2. Power plant engineering, P. K. Nag, 3rd edition, McGraw Hill, 2010.

Reference Books:

1. Power plant engineering, Domkundwar, 2nd edition, Dhanpat Rai and Sons. New Delhi. 96
2. Non-conventional energy resources , B. H. Khan, 2nd edition, McGraw Hill, New Delhi, 2006
3. Renewable energy Technology, Chetan Singh Solanki, 2nd edition, Prentice Hall Publication,
4. Solar Energy, S. P. Sukhatme, 3rd edition, Tata McGraw Hill, New Delhi, 2008
5. http://www.nptel.iitm.ac.in

Course outcomes:

Upon Completion of this course, students will able to

INU626(C).1 Describe the power generation scenario
INU626(C).2 Analyze the steam turbines and condensers along with their working principles and types
INU626(C).3 Recognize the layout, component details of hydroelectric power plant and nuclear power plant
INU626(C).4 Emphasize the fundaments of solar and wind power plants
INU626(C).5 Realize different method of energy conversion and importance of Instrumentation in power plants

CO – PO –PSO Mapping:

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Principal
(Prof. A.M.Mahalle)

CO	PO/PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	0	0	0	2	0	0	2	0	0	2	0	0	1	0	2
CO2	3	2	2	3	0	0	2	0	2	0	0	0	0	2	2
CO3	3	0	0	0	0	0	3	0	0	2	0	0	2	0	0
CO4	2	0	0	2	0	0	2	2	0	0	0	0	0	2	0
CO5	3	0	3	2	2	0	2	3	3	0	2	0	2	3	2

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Programme Elective – II

INU626 (D) MECHATRONICS

Teaching Scheme: 03 L+00 T **Total: 03** **Credit: 03**
Evaluation Scheme: 30 MSE +10TA+ 60 ESE **Total Marks: 100**
Duration of ESE : 2hrs.30min

Course objectives:

I. To introduce the basic elements of mechatronics
II. To study of Data acquisition and sensors
III. To understand the Electrical , Mechanical Actuator and Robotic systems
IV. To learn Mechatronic Systems in Control Architectures
V. To illustrate Case studies and examples in Mechatronics with case study material.

Introduction: Fundamental of Mechantronics: Definition and concepts of Mechatronics, Mechatronic system components, Key elements of a mechatronic system, Conventional system vs. Mechatronic system, Need and Role of Mechantronics in Design, Manufacturing and Factory Automation. Measurement System in mechatronics eg. Digital Thermometer.
Data acquisition and sensors: Introduction, Sampling and aliasing Quantization theory**,** Digital-to-analog conversion hardware, Analog-to-digital conversion hardware, Various sensors used for measurement of Speed, position, stress , strain, temperature, force, vibration and acceleration.
Electrical and Mechanical Actuator Systems : Introduction to Electrical actuator systems, Moving-iron transducers, Solenoids, Relays, Electric motors, Direct current motors, Dynamic model and control of d.c. motors, the servo motor, stepper motor, selection of motor.
Introduction to Mechanical actuator systems, Hydraulic and pneumatic systems, Mechanical elements, Kinematic chains, Cam mechanisms, Gears, Ratchet mechanisms, Flexible mechanical elements, Friction clutches, Design of clutches, Brakes.
Robotic systems : Robotics: component of robots, classification of robots, Robotic arm terminology, Robotic arm configuration, Robot applications, Basic robotic systems Robotic manipulator kinematics, Robotic arm positioning concepts, Robotic arm path planning.
Mechatronic Systems in Control Architectures: Introduction of Control Architectures, Analog Circuits, Digital Circuits, Programmable Logic Controller, Microcontrollers and DSPs, Single-Board Computer, Personal Computer

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Introduction to Control Theory, Armature-Controlled DC Motor, Open-Loop Response, Feedback Control of a DC Motor, Controller Empirical Design, Controller Implementation

Case studies and examples in Mechatronics :

Myoelectrically Controlled Robotic Arm, Mechatronic Design of a Coin Counter , Mechatronic Design of a Robotic Walking Machine, A PC-based computer numerically controlled (CNC) drilling machine.

Text Books:

1. Introduction to Mechatronics and measurement system, David Alciatore and Histand, 4th edition, TMH, 2011
2. Mechatronics Principle and Applications, Godfrey Onwubolu, Elsevier Butterworth-Heinemann, 2005

Reference Books:

1. Mechatronis: Electronic Control Systems in mechanical and electrical engineering, W. Bolton, 3rd Edition, Pearson education (Singapore) Ltd., 2005.
2. Mechatronics, M. D. Singh, J. G. Joshi, PHI, 2006
3. Mechatronics, Dan Necsulescu, 1st edition, Pearson Education, Asia, 2001
4. The Mechatronics Handbook, Robert H. Bishop, CRC Press, with ISA–The Instrumentation, Systems, Automation Society, 2002.
5. Model based control of a Robot manipulator, Atkeson C. G. andHollerbach J. M., MIT Press, Mass., 1988.

Course outcomes:

On Completion of this course, students will able to

INU626(D).1 : Recalling the basic techniques, skills and modern tools in mechatronics engineering technology.
INU626(D).2 : Understand the basics of Data acquisition and sensors
INU626(D).3 : Apply concepts of Electrical actuator systems , motors, Hydraulic and pneumatic, robotic systems of mechatronics.
INU626(D).4 : Analyze principles of Mechatronic Systems in Control Architectures
INU626(D).5 : Illustrate Case studies.

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CO – PO –PSO Mapping:

CO	PO/PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	0	0	0	1	0	0	3	0	0	1	0	0
CO2	2	3	2	1	0	0	0	0	0	0	2	0	2	2	1
CO3	2	1	3	0	0	2	0	0	0	1	0	1	1	3	0
CO4	1	2	1	2	2	0	1	0	0	0	2	0	0	1	0
CO5	0	2	1	1	0	0	0	0	0	2	0	2	1	2	1

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

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Programme Elective – II

INU626 (E) BIOMEDICAL IMAGE PROCESSING

Teaching Scheme: 03 L+00 T **Total: 03** **Credit: 03**
Evaluation Scheme: 30 MSE +10TA+ 60 ESE **Total Marks: 100**
Duration of ESE : 2hrs.30min

Course Objectives:

I. To apply the fundamental concept of digital image processing
II. To get overview of image processing systems, Image formation and perception, Continuous digital image representation
III. To study of Image smoothing and image sharpening by spatial and frequency domain linear filtering and its applications
IV. To study of concepts of segmentation, compression with different techniques to various biomedical applications
V. To study of the concept of image processing in biomedical applications like Xray CT ,MRI, Ultrasound

Digital Image Fundamentals: Fundamentals steps and component of an Image Processing system, sampling and quantization. basic relationship between pixels.

Image enhancement in the spatial domain and frequency domain : Basic Gray level transformation, Basics of spatial filtering, smoothing spatial filters, Sharpening spatial filters. Smoothing frequency domain filters. Sharpening frequency domain filters. Homomorphism filtering. Application of spatial and frequency domain filtering in biomedical imaging

Image Segmentation, compression : Detection of discontinuities, edge linking and boundry detection, thresholding, distance measures, region growing and clustering based segmentation, compression models, image compression standards .

Introduction to Imaging in Biomedical:

X ray Imaging: Basic imaging principle-ray detectors, conventional X-ray radiography, digital radiography, angiography.

Computed tomography: Basic imaging principle Conventional tomography, generation of CT machines ,introduction to reconstruction algorithms, application of CT in biomedical

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Ultrasonography: Basic imaging principle Acoustic propagation, absorption and scattering, ultrasonic transducers, A mode, B mode, M mode scanners, Biomedical application of Ultrasonography

Magnetic resonance imaging : Basic imaging principle , magnetization, larmor frequency, free induction decay, relaxation time pulse sequences, Biomedical application of MRI

Text Books:

1. Digital Image Processing, Gonzalez R.C. and Woods R.E, 2nd edition, Pearson education, 2002
2. Medical imaging signals and systems, Jerry L Prince and Jonathan M links, Pearson publication

Reference Books:

1. Digital Image Processing, John Wiley , A K Jain 3rd edition, Eastern publication 1998
2. Basics of MRI , Ray H Hashemi and William G bradely Jr, Lippinocott Williams and Wilkins
3. Diagnostic ultrasound and Principles and Instruments, Frederick W kremaku, 5th edition

Course Outcomes:

On completion of the course, students will be able to:

INU626(E).1 Apply the fundamental concept of digital image processing

INU626(E).2 Choose and implement the Image enhancement techniques in the spatial domain and frequency domain for different biomedical applications

INU626(E).3 Categorize, evaluate the various image segmentation and compression techniques

INU626(E).4 Describe the imaging techniques used for biomedical applications

INU626(E).5 Differentiate between X-Ray, CT, US, MRI images

CO – PO –PSO Mapping:

CO	PO/PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	0	-	-	-	0	-	0	-	-	-	-	1	3	-
CO2	3	0	-	1	2	-	-	-	-	-	-	-	2	2	0
CO3	2	0	-	1	2	-	-	-	-	-	-	-	1	2	0
CO4	3	0	-	1	1	-	-	0	-	-	-	-	1	3	1
CO5	-	-	-	1	2	-	-	-	1	-	-	-	0	2	1

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

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Program Elective-II

INU626 (F) MEASUREMENT DATA ANALYSIS

Teaching Scheme : 03 L + 0 T **Total 03** **Credit: 03**
Evaluation Scheme: 30MSE +10 TA+ 60 ESE **Total Marks:100**
Duration of ESE : 2hrs.30min

Course Objectives:

I. To apply need of experimental designs
II. To identify the main elements of a measurement system
III. To investigate the performance of measurement systems
IV. To study the tools of probability
V. To examine different type of distributions and uncertainty methods

Fundamentals Of Experimental Design: Experimentation, Need for Statistically Designed Experiments, Steps in Experimentation, Choice of Sample Size, Simple and multiple Linear Regression, Classification of Experiments

Measurement Systems: Measurement System Elements, Sensors and Transducers: Principle, example and scaling, amplifier, filters and ADC

Calibration and Response: Static Response Characterization, Dynamic Response Characterization, Zero-Order System Dynamic Response, First-Order System Dynamic Response, Second-Order System Dynamic Response

Probability: Relation to Measurements, Probability Density Function, Various Probability Density Functions, Probability Distribution Function, Probability Concepts

Statistics: Normal Distribution, Normalized Variables, Student's t Distribution, Standard Deviation of the Means, Chi-Square Distribution, Hypothesis Testing

Uncertainty Analysis: Comparing Theory and Measurement, Systematic and Random Errors, Measurement Process Errors, Measurement Uncertainty Analysis, General Uncertainty Analysis, Detailed Uncertainty Analysis

Text Books:

1. Measurement and data analysis for engineering and science, Patrick F. Dunn, 2nd edition, CRC Press 2010

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Reference Books:

1. Theory and Design for Mechanical Measurements, Figliolaand Beasley, Wiley, 3rd Edition, , 2000.

Course Outcomes:

On completion of the course, students will be able to:

INU626(F).1 Apply need of experimental designs
INU626(F).2 Identify the main elements of a measurement system
INU626(F).3 Investigate the performance of measurement systems
INU626(F).4 Study the tools of probability
INU626(F).5 Examine different type of distributions and uncertainty methods

CO – PO –PSO Mapping:

CO	PO/PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	2	3	0	0	0	0	0	0	0	0	2	3	0
CO2	2	3	2	3	0	0	0	0	0	0	0	0	0	3	0
CO3	2	0	0	0	0	0	0	0	0	0	0	0	0	3	0
CO4	2	3	2	3	0	0	0	0	0	0	0	0	0	3	0
CO5	2	3	2	3	0	0	0	0	0	0	0	0	0	3	0

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INU627 PROCESS CONTROL LAB

Teaching Scheme: 02 P **Total : 02** **Credit: 01**
Evaluation Scheme: 25 ICA + 25 ESE **Total Marks: 50**
Duration of ESE: 3 hrs.

