RSET

RAJAGIRI SCHOOL OF ENGINEERING & TECHNOLOGY

Department of Applied Electronics & Instrumentation

COURSE HANDOUT : FIFTH SEMESTER

RSET VISION

To evolve into a premier technological and research institution, moulding eminent professionals with creative minds, innovative ideas and sound practical skill, and to shape a future where technology works for the enrichment of mankind.

RSET MISSION

To impart state-of-the-art knowledge to individuals in various technological disciplines and to inculcate in them a high degree of social consciousness and human values, thereby enabling them to face the challenges of life with courage and conviction.

DEPARTMENT VISION

To evolve into a centre of academic excellence, developing professionals in the field of electronics and instrumentation to excel in academia and industry.

DEPARTMENT MISSION

Facilitate comprehensive knowledge transfer with latest theoretical and practical concepts, developing good relationship with industrial, academic and research institutions thereby moulding competent professionals with social commitment.

PROGRAMME EDUCATIONAL OBJECTIVES

PEOI: Graduates will possess engineering skills, sound knowledge and professional attitude, in electronics and instrumentation to become competent engineers.

PEOII: Graduates will have confidence to design and develop instrument systems and to take up engineering challenges.

PEOIII: Graduates will possess commendable leadership qualities, will maintain the attitude to learn new things and will be capable to adapt themselves to industrial scenario.

PROGRAMME OUTCOMES

Engineering Graduates will be able to:

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

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

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

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

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

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

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

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

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

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

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

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

Program Specific Outcome

Students of the program

PSO 1: will have sound technical skills in electronics and instrumentation.

PSO 2: will be capable of developing instrument systems and methods complying with standards.

PSO 3: will be able to learn new concepts, exhibit leadership qualities and adapt to changing industrial scenarios

INDEX

SCHEME

SLOT	COURSE NO.	COURSES	L-T-P	HOURS	CREDIT
A	AET301	CONTROL SYSTEMS	3-1-0	4	4
B	AET303	INDUSTRIAL INSTRUMENTATION	3-1-0	4	4
C	AET305	COMPUTER ARCHITECTURE AND EMBEDDED SYSTEMS	3-1-0	4	4
D	AET307	ANALOG INTEGRATED CIRCUITS	3-1-0	4	4
E 1/2	HUT300	INDUSTRIAL ECONOMICS & FOREIGN TRADE	3-0-0	3	3
	HUT310	MANAGEMENT FOR ENGINEERS	3-0-0	3	3
F	MCN301	DISASTER MANAGEMENT	2-0-0	2	--
S	AEL331	ANALOG INTEGRATED CIRCUITS AND INSTRUMENTATION LAB	0-0-3	3	2
T	AEL333	EMBEDDED SYSTEMS LAB	0-0-3	3	2
R/M/H	VAC	REMEDIAL/MINOR/HONOURS COURSE	3-1-0	4*	4
TOTAL				27/31	23/27

AET301: CONTROL SYSTEMS

COURSE INFORMATION SHEET

PROGRAMME: **APPLIED ELECTRONICS AND INSTRUMENTATION**	DEGREE: BTECH
COURSE: **CONTROL SYSTEM**	SEMESTER: 5 CREDITS: 4
COURSE CODE: **AET301** REGULATION: 2019	COURSE TYPE: CORE
COURSE AREA/DOMAIN: SYSTEM THEROY	CONTACT HOURS: 3+1 (Tutorial) hours/Week.
CORRESPONDING LAB COURSE CODE (IF ANY): NIL	LAB COURSE NAME: NIL

SYLLABUS:

UNIT	DETAILS	HOURS
I	**System modeling - Transfer function approach:** Introduction to control systems – Classification of control systems. Principles of automatic control. Feedback control systems – Practical examples – Transfer function – Transfer function of electrical, mechanical and electromechanical system – Block diagram – Signal flow graph – Mason's gain formula.	9
II	**Time domain analysis:** Standard test signals - Response of systems to standard test signals – Step response of second order systems in detail – Time domain specifications – delay time, rise time, peak time, maximum percentage overshoot and settling time. Steady state response – Steady state error- Static & Dynamic error coefficients.	10
III	**Stability of linear systems in time domain:** Asymptotic and BIBO stability, Routh-Hurwitz criterion of stability. Root locus - Construction of root locus – Effect of addition of poles and zeros on root locus.	8
IV	**Frequency domain analysis:** Frequency response – Frequency domain specifications – Stability in the frequency domain- Nyquist stability criterion – Stability from polar and Bode plots - Relative stability – Gain margin and phase margin – M & N circles – Nichol's chart.	8
V	**State variable analysis:** State space representation of Continuous Time systems. Transfer function from State Variable Representation, Solution of state equations, state transition matrix, Concepts of Controllability and Observability, Kalman's Test.	10
	TOTAL HOURS	**45**

TEXT/REFERENCE BOOKS:

T/R	BOOK TITLE/AUTHORS/PUBLICATION
T	S. Hassan Saeed, Automatic Control Systems(with MATLAB programs),KATSON Books.
T	Norman S Nise, Control System Engineering, Sixth Edition.
R	Control systems principles and design: M. Gopal, TMH.
R	Automatic control system – B.C. Kuo, PHI.
R	Control system design: Graham C Goodwin, PHI.
R	Modern Control Systems: Dorf, Pearson Education.
R	Katsuhiko Ogata, Modern Control Engineering, Pearson Education.

COURSE PRE-REQUISITES:

C.CODE	COURSE NAME	DESCRIPTION	SEM
ECT205	NETWORK THEORY	Node and mesh analysis	3

COURSE OBJECTIVES:

1	To analyze and design control systems

COURSE OUTCOMES:

Sl. No.	DESCRIPTION	Bloom's Taxonomy Levels
1	Analyze the control systems by transfer function approach.	Analyze (4)
2	Get an adequate knowledge in the time response of systems & steady state error analysis	Knowledge (1)
3	Learn the concept of stability of control systems and methods of stability analysis.	Understand (2)
4	Analyze the control systems using frequency domain method.	Analyze (4)
5	Apply the State Space Techniques to Control Systems.	Apply (3)

CO-PO AND CO-PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO.1	3	2	-	-	-	-	-	-	-	-	-	-	-	2	2
CO.2	3	2	-	-	-	-	-	-	-	-	-	-	-	-	3
CO.3	3	3	-	-	-	-	-	-	-	-	-	-	2	-	2
CO.4	2	3	2	-	-	-	-	-	-	-	-	-	-	3	2
CO.5	3	2	-	-	-	-	-	-	-	-	-	-	-	2	2

JUSTIFATIONS FOR CO-PO-PSO MAPPING

MAPPING	LOW/MEDIUM /HIGH	JUSTIFICATION
CO.1- PO1	H	Knowledge of mathematical modeling for understanding complex control systems by finding their transfer function.
CO.1 – PO2	H	Formulate transfer functions from mathematical model to understand control systems better.
CO.1 – PSO2	M	Knowledge of electrical and mechanical systems required for design of instrument systems.
CO.1 – PSO3	M	Learn new concepts about linear systems, their properties and models
CO.2 – PO1	M	Analysis of transfer function for finding solution to complex control systems
CO.2 – PO2	M	Analyze the different responses and steady state errors in control systems.
CO.2 – PSO3	M	New concepts in system analysis in time domain
CO.3 – PO1	H	Analyze stability of systems using principles of mathematics.
CO.3 – PO2	M	Knowledge of analytical methods for stabilizing unstable systems.
CO.3 – PSO1	M	Better knowledge of instrument systems by knowing stability issues.
CO.3 – PSO3	M	New concepts in stability analysis
CO.4 – PO1	M	Analyze a given system and identify the additional requirement that can be met with a compensator.
CO.4 – PO2	H	Design of compensators for meeting specific performance criteria.

CO.4 – PO3	M	Conduct investigation of current system performance using frequency domain analysis (Bode plot).
CO.4 – PSO2	H	Compensator design using RC networks and obtaining their mathematical models.
CO.4 – PSO3	M	Learning concept of compensators and their design.
CO.5 – PO1	H	Use of MATLAB for analysis of control systems.
CO.5 – PO2	M	Imparting knowledge for making industry ready graduates that enable lifelong learning.
CO.5 – PSO2	M	Understanding of universal standard analysis tool like MATLAB
CO.5 – PSO3	M	Learning of new analysis methods using MATLAB

GAPES IN THE SYLLABUS - TO MEET INDUSTRY/PROFESSION REQUIREMENTS:

Sl.NO:	DESCRIPTION	PROPOSED ACTIONS
1	Introduction to Laplace Transforms	Assignment & Bridge Course
2	MATLAB in detail, Simulink	Web reference[3]

PROPOSED ACTIONS: TOPICS BEYOND SYLLABUS/ASSIGNMENT/INDUSTRY VISIT/GUEST LECTURER/NPTEL ETC

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN:

1	Conceptual problems, definitions, to help students in competitive examinations.

WEB SOURCE REFERENCES:

1	http://nptel.iitm.ac.in/courses/108101037/
2	http://nptel.iitm.ac.in/video.php?subjectId=108102043
3	http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT-Delhi/Control%20system%20design%20n%20principles/index.htm

DELIVERY/INSTRUCTIONAL METHODOLOGIES:

■ CHALK & TALK	■ STUD. ASSIGNMENT	■ WEB RESOURCES	
☐ LCD/SMART BOARDS	☐ STUD. SEMINARS	☐ ADD-ON COURSES	

ASSESSMENT METHODOLOGIES-DIRECT

■ ASSIGNMENTS	☐ STUD. SEMINARS	■ TESTS/MODEL EXAMS	■ UNIV. EXAMINATION
☐ STUD. LAB PRACTICES	☐ STUD. VIVA	☐ MINI/MAJOR PROJECTS	☐ CERTIFICATIONS
☐ ADD-ON COURSES	☐ OTHERS		

ASSESSMENT METHODOLOGIES-INDIRECT

☐ ASSESSMENT OF COURSE OUTCOMES (BY FEEDBACK, ONCE)	☐ STUDENT FEEDBACK ON FACULTY (TWICE)
☐ ASSESSMENT OF MINI/MAJOR PROJECTS BY EXT. EXPERTS	☐ OTHERS

Prepared by

Ms.Mary Hexy

Approved by

Dr. Hari C.V.

(HOD)

COURSE PLAN

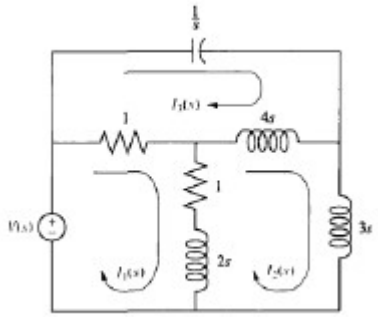
Sl.No	Module	Planned
1	1	System modeling- Transfer function approach: Introduction to control
2	1	Classification of control systems
3	1	Principles of automatic control.
4	1	Stability from polar and Bode plots- Relative stability.
5	1	Feedback control systems
6	1	Practical examples- Transfer function
7	1	Transfer function of Electrical system
8	1	Transfer function of Mechanical, Electromechanical system
9	1	Block diagram
10	1	Signal flow graph- Mason's gain formula
11	1	Signal flow graph- Mason's gain formula
12	1	Signal flow graph- Mason's gain formula
13	2	Time domain analysis: Standard test signals.
14	2	Response of systems to standard test signals.
15	2	Step response of second order systems in detail.
16	2	Time domain specifications
17	2	Delay time, rise time, peak time, maximum percentage overshoot and settling time.
18	2	Steady state response- Steady state error
19	2	Static and Dynamic error coefficients.
20	2	Static and Dynamic error coefficients.
21	2	Static and Dynamic error coefficients. Tutorials
22	2	Tutorials
23	3	Stability of linear systems in time domain: Asymptotic and BIBO stability
24	3	Routh-Hurwitz criterion of stability
25	3	Root locus - Construction of root locus
26	3	Root locus - Construction of root locus

27	3	Effect of addition of poles and zeros on root locus
28	3	Effect of addition of poles and zeros on root locus
29	3	Effect of addition of poles and zeros on root locus
30	4	Frequency domain analysis: Frequency response
31	4	Frequency domain specifications
32	4	Stability in the frequency domain
33	4	Nyquist stability criterion
34	4	Nyquist stability criterion
35	4	Stability from polar and Bode plots - Relative stability
36	4	Stability from polar and Bode plots - Relative stability
37	4	Gain margin and phase margin
38	4	M & N circles
39	4	Nichol's chart.
40	5	State variable analysis: State space representation of Continuous Time systems.
41	5	Transfer function from State Variable Representation
42	5	Solution of state equations
43	5	state transition matrix
44	5	Concepts of Controllability and Observability, Kalman's Test.
45	5	Concepts of Controllability and Observability, Kalman's Test.
46	5	Revision Module
47	5	Revision Module

ASSIGNMENTS

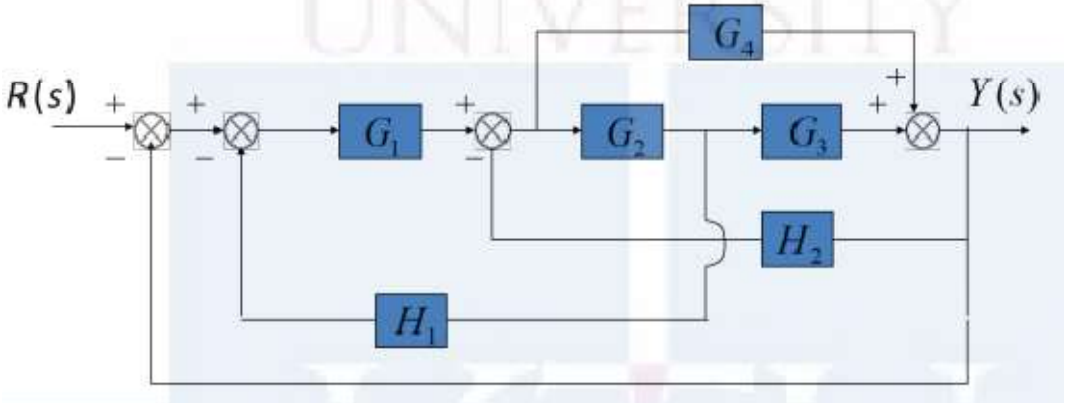
ASSIGNMENT-1

1. Write any 2 advantages and disadvantages of closed-loop control systems.
2. Define the transfer function of a linear system. Write its properties.
3. Write any five standard classifications of the control system.
4. (a) Define system & subsystem(b) Define linear system with example.
5. Find the differential equation governing the electrical system as shown in the
   i. figure.