Course Objectives:-

I. To Design of an ON-OFF and PID controller for different processes.
II. To understand the basic construction of valve and plot the Control Valve characteristics.
III. To analyze and Design of Advanced Control systems

Minimum Eight Experiments should be conducted from the sample list given below.

1. To understand the effect of interacting and non interacting systems as single or multi-capacity process.
2. To understand difference between self regulating and non self regulating process.
3. Design of an electronic ON-OFF controller and plot the characteristics of natural zone of controller
4. Design an PID controller
5. Simulation of pneumatic and hydraulic controllers for single and double acting cylinder.
6. To obtain and plot the pressure profile across orifice and venturimeter.
7. To obtain and plot the Control Valve characteristics
8. To control the pressure in closed tank by using closed loop control system and plot its characteristics.
9. To interface Pressure control loop to soft PID and plot its characteristics
10. Design of Cascade Control using Cascade control system trainer.
11. Design ratio control system for flow control application.
12. To determine the mathematical model of the given process.
13. Analysis of first order and second order system.

Course Outcomes:

On completion of the course, students will be able to:

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INU627.1: Understand the Design concept of an ON-OFF and PID controller for different Processes.

INU627.2: Draw and explain the basic characteristics Control valve.

INU627.3: Analyze and Design of Advanced Control systems.

Note:

ICA- The Internal Continuous Assessment shall be based on the practical record and Knowledge/skill acquired. The performance shall be assessed experiment wise by using continuous assessment formats A and B.

ESE- The End Semester Exam shall be based on performance in one of the Experiments and may be followed by sample questions.

CO – PO –PSO Mapping:

CO	PO/PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	0	0	0	0	0	0	0	1	0	2	2	1
CO2	3	1	3	1	0	2	0	0	0	1	0	1	1	3	1
CO3	1	2	1	1	0	0	0	0	0	2	0	1	1	2	-

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INU628 INDUSTRIAL AUTOMATION LAB

Teaching Scheme: 02 P **Total: 02** **Credit: 01**
Evaluation Scheme: 25 ICA + 25 ESE **Total Marks: 50**
Duration of ESE: 3hrs

Course objectives:

I. To get Knowledge of PLC components, configuration and programming concepts
II. To Study of role and applications of PLC to various processes
III. To explore and understand industry grade virtual automation software

Minimum 8 Experiments should be conducted from the Representative / sample list given below.

1. Architectural study of (Allen Bradly/Siemens etc) PLC.
2. Study of any one PLC software package.
3. Developments of Ladder diagram for the controlling motor operation
4. Development of ladder diagram for temperature control system.
5. Study of virtual automation software (Autom Gen, Autosim gen) for PLC controller
6. Study of virtual automation software for SCADA
7. Development of mimic diagram for a particular process using SCADA software
8. Development of PLC programming using virtual software for particular process
9. Study of any one DCS software package.
10. Development of PLC programming using virtual software for pneumatic process
11. Development of PLC programming using virtual software for, hydraulic process

ICA- The Internal Continuous Assessment shall be based on the practical record and Knowledge/skill acquired. The performance shall be assessed experiment wise by using continuous assessment formats A and B.

ESE- The End Semester Exam shall be based on performance of experiments based on file/journal submitted by students and /or viva.

Course Outcomes:

On completion of the course, students will be able to

INU628.1 Identify and configure various modules of PLC
INU628.2 Develop small programs using PLC

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INU628.3 Develop small programs using Virtual automation software

CO – PO –PSO Mapping:

CO	PO/PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	2		2	0	0	0	0	0	0	0	2	2	0
CO2	0	2	2	0	2	0	0	0	0	0	0	0	2	1	2
CO3	1	0	1	0	3	0	0	0	0	0	0	0	2	1	2

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INU629 INTERNET OF THINGS LAB

Teaching Scheme: 02 P **Total: 02** **Credit: 01**
Evaluation Scheme: 25 ICA +25 ESE **Total Marks: 50**
Duration of ESE: 3hrs

Course objectives:

I. To get knowledge of arduino programming concepts
II. To study of the applications of arduino programming
III. To explore and understand interfacing techniques for daily applications

Minimum 8 Experiments should be conducted from the Representative / sample list given below.

1. To interface LED/Buzzer with Arduino/Raspberry Pi and write a program to turn ON LED for 1 sec after every 2 seconds
2. To interface Push button/Digital sensor (IR/LDR) with Arduino/Raspberry Pi and write a program to turn ON LED when push button is pressed or at sensor detection.
3. To interface DHT11 sensor with Arduino/Raspberry Pi and write a program to print temperature and humidity readings.
4. To interface motor using relay with Arduino/Raspberry Pi and write a program to turn ON motor when push button is pressed.
5. To interface Bluetooth with Arduino/Raspberry Pi and write a program to send sensor data to smartphone using Bluetooth
6. Displaying Time over 4-Digit 7-Segment Display using Raspberry Pi/ Arduino
7. Raspberry Pi/ Arduino Based Oscilloscope
8. Controlling Raspberry Pi/ Arduino with WhatsApp
9. Setting up Wireless Access Point using Raspberry Pi/ Arduino
10. Fingerprint Sensor interfacing with Raspberry Pi/ Arduino
11. Raspberry Pi/ Arduino GPS Module Interfacing
12. IoT based Web Controlled Home Automation using Raspberry Pi/ Arduino
13. Visitor Monitoring with Raspberry Pi/ Arduino and Pi Camera
14. Interfacing Raspberry Pi/ Arduino with RFID.

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ICA- The Internal Continuous Assessment shall be based on the practical record and Knowledge/skill acquired. The performance shall be assessed experiment wise by using continuous assessment formats A and B.

ESE- The End Semester Exam shall be based on performance of experiments based on file/journal submitted by students and /or viva.

Web Resource:

https://ai.berkeley,edu/project_overview.html

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

INU629.1 Knowledge of arduino programming concepts
INU629.2 Study of the applications of arduino programming
INU629.3 Explore and understand interfacing techniques for daily applications

CO – PO –PSO Mapping:

CO	PO/PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	0	2	2	1	0	0	0	0	0	0	2	2	0
CO2	3	1	0	2	2	2	1	0	0	0	0	0	2	1	2
CO3	3	3	0	2	3	1	2	0	0	0	0	0	2	1	2

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INU 630 MINOR PROJECTS

Teaching Scheme: 04 Hrs/Wk P **Total 04** **Credit: 02**
Evaluation Scheme: 25 ICA+25ESE **Total Marks: 50**

Course Objectives:

I. To apply the Instrumentation engineering subjects knowledge for practical applications
II. To learn the recent technologies and used for implementation of minor projects
III. To carry out the budget and time scheduling of the project

The Minor Project consist of Design and fabrication of Instrumentation oriented projects based on following areas

1. Process Instrumentation and Industrial Automation
2. Biomedical Instrumentation
3. Electronic Instrumentation
4. Microprocessor and Microcontroller based Instrumentation.
5. Virtual Instrumentation
6. IoT and some relevant advance techniques/Advanced Instrumentation area topics

The minor project work should be carried out in Laboratory only. The topic may be given to the individual student or group of not more than three students. The evaluation will be based on the quality of work, report, presentation and demonstration by the students in front of the Expert committee from the department.

Note:

ICA- The Internal Continuous Assessment shall be based on the practical record and Knowledge/skill acquired. The performance shall be assessed experiment wise by using continuous assessment formats A and B.

ESE- The evaluation shall be based on demonstration by the students in front of the Expert committee from the department.

Course Outcomes: After completion of the course students will be able to

INU630.1 The Instrumentation techniques/engineering principles for specific application

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INU630.2 Design and develop Small Instrumentation project based on hardware and software for engineering systems.

INU630.3 Carry out budget ,time planning ,presentation of the project to evaluators

INU630.4 Do effective trouble-shooting of the mini project

CO – PO –PSO Mapping:

CO	PO/PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	0	2	0	2	0	0	0	2	0	0	1	1	3	0
CO2	0	2	3	0		0	0	0	0	0	0	2	3	2	1
CO3	0	0	0	0	0	0	0	0	0	3	0	1	-	0	3
CO4	0	2	1	0	0	0	0	0	0	0	0	2	1	2	1

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GOVT. COLLEGE OF ENGINEERING AMRAVATI

DEPARTMENT OF INSTRUMENTATION ENGINEERING

PROPOSED CURRICULUM

For

B. TECH. (VII and VIII Semester Instrumentation Engineering)

2022- 2023

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INU721 PROJECT ENGINEERING MANAGEMENT

Teaching Scheme : 03 L **Total: 03** **Credit: 03**
Evaluation Scheme: 30 MSE +10TA+ 60 ESE **Total Marks: 100**
Duration of ESE : 2hrs.30min

Course Objectives:

I. To understand the ethical responsibilities of practicing engineering managers and the impact of their decisions with in a global and societal context
II. To apply systems engineering to solve technical and operational problems to meet human ergonomics
III. To analyze systems and operations using both qualitative and quantitative tools and perspectives.
IV. To design drawing related problems by applying their knowledge of science and engineering.
V. To adapt the skills to manage creative teams and project processes with effective time management & efficient working

Concept study and definition of Project Engineering Management: Basics of Project Management, Definition and objectives of Project Management, Stages of Project Management, Project Planning Process, Establishing Project organization. Organization Structure, The Project team, Roles and responsibilities of project team members and team leader, Interactions involved in Project and their co-ordination project statement.
Defining work content, Time Estimation Method, Project Cost Estimation and budgeting, Project Risk Management, Project scheduling and Planning Tools: Work Breakdown structure.
Program evaluation and review techniques (PERT) and Critical path method (CPM), Life cycle phases, Statement of work (SOW), Project Specification, milestone scheduling. Project cash flow analysis, Project scheduling with resource Constraints: Resource Leveling and Resource Allocation. Project Implementation: Project Monitoring and Control with PERT/Cost, Computers applications in Project Management, Contract Management, Project Procurement Management; Post Project Analysis.

Project engineering documents and drawing: P & I diagram based on Process Flow Sheet, P & ID symbols for process loops like temperature, flow, level, pressure, etc. Material balance sheet and Temperature pressure sheet, Methods of tagging and nomenclature scheme based on ANSI / ISA standards, Standards used in instrumentation project: ISA S5.1, S5.3, S5.4, S5.5 and S5.20, ANSI, & NFPA. Instrument index sheet, installation sketches, specification sheets.

Detailed Project engineering: Plant layouts and General arrangement drawing (Plans and Elevation), Isometric of instrument piping, installation sketches of filed instrument. Cable

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Engineering (Class of conductors, Types, Specification and Application), Selection of cables with respect to specific application, Cable identification schemes, Cable trays, Basic Wiring Practice, wire numbering & numbering methods. Failsafe wiring Practice, Hazardous area classifications & its effect on design, Loop wiring diagrams, BOM and MBOM. Earthling and Grounding for General, Power and Signal.

Procurement activities: Vendor registration, Tendering and bidding process, Bid evaluation, Purchase orders, Pre-Qualification Evaluation of Vendor, Kick-off meeting, Vendor documents, drawing and reports as necessary at above activities. Construction activities: Site conditions and planning, Front availability, Installation and commissioning activities and documents require at this stage. Cold Commissioning and hot commissioning.

Control Centers and Panels: Types, Design, Inspection and Specification, Control room layout and engineering, Types of operating Stations, Intelligent Operator Interface (IOI). Panel testing Procedure. Onsite inspection and testing (SAT), Customer Acceptance Test (CAT), Factory Acceptance Test (FAT), Performance trials and final hand over. Calibration records, Test and inspection reports.

Text Books:

1. Applied Instrumentation in the Process Industries Volume-II , Andrew William, Gulf Publishing Company.
2. Instrument Engineers Handbook, Process Measurement Volume-I & Process Control Volume -II , Liptak B. G.

Reference Books:

1. Introduction to Operation Research, Tata McGrawHill, 7th edition 2003
2. Electronic & Instrument System Design , B. D. Shinde & K. V. Gitapathi, Centre of Technical Coordination, Pune
3. Project Management Scheduling & Monitoring by PERT/CPM , B. M.Naik, Vani Education Books New Delhi.
4. Project Management-A System Approach to planning, Scheduling , Herold Kerzner

Course outcomes: On completion of the course, students will be able to

INU721.1 To learn the ethical responsibilities of practicing engineering managers and the impact of their decisions with in a global and societal context

INU721.2 Apply systems engineering to solve technical and operational problems to meet human ergonomics

INU721.3 Analyze systems and operations using both qualitative and quantitative tools and perspectives.

INU721.4 Evaluate drawing related problems by applying their knowledge of science and engineering.

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INU721.5 Acquire the skills to manage creative teams and project processes with effective time management & efficient working

CO – PO –PSO Mapping:

CO	PO/PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	0	1	0	2	0	1	2	3	3	0	3	2	2	2	3
CO2	2	3	2	0	1	2	2	0	2	0	3	1	0	0	1
CO3	1	0	2	2	3	0	0	2	3	0	2	1	2	1	0
CO4	3	1	2	0	2	0	0	2	2	0	3	0	1	0	0
CO5	1	0	0	0	0	1	0	3	0	3		3	1	1	1

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INU722 BIOMEDICAL INSTRUMENTATION

Teaching Scheme : 03 L+00 T Total: 03 Credit: 03
Evaluation Scheme: 30 MSE +10 TA + 60 ESE Total Marks: 100
Duration of ESE : 2hrs 30min.

Course Objectives:

I. To Introduce the Mechanisms, Anatomy and Physiology of Human body systems
II. To understand the knowledge of engineering principles applied to biomedical systems
III. To analyse of the bio potentials, bioelectric signals and electrode systems
IV. To deduce the characteristics of the ECG, EMG, EEG Waveforms
V. To measure non electrical parameters with safety aspects in BME

Introduction: Biomedical Instrumentation, classification of biomedical Instruments, Scope for Biomedical Engineers.

Physiology and Biopotential Electrodes: Physiology of cardiovascular system, respiratory system, nervous system, Resting and Action Potential, Electrode electrolyte interface, half-cell potential, Electrodes Limb electrodes, floating electrodes, pregelled disposable electrodes, needle and surface electrodes

Cardio Vascular system Heart electro cardiogram, Measurement and analysis of EGG waveform, ECG recorder principles, block schematic of ECG recorder. Bio signal amplifiers, signal processing Introduction of defibrillators.

Electrical activity of the brain (EEG): Sources of brain potential, generation of signals, EEG rhythm waves and its classification , EEG recording electrodes, 10-20 electrode system, Phonocardiography.

Electrical activity of neuromuscular system(EMG): muscular system, electrical signals of motor unit and gross muscle, human motor coordination system, EMG and its waveforms.

Introduction to Non-Electrical Parameter Measurements: Measurement of blood pressure, Phonocardiograph, pulmonary function measurements, Body Plethysmography Blood Gas analyzers: measurement of blood pCO2, pO2, finger-tip oxymeter.

Modern imaging systems – Concepts of X ray machine, Computer tomography, Magnetic resonance imaging system, ultrasonic imaging systems

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Electrical Saftey in Medical system : Safety aspects, Macro/Micro shock, Equipotential grounding system, Ground loop and ground current ,Design consideration for reducing electrical hazards

Text Books:

3. Hand book of Biomedical Instrumentation, Khandpur R. S., 2nd edition, Prentice Hall of India Pvt. Ltd, New Delhi, India, 2003.
4. Biomedical Instrumentation and measurement, Leslie Cromwell, 3rd edition, Prentice Hall of India, New Delhi, 1997.

Reference Books:

4. Biomedical Instrumentation, Webster J. G., 4th edition, John Wiley and Sons, Hoboken, NJ, 2004.
5. Introduction to Biomedical Equipment Technology, Carr J., and Brown J., 4th edition, Pearson Education, 2000.
6. Biomedical Digital Signal Processing, Willis J. Tompkins, Prentice Hall of India publications/ Eastern Economy Edition, 2nd Print, 2000.
7. Medical Instruments, Chaudhary D. S., 1999.
8. https://www.coursera.org/learn/bioengineering

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

INU722.1 Define and apply the engineering principles to medical engineering
INU722.2 Interpret mechanisms, anatomy and physiology of various systems of the Human body
INU722.3 Demonstrate the measurements on and interpretation of data from ECG, EMG, EEG waveform
INU722.4 Apply the knowledge of non electrical parameter measurements in biomedical engineering
INU722.5 Categorize the biomedical equipments along with their technical and safety aspects

CO-PO-PSO Mapping: On completion of the course, students will be able to

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
INU722.1	3	1	0	0	0	1	0	2	0	0	0	0	2	3	0
INU722.2	3	1	0	0	0	0	0	0	0	0	0	0	1	3	0
INU722.3	2	2	0	3	1	0	0	0	0	0	0	0	2	2	0
INU722.4	3	1	0	0	0	0	0	2	0	0	0	0	2	1	1
INU722.5	2	0	0	0	1	3	0	2	0	0	0	0	1	0	2

1 – Weakly correlated 2 Moderately Correlated 3 Strongly Correlated

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Programme Elective-III

723(A) PROCESS MODELING AND OPTIMIZATION

Teaching Scheme : 03 L **Total: 03** **Credit: 03**
Evaluation Scheme: 30 MSE +10TA+ 60 ESE **Total Marks: 100**
Duration of ESE : 2hrs.30min

Course objectives:

I. To determine Mathematical Models of specific chemical process
II. To analyze the Mechanical and Chemical systems
III. To identify the characteristics physical processes.
IV. To define constraints of Optimization.
V. To devlope the optimization techniques for different processes

Mathematical Modeling: Introduction, Uses of Mathematical Models, Scope of Coverage , Principles of Formulation Fundamental laws: Continuity equations, Energy Equations, Equations of motion, transport Equations, Equations of state, Equilibrium and Chemical Kinetics.

Modeling and Simulation of Mechanical, Chemical systems: Examples of Mathematical Models of Chemical Engineering Systems: Series of Isothermal, Constant-Holdup CSTRs , CSTRs With Variable Holdups,Two Heated Tanks Gas-Phase, Pressurized CSTR Multicomponent Flash Drum Batch Reactor , Reactor With Mass Transfer.

Simulation Examples:- Gravity flow tank, Three CSTRs in Series, Nonisothermal CSTR Plug flow reactor model, modeling of flash drum, Binary Distillation Column, Multicomponent Distillation Column

Process Identification: Identification of physical processes, Direct Methods , Time-Domain "Eyeball " Fitting of Step Test Data, Direct Sine-Wave Testing ,Step testing, pulse testing, sine wave testing, ATV identification method, Autotuning , Approximate Transfer Functions, Least square method, Relationships among time, Laplace and frequency domain.

Basic Concepts of Optimization : Concept, need, scope and Hierarchy of optimization, Essential features of optimization Problem, General procedure for solving optimization problems, Equality and Inequality Constraints. Continuity of functions, NPL problem statements, Convexity and its applications, Interpretation of objective function in terms of quadratic approximation.

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Optimization Techniques: Unconstrained Functions One Dimensional: Numerical methods for optimizing a function of one variable , scanning and bracketing procedures, Newton, Quasi-Newton and Secant methods, Multidimensional problem, evaluation of unidimensional search methods.

Text Books:

1. Modeling, Simulation and Control for Chemical Engineers , W. L. Luyben, Process, McGraw Hill, 1973.
2. Optimization of Chemical Processes , Thomas Edgar, David Himmelblau, • 2nd edition, McGraw Hill, 2001.

Reference Books:

1. Design of Thermal Systems International Education , W. F. Stoecker, , McGraw hill 1989.
2. Practical Process Instrumentation and Control , J. Malley, McGraw Hill.
3. System Simulation with digital Computer , Deo Narsingh , Prentice Hall India, New Delhi.
4. Engineering Optimization (Theory & Practice), Singiresu S.Rao, 3rd Edition, New Age International(p) Ltd, Publishers.
5. Advanced Modeling and Optimization of Manufacturing Processes: International Research and Development , R. Venkata Rao, December 2010.

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

INU723(A).1	Determine Mathematical Models of specific chemical process
INU723(A).2	Analyze the Mechanical and Chemical systems
INU723(A).3	Identify the characteristics physical processes.
INU723(A).4	Define constraints of Optimization.
INU723(A).5	Devlope the optimization techniques for different processes

CO – PO –PSO Mapping:

CO	PO/PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	3	3	0	0	0	0	0	1	1	3	2	0
CO2	2	3	2	2	2	0	0	0	0	0	0	1	3	2	0
CO3	2	3	0	2	3	0	0	0	0	0	1	1	1	1	0
CO4	2	1	0	3	2	0	0	0	0	0	0	1	1	1	0
CO5	2	2	3	3	3	0	0	0	0	0	0	2	3	2	0

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

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Programme Elective-III

723(B) ENVIRONMENTAL INSTRUMENTATION

Teaching Scheme : 03 L **Total: 03** **Credit: 03**
Evaluation Scheme: 30 MSE +10TA+ 60 ESE **Total Marks: 100**
Duration of ESE : 2hrs.30min

Course Objectives:

I. To introduce various sources of pollution and pollutants
II. To interpret different waste water treatment measurement techniques
III. To distinguish instrumentation methodologies for environment monitoring
IV. To analyse water quality monitoring and waste water treatment
V. To adapt the instrumentation required for air pollution monitoring

Introduction: Necessity of instrumentation & control for environment, sensor requirement for environment. Instrumentation methodologies: Ultraviolet analyzers, total hydrocarbon analyzers using flame, ionization detector, Gas chromatography in environmental analysis, photo ionization, portable & stationary analytical instruments. Instruments in Weather station: Instruments in Weather station like Barometer, Rain gauge, Ceilometer etc., Global environmental analysis, Virtual Instruments in Environmental Engineering Laboratory, Rover Environmental Monitoring station (REMS)

Quality of water: Standards of raw & treated water, sources of water & their natural quality, effects of water quality. Water quality parameters: Thermal conductivity, detectors, Opacity monitors, pH analyzers & their application, conductivity analyzers & their application.