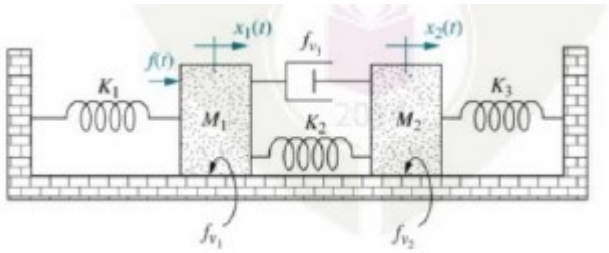
6. Write any 5 rules for block diagram reduction

7. Using the block diagram reduction technique, find the overall transfer function of the system shown below:

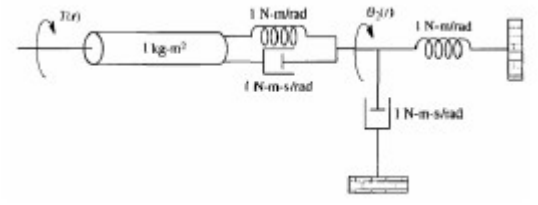


8. Derive the transfer function for armature-controlled DC motor.

9. Draw the free-body diagrams of masses M1 and M2, for the system shown below. Find the transfer function X2(s)/ F(s).



10. Find the transfer function G(s) =2(s) / T(s), for the rotational mechanical system shown in the figure.



11. Derive the transfer function for armature-controlled DC motor.

ASSIGNMENT-2

1. **Response of the first order**
2. **System to the unit step input**
3. **Response of the undamped second order system**
4. **Response of the underdamped second order system**

Tutorial Questions

1

Convert the block diagram to signal flow graph and determine the transfer function using Mason's gain formula.

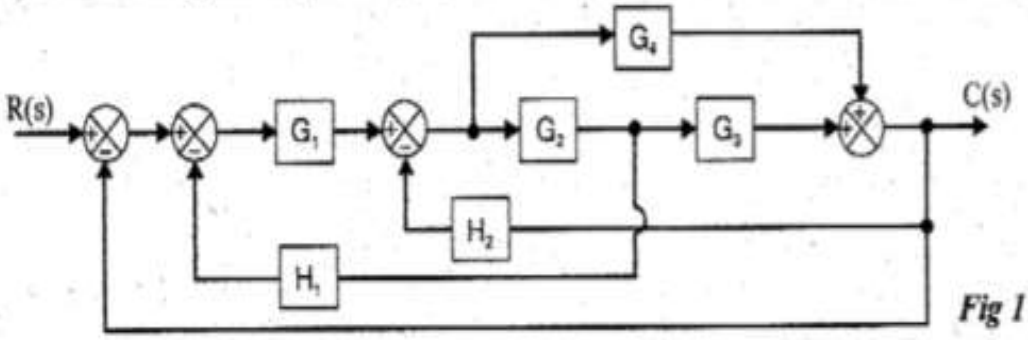
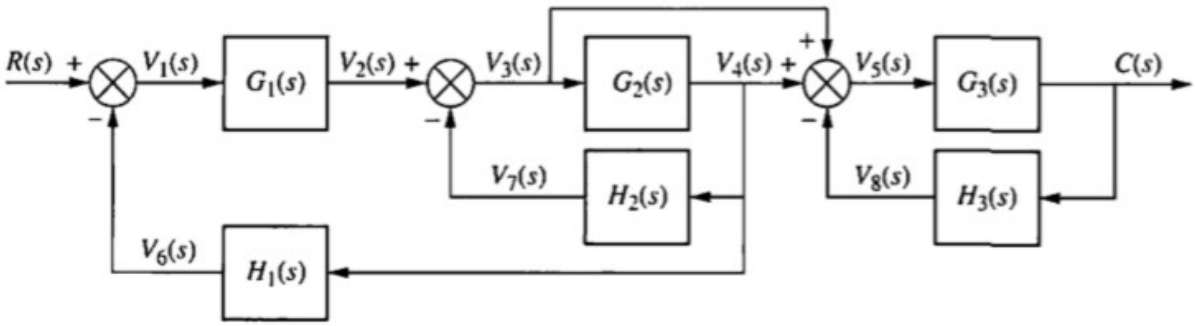


Fig 1

2.

PROBLEM: Reduce the system shown in Figure 5.11 to a single transfer function.



AET303: INDUSTRIAL INSTRUMENTATION

COURSE INFORMATION SHEET

PROGRAMME: APPLIED ELECTRONICS & INSTRUMENTATION	DEGREE: BTECH
COURSE: *INDUSTRIAL* INSTRUMENTATION	SEMESTER: 5 CREDITS: 4
COURSE CODE: AET303 REGULATION: 2019	COURSE TYPE: CORE
COURSE AREA/DOMAIN: SYSTEM THEORY	CONTACT HOURS: 3+1(Tutorial) hours/Week.
CORRESPONDING LAB COURSE CODE (IF ANY): NIL	LAB COURSE NAME: NIL

SYLLABUS:

UNIT	DETAILS	HOURS
I	**Temperature Measurement**: Resistance Temperature Detectors – Applications, Industrial RTD construction requirement, RTD Transmitters. Thermistors – Principle of Operation, Sensor types,Temperature Measurement using Thermistors. Thermocouples – Theory of Operation, Thermocouple types. Diode – Type Temperature Sensors, Fluidic Sensors, Johnson noise thermometer, ElectronicTemperature Switches.	9
II	**Pressure Measurement:** Manometers, Bourdon Tubes, Diaphragm Elements. **Electronic Pressure Sensors –** Strain Gauge Transducers, Capacitance Transducer, Potentiometric Transducer, Resonant Wire Transducer, Piezoelectric Pressure Sensors, Linear Variable Differential Transformer, Optical Transducers. **Differential Pressure Transmitters** – Pneumatic transmitter.	9
III	**Flow Measurement:** Introduction, Orifice Plates, Venturi Tubes and Nozzles, Pitot Tubes. **Positive Displacement Flowmeters -** Nutating disc flow meter, Sliding vane flow meter, Lobed impeller flow meter, Reciprocating piston flowmeter **Mass Flowmeters** – Radiation type, Angular – Momentum type, Impeller-Turbine Flowmeter, Constant torque - Hysteresis Clutch, Twin-Turbine.	9
IV	**Anemometers –** Mechanical Anemometer, Hot-wire anemometer, Laser Doppler anemometer.Cross-Correlation flow meter, Ultrasonic flow meter – Transit-time flow meter, Doppler flow meter **Measurement of Viscosity –** Introduction, Viscometer selection and application. Capillary Viscometers – Differential Pressure type.	9
V	**Electrical Methods –** Resistance, Conductance, Inductive and Capacitive level gauging**,** Ultrasonic Method, Microwave Level Switches, Non	9

	contacting optical level sensor, Rotating Paddle Switches.	
TOTAL HOURS		**45**

TEXT/REFERENCE BOOKS:

T/R	BOOK TITLE/AUTHORS/PUBLICATION
T	Liptak B.G, "*Process Measurement and Analysis*", 4th Edition, Chilton Book Company, Radnor, Pennsylvania, 2003.
T	Doebelin E.O, "*Measurement Systems: Application and Design*", 4th Edition, McGraw Hill, New York, 2003.
T	Doebelin E.O, "*Measurement Systems: Application and Design*", 4th Edition, McGraw Hill,New York, 2003.
R	Andrew W.G, "*Applied Instrumentation in Process Industries – A survey*", Vol I & Vol II, Gulf Publishing Company, Houston, 2001.
R	Douglas M. Considine, "*Process / Industrial Instruments & Controls Handbook*", 5th Edition, McGraw Hill, Singapore, 1999.
R	Spitzer D. W., *Flow measurement*, ISA press, New York, 1998 4. Noltingk B.E., *"Instrumentation Reference Book"*, 2nd Edition, Butterworth Heinemann, 1995.
R	Noltingk B.E., *"Instrumentation Reference Book"*, 2nd Edition, Butterworth Heinemann,1995.

COURSE PRE-REQUISITES:

C.CODE	COURSE NAME	DESCRIPTION	SEM
	NIL		

COURSE OBJECTIVES:

1	**This course aims to develop a strong understanding of the principle of operation of various temperature, pressure, flow and level measuring devices.**

COURSE OUTCOMES:

SNO	DESCRIPTION	Blooms' Taxonomy Level
1	Understand the working of different types of temperature sensors	Analyze (4)
2	Familiarize with the various types of pressure measurement techniques	Knowledge (1)
3	Study the working of various flow measurement devices	Understand (2)
4	Familiarize with the working of anemometers and viscometers	Analyze (4)
5	Understand the various level measurement techniques	Apply (3)

CO – PO and CO – PSO mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	-	-	-	-	-	-	-	-	-	-	-	-	2
2	3	3	-	-	-	-	-	-	-	-	-	-	-	-	2
3	3	3	-	-	-	-	-	-	-	-	-	-	-	-	2
4	3	3	-	-	-	-	-	-	-	-	-	-	-	-	2
5	3	3	-	-	-	-	-	-	-	-	-	-	-	-	2

Justification for CO-PO-PSO mapping

Course Outcome	LOW/MEDIUM/HIGH	Justification
CO.1- PO1	H	Imparts good level knowledge in terms principle and application engineering
CO.1 – PO2	H	Imparts good level knowledge in terms principle and application engineering
CO.1 – PSO3	M	Contains design aspects for design projects
CO.2 – PO1	M	Imparts good level knowledge in terms principle and application engineering
CO.2 – PO2	M	Imparts good level knowledge in terms principle and application engineering
CO.3 – PO1	H	Contains mathematical modelling for analysis
CO.3 – PO2	M	Contains mathematical modelling for synthesis
CO.3 – PSO3	M	Deals with all fundamental measurements in industry
CO.4 – PO1	M	Imparts good level knowledge in terms application engineering
CO.4 – PO2	H	Imparts good level knowledge in terms application engineering
CO.4 – PSO3	M	Interdisciplinary nature of the subject provokes diverse thinking
CO.5 – PO1	H	Imparts good level knowledge in terms principle
CO.5 – PO2	M	Imparts good level knowledge in terms principle

GAPS IN THE SYLLABUS - TO MEET INDUSTRY/PROFESSION REQUIREMENTS:

SNO	DESCRIPTION	PROPOSED ACTIONS
1	Datasheet of DP transmitter	lectures

PROPOSED ACTIONS: TOPICS BEYOND SYLLABUS/ASSIGNMENT/INDUSTRY VISIT/GUEST LECTURER/NPTEL ETC

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN:

SNO	DESCRIPTION
1	Introduction to current to pressure transducer

WEB SOURCE REFERENCES:

1	https://onlinecourses.nptel.ac.in/noc22_me08/preview
2	https://www.idc-online.com/technical_references/pdfs/instrumentation/Industrial_Instrumentation%20-%20Flow.pdf
3	http://www.nitttrc.edu.in/nptel/courses/video/103103147/lec28.pdf

DELIVERY/INSTRUCTIONAL METHODOLOGIES:

☐CHALK & TALK ☑	☐STUD. ASSIGNMENT ☑	☐WEB RESOURCES☑	☐LCD/SMART BOARDS
☐STUD. SEMINARS	☐ADD-ON COURSES		

ASSESSMENT METHODOLOGIES-DIRECT

☐ASSIGNMENTS ☑	☐STUD. SEMINARS	☐TESTS/MODEL EXAMS ☑	☐UNIV. EXAMINATION ☑
☐STUD. LAB PRACTICES	☐STUD. VIVA	☐MINI/MAJOR PROJECTS	☐CERTIFICATIONS
☐ADD-ON COURSES	☐OTHERS		

ASSESSMENT METHODOLOGIES-INDIRECT

☐ASSESSMENT OF COURSE OUTCOMES (BY FEEDBACK, ONCE) ☑	☐STUDENT FEEDBACK ON FACULTY (TWICE) ☑
☐ASSESSMENT OF MINI/MAJOR PROJECTS BY EXT. EXPERTS	☐OTHERS

Prepared by
Mr. Krishna kumar KP
(Faculty)

Approved by

Dr. Hari C.V.
(HOD)

COURSE PLAN

Sl No	Module	Topic
1	1	Temperature Measurement: Resistance Temperature Detectors
2	1	Applications, Industrial RTD construction requirement, RTD Transmitters
3	1	Thermistors – Principle of Operation, Sensor types
4	1	Temperature measurement using Thermistors
5	1	Thermocouples – Theory of Operation, Thermocouple types.
6	1	Diode – Type Temperature Sensors
7	1	Fluidic Sensors, Johnson noise thermometer
8	1	Electronic Temperature Switches.
9	2	Pressure Measurement: Manometers, Bourdon Tubes, Diaphragm Elements
10	2	Electronic Pressure Sensors – Strain Gauge Transducers
11	2	Capacitance Transducer, Potentiometric Transducer
12	2	Resonant Wire Transducer, Piezoelectric Pressure Sensors
13	2	Linear Variable Differential Transformer, Optical Transducers.
14	2	Differential Pressure Transmitters – Pneumatic transmitter.
15	3	Flow Measurement: Introduction, Orifice Plates
16	3	Venturi Tubes and Nozzles, Pitot Tubes
17	3	Positive Displacement Flowmeters - Nutating disc flowmeter, Sliding vane flowmeter
18	3	Lobed impeller flowmeter, Reciprocating piston flowmeter
19	3	Mass Flowmeters – Radiation type
20	3	Angular – Momentum type, Impeller-Turbine Flowmeter
21	3	Constant torque - Hysteresis Clutch, Twin-Turbine.
22	4	Anemometers – Mechanical Anemometer, Hot-wire anemometer, Laser Doppler anemometer
23	4	Cross-Correlation flow meter, Ultrasonic flow meter – Transit-time flow meter
24	4	Doppler flow meter
25	4	Measurement of Viscosity – Introduction, Viscometer selection and application
26	4	Capillary Viscometers – Differential Pressure type.
27	5	Level Measurement – Float Type level indicator
28	5	Displacer Type – Torque tube assembly
29	5	Electrical Methods – Resistance, Conductance
30	5	Inductive and Capacitive level gauging
31	5	Ultrasonic Method, Microwave Level Switches
32	5	Noncontacting optical level sensor
33	5	Rotating Paddle Switches.

Assignment 1

Q1) Submit class notes part1

Assignment 2

Q1) Submit class notes part2

AET 305: COMPUTER ARCHITECTURE AND EMBEDDED SYSTEMS

COURSE INFORMATION SHEET

PROGRAMME: Applied Electronics and Instrumentation Engg.	DEGREE: BTECH
COURSE: COMPUTER ARCHITECTURE AND EMBEDDED SYSTEMS	SEMESTER: **5** CREDITS: **4**
COURSE CODE: AET305 **REGULATION: 2019**	COURSE TYPE**: CORE**
COURSE AREA/DOMAIN: ELECTRONICS	CONTACT HOURS: **3+1** (Tutorial) hours/Week.
CORRESPONDING LAB COURSE CODE (IF ANY): AEL333	LAB COURSE NAME: **EMBEDDED SYSTEMS LAB**

SYLLABUS:

UNIT	DETAILS	HOURS
I	Computer Arithmetic and Processor Basics: Functional units of a computer, Von Neumann and Harvard computer architectures. Processing unit- Fundamental concepts, Execution of a complete Instruction, Hardwired Control, Multiple Bus organization, other enhancements, Microprogrammed control. Number representations - Fixed and floating point-number representation, Arithmetic operations on floating point numbers	11
II	8051 Architecture: Microcontrollers and Embedded Processors. Architecture – Block diagram of 8051, Pin configuration, Registers, Internal Memory, Timers, Port Structures, Interrupts. Assembly Language Programming - Addressing Modes, Instruction set of 8051, Simple programming examples in assembly language.	9
III	Programming and Interfacing of 8051: Interfacing with 8051 using Assembly language programming: LED, Seven segment LED display.. Interfacing of Keyboard, Stepper Motor and DAC -- with 8051 and its programming. 8051 Timers/Counters - Modes and Applications	10
IV	Embedded programming: Introduction to Embedded Systems: Definition of Embedded System, Embedded Systems Vs General Computing Systems. Programming concepts of Embedded programming in C Program Elements, Macros and functions - Use of Pointers - NULL Pointers - Use of Function Calls – Multiple function calls in a Cyclic Order in the Main Function Pointers – Function Queues and Interrupt Service Routines Queues Pointers	9
V	RTOS Based Embedded System: RTOS Based Embedded System Design: Operating System Basics, Types of Operating Systems, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling. How to Choose an RTOS?	6
	TOTAL HOURS	45

TEXT/REFERENCE BOOKS:

T/R	BOOK TITLE/AUTHORS/PUBLICATION
T	V. Carl Hamacher, Zvono G. Vranesic, Safwat G. Zaky, Computer Organization. McGraw-Hill International Editions
T	Muhammad Ali Mazidi, *ARM Assembly Language Programming & Architecture*, Kindle edition
T	Shibu K.V, Introduction to Embedded Systems, Mc Graw Hill
R	Computer organization and design: The Hardware/Software interface/David A.Patterson, John L. Hennessy. — 5th ed.
R	Mano M M, Computer System Architecture, 3rd Ed, Prentice Hall of India.
R	Wayne Wolf, Computers as Components: Principles of Embedded Computing System Design – Harcourt India, Morgan Kaufman Publishers, First Indian Reprint 2001
R	Lyla B Das, Embedded Systems An Integrated Approach, Pearson, 2013
R	Rajkamal, Embedded Systems Architecture, Programming and Design, TATA McGrawHill, First reprint Oct. 2003

COURSE PRE-REQUISITES:

C.CODE	COURSE NAME	DESCRIPTION	SEM
ECT203	Logic Circuit Design	To impart the basic knowledge of logic circuits and enables students to apply it to design a digital system.	3
EST102	EST102 Programming in C	Preparing the Engineering Graduates capable of writing readable C programs to solve computational problems that they may have to solve in their professional life.	2

COURSE OBJECTIVES:

1	To impart knowledge of basic computer architecture, 8051 microcontroller and embedded programming.

To expose the processors

COURSE OUTCOMES:

SNO	DESCRIPTION	Blooms' Taxonomy Level
1	Students will be able to **explain** the processor architecture and operation.	Understand (Level 2)
2	Students will be able to **explain** the architecture of 8051 microcontroller.	Understand (Level 2)
3	Students will be able to **develop** programs using assembly language 8051.	Apply (Level 3)
4	Students will be able to **develop** programming concepts of Embedded programming in C.	Apply (Level 3)
5	Students will be able to **explain** the concepts of RTOS based embedded	Understand

	system.	(Level 2)

CO-PO AND CO-PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO.1	3	3	-	-	-	-	-	-	-	-	-	3	2	-	1
CO.2	3	3	-	-	-	-	-	-	-	-	-	3	2	-	1
CO.3	3	3	3	3	3	-	-	-	-	-	-	3	2	-	1
CO.4	3	3	3	3	3	-	-	-	-	-	-	3	2	-	2
CO.5	3	3	-	-	-	-	-	-	-	-	-	3	2	-	2
CO.6	3	3	-	-	-	-	-	-	-	-	-	3	2	-	1

JUSTIFATIONS FOR CO-PO-PSO MAPPING

MAPPING	LOW/MEDIUM/ HIGH	JUSTIFICATION
CO.1- PO1	H	Understand the fundamentals, capabilities, programming model and implementation of a computer system.
CO.1- PO2	H	Formulate the execution of computer instruction at the micro level.
CO.1- PO12	H	Lifelong learning enables to keep up with society's changes especially the technological ones.
CO.1 – PSO1	M	Provide sound technical knowledge in digital electronics.
CO.1 – PSO3	L	Able to learn the data flow, memory hierarchy, hardware requirements/costs, software-hardware trade-offs.
CO.2- PO1	H	Understand the architecture, data types, addressing modes and instruction set of 8051 microcontroller.
CO.2 – PO2	H	Able to formulate programs using 8051 instruction set.
CO.2 – PO12	H	Lifelong learning helps to adapt more easily to changes.
CO.2 – PSO1	M	Understanding of the programs will be useful in the development of a new system.
CO.2 – PSO3	L	Enable to learn programming concepts and adapt to changing industrial scenarios.
CO.3- PO1	H	Understand the basic assembly language programming and design various interfacing circuits using 8051 microcontroller.
CO.3 – PO2	H	Identifying the technique involved in various 8051 interfacing.
CO.3 – PO3	H	Able to design assembly language programs for interfacing various circuits with 8051 microcontroller.
CO.3 – PO4	H	Able to design and analyze various 8051 interfacing experiments.
CO.3 – PO5	H	Understands the usage of modern tools for the simulation of 8051 experiments.
CO.3 – PO12	H	Helps to develop life-long learning skills such as investigating and identifying problems, independent research, experimentation and decision making.
CO.3 – PSO1	M	Able to interface hardware and software systems.
CO.3 – PSO3	L	Able to learn assembly language programming concepts.

CO.4- PO1	H	Understands concepts of embedded systems and processor design.
CO.4 – PO2	H	Analyze the design, development and implementation of software that is programmed into devices built around a microprocessor.
CO.4- PO3	H	Design the solutions of complex engineering problem with the knowledge of programming and hardware components.
CO.4- PO4	H	Able to design and analyze embedded systems using embedded C programming.
CO.4- PO5	H	Use latest tools for doing the simulations of different types of embedded systems.
CO.4- PO12	H	Lifelong learning is needed to cope up with the emerging trends in embedded systems that are being adopted.
CO.4 – PSO1	M	Analyze and understand the designing of different embedded systems.
CO.4 – PSO3	M	Able to learn embedded C programming concepts and adapt to changing industrial scenarios.
CO.5- PO1	H	Understands the concepts RTOS based embedded systems.
CO.5 – PO2	H	Identify the maximum utilization of devices and systems with less memory usage.
CO.5 – PO12	H	Knowledge about the real time operating system will aid in proving substantiated solutions to the widely increasing demands of the industries.
CO.5 – PSO1	M	Enable to provide solutions to real time applications.
CO.5 – PSO3	M	Able to understand real time operating system concepts.

GAPS IN THE SYLLABUS - TO MEET INDUSTRY/PROFESSION REQUIREMENTS:

SNO	DESCRIPTION	PROPOSED ACTIONS	RELEVANCE WITH POs	RELEVANCE WITH PSOs
1	Familiarization of Microprocessors	Lecture notes and NPTEL Videos are provided. https://www.digimat.in/nptel/courses/video/108105102/L07.html	PO1	PSO1, PSO3
2	Interfacing of LCD with 8051 and its programming	Extra lab experiments.	PO4, PO6	PSO1, PSO3

PROPOSED ACTIONS: TOPICS BEYOND SYLLABUS/ASSIGNMENT/INDUSTRY VISIT/GUEST LECTURER/NPTEL ETC

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN:

SNO	DESCRIPTION	PROPOSED ACTIONS	RELEVANCE WITH POs	RELEVANCE WITH PSOs
1	ARM Microcontroller	NPTEL Video https://nptel.ac.in/courses/117/106/117106111/	PO1	PSO1, PSO3

WEB SOURCE REFERENCES:

1	**https://nptel.ac.in/courses/108/105/108105102/**
2	https://nptel.ac.in/courses/106/105/106105229/
3	https://nptel.ac.in/courses/106/105/106105172/
4	https://www.watelectronics.com/8051-microcontroller-architecture/
5	Microchip semiconductor web site – www.microchip.com
6	www.embeddedcraft.org
7	www.technologystudent.com

DELIVERY/INSTRUCTIONAL METHODOLOGIES:

☐ **CHALK & TALK**	☐ **STUD. ASSIGNMENT**	☐ WEB RESOURCES	
☐ LCD/SMART BOARDS	☐ STUD. SEMINARS	☐ ADD-ON COURSES	

ASSESSMENT METHODOLOGIES-DIRECT

☐ **ASSIGNMENTS**	☐ **STUD. SEMINARS**	☐ **TESTS/MODEL EXAMS**	☐ **UNIV. EXAMINATION**
☐ **STUD. LAB PRACTICES**	☐ **STUD. VIVA**	☐ MINI/MAJOR PROJECTS	☐ CERTIFICATIONS
☐ ADD-ON COURSES	☐ OTHERS		

ASSESSMENT METHODOLOGIES-INDIRECT

☐ **ASSESSMENT OF COURSE OUTCOMES (BY FEEDBACK, ONCE)**	☐ STUDENT FEEDBACK ON FACULTY (TWICE)
☐ ASSESSMENT OF MINI/MAJOR PROJECTS BY EXT. EXPERTS	☐ OTHERS

Prepared by
Ms. Remya K.R.
(Faculty)

Approved by
Dr.Hari C.V.
(HOD)

Course Plan

Sl No	Module	Topics Planned
1	1	Computer Arithmetic and Processor Basics: Functional units of a computer
2	1	Von Neumann and Harvard computer architectures
3	1	Processing unit- Fundamental concepts
4	1	Execution of a complete Instruction
5	1	Hardwired Control
6	1	Multiple Bus organization, Other enhancements
7	1	Microprogrammed control
8	1	Number representations - Fixed and floating point-number representation
9	1	Tutorial: Execution of a complete instruction
10	1	Arithmetic operations on floating point numbers
11	2	8051 Pin configuration, Registers
12	2	8051 Internal Memory
13	2	8051 Architecture: Microcontrollers and Embedded processors
14	2	Timers
15	2	port structures
16	2	Block diagram of 8051, Interrupts
17	2	Tutorial: Module I practice test
18	2	Assembly Language programming: Addressing modes
19	2	Instruction set of 8051
20	2	Simple programming examples in assembly language
21	2	Tutorial: Assembly language programming
22	3	Programming and Interfacing of 8051: LED interfacing with 8051
23	3	Seven segment LED display interfacing with 8051
24	3	Interfacing of Keyboard with 8051 microcontroller
25	3	Interfacing of Keyboard with 8051 microcontroller and its programming
26	3	Interfacing of DAC with 8051 microcontroller
27	3	Interfacing of Stepper Motor with 8051 microcontroller
28	3	Interfacing of stepper motor with 8051 microcontroller
29	3	8051 Timers/Counters - Modes
30	3	8051 Timers/Counters - Modes and Applications

31	4	Definition of Embedded System, Embedded Systems Vs General Computing Systems.
32	4	Programming concepts of Embedded programming in C Program Elements
33	4	Macros and functions
34	4	Use of Pointers - NULL Pointers
35	4	Use of Data Structures
37	4	Use of Function calls
38	4	Multiple function calls in a Cyclic Order
39	4	Function queues and Function Queues
40	3	Tutorial: Interfacing of peripherals with 8051 microcontroller
41	4	Interrupt Service Routines Queues Pointers
42	5	Tasks
43	5	Operating System Basics, Types of Operating Systems
44	5	Process and Threads
45	5	Difference between process and thread
46	5	Multiprocessing and Multitasking
47	5	Task Scheduling.
48	5	How to Choose an RTOS

Assignment questions

ASSIGNMENT – 1

1. Write the sequence of elementary operations requires to execute the following instructions
a) Sub (R4), R3
b) Add (R4), R1
2. Prepare the microroutine for Question No:1
3. Represent -126 using IEEE 754 floating point standard with double precision.
4. Multiply the following floating point numbers 10.01110 x 2-1 by 1.011010 x 2-4 and represent the result in single precision IEEE format.
5. Explain the execution of the instruction MUL R2, R3, R5 using a 3 bus structure with a neat diagram.
6. Write a program to find the sum of the values at RAM locations 50H – 54H (5 values). At the end of the program, register A should contain the lower byte of the sum and R7 the higher byte of the sum.
7. Is "DIV A, R1" a valid instruction? Justify your answer
8. The following shows the crystal frequency for three different 8051 based systems. Find the time required to execute 1 machine cycle.
a. 11.0592MHz
b. 16MHz
c. 20MHz
9. Explain the working of the following instructions with suitable example.
a) MOVX b) XCHD c) AJMP d) SWAP e) DAA
10. Explain about the port structures of 8051 microcontroller.

ASSIGNMENT – 2

1. Write an embedded C program to interface seven segment display with 8051 microcontroller. Also perform the simulation using PROTEUS software. Assume XTAL frequency is 11.0592 MHz.

2. Write an embedded C program to interface stepper motor with 8051 microcontroller. Also perform the simulation using PROTEUS software. Assume XTAL frequency is 11.0592 MHz.