Water treatment: Requirement of water treatment facilities, process design.
Sedimentation & Flotation: General equation for settling or rising of discrete particles, hindered settling, effect of temperature, Viscosity, efficiency of an ideal settling basin , reduction in efficiency due to various causes, sludge, storage & removal, design criteria of settling tank, effect of temperature on coagulation, Ground water monitoring: Level measurement in ground water monitoring wells, laboratory analysis of ground water samples, instrumentation in ground water monitoring, instrumentation in assessment of soil & ground water pollution

Waste Water management: Automatic waste water sampling, optimum waste water sampling locations, and waste water, measurement techniques. Instrumentation set up for waste water treatment plant. Latest Chemical Oxygen Demand (COD), Biochemcal Oxygen Demand (BOD)

Air Pollution and Sound Monitoring Systems: Definitions, energy environment relationship, importance of air pollution, Air sampling methods & equipments, analytical methods for air

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pollution studies. Control of air pollution. Sound pollution: basics of sound pollution, its effect to environment. Acoustic noise measurement & monitoring, Environmental Laws

Text Books:

1. Physici- chemical processes for water quality control , Walter J Weber, Wiley Inter-science Publications 2012.
2. Air pollution , M N Rao and S K S Rao, TMH publications 26th reprint 2007.

Reference Books:

1. Air Pollution , Rao, M. N. and Rao, H. V. N, Tata McGraw Hill Publishing Company Limited, New Delhi, 1989,
2. Air Pollution: Its Origin and Control , Kenneth Wark, Cecil F.Warner, Wayne T.Davis, 3rd edition, Pearson
3. Environmental Engineering, Peany Howard S, Donal R Rowe and George TachoBanoylous Teddy , 1st Edition , McGraw Hill Education
4. Environmental Noise Pollution , Patrick F. Cunniff, John Wiley & Sons Inc
5. Environmental Engineering and Science , Gilber M Masters, Pearson Education (1997).

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

INU723(B).1 Identify various sources of pollution and pollutants.
INU723(B).2 Interpret different waste water treatment measurement techniques
INU723(B).3 Demonstrate instrumentation methodologies for environment monitoring
INU723(B).4 Analyze water quality monitoring and waste water treatment
INU723(B).5 Adapt the instrumentation required for air pollution monitoring

CO – PO –PSO Mapping:

CO	PO/PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	2	3	2	2	0	1	0	1	2	2	0	0	2
CO2	2	2	2	3	3	3	2	0	2	0	1	1	1	1	0
CO3	2	1	2	1	3	0	1	0	0	0	1	2	1	1	0
CO4	2	3	2	2	2	0	0	1	0	0	2	2	1	2	0
CO5	2	1	2	2	1	0	0	1	0	0	1	3	1	1	1

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

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Programme Elective-III

723(C) MODERN CONTROL THEORY

Teaching Scheme : 03 L **Total: 03** **Credit: 03**
Evaluation Scheme: 30 MSE +10TA+ 60 ESE **Total Marks: 100**
Duration of ESE : 2hrs.30min

Course objectives:

I. To introduce usage of static space in control system engineering
II. To analyze dynamics of a linear system by State Space Representation.
III. To determine the stability of a linear system using pole-placement technique.
IV. To design state observers.
V. To realize the structure of a discrete time system.

Introduction to State Space: Terminology of state space (state, state variables, state equations, state space and state model), state space representation, physical variable state space representation, phase variable forms (companion forms: controllable canonical form and observable canonical form). Canonical variable forms: diagonal canonical and Jordan canonical forms, determination of transfer function from state space Model.

Analysis of control system in state space: Concept of eigen values and eigen vectors, diagonalisation of plant matrix through similarity transformations, Vander Monde matrix, solution of homogeneous state equation, state transition matrix: definition, derivation and properties, computation of state transition matrix by Laplace transform method, Cayley Hamilton method, similarity transformation method, solution of non-homogeneous state equation

Controllability, Observability and stability: Concept of controllability: definition, controllability matrix, concept of Observability: definition, Observability matrix. Investigation of state controllability and state Observability using Kalman's test, Gilbert's test, concept of asymptotic stability and stability in the sense of Lyapunov, Lyapunov stability analysis (direct method) of continuous time LTI systems

Design concepts in state space: State variable feedback, control system design via pole placement: necessary and sufficiency condition, computation of state feedback gain matrix K through sufficiency condition, Ackermann formula and coefficient comparison method. State

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observer: necessity, types, theory, principle of duality between state feedback gain matrix K and observer gain matrix Ke, design of full order state observer.

Sampled data Control Systems: Introduction to discrete time control systems, necessary for digital control system, block diagram of digital control systems, operation and equivalents of ADC and DAC, analytical equivalent block diagram of digital control system, sampling and reconstruction process, sampling theorem, Operation and transfer function of zero order hold.

Text Books:

1. Modern Control Engineering , K. Ogata, 4th Edition, Prentice Hall of India, 2002.
2. Control System Engineering , J. Nagrath and M. Gopal, 2nd Edition, Wiley Eastern Limited.

Reference Books:

1. Control Systems, Principles and Design, M. Gopal, 2nd Edition, TMH, New Delhi, 2002.
2. Automatic Control Systems , B. C. Kuo, 7th Edition, Prentice Hall of India, New Delhi, 2002.
3. Control System , A. Nagoor Kani, RBA Publications.
4. Digital Control & State Variable Methods , M. Gopal , TMH.
5. Modern Control Theory , William L. Brogan, 1974.
6. https://nptel.ac.in/courses/108/107/108107115/

Course Outcomes (COs): On completion of the course, students will be able to

INU723(C).1 Discuss usage of static space in control system engineering.
INU723(C).2 Analyze dynamics of a linear system by State Space Representation.
INU723(C).3 Determine the stability of a linear system using pole-placement technique.
INU723(C).4 Design state observers
INU723(C).5 Realize the structure of a discrete time system

CO – PO –PSO Mapping:

CO	PO/PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	0	2	0	2	0	0	0	0	0	0	1	1	1	0
CO2	2	0	2	0	0	0	0	0	0	0	0	0	1	1	0
CO3	2	0	2	2	3	0	0	0	0	0	1	1	2	1	0
CO4	2	0	2	0	3	0	0	0	0	0	0	2	1	1	0
CO5	2	0	2	0	2	0	0	0	0	0	0	0	2	1	0

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

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Programme Elective-IV

INU724 (A) NEURAL AND FUZZY BASED CONTROL

Teaching Scheme : 03 L **Total: 03** **Credit: 03**
Evaluation Scheme: 30 MSE +10TA+ 60 ESE **Total Marks: 100**
Duration of ESE : 2hrs.30min

Course objectives:

I. To introduce the fuzzy set theory of feed forward neural networks.
II. To provide adequate knowledge about feedback neural networks.
III. To establish the concept of fuzziness involved in various systems.
IV. To explain comprehensive knowledge of fuzzy logic control
V. To apply adequate knowledge of application of fuzzy logic control to real time systems

Introduction Fuzzy Logic : Basic concepts of fuzzy logic, Fuzzy sets and Crisp sets, Fuzzy set theory and operations, Properties of fuzzy sets, Fuzzy and Crisp relations, Fuzzy to Crisp conversion.

Fuzzy Membership & Rules: Membership functions, interference in fuzzy logic, fuzzy if- then rules, Fuzzy implications and Fuzzy algorithms, Fuzzyfications & Defuzzificataions, Fuzzy Controller, Industrial applications.

Fuzzy Logic Based Control: Fuzzy Controllers: Preliminaries Fuzzy sets in commercial products basic construction of fuzzy controller Analysis of static properties of fuzzy controller Analysis of dynamic properties of fuzzy controller simulation studies case studies fuzzy control for smart cars.

Introduction Neural Networks : Neuron, Nerve structure and synapse, Artificial Neuron and its model, activation functions, Neural network architecture: single layer and multilayer feed forward networks, recurrent networks. Various learning techniques; perception and convergence rule, Auto- associative and hetro- associative memory.

Neuro –Fuzzy based system & controller : Neuro Fuzzy and Fuzzy Neural Controllers Neuro fuzzy systems: A unified approximate reasoning approach Construction of rule bases by self-learning: System structure and learning algorithm A hybrid neural network based Fuzzy controller with self- learning teacher. Fuzzified CMAC and RBF network based self- learning controllers.

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Text Books:

1. Fuzzy Logic and Genetic Algorithm: Synthesis and Applications Neural Networks, S. Rajsekaran& G.A. VijayalakshmiPai, Prentice Hall of India.

2. Fuzzy Logic with Engineering Applications ,Timothy J. Ross, Wiley India.

Reference Books:

1. Neural Networks. Siman Haykin, Prentice Hall of India
2. Fuzzy sets, Uncertainty and Information, Klir G.J and Folger T.A, Prentice Hall of India, New Delhi 1994.
3. Neural Networks, Kumar Satish, Tata McGraw Hill
4. Artificial Neural Networks, Bose and Liang, Tata Mc- graw Hill, 1996.
5. Neural Networks and Fuzzy Systems: A Dynamic Approach to Machine Intelligence, Kosco B, Prentice Hall of India, New Delhi, 1992.

Course outcomes: On Completion of this course, students will able to

INU724(A).1 Introduce the fuzzy set theory of feed forward neural networks.
INU724(A).2 Provide adequate knowledge about feedback neural networks.
INU724(A).3 Establish the concept of fuzziness involved in various systems
INU724(A).4 Acquire comprehensive knowledge of fuzzy logic control
INU724(A).5 Apply adequate knowledge of application of fuzzy logic control to real time systems

CO – PO –PSO Mapping:

CO	PO/PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	0	0	0	2	0	0	0	0	0	0	0	1	0	0
CO2	0	2	0	0	2	0	0	0	0	2	0	0	1	0	0
CO3	2	0	0	0	0	0	0	0	0	2	0	2	1	0	0
CO4	2	0	0	0	0	0	0	0	0	2	0	0	0	1	0
CO5	0	2	0	0	0	0	0	0	0	0	0	0	1	0	0

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

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Programme Elective-IV

INU724 (B) BATCH PROCESS CONTROL

Teaching Scheme : 03 L **Total: 03** **Credit: 03**
Evaluation Scheme: 30 MSE +10TA+ 60 ESE **Total Marks: 100**
Duration of ESE : 2hrs.30min

Course objectives:

I. To examine the different techniques required for Batch process control.
II. To study different standards for batch process control.
III. To identify the standards for different batch process.
IV. To design of batch control systems.
V. To analyze the specifications batch control system

Introduction: Introduction to batch control system, batch control system terminology, and characteristics of batch processes, hierarchical batch model, control structure for batch systems. Standards in batch process: Role of standards in batch control systems, study of international standards and practices such as S88, S95, USA FDA regulation, 21CFR 11, etc.