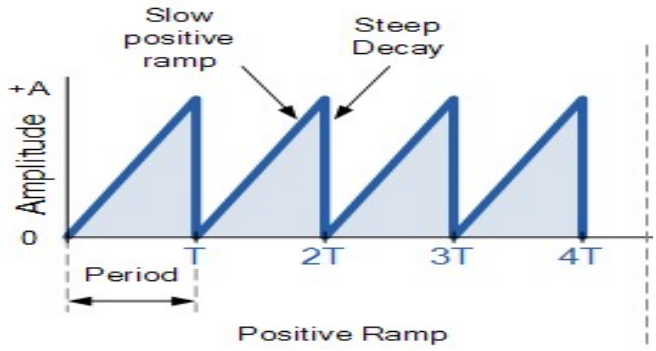
3. Write a program to generate a square wave of 10 Hz frequency on pin P1.0 of 8051 microcontroller with 50% duty cycle (Ton = Toff). Assume XTAL frequency is 11.0592 MHz.

Tutorial

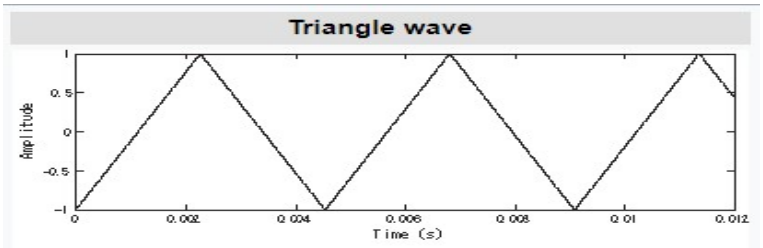
AET 305 COMPUTER ARCHITECTURE AND EMBEDDED SYSTEMS

QUIZ QUESTIONS

1. Write a program to generate a sinusoidal wave Vout = 2 + 2 sinθ using DAC 0808.
2. Write a program to generate a sinusoidal wave Vout = 3 + 3 sinθ using DAC 0808.
3. Write a program to generate a sinusoidal wave Vout = 4 + 4 sinθ using DAC 0808.
4. Write a program to generate a sinusoidal wave Vout = 1 + sinθ using DAC 0808.
5. Write a program to generate a sinusoidal wave Vout = 6 + 6 sinθ using DAC 0808.
6. Write a program to generate a sinusoidal wave Vout = 7 + 7 sinθ using DAC 0808.
7. Write a program to generate a sinusoidal wave Vout = 8 + 8 sinθ using DAC 0808.
8. Write a program to generate a sinusoidal wave Vout = 8 + 8 sinθ using DAC 0808.
9. Write a program to generate a sinusoidal wave Vout = 9 + 9 sinθ using DAC 0808.
10. Write a program to generate a sinusoidal wave Vout = 10 + 10 sinθ using DAC 0808.
11. Write a program to generate the following waveform using DAC 0808.



12. Write a program to generate the following waveform using DAC 0808.



13. Write a program to rotate stepper motor in clockwise direction with 2ms delay in wave drive mode using rotate instruction
14. Write a program to rotate stepper motor in anticlockwise direction with 3ms delay in wave drive mode using rotate instruction
15. Write a program to rotate stepper motor in clockwise direction with 4ms delay in wave drive mode using rotate instruction
16. Write a program to rotate stepper motor in anticlockwise direction with 6ms delay in wave drive mode using rotate instruction
17. Write a program to rotate stepper motor in clockwise direction with 7ms delay in wave drive mode using rotate instruction
18. Write a program to rotate stepper motor in clockwise direction with 8ms delay in wave drive mode using rotate instruction
19. Write a program to rotate stepper motor in clockwise direction with 9ms delay in wave drive mode using rotate instruction
20. Write a program to rotate stepper motor in 54^0 anticlockwise direction with a step angle of 4^0
21. Write a program to rotate stepper motor in 76^0 anticlockwise direction with a step angle of 4^0
22. Write a program to rotate stepper motor in 150^0 clockwise direction and 480^0 anticlockwise direction
23. Write a program to rotate stepper motor in 180^0 clockwise direction and 540^0 anticlockwise direction
24. Write a program to rotate stepper motor in 60^0 clockwise direction and 480^0 anticlockwise direction
25. Write a program to rotate stepper motor in 210^0 clockwise direction and 390^0 anticlockwise direction
26. Write a program to rotate stepper motor in 54^0 anticlockwise direction with a step angle of 2^0
27. Write a program to rotate stepper motor in 150^0 anticlockwise direction with a step angle of 3^0
28. Write a program to rotate stepper motor in 180^0 clockwise direction and 380^0 anticlockwise direction

29. Write a program to rotate stepper motor in 280^0 clockwise direction and 390^0 clockwise direction

30. Write a program to rotate stepper motor in 480^0 clockwise direction and 220^0 clockwise direction

31. write a program to interface seven segment display to display digits 0,2,4,6,8,0,2,4,….with 8051 microcontroller. Assume XTAL = 11.0592 MHz.

32. Write a program to interface seven segment display to display digits 1,3,5,7,9,1,3, ….with 8051 microcontroller. Assume XTAL = 11.0592 MHz.

33. Write a program to interface seven segment display to display digits 0,1,2,3,4,0,1,2, ….with 8051 microcontroller. Assume XTAL = 11.0592 MHz.

34. Write a program to interface seven segment display to display digits 0,2,5,7,9,0,2,5,7, ….with 8051 microcontroller. Assume XTAL = 11.0592 MHz.

35. Write a program to interface seven segment display to display digits 1,2,8,7,9,1,2,8,7,….with 8051 microcontroller. Assume XTAL = 11.0592 MHz.

36. Write a program to interface seven segment display to display digits 4,5,6,7,4,5,6,7,….with 8051 microcontroller. Assume XTAL = 11.0592 MHz.

37. Write a program to interface seven segment display to display digits 1,2,6,7,1,2,6,7,….with 8051 microcontroller. Assume XTAL = 11.0592 MHz.

38. Write a program to interface seven segment display to display digits 0,4,7,9,0,4,7,9,….with 8051 microcontroller. Assume XTAL = 11.0592 MHz.

39. Write a program to interface seven segment display to display digits 9,8,7,6,5,9,8,7,6,….with 8051 microcontroller. Assume XTAL = 11.0592 MHz.

40. Write a program to interface seven segment display to display digits 0,1,8,7,6,5,0,1,8,7,6,5,….with 8051 microcontroller. Assume XTAL = 11.0592 MHz.

41. Write a program to generate a square wave of 60 Hz frequency on pin P1.0 with 50% duty cycle (Ton = Toff). Assume XTAL = 11.0592 MHz

42. Write a program to generate a square wave on pin P1.0 with T_{ON} = 5mS and T_{OFF} = 3ms. Assume XTAL = 11.0592 MHz

43. Generate a square wave with an ON time of 3ms and an OFF time of 10ms on all pins of P0. XTAL =16MHz. Select timer 0, mode 1 operation.

44. Generate a square wave with an ON time of 7ms and an OFF time of 12ms on all pins of P0. XTAL =16MHz. Select timer 0, mode 0 operation.
45. Write a program to blink a LED which is connected to P3.1 with 1ms delay. Select timer 0, mode 1 operation
46. Write a program to blink a LED which is connected to P3.1 with 2ms delay. Select timer 0, mode 1 operation
47. Write a program to blink a LED which is connected to P3.1 with 3ms delay. Select timer 0, mode 1 operation
48. Write a program to blink a LED which is connected to P3.1 with 4ms delay. Select timer 0, mode 1 operation
49. Write a program to blink a LED which is connected to P3.1 with 7ms delay. Select timer 0, mode 1 operation
50. Write a program to blink a LED which is connected to P3.1 with 6ms delay. Select timer 0, mode 1 operation
51. Write a program to blink a LED which is connected to P2.2 with 8ms delay. Select timer 0, mode 1 operation
52. Write a program to blink a LED in P2.3 with 15ms delay. Select timer 0, mode 1 operation
53. Write a program to blink a LED which is connected to P3.1 with 1ms delay. Select timer 0, mode 0 operation
54. Write a program to blink a LED which is connected to P3.1 with 2ms delay. Select timer 0, mode 0 operation
55. Write a program to blink a LED which is connected to P3.1 with 3ms delay. Select timer 0, mode 0 operation
56. Write a program to blink a LED which is connected to P3.1 with 4ms delay. Select timer 0, mode 0 operation
57. Write a program to blink a LED which is connected to P3.1 with 7ms delay. Select timer 0, mode 0 operation
58. Write a program to blink a LED which is connected to P3.1 with 6ms delay. Select timer 0, mode 0 operation

AET 307: ANALOG INTEGRATED CIRCUITS

COURSE INFORMATION SHEET

PROGRAMME: APPLIED ELECTRONICS & INSTRUMENTATION	DEGREE: BTECH
COURSE: ANALOG INTEGRATED CIRCUITS	SEMESTER: 5 CREDITS: 4
COURSE CODE: AET 307 REGULATION: 2019	COURSE TYPE: CORE
COURSE AREA/DOMAIN: ELECTRONICS	CONTACT HOURS: 3+1 (Tutorial) Hours/Week.
CORRESPONDING LAB COURSE CODE (IF ANY): AEL331	LAB COURSE NAME: ANALOG INTEGRATED CIRCUITS & INSTRUMENTATION LAB

SYLLABUS:

UNIT	DETAILS	HOURS
I	**Operational amplifiers (Op Amps):** The 741 Op Amp, Block diagram, Ideal op-amp parameters, typical parameter values for 741, Equivalent circuit, Open loop configurations, Voltage transfer curve, Frequency response curve. **Differential Amplifiers:** Differential amplifier configurations-Dual input Balanced Output, Dual input Unbalanced Output, Single input Balanced Output, Single input Unbalanced Output- using BJT, Basic Differential pair using BJT- DC Analysis- transfer characteristics; AC analysis- differential and common mode gains, CMRR, input and output resistance, Voltage gain. Virtual ground. Concept of current mirror-the two transistor current mirror, Wilson and Widlar current mirrors.	9
II	**Op-amp with negative feedback**: General concept of Voltage Series, Voltage Shunt, current series and current shunt negative feedback, Op Amp circuits with voltage series and voltage shunt feedback, Virtual ground Concept; analysis of practical inverting and non-inverting amplifiers for closed loop gain, Input Resistance and Output Resistance. **Op-amp applications:** Summer, Voltage Follower-loading effects, Differential and Instrumentation Amplifiers, Voltage to current and Current to voltage converters, Integrator, Differentiator, Precision rectifiers, Comparators, Schmitt Triggers, Log and antilog amplifiers.	10
III	**Op-amp Oscillators and Multivibrators:** Phase Shift and Wien-bridge Oscillators, Triangular and Sawtooth waveform generators, Astable and monostable multivibrators. **Active filters**: Comparison with passive filters, First and second order low pass, High pass, Band pass and band reject active filters, state variable filters.	9
IV	**Timer and VCO:** Timer IC 555- Functional diagram, Astable and monostable operations;. Basic concepts of Voltage Controlled Oscillator	

	and application of VCO IC LM566, **Phase Locked Loop –** Operation, Closed loop analysis, Lock and capture range, Basic building blocks, PLL IC 565, Applications of PLL.	8
V	**Voltage Regulators:** Fixed and Adjustable voltage regulators, IC 723 – Low voltage and high voltage configurations, Current boosting, Current limiting, Short circuit and Fold-back protection. **Data Converters:** Digital to Analog converters, Specifications, Weighted resistor type and R-2R Ladder type. Analog to Digital Converters: Specifications, Flash type and Successive approximation type.	9
TOTAL HOURS		**45**

TEXT/REFERENCE BOOKS:

T/R	BOOK TITLE/AUTHORS/PUBLICATION
T	Roy D. C. and S. B. Jain, Linear Integrated Circuits, New Age International, 3/e, 2010
T	Franco S., Design with Operational Amplifiers and Analog Integrated Circuits, 3/e, Tata McGraw Hill, 2008
R	Gayakwad R. A., Op-Amps and Linear Integrated Circuits, Prentice Hall, 4/e, 2010.
R	Salivahanan S. and V. S. K. Bhaaskaran, Linear Integrated Circuits, Tata McGraw Hill, 2008
R	R.F. Coughlin & Fredrick Driscoll, Operational Amplifiers & Linear Integrated Circuits, 6th Edition, PHI,2001
R	C.G. Clayton, Operational Amplifiers, Butterworth & Company Publ. Ltd./ Elsevier, 1971.
R	David A. Bell, Operational Amplifiers & Linear ICs, Oxford University Press, 2nd edition,2010
R	Botkar K. R., Integrated Circuits, 10/e, Khanna Publishers, 2010.
R	Sedra A. S. and K. C. Smith, Microelectronic Circuits, 6/e, Oxford University Press, 2013

COURSE PRE-REQUISITES:

C.CODE	COURSE NAME	DESCRIPTION	SEM
ECT202	ANALOG CIRCUITS (2019 Sch.)	Small signal analysis of BJT, MOSFET is familiarized. High frequency analysis of BJT, MOSFET is dealt. Basic concepts of power amplifiers, feed back amplifiers and voltage regulators were discussed.	3

COURSE OBJECTIVES:

1	To equip the students with a sound understanding of fundamental concepts of operational amplifiers
2	To know the diversity of operations that op amp can perform in a wide range of applications
3	To introduce a few special functions integrated circuits.
4	To impart basic concepts and types of data converters

COURSE OUTCOMES:

SNO	DESCRIPTION	Blooms' Taxonomy Level
1	Outline Op Amp fundamentals and differential amplifier configurations.	Understand (level 2)
2	Design operational amplifier circuits for various applications	Understand, Apply (level 2, 3)
3	Design Oscillators and active filters using op amps	Understand, Apply (level 2, 3)
4	Explain the working and applications of timer, VCO and PLL ICs	Understand, Apply (level 2, 3)
5	Outline the working of Voltage regulator IC's and Data converters	Understand, Apply (level 2, 3)

CO – PO and CO – PSO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO.1	3	3	1	2	-	-	-	-	-	-	-	1	3	-	1
CO.2	3	3	2	2	2	-	-	-	-	-	-	1	3	1	1
CO.3	3	3	2	2	2	-	-	-	-	-	-	1	3	1	1
CO.4	3	3	1	2	2	-	-	-	-	-	-	1	3	1	1
CO.5	3	3	2	2	2	-	-	-	-	-	-	1	2	-	1

CO – PO mapping Justification

MAPPING	LOW/ MEDIUM/HIGH	JUSTIFICATION
CO1- PO1	H	Students understand the need and complete working of differential amplifier and its analysis.
CO1- PO2	H	Students are able to analyze various OPAMP applications.
CO1- PO3	L	Analog circuits can be designed and modified to provide solutions to real-life problems
CO1-PO4	M	Op-amp based circuits will help to conduct investigations, solve complex problems
CO1-PO12	L	With prior knowledge of op-amp fundamentals, students

		can use their knowledge to simulate, experiment & develop newer applications in real life.
CO1- PSO1	H	Students understand the importance of differential amplifier.
CO1-PSO3	L	Understanding OPAMP helps students to take part in multidisciplinary projects
CO2 – PO1	H	Design & demonstration of experiments will help to identify the problems and lead to modifications
CO2 – PO2	H	Analog circuits can be designed and modified to provide solutions to real-life problems
CO2 – PO3	M	Design & demonstration of experiments will help to identify the problems and lead to modifications
CO2 – PO4	M	Op-amp based circuits will help to conduct investigations, solve complex problems in different applications.
CO2 – PO5	M	Analog circuits can be designed and modified using model simulation tools to provide solutions to different applications.
CO2-PO12	L	With prior knowledge of op-amp basics, students can use their knowledge to simulate, experiment & develop newer applications in real life.
CO2 - PSO1	H	Students understand the importance of feedback.
CO2 – PSO2	L	Able to design OPAMP circuits helps in developing new circuits for different applications
CO2 – PSO3	L	Designing various applications using opamp helps in team building and leadership
CO3-PO1	M	Students are able to analyze various OPAMP applications.
CO3-PO2	L	Students will be able to learn model tool usage.
CO3-PO3	L	Students are capable to develop various OPAMP application circuits.
CO3-PO4	M	Op-amp based circuits will help to conduct investigations, solve complex problems in different applications.
CO3-PO5	M	Students will be able to analyze various waveform generators and filters.
CO3-PO12	L	With prior knowledge of op-amp basics, students can use their knowledge to simulate, experiment & develop newer applications in real life.
CO3-PSO1	H	Students understand the importance of OPAMPs in wave form generators.
CO3-PSO2	L	Able to design OPAMP circuits helps in developing new systems
CO3-PSO3	L	Designing circuits using opamp helps in team building and leadership
CO4-PO1	L	Students will be able to design the circuits based on 555 timer.
CO4-PO2	M	Students are able to understand and explain PLL.

CO4-PO3	M	Students learn new concepts on basic ICs
CO4-PO4	H	Knowledge of design of basic ICs helps solve complex problems in different applications.
CO4-PO5	L	Students will be able to design the circuits to perform various data conversion operation.
CO4-PO12	M	Students are able to understand and explain data converters.
CO4-PSO1	H	Sound knowledge of the core concept of working of OPAMP as a differential amplifier
CO4-PSO2	L	Able to design basic ICs circuits helps in developing new systems
CO4-PSO3	L	Doing circuits with ICs helps in team building and leadership
CO5-PO1	H	Students understand the basics of data converters – DAC/ADC
CO5-PO2	H	Students can design data converters – DAC/ADC for new applications
CO5-PO3	M	Students are able to solve real world problems using ADC/DAC
CO5-PO4	M	Knowledge of design helps solve complex problems
CO5-PO5	M	Analog circuits can be designed and modified using model simulation tools to provide solutions to different applications.
CO5-PO12	L	With prior knowledge of op-amp basics, students can use their knowledge to simulate, experiment & develop newer applications in real life.
CO5-PSO1	M	Students understand the importance of regulator and ADC/DAC circuits
CO5-PSO3	L	Designing circuits based on ADC/DAC and regulators in projects helps in team building and leadership

GAPS IN THE SYLLABUS - TO MEET INDUSTRY/PROFESSION REQUIREMENTS:

SNO	DESCRIPTION	PROPOSED ACTIONS	RELEVANCE WITH POs	RELEVANCE WITH PSOs
1	Internal block diagram of opamp and its analysis.	NPTEL	PO1, PO2	PSO3
2	MOSFET operational amplifiers	NPTEL	PO1, PO2	PSO3

PROPOSED ACTIONS: TOPICS BEYOND SYLLABUS/ASSIGNMENT/INDUSTRY VISIT/GUEST LECTURER/NPTEL ETC

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN:

SNO	DESCRIPTION	PROPOSED ACTIONS	RELEVANCE WITH POs	RELEVANCE WITH PSOs

1	Other applications of 555 timer	Assignment	PO1, PO2	PSO1, PSO3
2	Operational Transconductance amplifiers (OTA)	Assignment	PO1	PSO1, PSO3
3	Power operational amplifiers (POA)	Assignment	PO1	PSO1, PSO3

WEB SOURCE REFERENCES:	
1	https://nptel.ac.in/courses/117/107/117107094/#
2	www.ti.com
3	www.analog.com
4	www.ocw.mit.edu

DELIVERY/INSTRUCTIONAL METHODOLOGIES:

☐ CHALK & TALK ✓	☐ STUD. ASSIGNMENT ✓	☐ WEB RESOURCES	☐ LCD/SMART BOARDS
☐ STUD. SEMINARS	☐ ADD-ON COURSES		

ASSESSMENT METHODOLOGIES-DIRECT

☐ ASSIGNMENTS ✓	☐ STUD. SEMINARS	☐ TESTS/MODEL EXAMS ✓	☐ UNIV. EXAMINATION ✓
☐ STUD. LAB PRACTICES	☐ STUD. VIVA	☐ MINI/MAJOR PROJECTS	☐ CERTIFICATIONS
☐ ADD-ON COURSES	☐ OTHERS		

ASSESSMENT METHODOLOGIES-INDIRECT

☐ ASSESSMENT OF COURSE OUTCOMES (BY FEEDBACK, ONCE) ✓	☐ STUDENT FEEDBACK ON FACULTY (TWICE) ✓
☐ ASSESSMENT OF MINI/MAJOR PROJECTS BY EXT. EXPERTS	☐ OTHERS

Prepared by
Dr. Poornima S.
(Faculty)

Approved by
Dr. Hari C.V.
(HOD)

Course Plan

Sl No	Module	Topics Planned
1	1	Syllabus introduction,revision of biasing and transistor as amplifier
2	1	Differential amplifier configurations
3	1	Block diagram of op-amp,parameters of op-amp
4	1	Ideal characteristics of op-amp,equivalent circuit of practical op-amp,ideal voltage transfer curve of op-amp
5	1	Open loop configurations of op-amp
6	1	Effect of open loop gain,bandwidth and slew rate on circuit performance
7	2	Introduction to negative feedback,configurations of op-amp with negative feedback
8	2	Voltage series feedback amplifier-derivation of i/p resistance,voltage gain
9	2	Voltage series feedback amplifier-derivation of o/p resistance,bandwidth
10	2	Voltage shunt feedback amplifier-derivation of i/p resistance,voltage gain,o/p resistance,BW
11	2	Assumptions for analysis of op-amp,analysis of non-inverting amplifier
12	2	Inverting amplifier,subtractor
13	2	Inverting ,non-inverting adders
14	2	Adder-subtractor derivation
15	2	Problems on op-amp circuits
16	2	Instrumentation amplifier
17	2	V to I and I to V converters
18	2	Precision HWR
19	2	precision FWR
20	2	Log amplifier
21	2	Antilog amplifier
22	2	Integrator
23	2	Differentiator
24	2	Comparators
25	3	Zero crossing detector,Schmitt trigger
26	3	Schmitt trigger with different triggering levels
27	3	Wien bridge oscillator
28	3	RC phase shift oscillator
29	3	Triangular & Sawtooth wave generator
30	3	Astable multivibrator

31	3	Monostable multivibrator
32	3	Active filters-1st order LPF,HPF
33	3	I order BSF,BPF,problems
34	3	Second order LPF
35	4	Second order HPF
37	4	Design of second order BPF, BSF, State variable filters
38	4	IC 555- Functional diagram
39	4	Astable MV using 555, Monostable MV using 555
40	4	Basic concepts of Voltage Controlled Oscillator
41	4	Application of VCO IC LM566, PLL working
42	5	Closed loop analysis of PLL, Blocks of PLL IC 565 in detail
43	5	Applications of PLL
44	6	Fixed & Adjustable Voltage regulators-iC723-low & high voltage
45	6	Short circuit protection, current limiting,foldback protection, Current boosting
46	6	DAC specifications,weighted resistor type DAC
47	6	R-2R ladder type DAC
48	6	ADC specifications, counter ramp ADC
51	1	Successive approximation type ADC
52	1	Flash type ADC
53	1	AC analysis,CMRR derivation
54	1	Methods to improve CMRR
55	1	Current source,current mirror circuits
56	1	Active load
57	1	Wilson current mirror
58	1	Frequency response of Differential amplifiers
59	1	Gilbert multiplier cell
60	1	Problems + Remedial
61	1	Solving previous Q.papers

ASSIGNMENT QUESTIONS

AET 307 ANALOG INTEGRATED CIRCUITS

ASSIGNMENT 1

Date : 10/1/2022 Max Marks 15

Submit on or before 23/01/2022

The following simulations can be done in QUCS, KiCad or PSPICE or TINA TI.

1. Design and simulate inverting amplifier for gain 15. Observe the input and output signals. Run the ac simulation and observe the frequency response and 0dB bandwidth.
2. Design and implement Schmitt trigger circuit for upper triggering point of +3 V and a lower triggering point of −3 V using op-amps.
3. Design a non-inverting comparator circuit using opamp for different reference voltages, Vref =i) 2V ii) -2V and iii) 0V and iv) 3V generated using potential divider from the +/-15V power supply. (Do not use extra supply for Vref) Plot input & output waveforms& transfer characteristics.
4. Design and simulate Wien bridge oscillator for a frequency of 10 kHz. Run a transient simulation and plot the output waveform.
5. Design and simulate an RC Phase Shift oscillator for a frequency of 20 kHz. Run a transient simulation and plot the output waveform.
6. Design and implement differential amplifier and measure its CMRR. Plot its transfer characteristics.
7. Design and simulate non-inverting amplifier for gain 5. Observe the input and output signals. Run the ac simulation and observe the frequency response and 3dB bandwidth.
8. Design an inverting comparator circuit using opamp for different reference voltages, Vref =i) 2V ii) -2V and iii) 0V and iv) 3V generated using potential divider from the +/-15V power supply. (Do not use extra supply for Vref) Plot input & output waveforms & transfer characteristics.
9. Design and implement Schmitt trigger circuit for upper triggering point of +8 V and a lower triggering point of −4 V using op-amps.
10. Design a circuit to generate the following output: Vo = V1 +2V2 – V3 -V4.
11. Design an opamp circuit to obtain an output voltage $V_0 = -(2V_1 + 4V_2 + 3V_3)$

AET 307 ANALOG INTEGRATED CIRCUITS

ASSIGNMENT 2

Date :7/2/2022 Max Marks 15

Submit on or before 20/02/2022

Each question carries 3 marks

1. Design an opamp circuit to obtain an output voltage $V_0 = -(2V_1 + 4V_2 + 3V_3)$
2. Design a circuit to generate the following output: Vo = V1 +2V2 – V3 -V4.
3. Draw the circuit diagram of a differential instrumentation amplifier with a transducer bridge and show that the output voltage is proportional to the change in resistance.
4. Design aWien bridge oscillator for a frequency of 10 kHz.
5. Design an RC Phase Shift oscillator for a frequency of 10 kHz.

Tutorials

Tutorial 1

21/12/21 5th hour

Problems on OPAMP circuits

1. A differential amplifier shown below has a differential gain of 100 and a CMRR of 40 dB. If V1 = 0.6 V and V2 = 0.4 V calculate the output voltage. (Given V0=AdVd+AcVc, where Ad is the difference mode gain, Ac is the common mode gain, Vd is the input difference voltage &Vc is the common mode voltage, Vc=(V1+V2)/2).
2. An inverting op-amp has an open-loop voltage gain and closed-loop voltage gain of 100,000 and 30 respectively. If an op-amp with an open-loop voltage gain of 300,000 is substituted in the arrangement, the closed-loop gain ……(a)doubles (b) drops to 15 (c)remains at 30

HUT300: INDUSTRIAL ECONOMICS & FOREIGN TRADE

COURSE INFORMATION SHEET

PROGRAMME: COMMON TO ALL BRANCHES	DEGREE: B.TECH
COURSE: *INDUSTRIAL ECONOMICS & FOREIGN TRADE*	**SEMESTER:** 5 **CREDITS:** 3
COURSE CODE: HUT300 **REGULATION: 2019**	**COURSE TYPE:** CORE
COURSE AREA/DOMAIN: APPLIED ECONOMICS	**CONTACT HOURS:** 3-0-0
CORRESPONDING LAB COURSE CODE (IF ANY): NIL	**LAB COURSE NAME:** NIL

Preamble: To equip the students with basic economic concepts to take industrial decisions and to create an awareness of economic environment.