Control of batch Process: General control requirements, safety interlocking, regulatory & discrete controls, sequential control of batch processes, control activities and process management, information handling for a batch process.

Design of batch control systems: Batch management, recipe management, and production scheduling & information management. Batch control system design, system requirements, system hardware/reliability requirement.

Specifications and data management: Batch control system specifications and implementation, Information/display requirements, cost justification and benefits, data management.

Implementation & case studies: Generic implementation of batch processes, case study of batch control system implementation for applications in food and beverages, pharmaceuticals etc.

Text Books:

1. Batch Control Systems , Thomas .G. Fisher William M. Hawkins, ISA series, 1st ed., 2008.
2. Control of Batch Processes , Cecil L. Smith, 2014

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Reference Books:

1. Practical Batch Process Management, Jawahar Rawtani and Mike Barker, 2004
2. and Control of Batch Processes: Theory and Applications Modeling, Abhinav Garg, Brandon Corbett, and Prashant Mhaskar, November 2018
3. Batch processes , Ekaterini Korovessi, 2005
4. Batch Processing: Modeling and Design, Urmila M. Diwekar, 2010

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

INU724(B).1 Acquired knowledge of standards used for Batch process control.
INU724(B).2 Establish of control schemes for different batch process.
INU724(B).3 Develop a deep understanding of the application of statistical techniques to process control.
INU724(B).4 Study Design of batch control systems and the concepts upon which they are based.
INU724(B).5 Describe some case study of batch control system

CO – PO –PSO Mapping:

CO	PO/PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	0	0	2	0	0	0	0	0	0	0	2	1	0
CO2	0	0	2	0	0	0	0	0	0	0	0	0	1	0	0
CO3	2	0	2	0	0	0	0	0	0	0	0	0	0	1	0
CO4	0	0	3	0	0	0	0	0	0	0	0	0	1	0	0
CO5	2	0	0	0	0	0	0	0	0	1	0	1	0	0	1

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

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Program Elective-IV

INU724 (C) BUILDING AUTOMATION

Teaching Scheme : 03 L+00 T **Total: 03**

Credit:03 **Evaluation Scheme: 30 MSE +10 TA + 60 ESE**

Total Marks: 100 **Duration of ESE : 2hrs 30min.**

Course Objectives:

I. To introduce the concept of Building automation system
II. To understand the communication standard and BAS protocols
III. To study the distinguished Building Management Security systems
IV. State of art technique for green building etc.
V. To develop the integration of building management systems for intelligent automation

Introduction: Introduction to Building Automation System, Features, Characteristics, need of Building Automation system. Various Systems of Building Automation – Introduction to Building Management System, Energy Management System, Security System, Safety System, Video Management System. Use of renewable energy sources in building automation. Drawbacks of Building Automation system.

BAS Protocols: BAS communication standards, open protocols and its features –BACnet, Profibus, Modbus,compatibility of different open protocol standards ,use of internet technologies in BAS.

HVAC (Heating ventilation and air conditioning) system -Fundamentals: Introduction to HVAC, HVAC Fundamentals, Basic Processes (Heating, Cooling etc) , Heating Process & Applications (i.e. Boiler, Heater), Cooling Process & Applications (i.e. Chiller), Ventilation Process & Applications (i.e. Central Fan System, AHU, Exhaust Fans), Unitary Systems (VAV, FCU etc).

Fire Alarm System (FAS) –Principles of Operation FAS Components: Field Components, Panel Components, Applications. FAS Architectures: Types of Architectures, Examples FAS loops: Classification of loops, Power Supply design for FAS. Cause & effect matrix

Saftey & Security Systems – Concepts of automation in access control system for safety , Introduction to Security Systems, CCTV systems, Camera Selection Criteria and its application in BAS , Concepts Access Control System: Access Components, Burglar alarm system, Biometrics, steps in access control system Design, programming.

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Energy Management systems & Green building Concept - Instrumentation in BAS, Architecture: Honeywell Architecture, Energy management system , Green building concept

Text Books:

1. Building Control Systems, Applications Guide (CIBSE Guide) by The CIBSE (2000)
2. Security/Fire Alarm Systems: Design, Installation, and Maintenance, John E. Traister, 1995
3. Intelligent building and Automation system by Shengwei Wang

Reference Books:

1. Access Control Systems: Security, Identity Management and Trust Models, Benantar, Messaoud, Springer, 2005
2. Building Automation Online by McGowan; McGowan, John J.
3. CCTV by Damjanovski, Vlado, 3rd edition, Butterworth- Heinemann
4. HVAC Control in the New Millennium, Hordeski; Hordeski, Michael F.; Marcel Dekker; Fairmont Press, 2001
5. HVAC Controls and Systems, Levenhagen, John I.Spethmann, Donald H. McGraw-Hill Professional Publishing
6. Integrated Security Systems Design: Concepts, Specifications, and Implementation (Vol. 1), Thomas L. Norman, 2007
7. Security, ID Systems and Locks: The Book on Electronic Access Control (Newnes), Joel Konicek and Karen Little, 1997

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

INU724(C).1 To introduce the concept of Building automation system

INU724(C).2 To understand the communication standard and BAS protocols

INU724(C).3 To study the distinguished Building Management Security systems

INU724(C).4 State of art technique for green building

INU724(C).5 To develop the integration of building management systems for intelligent automation

CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
INU722.1	3	0	0	0	0	0	0	0	0	0	0	0	0	3	0
INU722.2	3	0	0	0	0	0	0	0	0	0	0	0	0	3	0
INU722.3	0	0	0	2	0	0	0	0	0	0	0	0	3	0	0
INU722.4	0	0	0	0	3	0	0	0	0	0	0	1	2	0	0
INU722.5	0	0	3	0	0	0	0	0	0	0	0	0	3	0	0

1 – Weakly correlated 2 Moderately Correlated 3 Strongly Correlated

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Program Elective-V

INU725 (A) COMMUNICATION PROTOCOL

Teaching Scheme : 03 L+00 T **Total: 03**

Credit:03 **Evaluation Scheme: 30 MSE +10 TA + 60 ESE**

Total Marks: 100 **Duration of ESE : 2hrs 30min.**

Course objectives:

I. To summarize the different network architectures and protocols.
II. To get aware of TCP/IP protocols.
III. To understand various network security technologies and protocols.
IV. To learn Serial data communications interface standards.
V. To distinguished the Fieldbus, ProfiBus and Foundation Fieldbus.

Introduction: Overview – Protocol structure – Function codes – Modbus plus protocol –Data Highway – AS interface (AS-i)-DeviceNet: Physical layer – Topology – Device taps –Profibus PA/DP/FMS: Protocol stack – System operation. CANBUS: Concepts of bus access and arbitration – CAN: Protocol-Errors: Properties – Detection – processing –

Introduction Fieldbus, ProfiBus and Foundation Fieldbus : Physical layer and wiring rules Data Link layer Application layer User layer Wiring and installation practice with Fieldbus Termination Preparation ,Installation of the complete system. Introduction to ProfiBus standard: ProfiBus protocol stack Physical layer Data Link layer Application layer, Comparison of HART, Foundation Fieldbus, Devicenet, Profibus, Controlnet, Industrial Ethernet. LORA networking

Serial data communications: Serial data communications interface standards, balanced and unbalanced transmission lines, RS-232 standard, RS-449 interface standard, RS-423 interface standard, RS-422 interface standard, Comparison. I2C Protocol, SPI Protocol, USB Protocol, eSPI Protocol, EIA-232 interface standard – EIA-485 interface standard – Current loop and EIA-485 converters

Network Security Technologies and Protocols: Kerberos: Network Authentication Protocol – RADIUS: Remote Authentication Dial In User Service, SSH: Secure Shell Protocol, L2F: Layer 2 Forwarding Protocol, L2TP: Layer 2 Tunneling Protocol PPTP: Point-to-Point Tunneling Protocol, DiffServ: Differentiated Service Architecture, GRE: Generic Routing Encapsulation

Text Books:

1. Network Protocols Handbook , Jielin Dong, 4th Edition, Javvin Press, 2007.

References:

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1. Packet Guide to Core Network Protocols ,Bruce Hartpence, OReilly Media, Inc., 2011.
2. Home Network Basis: Transmission Environments and Wired/Wireless Protocols, Walter Y. Chen, , Prentice Hall, 2003.
3. Local Networks and the Internet: From Protocols to Interconnection , Ana Minaburo, Laurent Toutain, , John Wiley and Sons, 2011.

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

INU725(A).1 Summarize the different network architectures and protocols.
INU725(A).2 Get aware of TCP/IP protocols.
INU725(A).3 Identify various network security technologies and protocols
INU725(A).4 Learn Serial data communications interface standards
INU725(A).5 Distinguished the Fieldbus, ProfiBus and Foundation Fieldbus.

CO – PO –PSO Mapping:

CO	PO/PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	0	0	0		2	0	0	0	0	0	0	0	0	0
CO2	2	0	0	0	2	0	0	0	0	2	0	0	0	0	0
CO3	0	0	0	2	0	0	0	0	0	3	0	0	1	0	0
CO4	2	0	0	0	0	0	0	0	0	3	0	0	0	1	0
CO5	0	0	2	0	0	0	0	0	0	2	0	0	2	0	0

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

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Programme Elective-V

INU725 (B) ROBOTICS

Teaching Scheme : 03 L **Total: 03** **Credit: 03**
Evaluation Scheme: 30 MSE +10TA+ 60 ESE **Total Marks: 100**
Duration of ESE : 2hrs.30min

Course Objectives:

I. To get aware with history, evolution and anatomy of robot.
II. To apply machine vision for robotic application
III. To impart knowledge about kinematic and dynamic analysis of robot manipulators.
IV. To develop the program for basic robotic actions
V. To design localization and path planning algorithms for mobile Robot navigation.

Robot anatomy & Sensors in Robotics: Definition, law of robotics, History and Terminology of Robotics. Important characteristics of Robots (Cycle time concepts). Specifications of Robot (Drives, joints andlinks, sensors). Robot classifications-Architecture of robotic systems. ROI Robot System Value Calculator (Robotic Industries Association). Different sensors used in robotics.

Machine Vision: Introduction to machine vision, Low level & High level vision, Sensing & Digitizing, Image processing & analysis, Segmentation, Edge detection, Applications, training the vision system, robotic applications.

Kinematics, dynamics and control: Object location, three dimensional transformation matrices, inverse transformation, kinematics and path planning, Jacobian work envelope, manipulator dynamics, dynamic stabilization, position control and force control.

Programming: Methods of robot programming, lead -through programming methods, a robot program as a path in space, motion interpolation, wait, signal and delay commands, branching, capabilities and limitations of lead-through methods, Assembly and robotic assembly automation, parts presentation methods, assembly operations, compliance and remote centre compliance (RCC) device, assembly system configurations, use of simulation software

Autonomous Mobile Robots: Introduction, basic control scheme for mobile robots (basic understanding of perception, localization, cognition path planning, motion control). Planning & Navigation: Introduction, competences for navigation, path planning, obstacle avoidance, navigation architectures.

Text Books:

1. IndustrialRobotics, Technology programming and Applications , Mikell P Groover, Nicholas G Odrey, Mitchel Weiss, Roger N Nagel, Ashish Dutta, McGraw Hill, 2012.