Prerequisite: Nil

SYLLABUS:

UNIT	DETAILS	HOURS
I	**Basic Concepts and Demand and Supply Analysis:** • Scarcity and Choice-Basic Economic Problems-PPC • Firms and its Objectives–Types of Firms • Utility–Law of Diminishing Marginal Utility • Demand and its Determinants–Law of Demand – Elasticity of Demand - measurement of Elasticity and its applications • Supply, Law of Supply and Determinants of Supply • Equilibrium – Changes in Demand and Supply and its effects • Consumer Surplus and Producer Surplus (Concepts) • Taxation and Deadweight Loss.	7
II	**Production and Cost:** • Production Function – Law of Variable Proportion – Economies of Scale – Internal and External Economies • Isoquants, Isocost Line and Producer's Equilibrium – Expansion path • TechnicalProgress and its Implications – Cobb-Douglas Production Function • Cost concepts – Social Cost: Private Cost and External Cost – Explicit and Implicit Cost – Sunk Cost • Short Run Cost Curves - Long Run Cost Curves • Revenue (concepts) • Shutdown Point – Break-even Point.	7
	FIRST INTERNAL EXAM	
III	**Market Structure**: • PerfectandImperfectCompetition • Monopoly,RegulationofMonopoly • MonopolisticCompetition (features and equilibrium of a firm) • Oligopoly – Kinked Demand Curve – Collusive Oligopoly (meaning)	6

	• Non-priceCompetition • ProductPricing–CostPlusPricing–TargetReturnPricing - Penetration Pricing – Predatory Pricing – Going Rate Pricing – Price Skimming.	
IV	**Macro-Economic Concepts:** • Circular Flow of Economic Activities • Stock and Flow – Final Goods and Intermediate Goods - Gross Domestic Product • National Income • Three Sectors of an Economy- Methods of Measuring National Income • Inflation- Causes and Effects – Measures to Control Inflation- Monetary and Fiscal Policies • Business Financing- Bonds And Shares -Money Market And Capital Market – Stock Market – DematAccount And Trading Account - SENSEX And NIFTY	7
SECOND INTERNAL EXAM		
V	**International Trade:** • Advantages and Disadvantages of International Trade • Absolute and Comparative Advantage Theory • Heckscher- Ohlin Theory • Balance of Payments – Components – Balance of Payments – Deficit and Devaluation • Trade Policy–Free Trade Versus Protection – Tariff and Non-Tariff Barriers.	8
TOTAL HOURS		**35**

TEXT/REFERENCE BOOKS:

T/R	BOOK TITLE/AUTHORS/PUBLICATION
T	Gregory N Mankiw, 'Principles of Micro Economics', CengagePublications
T	Gregory N Mankiw, 'Principles of Macro Economics', CengagePublications
T	Dwivedi D N, 'Macro Economics', Tata McGraw Hill, NewDelhi.
T	Mithani D M, 'Managerial Economics', Himalaya Publishing House,Mumbai.
T	Francis Cherunilam, 'International Economics', McGraw Hill, NewDelhi.

COURSE OBJECTIVES:

1	**To familiarise the underlying concepts like scarcity, choice, demand and supply, and utility in economics**
2	To understand the concepts related to cost and apply while analysing production function of a firm
3	To differentiate between different market structures and evaluate the competitive conditions of each market feasible for firms

4	To effectively analyse reasons behind economic fluctuations occurring in the country by learning important macroeconomic indicators and policies
5	To logically identify the link between domestic and international market and its implications on the host country

COURSE OUTCOMES:

COURSE OUTCOME	EXPLANATION
CO1	Explain the problem of scarcity of resources and consumer behaviour, and to evaluate the impact of government policies on the general economic welfare. (Cognitive knowledge level: **Understand**)
CO2	Take appropriate decisions regarding volume of output and to evaluate the social cost of production. (Cognitive knowledge level: **Apply**)
CO3	Determine the functional requirement of a firm under various competitive conditions. (Cognitive knowledge level: **Analyse**)
CO4	Examine the overall performance of the economy, and the regulation of economic fluctuations and its impact on various sections in the society. (Cognitive knowledge level: **Analyse**)
CO5	Determine the impact of changes in global economic policies on the business opportunities of a firm. (Cognitive knowledge level: **Analyse**)

CO-PO MAPPING

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2										3	
CO 2	2	2			2	2	3				3	
CO 3	2	2	1								3	
CO 4	2	2	1			1					3	
CO 5	2	2	1								3	

CO-PO MAPPING (JUSTIFICATION)

CO/PO	PO 1	PO 2	PO 3	PO 5	PO 6	PO 7	PO 11
CO 1	Knowledge of economic concepts elaborated in Module I are required to understand, analyse and find solutions to societal problems.						Module I helps to apply the concept of scarcity considering the major economic problems and finding the feasible output production at a point of time. Eg: PPF
CO 2	Knowledge of economic concepts elaborated in Module II are required to analyse and evaluate the cost of production and find optimum output at firm level.	The concepts related to Production cost in Module II like TC, AC, MC etc,in identifying the variations in production functionand its impact on an industrial undertaking.	.	As an economy progresses technological advancement and inclusive development are indispensable. The resource utilization and its optimal utilization is of greater importance during this advancement. Module II provides theoretical	Every firm level/industrial level activity has its repercussion on the society. This impact can be identified using the cost concepts in Module III. For example, calculating	A firm in order to sustain should have an idea about profitability, that is about cost and revenue. The idea of social cost for example provides the impact of a firm's activity on the society/environment. Shut down point helps a firm to minimise its	Module II helps to apply the concepts of production like AC,VC& MC to determine the prices of factors of production, to calculate the cost of production, to identify optimal pricing and ways to minimise loss.

				understanding about Law of Variable Proportions, Optimal output production etc for firms/industry who engage in experimenting with new methods of production/technology.	social cost.	loss. Module II gives this idea of Production costs.	
CO 3	Knowledge of economic concepts elaborated in Module III are required to understand and evaluate various forms of market structures and identify feasible markets for different types of firms.	Knowledge of types of markets and their features in Module III are required to identify the types of market, the comparison between firms in different types of markets.	Module III details about different kinds of markets feasible for different kinds of firms. Identifying the exact market for a product will increase the scope for more innovations and solutions.				Module III provides knowledge on markets where every market has different features and hence it gives an idea about which product will sustain in which market. Identifying market types give an idea about various market strategies that helpfirms to survive competitions in

							such markets.
CO 4	Knowledge of economic concepts elaborated in Module IV are important macroeconomic indicators like GDP, Inflation, etc to analyse and evaluate how variations in these indicators affect the economic conditions within an economy.	Module IV provides insight in to the endogenous factors affecting firm/industry. This helps in solving/finding solutions to industrial problems within a country.	Not all layers of the economy are equal. Every segment of the society deals with different kinds of problem. A policy impact may sometimes become boon to some segments but it can be a curse to some other segments of the economy. Module IV gives a general understanding of the macroeconomic indicators and policy	The economic activities in a country are interdependent. An investment, the launch of a new product, expansion of an industry, inclusion of new technology create more employment opportunities, more revenue, increased demand, market failure etc. Module IV provides an understanding of how these economic activities are linked to each other and the changes resulting from this interdependence.			Launching a product or service in a society has its own implications, since every economic activity is interdependent. Module IV gives an idea on macroeconomic indicators required to understand the practicality of a anindustrial activity. The understanding of share market gives an idea about share capital, competition

			framework of our country.				among firms and the money market as a whole.
CO 5	Domestic and international markets are linked in a complex way in this era of globalization. Module V lays down the basic concepts to understand that link between the two markets.	Module V gives an insight in to how a firm is linked to a global network and the repercussions. It provides an idea about the exogenous forces affecting a firm's/industry's survival.	When firms/industries go global it is important to understand how export and import prices affect pricing of a product. This decides the profitability of a product and thereby the firm. Module V deals with foreign trade and its impact on the growth of a firm globally.				Entering a global market invites new technological spill over, export receipts, more investment, cost and more competition. Module V provides the complexities of international trade and the challenges the firm might face. This gives ground knowledge about how versatile a leader should be while managing a global firm/industry.

GAPS IN THE SYLLABUS - TO MEET INDUSTRY/PROFESSION REQUIREMENTS:

SNO	DESCRIPTION	PROPOSED ACTIONS
1	Cost Engineering	Audio PPT
2	Location Theories	Assignment
3	Industrial Policy and Growth in India	Classroom Discussion
4	Methods of evaluating Investment Decisions	Audio PPT
5.	Patents	Assignment
6	Risk Analysis and Decision Making	Audio PPT
7	Innovation and Rivalry	Classroom Discussion

Proposed Actions: Topics beyond Syllabus/Assignment/Industry Visit/Guest Lecturer/Nptel Etc

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN:

1	Theories of Industrial Location and Regional Development
2	Industrial Investment –Trends – Kerala Model
3	Trends and Pattern of Regional Development in Kerala
4	Theories of Growth of Firms
5	Industrial Finance – Sources of Finance
6	Social Cost Benefit Analysis

WEB SOURCE REFERENCES:

1	https://www.india.gov.in/topics/industries	National Portal of India
2	https://www.cii.in/	The Confederation of Indian Industry (CII) works to create and sustain an environment conducive to the development of India, partnering industry, Government, and civil society, through advisory and consultative processes.
3	https://commerce.gov.in/	The Department formulates, implements and monitors the Foreign Trade Policy (FTP) which provides the basic framework of policy and strategy to be followed for promoting exports and trade
4	http://mospi.nic.in/annual-survey-industries	The ASI frame is based on the lists of registered factories / units maintained by the Chief Inspector of Factories in each State and those maintained by registration authorities in respect of bidi and cigar establishments and electricity undertakings.
5	https://msme.gov.in/	MSMEs are complementary to large industries as ancillary units and this sector contributes enormously to the socio-economic development of the country.

DELIVERY/INSTRUCTIONAL METHODOLOGIES:

✓ CHALK & TALK	✓ STUD. ASSIGNMENT	☐ WEB RESOURCES	☐LCD/SMART BOARDS

✓ STUD. SEMINARS	☐ ADD-ON COURSES	✓ ICT ENABLED CLASSES	

ASSESSMENT METHODOLOGIES-DIRECT

✓ ASSIGNMENTS	✓ STUD. SEMINARS	✓ TESTS/MODEL EXAMS	✓ UNIV. EXAMINATION
☐ STUD. LAB PRACTICES	☐ STUD. VIVA	☐ MINI/MAJOR PROJECTS	☐ CERTIFICATIONS
☐ ADD-ON COURSES	☐ OTHERS	✓ GROUP DISCUSSION(IV)	

ASSESSMENT METHODOLOGIES-INDIRECT

✓ ASSESSMENT OF COURSE OUTCOMES (BY FEEDBACK, ONCE)	✓ STUDENT FEEDBACK ON FACULTY (TWICE)
☐ ASSESSMENT OF MINI/MAJOR PROJECTS BY EXT. EXPERTS	☐ OTHERS

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HOD(Basic Sciences & Humanities)

Course Plan

Sl.No	Module	Planned
1	1	Scarcity and Choice,Basic Economic Problems Production Possibility Curve, Firms and its Objectives Demand,determinants,law of demand,elasticity Supply,determinants,law of supply,elasticity Equilibrium,Changes in demand and supply Consumer surplus and Producer surplus Taxation and deadweight loss.
2	1	Law of Variable Proportion
3	1	Internal and External economies of scale Isoquants,isocost line and Producer's equilibrium Expansion path-Technical progress and its implications Cobb-Douglas production function
4	1	Cost concepts-social, private and external cost. Explicit and Implicit cost.
5	1	Short run cost curves and Long run cost curves. Shut down point and Break-even point.
6	1	Perfect competition and Imperfect competition Monopoly and Monopolistic competition Oligopoly and Collusive Oligopoly
7	1	Product pricing, Cost plus pricing, Target return pricing
8	1	Penetration pricing, Predatory pricing Going rate pricing, Price skimming Circular flow of economic activities Circular flow of economic activities
9	2	Stock and flow,Final goods and intermediate goods. National Income-Three sectors of an economy Methods of measuring national income.
10	2	Inflation and causes and effects,measures to control inflation. Monetary and fiscal policies
11	2	Bonds and shares,money market and capital market Stock market,demat account and trading account.
12	2	Advantages and disadvantages on international trade,absolute and comparativ Heckscher-Ohlin theroy and BOP
13	2	Trade policy,free trade versus protection,tariff and non-tariff barriers
14	2	Scarcity and Choice,Basic Economic Problems Production Possibility Curve
15	2	Firms and its Objectives Demand,determinants,law of demand,elasticity Supply,determinants,law of supply,elasticity Equilibrium,Changes in demand and supply Consumer surplus and Producer surplus Taxation and deadweight loss.
16	2	Law of Variable Proportion
17	2	Internal and External economies of scale Isoquants,isocost line and Producer's equlibrium Expansion path-Technical progress and its implications Cobb-Douglas production function
18	3	Cost concepts-social,private and external cost. Explicit and Implicit cost.
19	3	Short run cost curves and Long run cost curves. Shut down point and Break even point.
20	3	Perfect competition and Imperfect coompetition Monopoly and Monopolistic competition Oligopoly and Collusive Oligopoly
21	3	Product pricing, Cost plus pricing,Target return pricing

22	3	Penentration pricing,Predatory pricing Going rate pricing,Price skimming Circular flow of economic activities Circular flow of economic activities
23	3	Stock and flow,Final goods and intermediate goods. National Income-Three sectors of an economy Methods of measuring national income.
24	4	Inflation and causes and effects,measures to control inflation. Monetary and fiscal policies
25	4	Bonds and shares,money market and capital market Stock market,demat account and trading account.
26	4	Advantages and disadvantages on international trade,absolute and comparativ Heckscher-Ohlin theroy and BOP
27	4	Trade policy,free trade versus protection,tariff and non-tariff barriers
28	4	Scarcity and Choice,Basic Economic Problems Production Possibility Curve
29	4	Firms and its Objectives Demand,determinants,law of demand,elasticity Supply,determinants,law of supply,elasticity Equilibrium,Changes in demand and supply Consumer surplus and Producer surplus Taxation and deadweight loss.
30	4	Law of Variable Proportion
31	4	Internal and External economies of scale Isoquants,isocost line and Producer's equlibrium Expansion path-Technical progress and its implications Cobb-Douglas production function
32	4	Cost concepts-social,private and external cost. Explicit and Implicit cost.
33	5	Short run cost curves and Long run cost curves. Shut down point and Break even point.
34	5	Perfect competition and Imperfect coompetition Monopoly and Monopolistic competition Oligopoly and Collusive Oligopoly
35	5	**Revision**

ASSIGNMENT QUESTIONS

INDUSTRIAL ECONOMICS AND FOREIGN TRADE (HUT 300)

QUESTION NO: 1 - CO3 and CO4

Intellectual Property Rights (IPR) refers to creations of the mind: inventions, literary and artistic works and symbols, names and images and designs used in commerce. For a long time IPR protection was very low in India. As a student is it possible to identify the issues related with IPR in connection with the different types of IPR.

[Hint: Definition, Types, Issue with a case study, Validation.]

Content clarity: 4

Submission on time: 2

Presentation Style: 1.5

QUESTION NO: 2 – CO1 and CO2

Our environment faces several problems, and many of these seem to be worsening with time, bringing us into a time of a true environmental crisis. It is therefore becoming increasingly important to raise awareness of the existence of these issues, as well as what can be done to reduce their negative impact. One of the key issue is pollution and one among them is spillover of industrial waste.

Content clarity: 4

Submission on time: 2

Presentation Style: 1.5

MCN301: DISASTER MANAGEMENT

COURSE INFORMATION SHEET

PROGRAMME: ALL	DEGREE: BTECH
COURSE: DISASTER MANAGEMENT	SEMESTER:5 CREDITS: 2
COURSE CODE: MCN301 REGULATION: 2019	COURSE TYPE: ELECTIVE
COURSE AREA/DOMAIN: Non-credit	CONTACT HOURS: 2+0(Tutorial) hours/Week.
CORRESPONDING LAB COURSE CODE (IF ANY): NIL	LAB COURSE NAME: NIL

SYLLABUS:

UNIT	DETAILS	HOURS
I	Systems of earth Lithosphere- composition, rocks, soils; Atmosphere-layers, ozone layer, greenhouse effect, weather, cyclones, atmospheric circulations, Indian Monsoon; hydrosphere- Oceans, inland waterbodies; biosphere. Definition and meaning of key terms in Disaster Risk Reduction 5 and Management disaster, hazard, exposure, vulnerability, risk, risk assessment, risk mapping, capacity, resilience, disaster risk reduction, disaster risk management, early warning systems, disaster preparedness, disaster prevention, disaster mitigation, disaster response, damage assessment, crisis counselling, needs assessment.	5
II	Hazard types and hazard mapping; Vulnerability types and their assessment-physical, social, economic and environmental vulnerability. Disaster risk assessment-approaches, procedures	5
III	Disaster risk management -Core elements and phases of Disaster Risk Management Measures for Disaster Risk Reduction - Disaster prevention, mitigation, and preparedness. response- objectives, requirements; response planning; types of responses. Relief, international relief organizations	5
IV	Participatory stakeholder engagement; Disaster communication-importance, methods, barriers; Crisis counselling Capacity Building: Concept Structural and Non-structural Measures, Capacity Assessment; Strengthening Capacity for Reducing Risk	5
V	Common disaster types in India; Legislations in India on disaster management; V National disaster management policy; Institutional arrangements for disaster management in India. The Sendai Framework for Disaster Risk Reduction- targets, priorities for action, guiding principles	5
	TOTAL HOURS	**25**

TEXT/REFERENCE BOOKS:

T/R	BOOK TITLE/AUTHORS/PUBLICATION
T1	R. Subramanian, Disaster Management, Vikas Publishing House, 2018
T2	M. M. Sulphey, Disaster Management, PHI Learning, 2016
T3	UNDP, Disaster Risk Management Training Manual, 2016
T4	United Nations Office for Disaster Risk Reduction, Sendai Framework for Disaster Risk Reduction 2015-2030, 2015.

COURSE PRE-REQUISITES:

C.CODE	COURSE NAME	DESCRIPTION	SEM
NIL	NIL	NIL	NIL

COURSE OBJECTIVES:

1	The objective of this course is to introduce the fundamental concepts of hazards and disaster management

COURSE OUTCOMES:

Sl No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	Define and use various terminologies in use in disaster management parlance andorganise each of these terms in relation to the disaster management cycle (Cognitiveknowledge level: Understand)														
		2				2				2		2	1		
2	Distinguish between different hazard types and vulnerability types and dovulnerability assessment (Cognitive knowledge level: Understand).														
	2	3	2		2	2	3			3		2		1	
3	Identify the components and describe the process of risk assessment, and apply appropriate methodologies to assess risk (Cognitive knowledge level:Understand).														
	2	3	2	2	2	2	3			3		2			2
4	Explain the core elements and phases of Disaster Risk Management and developpossible measures to reduce disaster risks across sector andcommunity (Cognitiveknowledge level: Apply)														
	3	3	3		2	2	3					2		2	2
5	Identify factors that determine the nature of disaster response and discuss the variousdisaster response actions (Cognitive knowledge level: Understand).														
	3	3			2	2	3					2	1		
6	Explain the various legislations and best practices for disaster management and riskreduction at national and international level (Cognitive knowledge level: Understand).														
	3					2	3	3				2	2		2

JUSTIFICATION FOR CO-PO MAPPING:

CO	PO	MAPPING	JUSTIFICATION
CO1	PO2	M	Awareness of standard terms used in disaster management will help students address practical engineering problems in challenging environments.
	PO6	M	Awareness of standard terms used in disaster management will help students assess the societal, health, and safety issues relevant to professional engineering practice.
	PO10	M	Awareness of standard terms used in disaster management will help students communicate effectively with the engineering community and

CO	PO	MAPPING	JUSTIFICATION
			society during an emergency.
	PO12	M	Awareness of standard terms used in disaster management will help students pursue independent and life-long learning in the broadest context of technological change post-pandemic.
CO2	PO1	M	Various mathematical and numerical tools are used in vulnerability assessment.
	PO2	H	Extensive research and a basic understanding of mathematics are needed to conduct vulnerability assessments.
	PO3	M	Assessing vulnerability helps the stakeholders to design a practical disaster management framework.
	PO5	M	Complex analytical and numerical modeling tools are used in vulnerability assessment.
	PO6	M	Awareness of different hazard types and vulnerabilities will help the students to assess the societal, health, and safety issues relevant to the professional engineering practice.
	PO7	H	Assessing vulnerability is essential in improving the capacity to reduce the risks related to disasters.
	PO10	H	The students will identify the vulnerable community/society/individuals and communicate with them effectively.
	PO12	M	Awareness of disasters and vulnerability will help students pursue independent and life-long learning in the broadest context of technological change post-pandemic.
CO3	PO1	M	Various empirical and analytical methods are used in risk assessment.
	PO2	H	Extensive research and a basic understanding of science, mathematics, and social sciences are needed to conduct a risk assessment.
	PO3	M	Risk assessment helps the stakeholders to design a practical disaster management framework.
	PO4	M	Research-based knowledge and a basic understanding of data analysis, data interpretation, and information synthesis are required to carry out a risk assessment.
	PO5	M	Complex analytical and numerical modeling tools are used to assess natural hazards like floods, earthquakes, landslides, etc.
	PO6	M	Awareness of risk assessment fundamentals will help the students assess the societal, health, and safety issues relevant to the professional engineering practice.
	PO7	H	Understanding elements at risk and risk assessment are essential in strengthening the capacity, developing sustainable mitigation measures, and improving resilience.
	PO10	H	The students will identify the community/society/individuals at risk and communicate with them effectively.
	PO12	M	Awareness of future risks and risk assessment will help students pursue independent and life-long learning in the broadest context of technological change post-pandemic.
CO4	PO1	H	A basic understanding of engineering sciences and mathematics is needed to reduce disaster risks across sectors and communities.

CO	PO	MAPPING	JUSTIFICATION
	PO2	H	Extensive research and a basic understanding of science, mathematics, and social sciences are needed to develop risk reduction measures.
	PO3	H	A decent disaster management framework helps the stakeholders to develop risk reduction measures.
	PO5	M	GIS and numerical modelingsoftwares can be used toanalyze natural hazards like floods, earthquakes, landslides, etc.
	PO6	M	Awareness of disaster risk management fundamentals will help the students assess the societal, health, and safety issues relevant to the professional engineering practice.
	PO7	H	Understanding the core elements and phases of disaster risk management is essential in strengthening the capacity, developing sustainable mitigation measures, and improving resilience.
	PO12	M	Awareness of disaster risk management strategies will help students pursue independent and life-long learning in the broadest context of technological change post-pandemic.
CO5	PO1	H	A basic understanding of engineering and social sciences is needed to formulate disaster response strategies.
	PO2	H	Extensive research and a basic understanding of science, mathematics, and social sciences are needed to develop disaster response measures.
	PO5	M	Modern tools like GIS, GPS, etc., are used to develop emergency plans for natural hazards.
	PO6	M	Awareness of the fundamentals of disaster response will help the students to assess the societal, health, and safety issues relevant to the professional engineering practice
	PO7	H	Understanding disaster response strategies is essential in strengthening the capacity, developing sustainable mitigation measures, and improving resilience.
	PO12	M	Awareness of disaster response strategies will help students pursue independent and life-long learning in the broadest context of technological change post-pandemic.
CO6	PO1	H	Awareness of various legislations, policies, and frameworks in disaster management will help students address practical engineering problems in challenging environments.
	PO6	H	Awareness of various legislations, policies, and frameworks in disaster management will help students assess the societal, health, and safety issues relevant to professional engineering practice.
	PO7	H	Understanding various legislations, policies, and frameworks in disaster management is essential in strengthening the capacity, developing sustainable mitigation measures, and improving resilience.
	PO8	H	A professional engineer should be aware of various legislations, policies, and frameworks in disaster management.
	PO12	M	Awareness of various legislations, policies, and frameworks in disaster management will help students pursue independent and life-long learning in the broadest context of technological change post-pandemic.

JUSTIFICATION FOR CO-PSO MAPPING:

CO	PSO	MAPPING	JUSTIFICATION
CO1	PSO1	L	Awareness of standard terms used in disaster managmenet will help students address practival engineering problems in challenging enviornments using instrumentation devices.
CO2	PSO2	L	Develop suitable instruments with standard to b used during disaster management.
CO3	PSO3	M	Develop the leadership qualities in situations of risk management and analysis methods.
CO4	PSO2	M	Designing suitable disaster management devices
	PSO3	M	Developing new devices working in a team
CO5	PSO1	L	Apply engieneering knowledge for disaster management
CO6	PSO1	L	Developing and designing new instrumentation system for disaster management.
	PSO3	H	Awareness of various legislations, policies, and frameworks in disaster management will help students pursue independent and life-long learning in the broadest context of technological change post-pandemic

GAPS IN THE SYLLABUS - TO MEET INDUSTRY/PROFESSION REQUIREMENTS:

Sl No	DESCRIPTION	PROPOSED ACTIONS
1	Case study of Kerala Floods 2018	Classroom lectrures
2	Case studies of air accidents	Assignment

CONTENTS TAKEN BEYOND THE SYLLABUS:

Sl No	DESCRIPTION	PROPOSED ACTIONS
1	Early warning systems for Tsunami and Cyclone	NPTEL Videos

WEB SOURCE REFERENCES:

Sl No	DESCRIPTION
1	https://nptel.ac.in/courses/105/104/105104183/
2	https://nptel.ac.in/courses/124/107/124107010/

DELIVERY/INSTRUCTIONAL METHODOLOGIES:

CHALK & TALK	✓	**STUD. ASSIGNMENT**	✓	WEB RESOURCES	✓
LCD/SMART BOARDS		STUD. SEMINARS		ADD-ON COURSES	

ASSESSMENT METHODOLOGIES-DIRECT:

ASSIGNMENTS	✓	STUD. SEMINARS		**TESTS/MODEL EXAMS**	✓	**UNIV. EXAMINATION**	✓
STUD. LAB PRACTICES		STUD. VIVA		MINI/MAJOR PROJECTS		CERTIFICATIONS	

ADD-ON COURSES		OTHERS					

ASSESSMENT METHODOLOGIES-INDIRECT:

ASSESSMENT OF COURSE OUTCOMES (BY FEEDBACK, ONCE)	✓	**STUDENT FEEDBACK ON FACULTY (TWICE)**	✓
ASSESSMENT OF MINI/MAJOR PROJECTS BY EXT. EXPERTS		OTHERS	

Prepared &
Ms. Lekshmi M.S.
(Faculty)

Approved by
Dr. Hari C.V.
(HOD)

Course Plan

Sl.No	Module	Planned
1	1	Systems of earth: Lithosphere - composition, rocks, soils;Atmosphere-layers, ozone layer, greenhouse effect,
2	1	Weather, cyclones, atmospheric circulations, IndianMonsoon;
3	1	Hydrosphere- Oceans, inland water bodies; biosphere
4	1	Reduction and Management- disaster, hazard, exposure,vulnerability, risk, risk assessment, risk mapping,capacity,
5	1	Resilience, disaster risk reduction, disaster risk management, early warning systems, disaster
6	1	Disaster mitigation, disaster response, damage assessment, crisis counselling, needs assessment.
7	2	Hazards types and hazard mapping
8	2	Vulnerability and their assessment
9	2	Physical, social, economic and environmental vulnerability
10	2	Disaster risk assessment-approaches, procedures
11	3	Disaster risk management-Core elements and phases Disaster Risk Management
12	3	Measures for Disaster Risk Reduction-prevention, mitigation and preparedness
13	3	Disaster response-objectives, requirement, responseplanning, types of responses
14	3	Relief; international relief organizations
15	4	Participator stakeholder engagement; Disaster
16	4	Crisis counselling, Capacity Building Concept-Structuraland Non structural Measures
17	4	Capacity assessment, Strengthening Capacity for
18	5	Common disaster types in India; legislations in India on
19	5	National disaster management policy; Institutional
20	5	The Sendai Framework for Disaster Risk Reduction
21	5	Sendai Framework for Disaster Risk reduction-Targets,
22	5	Sendai Framework for Disaster Risk reduction: guidingprinciples

Assignment questions

Assignment questions

Assignment 1

1. Highlight the risk reduction measures and post disaster needs in case of ' air accidents'
2. "There is little scope for forecasting or warning in case of man made disaster". Discuss

Assignment 2

Write short note on Sendai Frame work

AEL331: ANALOG INTEGRATED CIRCUITS AND INSTRUMENTATION LAB

Course information sheet

PROGRAMME: APPLIED ELECTRONICS & INSTRUMENTATION	DEGREE: BTECH
COURSE: ANALOG INTEGRATED CIRCUITS AND INSTRUMENTATION LAB	SEMESTER: 5 CREDITS: 2
COURSE CODE: AEL331 REGULATION: 2019	COURSE TYPE: CORE
COURSE AREA/DOMAIN: ELECTRONICS	CONTACT HOURS: 3 Practical Hours/Week.
CORRESPONDING LAB COURSE CODE (IF ANY): NA	LAB COURSE NAME: NA

SYLLABUS:

UNIT	DETAILS	HOURS
1	Design and plot the frequency response of i) Inverting and Non inverting amplifiers ii) Differentiator and Integrator.	3
2	Design of Adder circuits	3
3	Measurement of Opamp parameters.	3
4	Difference Amplifier and Instrumentation amplifier	3
5	Schmitt trigger circuit using Op –Amps	3
6	Astable and Monostable multivibrator using Op -Amps	3
7	Triangular and square wave generators using Op- Amps	3
8	RC Phase shift Oscillator using Op-Amps	3
9	Wien bridge oscillator using Op-Amp - without & with amplitude stabilization	
10	Active second order filters using Op-Amp (LPF, HPF, BPF and BSF)	3
11	Astable and Monostable multivibrator using Timer IC NE555	3
12	Determination of the characteristics of LVDT ,Measurement of strain and load using strain gauges.	3
13	Determination of the characteristics of thermocouple.	3
14	Determination of the characteristics of RTD	
TOTAL HOURS		36