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

Reference Books:

1. Robotics Technology and flexible automation, S.R. Deb, Tata McGraw-Hill Education., 2009.
2. Robotics Engineering an Integrated Approach , Richard D. Klafter, Thomas .A, ChriElewski, Michael Negin, PHI Learning., 2009.
3. Engineering foundation of Robotics , N. Nagy, Andras Siegler, Prentice Hall Inc., 1987.
4. Robotics and Image Processing an Introduction , P.A. Janaki Raman, Tata McGraw Hill Publishing company Ltd., 1995
5. Kinematic Analysis of Robot manipulators , Carl D. Crane and Joseph Duffy, Cambridge University press, 2008.
6. Robotics control, sensing, vision and intelligence , Fu. K. S., Gonzalez. R. C. & Lee C.S.G., McGraw Hill Book co, 1987
7. Robots and Manufacturing Automation , Ray Asfahl. C., John Wiley & Sons Inc.,1985

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

INU725(B).1 Get aware with history, evolution and anatomy of robot.
INU725(B).2 Apply machine vision for robotic application
INU725(B).3 Impart knowledge about kinematic and dynamic analysis of robot manipulators.
INU725(B).4 Write the program for basic robotic actions
INU725(B).5 Develop localization and path planning algorithms for mobile Robot navigation.

CO – PO –PSO Mapping:

CO	PO/PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	0	0	0	0	0	0	0	0	0	0	0	0	2	0
CO2	1	2	3	0	2	0	0	0	0	0	0	0	2	1	1
CO3	3	0	0	0	2	0	0	0	0	0	0	0	0	3	0
CO4	2	0	1	0	3	0	0	0	0	0	0	0	2	1	2
CO5	2	0	2	0	3	0	0	0	0	0	0	0	3	0	1

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

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Programme Elective-V

INU725 (C) SPEECH SIGNAL PROCESSING

Teaching Scheme : 03 L **Total: 03** **Credit: 03**

Evaluation Scheme: 30 MSE +10TA+ 60 ESE **Total Marks: 100**

Duration of ESE : 2hrs.30min

Course Objectives:

I. To illustrate speech generation and related parameters of speech.
II. To understand the concepts of speech signal representations and coding.
III. To summerize different speech modeling involved in it
IV. To analyse signal analysis and speech synthesis.
V. To use different speech synthesis techniques

Fundamentals of Speech Processing: Introduction, Spoken Language Structure, Phonetics and Phonology, Syllables and Words , Syntax and Semantics, Probability, Statistics and Information Theory, Probability Theory, Estimation Theory, Significance Testing, Information Theory.

Speech Signal Representations and Coding: Overview of Digital Signal Processing, Speech Signal Representations, Short time Fourier Analysis, Acoustic Model of Speech Production, Linear Predictive Coding Cepstral Processing, Formant Frequencies , The Role of Pitch, speech Coding, LPC Coder, CELP, Vocoders

Speech Recognition: Hidden Markov Models, Definition, Continuous and Discontinuous HMMs, Practical Issues, Limitations. Acoustic Modeling, Variability in the Speech Signal, Extracting Features, Phonetic Modeling, Adaptive Techniques, Confidence Measures, Other Techniques.

Signal Models: Components of radar signal, amplitude models, type of clutters, noise model and signal to noise ratio, jamming, frequency models: doppler shift, special models, spectral model

Speech Synthesis: Attributes, Formant Speech Synthesis, Concatenative Speech Synthesis, Prosodic Modification of Speech, Source-filter Models for Prosody Modification, Evaluation of TTS Systems.

Text Books:

1. Speech and Audio Signal Processing, Processing and Perception of Speech and Music, Ben Gold and Nelson Morgan, Wiley- India Edition, 2006
2. Fundamentals of Speech Recognition , Lawrence Rabiner and Biing-Hwang Juang, Pearson Education, 2003.

Reference Books :

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1. Claudio Becchetti and Lucio Prina Ricotti, “”, John Wiley and Sons, 1999.
2. Speech and Language Processing – An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition , Daniel Jurafsky and James H Martin, Pearson Education, 2002.
3. Statistical Methods of Speech Recognition , Frederick Jelinek, MIT Press, 1997.
4. The Scientist and Engineer‟s Guide to Digital Signal Processing , Steven W. Smith, California Technical Publishing, 1997.
5. Discrete-Time Speech Signal Processing – Principles and Practice , Thomas F Quatieri, Pearson Education, 2004.

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

INU725(C).1 Model speech production system and describe the fundamentals of speech.
INU725(C).2 Extract and compare different speech parameters.
INU725(C).3 Choose an appropriate statistical speech model for a given application.
INU725(C).4 Design a speech recognition system.
INU725(C).5 Use different speech synthesis techniques.

CO – PO –PSO Mapping:

CO	PO/PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	0	0	0	0	0	0	0	0	0	0	0	0	2	0
CO2	1	2	3	0	2	0	0	0	0	0	0	0	2	1	1
CO3	3	0	0	0	2	0	0	0	0	2	0	0	0	3	0
CO4	2	0	1	0	3	0	0	0	0	0	0	0	2	1	2
CO5	2	0	2	0	3	0	0	0	0	2	0	0	3	0	1

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

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Open Elective –II

INU733 (A) INDUSTRIAL AUTOMATION

Teaching Scheme : 03 L+00 T Total: 03 Credit:03

Evaluation Scheme: 30 MSE +10 TA + 60 ESE Total Marks: 100

Duration of ESE : 2hrs 30min.

Course Objectives:

I. To get the basic Knowledge about the Industrial automation and its features
II. To learn the basic programming skills of PLC
III. To compare DCS with PLC & SCADA system
IV. To classify the communication standards and protocols in Industrial Automation
V. To explore the knowledge of DCS system with different DCS make architecture

Introduction to Industrial Automation : Role of automation in industry ,types of automation systems, introduction to automation pyramid, basic introduction of automation tools based on performance criterion, requirement and specification of automation systems

Introduction to Programmable logic controllers, PLC architecture and operation, definition of discrete process control, Developing programs using ladder diagrams, sequential flow charts, Functional block diagram, programming and its features, programming examples of typical processes. Interfacing of PLC to SCADA /DCS using communication link (RS232,485).

DCS & SCADA system: The centralized control, direct digital control, distributed process control and its features, Functional block diagram of DCS, ,supervisory computer displays, Software configurations, programming in DCS, control technique, functions including database, alarm, management ,diagnosis ,security and user access .DCS Study and Comparison of DCS architecture of different makes ,Introduction to Supervisory control and data acquisition (**SCADA)** systems

Introduction to Data highways, **standard protocols** Field buses, Multiplexers and remote sensing terminal units. system integration: with PLC and computer (Hybrid control system), I/O hardware, set point stations, Network protocols, ISO/OSI reference model , communication standard RS232 485 , Modbus, HART ,concept of OPC[object linking and embedding for process control],MAP/TOP protocols.

Computer integrating process: Communication Hierarch, Study of Yokogawa, Rosemount Honeywell DCS systems with industrial application .

Text Books:

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1. Process Control Instrument Engineers Handbook, Bela G. Liptak, 3rd edition, Butterworth Heinemann Company, 1999
2. Introduction to Programmable Logic Controllers, Gary Dunning, 2nd Edition, Thomson Delmar learning, 2002.

Reference Books:

1. Process Control Instrumentation Technology, Johnson C. D., 7th Edition, Pearson Education, New Delhi, 2003.
2. Programmable Controllers: Principles and Applications, Webb J. W. Mergy publishing co. 1988
3. Computer Based Industrial Control, Krishankant, 7th Edition, PHI, 2005,
4. Programmable logic controllers and Industrial Automation an introduction, Madhuchandra Mitra, Samarjit, Sen Gupta ,Penram publishing (India) Pvt Ltd,2009
5. Distributed computer control for Industrial automation, Popovik Bhatkar,Dekkar Pub.

Course outcomes: On completion of the course, students will be able to

INU733(A).1 Describe the basic Knowledge about the Industrial automation and its features
INU733(A).2 Implement the basic programming skills (LAD, FBD, SFC) of PLC
INU733(A).3 Compare the DCS with PLC, SCADA system
INU733(A).4 Explore the communication standards and protocols in Industrial Automation
INU733(A).5 Distinguish different architectures of DCS makes

CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
INU722.1	3	1	0	0	0	0	0	0	0	0	0	0	0	3	0
INU722.2	0	1	0	0	2	0	0	0	0	0	0	0	3	2	0
INU722.3	2	0	0	0	2	0	0	0	0	0	0	0	0	2	0
INU722.4	0	1	0	0	0	0	0	0	0	0	0	0	0	2	0
INU722.5	3	0	0	0	1	0	0	0	0	0	0	0	2	2	0

1 – Weakly correlated 2 Moderately Correlated 3 Strongly Correlated

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Open Elective –II

INU733 (B) INTRODUCTION OF MACHINE LEARNING

Teaching Scheme : 03 L+00 T Total: 03 Credit:03

Evaluation Scheme: 30 MSE +10 TA + 60 ESE Total Marks: 100

Duration of ESE : 2hrs 30min.

Course Objectives:

I. To introduce students to the basic concepts, tools and techniques of Machine Learning
II. To develop skills of using recent machine learning software
III. To analyze and evaluate the different ML models.
IV. To implement ML algorithms to solve real life problems.
V. To develop ML models using hypothesis

Introduction to Machine Learning: Basic concepts, Machine Learning methods: Supervised, Unsupervised, Semi-supervised, Inductive, Reinforcement Learning.

Linear Regression: Introduction to Linear regression, Logistic Regression, Naive Bayes Algorithm, Model Selection, Linear basis function model, model assessment, assessing importance of different variables, subset selection. Cross Validations.

Hypothesis Design: Types of variables, Types of measurement scales, Constructing the Hypothesis, Null hypothesis, Alternative Hypothesis. Hypothesis testing, type 1 error, Type 2 error, Confidence of Interval.

Instance Based Learning: Feature selection, supervised and unsupervised learning, Classification Algorithms: K-Nearest Neighbour Classification and Decision Tree.

Neural Network: Introduction, Feed forward network, Network training, Back propagation NN, Regularization, Error Analysis, Deep Neural Network.

Text Books:

1. Machine Learning , Tom M. Mitchell, 1st Edition, McGraw Hill Education,
2. Introduction to Machine Learning with Python: A Guide for Data Scientists, Andreas C. Müller and Sarah Guido 1st Edition, O'Reilly Media

Reference Books:

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1. The Elements of Statistical Learning: Data Mining, Inference, and Prediction , Trevor Hastie, Robert Tibshirani, and Jerome Friedman, 2nd Edition, Springer
2. Pattern Recognition and Machine Learning , Christopher M. Bishop, 2nd Edition, Springer
3. R for Data Science: Import, Tidy, Transform, Visualize, and Model Data , Hadley Wickham and Garrett Grolemund, 1st Edition, O'Reilly
4. https://archive.nptel.ac.in/courses/106/106/106106236/

Course outcomes: On completion of the course, students will be able to

INU733(B).1 Introduce students to the basic concepts, tools and techniques of Machine Learning
INU733(B).2 Develop skills of using recent machine learning software
INU733(B).3 Analyze and evaluate the different ML models.
INU733(B).4 Implement ML algorithms to solve real life problems.
INU733(B).5 Develop ML models using hypothesis

CO – PO –PSO Mapping:

CO	PO/PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	0	0		2	0	0	0	0	0	0	0	1	0	0
CO2	0	0	3	0	0	0	0	0	0	0	0	0	1	0	0
CO3	0	3	0	0	0	0	0	0	0	0	0	0	0	1	0
CO4	0	0	3	0	2	0	0	0	0	0	0	0	1	0	0
CO5	0	0	2	0	0	0	0	0	0	0	0	0	1	1	0

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

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Open Elective –II

INU733 (C) MECHATRONICS

Teaching Scheme : 03 L+00 T Total: 03 Credit:03

Evaluation Scheme: 30 MSE +10 TA + 60 ESE Total Marks: 100

Duration of ESE : 2hrs 30min.

Course objectives:

I. To introduce the basic elements of mechatronics
II. To summarize the different sensors & its usage in data acquisition system
III. To compare the Electrical , Mechanical Actuator systems
IV. To use Mechatronic Systems in Robotic
V. To Study PLC and its application in Mechatronics

Introduction: Fundamental of Mechantronics: Definition and concepts of Mechatronics, Conventional system vs. Mechatronic system, Need and Role of Mechantronics in Design, Manufacturing and Factory Automation. Measurement System in mechatronics

Sensors and Data acquisition: Introduction, Sampling and aliasing Quantization theory**,** Digital-to-analog conversion hardware, Analog-to-digital conversion hardware, Various sensors used for measurement of Speed, position, stress , strain, temperature, force, vibration and acceleration.

Mechanical Actuator Systems : Introduction to Mechanical actuator systems, Hydraulic and pneumatic systems, Mechanical elements, Kinematic chains, Cam mechanisms, Gears, Ratchet mechanisms, Flexible mechanical elements, Friction clutches, Design of clutches, Brakes.

Robotic systems :component of robots, classification of robots, Robotic arm terminology, Robot applications, Basic robotic systems Robotic manipulator kinematics, Robotic arm positioning concepts, Robotic arm path planning.

PLC and its application in Mechatronics: Introduction of Programmable Logic Controller and its Architectures, Basic PLC ladder Programming, Armature-Controlled DC Motor, Open-Loop Response, Feedback Control of a DC Motor, A PC or PLC based computer numerically controlled (CNC) drilling machine.

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Text Books:

3. Introduction to Mechatronics and measurement system, David Alciatore and Histand, TMH.
4. Mechatronics Principle and Applications, Godfrey Onwubolu

Reference Books:

6. Mechatronis: Electronic Control Systems in mechanical and electrical engineering, W. Bolton, 3rd Edition, Pearson education (Singapore) Ltd., 2005.
7. Mechatronics, M. D. Singh, J. G. Joshi, PHI.
8. Mechatronics, Dan Necsulescu, Pearson Education, Asia.
9. The Mechatronics Handbook, Robert H. Bishop, CRC Press, with ISA–The Instrumentation, Systems, Automation Society, 2002.
10. Model based control of a Robot manipulator, Atkeson C. G. &Hollerbach J. M., MIT Press, Mass., 1988.

Course outcomes: On Completion of this course, students will able to

INU733(C).1 : Introduce the basic elements of mechatronics
INU733(C).2 : Summarize the different sensors & its usage in data acquisition system
INU733(C).3 : Compare the Electrical, Mechanical Actuator systems.
INU733(C).4 : Use Mechatronic Systems in Robotic.
INU733(C).5 : Study PLC and its application in Mechatronics.

CO – PO –PSO Mapping:

CO	PO/PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	0	0	0	0	0	0	0	0	0	0	0	2	0	0
CO2	3	0	0	0	0	0	0	0	0	2	0	0	1	1	0
CO3	2	2	0	2	0	0	0	0	0	0	0	0	1	0	0
CO4	2	0	0	0	0	2	0	0	0	0	0	0	1	0	0
CO5	0	2	1	0	0	2	0	0	0	0	0	0	0	0	0

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

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INU727 PROJECT ENGINEERING MANGEMENT LAB

Teaching Scheme : 02 P **Total: 02** **Credit: 01**
Evaluation Scheme : 25 ICA + 25 ESE **Total Marks: 50**
Duration of ESE : 2hrs

Course objectives:

I. To draw the Process & Instrument diagram
II. To prepare documents required for SAT-FAT of a project
III. To study different symbols used in P&I diagram

List of Experiments:
Students are expected to perform Minimum Eight Experiments :

1. Develop SOW, project specifications and WBS for any instrumentation project.
2. Preparation of Inquiry, Quotation, Comparative statement, Purchase orders.
3. Study of standards and symbols (ANSI / ISA S-5.1).
4. Development of Process & Instrument diagram of typical process.
5. Develop Instrument index sheet for a P&ID developed in experiment 4.
6. Develop specification sheets for transmitters and actuators (ISA S-20 Format).
7. Prepare a loop wiring diagram and Cable schedule.
8. Prepare a Hook up drawings for installation of transmitters and control valve.
9. Prepare documents required for SAT-FAT of a project.

ICA-The Internal Continuous Assessment shall be based on the practical record and Knowledge/skill acquired. The performance shall be assessed experiment wise by using continuous assessment formats A and B.
ESE- The End Semester Exam shall be based on performance of experiments based on file/journal submitted by students and /or viva.

Course Outcome:

INU727.1	Draw the Process & Instrument diagram
INU727.2	Prepare documents required for SAT-FAT of a project
INU727.3	Study different symbols used in P&I diagram

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CO – PO –PSO Mapping:

CO	PO/PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	0	3	0	0	0	0	0	0	0	0	0	1	0	0
CO2	0	3	0	0	0	0	0	0	0	0	0	0	1	1	0
CO3	0	0	3	0	0	0	0	0	0	0	0	0	1	1	0

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlate

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INU728 BIOMEDICAL INSTRUMENTATION LAB

Teaching Scheme : 02 Total: 02 **Credit: 01**
Evaluation Scheme: 25 ICA +25 ESE **Total Marks: 50**
Duration of ESE : 3 hrs

Course Objective :

I To learn the basic functions and operations on Biomedical Equipments
II To Measure and calculate the basic health parameter like ,Heart Rate, BP ,RRetc
III To analyze the waveform pattern and interpret the ECG,EEG,EMG waveform in engineering

List of Experiments : Minimum Eight Experiments should be conducted from the sample list given below.

1 To Study, Observe and categorize different types of ECG, EMG, EEG electrodes
2 Measurement of Heart Rate by using Stethoscope
3 Measurement and Monitoring of Blood Pressure by using Digital Blood Pressure Meter
4 Measurement and Monitoring of Non Invasive Blood pressure (NIBP), SPO2 and ECG by using multiparameter monitoring device.
5 Measurement and analysis of Real Time ECG by using ECG Machine.
6 Monitoring of Normal ECG and Heart rate signals by using Normal biomedical signal simulator
7 Monitoring of Normal EEG signals (Alpha, Beta, Delta, Theta) by using Normal biomedical signal simulator
8 Monitoring of Various Abnormal Heart signals by using abnormal biomedical signal simulator
9 Monitoring of Cardiac Audio signals of Fetal and Adult by using Ultrasound Doppler technique.
10 Monitoring of Phonocardiograph signals by using Phonocardiograph simulator and digital CRO.
11 Measurement of Safety electrical parameters by using electrical safety analyzer.
12 To study and measure electrical energy in DC Defibrillator
13 Visit to hospital having some modern equipments.

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ICA-The Internal Continuous Assessment shall be based on the practical record and Knowledge/skill acquired. The performance shall be assessed experiment wise by using continuous assessment formats A and B.

ESE- The End Semester Exam shall be based on performance of experiments based on file/journal submitted by students and /or viva.

Course Outcome

INU728.1 Explain the basic functions and operations on Biomedical Equipments

INU728.2 Measure and calculate the basic health parameter like , Heart Rate, BP ,RR etc

INU728.3 Explain the waveform pattern and interpret the ECG,EEG, EMG waveform in engineering aspects

CO-PO-PSO Mapping

CO	PO/PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	0	0	0	0	0	0	0	0	0	0	0	1	2	1
CO2	2	0	0	0	2	1	0	1	0	0	0	0	1	2	1
CO3	1	0	0	3	1	1	0	1	0	0	0	0	1	2	1

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

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Programme Elective –VI

INU821(A) SMART MATERIALS

Teaching Scheme : 03 L+00 T Total: 03 Credit:03

Evaluation Scheme: 30 MSE +10 TA + 60 ESE Total Marks: 100

Duration of ESE : 2hrs 30min.

Course objectives:

I. To explain the different smart materials and its basics
II. To analyze the High-band width, low strain smart sensors.
III. To examine the Smart actuators
IV. To study Smart composites
V. To aware advances in smart structures & materials

Overview of smart materials : Introduction to Smart Materials, Principles of Piezoelectricty, Perovskyte Piezoceramic Materials, Single Crystals vs Polycrystalline Systems, Piezoelectric Polymers, Principles of Magnetostriction, Rare earth Magnetostrictive materials, Giant Magnetostriction and Magneto-resistance Effect, Introduction to Electro-active Materials, Electronic Materials, Electro-active Polymers, Ionic Polymer Matrix Composite (IPMC), Shape Memory Effect, Shape Memory Alloys, Shape Memory Polymers, Electro-rheological Fluids, Magneto Rhelological Fluids.

High-band width, low strain smart sensors : Piezeoelctric Strain Sensors, In-plane and Out-of Plane Sensing, Shear Sensing, Accelerometers, Effect of Electrode Pattern, Active Fibre Sensing, Magnetostrictive Sensing, Villari Effect, Matteuci Effect and Nagoka-Honda Effect, Magnetic Delay Line Sensing, Application of Smart Sensors for Structural Health Monitoring (SHM), System Identification using Smart Sensors.

Smart actuators : Modelling Piezoelectric Actuators, Amplified Piezo Actuation – Internal and External Amplifications, Magnetostrictive Actuation, Joule Effect, Wiedemann Effect, Magnetovolume Effect, Magnetostrictive Mini Actuators, IPMC and Polymeric Actuators, Shape Memory Actuators, Active Vibration Control, Active Shape Control, Passive Vibration Control, Hybrid Vibration Control.

Smart composites : Review of Composite Materials, Micro and Macro-mechanics, Modelling Laminated Composites based on Classical Laminated Plate Theory, Effect of Shear Deformation, Dynamics of Smart Composite Beam, Governing Equation of Motion, Finite Element Modelling of Smart Composite Beams.

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Advances in smart structures & materials: Self-Sensing Piezoelectric Transducers, Energy Harvesting Materials, Autophagous Materials, Self Healing Polymers, Intelligent System Design, Emergent System Design.

Text Books:

1. Smart Structures and Materials, Brian Culshaw, Artech House, 2000
2. Smart Structures, Gauenzi, P. Wiley, 2009 Cady, W. G., Piezoelectricity, Dover Publication

Reference Books:

1. Smart materials and structures by Mukesh V. Gandhi and and B D Thompson, 1992
2. Smart Materials and Structures by Peter L. Reece, 2006
3. Smart Materials and Structures: Proceedings of the 4th European and 2nd MIMR Conference, Harrogate, UK,1998
4. Advanced Thermal Stress Analysis of Smart Materials and Structures, Abdolhamid Akbarzadeh and Zengtao Chen 2019
5. SMART'13: Smart Materials and Structure, Erasmo Carrera, Marco Petrolo, Maria Cinefra, Federico Miglioretti

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

INU821(A).1 Desribe the different smart materials and its basics
INU821(A).2 Analyze the High-band width, low strain smart sensors.
INU821(A).3 Examine the Smart actuators
INU821(A).4 Study Smart composites
INU821(A).5 Aware advances in smart structures & materials

CO – PO –PSO Mapping:

CO	PO/PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CO2	1	2	2	0	2	0	0	0	0	0	0	0	2	1	1
CO3	3	0	0	0	1	0	0	0	0	0	0	0	0	1	0
CO4	1	0	1	0	3	0	0	0	0	0	0	0	2	1	0
CO5	2	0	2	0	1	0	0	0	0	0	0	0	2	0	1

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

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Programme Elective –VI

INU821(B) ARTIFICIAL INTELLIGENCE

Teaching Scheme : 03 L+00 T Total: 03 Credit:03

Evaluation Scheme: 30 MSE +10 TA + 60 ESE Total Marks: 100

Duration of ESE : 2hrs 30min.

Course Objectives:

I. To Understand the basic knowledge of Artificial Intelligence
II. To explore and solve the some problems using Artificial Intelligence
III. To summarize supervised and unsupervised learning algorithms
IV. To apply the knowledge of Artificial Intelligence in few case studies
V. To study the network based approach in Artificial Intelligence

Artificial Intelligence Meaning and definition of artificial intelligence, Physical Symbol System, intelligent agent ,problem solving, informed search and exploration ,constraint satisfaction problems ,adversarial search, knowledge and reasoning, logical agents, first order logic, inference in first order logic ,knowledge representation

Planning: planning and acting in the real world, uncertain knowledge and reasoning, uncertainty, probabilistic reasoning, probabilistic reasoning over time, making simple decisions, making complex decisions

Network-based representation and reasoning, Semantic networks, Conceptual Graphs, frames. Description logic (DL), concept language, reasoning using DL. Conceptual dependencies

Decision tree representation, hypothesis, issues in decision tree learning rule extraction from tree, learning rules from data, probabilistic classifier, byers rule, maximum likelihood estimation, unsupervised learning techniques, similarity and distance measures means, k-medoids algorithm.

Framework for ML application Human computer interaction, case studies and applications of AI.

Text Books

1. Artificial Intelligence: A Modern Approach, Staurt J Russel & Peter Norvig,3rd edition,PHI
2. Artificial Intelligence, Elaine Rich, Kevin Knight, Mc-Graw Hill.

Reference Books

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1. Introduction to AI & Expert System: Dan W. Patterson, PHI.
2. Artificial Intelligent by Luger (Pearson Education)
3. Pattern recognization and Machine learning ,C.Bishop,Springer 2011 NPTEL

Course Outcome : On completion of the course, students will be able to

INU821(B).1	Describe the knowledge of basic fundamentals of Artificial Intelligence
INU821(B).2	Explain the reasoning methodology
INU821(B).3	Represent the decision tree and classification
INU821(B).4	Design a classifier using the representation and classifier types
INU821(B).5	Illustrate the application of Artificial Intelligence

CO-PO-PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	0	0	0	0	0	0	0	0	0	0	0	0	3	0
CO2	2	0	0	0	0	0	0	0	0	0	0	0	0	3	0
CO3	0	0	0	0	2	0	0	0	0	0	0	0	2	0	0
CO4	0	0	3	0	2	0	0	0	0	0	0	0	3	0	0
CO5	2	0	0	0	0	0	0	0	0	0	0	0	0	2	0

1 – Weakly correlated 2 Moderately Correlated 3 Strongly Correlated

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Programme Elective –VI

INU821(C) PROCESS EQUIPMENT DESIGN

Teaching Scheme : 03 L+00 T Total: 03 Credit:03

Evaluation Scheme: 30 MSE +10 TA + 60 ESE Total Marks: 100

Duration of ESE : 2hrs 30min.

Course objectives:

VI. To summarize the different equipments used in process industry.

VII. To study the operation of heat exchanger, evaporator & distillation columns in instrumentation system

VIII. To understand the basic need design consideration

IX. To illustrate equipment design with mechanical concept

X. To learn the safety consideration in equipment design

Basic consideration in equipment Design: Nature of process equipment, general design procedure, fabrication techniques, Different types of equipments, Static & rotary equipments, Different types of static equipments, various mechanical properties of material, equipment classification

Design Considerations: material of construction and corrosion, stresses due to static and dynamic load, elastic instability, combined stresses and theories of failure, economic considerations

Heat Exchanger Design: Types of heat exchanger, design of tube & shell heat exchangers, classification of tube & shell heat exchangers, numerical based on heat exchanger designs

Evaporators & Crystallizers: Types of evaporators, entrainment separators, design considerations, types of crystallizers, design considerations, numerical based on evaporator & crystallizers

Distillation and Fractionation Designs: Basic design of fractionation equipment, stresses in column shell, determination of shell thickness, elastic stability, allowable deflection, design and construction features, numerical based on distillation & fractionation design

Safety measures in equipment Designs: Hazards in process industries, analysis of hazards, safety measures in equipment design

Text Books:

1. Process Equipment Design - M.V.Joshi & V V Mahajani, Third edition.

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2. Process Equipment Design (Mechanical Aspects) By B.C.Bhattacharya

Reference Books:

1. Process Equipment Design - Vessel Design - L.E. Brownell & E.H.Young, 1st Edition.
2. Illustrated Process Equipment Design by S B Thakore, 2nd edition,.
3. Dawande, S. D., Process Design of Equiments, 4th Edition, Central Techno Publications, Nagpure, 2005.
4. Green D. W., Perrys Chemical Engineers Handbook, 8th Edition McGraw Hill, 2007
5. https://archive.nptel.ac.in/courses/103/105/103105210/

Course Outcome: On completion of the course, students will be able to

INU821(C).1 To summarize the different equipments used in process industry.

INU821(C).2 To study the operation of heat exchanger, evaporator & distillation columns in instrumentation system

INU821(C).3 To understand the basic need design consideration

INU821(C).4 To illustrate equipment design with mechanical concept

INU821(C).5 To learn the safety consideration in equipment design

CO – PO –PSO Mapping:

CO	PO/PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	0	0	0	0	0	0	0	0	0	1	0	1	0	0
CO2	3	0	0	0	0	0	0	0	0	0	0	0	1	0	0
CO3	2	0	3	0	0	0	0	0	0	0	0	1	1	1	0
CO4	0	0	3	1	0	0	0	0	0	0	0	0	0	0	0
CO5	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

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Programme Elective –VI
For Internship Students Only

***Students going for Industrial Project/Thesis will complete above course through online platform such as MOOCs. , NPTEL etc or by self-study mode and will directly appear for ESE only. (Total internal marks (MSE+TA) will be awarded proportional to ESE marks secure)**

List of the courses equivalent to the elective courses offered in eighth semester

Sr. No	Name of offered Elective courses	Name of equivalent course available on NPTEL, MMOCs etc	Link for the course
1	Smart Materials and Intelligent System Design By Prof. Bishakh Bhattacharya | IIT Kanpur	INU821(A) Smart Materials	https://onlinecourses.nptel.ac.in/noc22_me17/preview
2	An Introduction to Artificial Intelligence By Prof. Mausam | IIT Delhi	INU821(B) Artificial Intelligence	https://onlinecourses.nptel.ac.in/noc22_cs56/preview
3	Process Equipment Design: By Prof. Shabina Khanam | IIT Roorkee	INU821(C) Process Equipment Design	https://onlinecourses.nptel.ac.in/noc22_ch29/preview

(Duration of these courses are for current academic years. Department will release the course names and corresponding links to the students for the particular academic year)

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INU822(A) PROJECT and SEMINAR OR (B) INDUSTRY INTERNSHIP PROJECT

Teaching Scheme : 28 P Total: 28 Credit:14

Evaluation Scheme: 200 ICA + 200 ESE Total Marks: 400

Duration of ESE : ----------

Course Objectives:

I. To Identify and compare technical and practical issues related to the instrumentation and allied areas.
II. To encourage the process of independent thinking and working together in a group.
III. To develop the ability to describe, interpret and analyze technical issues
IV. To implement innovative ideas for social benefit..
V. To understand the industrial problems and able to suggest the possible solutions .

Course Contents:

PROJECT AND SEMINAR

1. Student shall select a topic for Project as per guidelines of the institute in the field of Instrumentation Engineering.(Synopsis submission) after beginning of VIII Semester and shall be approved by the concerned guide and Program Head.
2. Exhaustive survey of literature based on a clear definition of the scope and focus of the topic should be carried out by the students
3. Students should complete implementation of ideas given in synopsis, so that project work should be completed before end of semester.
4. Students shall submit the final project report in proper format as per guidelines given on the college website
5. For uniform and continuous evaluation, evaluation committee for each group shall be formed by Program Head in which guide must be a member. Internal marks should be awarded by committee at the end of semester based on continuous evaluation.
6. Final examination of project shall include demonstration, presentation of complete work and oral examination based on the project work.

INDUSTRY INTERSHIP PROJECT

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I. The aim of Industry Internship Project is to provide the impactful strategy for creating a future talent pool for the industry .This gives a student an opportunity to solve the real industrial problems with innovative solutions

II. The students can work in group / individually decided by the department as per availability of the industry project. Each student / Group of student will have a Industry Mentor in the industry and Faculty guide in the institute.

III. Students /Group select the industry which is ready to provide Industry Internship Project through communication with industry through proper channel or through AICTE internship portal. The student/Group need to submit acceptance letter from Industry stating the approved topic of the project from Industry & Institute. Also students need to accept the institute internship policy if any with proper procedure before joining the internship.

IV. Students will not get any financial assistance from the institute but can accept the stipend provided by the industry if given.

V. The meeting with Project guide is once within week/two week at Institute. These meetings typically include assistance in finding solutions recent problems in the projects, technical support on applied software packages, and support with writing the final report.

VI. Industry Internship Project includes seminars/presentation to share the experience and knowledge to a larger audience. The Project monitoring will be done by Institute Guide & Industry guide to know whether learning objective is achieved or not.

VII. Students undergone the Industry Internship Project will have to submit following documents on the successful completion of Industry Institute Project

1. Authenticated attendance record from Industry internship project mentor/supervisor/Guide
2. Industry internship project signed by Industry Mentor/Guide
3. Industry internship project Completion Letter by Industry Mentor/ Guide
4. Project evaluation report signed by Industry Mentor/ Guide

Note:

ICA: The Internal Continuous Assessment shall be based on the active participation of the students in the Project work and knowledge / skill acquired. Oral examination shall be conducted on the Project report, by the panel of examiners consisting of Project Guide, Course Coordinator and Expert appointed by Program Head.

ESE: The End Semester Examination for Project shall consist of Demonstration if any, presentation and oral examinations based on the project report.

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

INU822.1 Identify and compare technical and practical issues related to the instrumentation and allied areas.

INU822.2 Develop a well organized report technical writing and critical thinking skills

INU822.3 Demonstrate the ability to describe, interpret and analyze technical issues related to problem

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