TEXT/REFERENCE BOOKS:

T/R	BOOK TITLE/AUTHORS/PUBLICATION
R1	Sergio Franco: *Design with Operational Amplifiers and Analog Integrated Circuits*, 3/e,TMH.
R2	Gayakwad : *Op-Amps and Linear Integrated Circuits* , 4/e, PHI.
R3	K R Botkar: Integrated Circuits, 10/e, Khanna publishers
R4	Salivahanan S. ,V. S. K. Bhaaskaran, Linear Integrated Circuits, Tata McGraw Hill, 2008

COURSE PRE-REQUISITES:

C.CODE	COURSE NAME	DESCRIPTION	SEM
ECT202	ELECTRONIC CIRCUITS	To develop the basic idea about transistor circuits.	4
AET307	ANALOG INTEGRATED CIRCUITS	To know the fundamentals of op amp circuits.	5

COURSE OBJECTIVES:

1	Develop skills in designing and testing analog integrated circuits
2	Expose the students to a variety of practical circuits using various analog ICs
3	Understand the working principle of various transducers and their application in engineering

COURSE OUTCOMES:

SNO	DESCRIPTION	Blooms' Taxonomy Level
CO 1	**Design** the linear and non-linear applications of an opamp and special application ICs.	Understand, Apply (Level 2,3)
CO 2	**Explain** and **compare** the working of multivibrators using special application IC 555	Apply, Analyse (Level 3,4)
CO 3	**Illustrate** the function of application specific ICs such as Voltage regulators, Data converters and PLL.	Understand, Apply (Level 2,3)
CO 4	**Explain** the working of various transducers and their applications	Understand (Level 2)

CO – PO and CO – PSO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	-	2	2	3	3	-	3	3	2	-	1	2	-	2
CO 2	3	-	2	2	3	3	-	3	3	2	-	2	2	-	2
CO 3	3	-	2	2	3	3	-	3	3	2	2	3	2	-	-
CO 4	3	-	2	-	3	3	-	3	3	2	-	3	2	2	-

CO-PO mapping Justification

MAPPING	LOW/ MEDIUM/HIGH	*JUSTIFICATION*
CO. 1- PO1	H	The basic applications of OPAMPs is understood
CO 1- PO3	M	Design/development of solutions using op amp circuits

CO 1- PO4	M	Learn to conduct investigations of relevant problems
CO 1- PO5	H	Use modern simulation tools to implement op amp circuits
CO 1- PO6	H	Apply reasoning based on the knowledge of basic opamp circuits in societal, health, safety sections relevant to engineering parctice
CO 1- PO8	H	Ethically apply the principles studied
CO 1- PO9	H	Students will be able to work as a team in designing various OPAMP circuits in lab
CO 1- P10	M	Students will be able to comprehend and analyze various OPAMP parameters in lab
CO 1- P12	L	Comprehending the problem and finding solution in the lab prepares the student for lifelong learning.
CO 1- PSO1	M	Fundamentals of OPAMP are studied and implemented for different applications.
CO 1- PSO3	M	Comprehending the problem and finding solution in the lab prepares the student for lifelong learning.
CO. 2- PO1	H	Various 555 timer circuits are designed and compared
CO 2- PO3	M	Students will be capable for developing circuits with OPAMPs
CO 2- PO4	M	Students are able to learn new concepts.
CO 2- PO5	H	Various 555 timer circuits are designed.
CO 2- PO6	H	Apply the design of timer circuits to solve problems in society.
CO 2- PO8	H	Apply the concept of timers for ethical applications.
CO 2- PO9	H	Students will be able to work as a team in designing various OPAMP circuits in lab
CO 2- P10	M	Students are able to comprehend new concepts and present them
CO 2- P12	M	Comprehending the problem and finding solution in the lab prepares the student for lifelong learning.
CO 2- PSO1	M	Fundamentals of timers are studied and implemented for different applications.
CO 2- PSO3	M	Comprehending the problem and finding solution in the lab prepares the student for lifelong learning.
CO. 3- PO1	H	Students understand the concept of regulators and PLL IC
CO 3- PO3	M	Students will be capable for designing regulators
CO 3- PO4	M	Students are able to learn and implement new application using PLL
CO 3- PO5	H	Various PLL circuits are learned and implemented.
CO 3- PO6	H	Apply the design of regulator and PLL circuits to solve problems in society.
CO 3- PO8	H	Apply the concept of PLL for ethical applications.
CO 3- PO9	H	Students will be able to work as a team in designing various PLL applications in lab
CO 3- P10	M	Students are able to comprehend new concepts and present them
CO 3- P11	M	Knowledge of regulators helps in cost management in various projects

CO 3- P12	H	Comprehending the problem and finding solution in the lab prepares the student for lifelong learning.
CO 3- PSO1	M	Fundamentals of various analog ICs are studied and implemented for different applications.
CO 3- PSO3	M	Comprehending the problem and finding solution in the lab prepares the student for lifelong learning.
CO. 4- PO1	H	Students understand the concept of transducers
CO 4- PO3	M	Students will be capable for correct usage of transducers
CO 4- PO5	M	Students are able to learn and implement new application using transducers
CO 4- PO6	H	Working of transducers are learnt and understand their usage.
CO 4- PO8	H	Apply the circuits using transducers to solve problems in society.
CO 4- PO9	H	Usage of transducers for ethical applications.
CO 4- P10	M	Students will be able to work as a team in designing various applications in lab
CO 4- P12	H	Students are able to comprehend new concepts and present them
CO 4- PSO1	M	Learning the concept of working of transducers and their application equips students for the industry
CO 4- PSO2	M	Experimenting with transducers equips students to build new systems meeting the industry standards

GAPS IN THE SYLLABUS - TO MEET INDUSTRY/PROFESSION REQUIREMENTS:

SNO	DESCRIPTION	PROPOSED ACTIONS	RELEVANCE WITH POs	RELEVANCE WITH PSOs
1	Log and Antilog amplifiers using op amp	Assignments	PO1, PO2	PSO3

PROPOSED ACTIONS: TOPICS BEYOND SYLLABUS/ASSIGNMENT/INDUSTRY VISIT/GUEST LECTURER/NPTEL ETC

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN:

SNO	DESCRIPTION	PROPOSED ACTIONS	RELEVANCE WITH POs	RELEVANCE WITH PSOs
1	Function generator using operational amplifier	PSPICE simulation	PO1	PSO3

WEB SOURCE REFERENCES:

1	***http://www.allaboutcircuits.com/worksheets/diffamp.html***
2	http://www.talkingelectronics.com/projects/200TrCcts/101-200TrCcts.html
3	http://www.talkingelectronics.com/projects/100%20IC%20Circuits/1-100_IC-Ccts.html
4	http://www.talkingelectronics.com/projects/50%20-%20555%20Circuits/50%20-%20555%20Circuits.html
5	http://www.stanford.edu/class/ee122/Parts_Info/datasheets/op_amp_circuit%20collection_

	AN-31.pdf
6	http://rfic.eecs.berkeley.edu/ee42/pdf/lect10.pdf
7	http://fourier.eng.hmc.edu/e84/lectures/opamp/node3.html
8	http://www.ti.com/lit/ds/symlink/dac0800.pdf
9	http://www.555-timer-circuits.com/
10	http://www.electroschematics.com/

DELIVERY/INSTRUCTIONAL METHODOLOGIES:

☐CHALK & TALK ✓	**☐STUD. ASSIGNMENT ✓**	**☐WEB RESOURCES✓**	**☐LCD/SMART BOARDS**
☐STUD. SEMINARS	☐ADD-ON COURSES		

ASSESSMENT METHODOLOGIES-DIRECT

☐ASSIGNMENTS ✓	**☐STUD. SEMINARS**	**☐TESTS/MODEL EXAMS ✓**	**☐UNIV. EXAMINATION ✓**
☐STUD. LAB PRACTICES	☐STUD. VIVA	☐MINI/MAJORPROJECTS	☐CERTIFICATIONS
☐ADD-ON COURSES	☐OTHERS		

ASSESSMENT METHODOLOGIES-INDIRECT

☐ASSESSMENT OF COURSE OUTCOMES (BY FEEDBACK, ONCE) ✓	**☐STUDENT FEEDBACK ON FACULTY (TWICE) ✓**
☐ASSESSMENT OF MINI/MAJOR PROJECTS BY EXT. EXPERTS	☐OTHERS

Prepared by
Dr. Poornima S. & Ms.Mary Hexy
(Faculty)

Approved by
Dr. Hari C.V.
(HOD)

LAB CYCLE

Sl.No	Planned
1	Differential Amplifier
2	Introduction to Operational Amplifiers
3	Familiarization of Operational amplifiers - Inverting and Non inverting amplifiers, frequency response
4	Measurement of Op-Amp parameters.
5	Adder, Averaging amplifier, Difference Amplifier & Instrumentation Amplifier
6	Integrator, Differentiator
7	Wien bridge oscillator
8	RC Phase shift Oscillator
9	Multivibrators
10	Triangular and square wave generators
11	Comparator, Zero crossing detector & Schimitt Trigger
12	Active second order filters using Op-Amp (LPF, HPF, BPF and BSF)
13	Notch filters to eliminate the 50Hz power line frequency
14	A/D converters- counter ramp and flash type.
15	D/A Converters- ladder circuit.

EXPERIMENT QUESTIONS

1. To design and setup inverting amplifier, non-inverting amplifier.
2. To set up a voltage follower and measure:
   i. (a)Slew rate
   ii. (b)Full power bandwidth
   iii. (c)Maximum output Swing
3. Measure (a) Input Resistance
   (b)CMRR
4. To design and set up a difference amplifier circuit.
5. To design and set up a Schmitt trigger using op-amp.
6. To plot the waveforms for the circuit.
7. To design and set up astable multivibrator and monostable multivibrator using op-amps.
8. To design and set up triangular and sawtooth wave generators using op-amp for 1kHz frequency.
9. To design and set up a Wien bridge oscillator for a frequency of 1 kHz.
10. To design and set up an RC phase shift oscillator at 1 kHz.
11. Design an astable multivibrator with time period 1.5ms
12. Design a monostable multivibrator with T_{on}=0.6 ms and total time period 2ms.
13. To design a low voltage variable regulator of 2 V to 7 V using IC 723

AEL 333: EMBEDDED SYSTEMS LAB

COURSE INFORMATION SHEET

PROGRAMME: APPLIED ELECTRONICS AND INSTRUMENTATION ENGINEERING.	DEGREE: BTECH
COURSE: EMBEDDED SYSTEMS LAB	SEMESTER: **5** CREDITS: **2**
COURSE CODE: AEL333 **REGULATION: 2019**	COURSE TYPE**: CORE**
COURSE AREA/DOMAIN: ELECTRONICS	CONTACT HOURS: **3 Practical hours/Week.**
CORRESPONDING LAB COURSE CODE (IF ANY): NIL	LAB COURSE NAME: **NIL**

SYLLABUS:

	DETAILS	HOURS
A.	**8051 Programs using kits :** 1. Data transfer/exchange between specified memory locations. 2. Largest/smallest from a series. 3. Sorting (Ascending/Descending) of data. 4. Addition / subtraction / multiplication / division of 8/16 bit data. 5. Sum of a series of 8 bit data. 6. Multiplication by shift and add method. 7. Square / cube / square root of 8 bit data. 8. Matrix addition. 9. LCM and HCF of two 8 bit numbers. 10. Code conversion – Hex to Decimal/ASCII to Decimal and vice versa.	6X3=18
B.	**Interfacing Experiments using 8051 Microcontroller** 1. Time delay generation and relay interface. 2. Display (LED/Seven segments/LCD) and keyboard interface. 3. ADC interface. 4. DAC interface with wave form generation. 5. Stepper motor and DC motor interface. 6. Realization of Boolean expression through port.	4X3=12
	TOTAL HOURS	30

TEXT/REFERENCE BOOKS:

T/R	BOOK TITLE/AUTHORS/PUBLICATION
1.	Muhammad Ali Mazidi, The 8051 Microcontroller and Embedded Systems, Pearson Education.
2.	Shibu K.V, Introduction to Embedded Systems, Mc Graw Hill
3.	Kenneth J Ayala, The 8051 Microcontroller, Penram International
4.	Rajkamal, Embedded Systems Architecture, Programming and Design, TATA McGrawHill, First reprint Oct. 2003

COURSE PRE-REQUISITES:

C.CODE	COURSE NAME	DESCRIPTION	SEM
NIL			

COURSE OBJECTIVES:

1	**Familiarize the students with Assembly Language Programming of modern microcontrollers.**
2	Impart the skills for interfacing the microcontroller with the help of Embedded C/Assembly Language Programming.

COURSE OUTCOMES:

SNO	DESCRIPTION	Blooms' Taxonomy Level
1	Students will be able to Write an Assembly language program/Embedded C program for performing data manipulation.	Knowledge Understand & Apply (Level 1,2 &3)
2	Students will be able to Develop ALP/Embedded C Programs to interface microcontroller with peripherals.	Knowledge Understand & Apply (Level 1,2 &3)
3	Perform programming/interfacing experiments with IDE for modern microcontrollers.	Knowledge & Apply (Level 1 & 3)

CO-PO AND CO-PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO.1	3	-	3	-	3	-	-	-	3	-	-	3	1	-	-
CO.2	3	-	3	2	3	-	-	-	3	-	-	3	1	-	-
CO.3	2	-	3	3	3	3	-	-	3	-	3	3	2	-	1

JUSTIFATIONS FOR CO-PO-PSO MAPPING

MAPPING	LOW/ MEDIUM /HIGH	JUSTIFICATION
CO.1- PO1	H	Describe the functions, capabilities, programming model and

		implementation of a computer system.
CO.1- PO3	H	Understands the execution of computer instruction at the micro level.
CO.1- PO5	H	Understand how to execute programs using the processor and controller kits and interfacing cards for executing programs and finding the solutions.
CO.1- PO9	M	Capable of solving various problems by developing different programs as a team
CO.1- PO12	L	With the knowledge acquired, development of different program to various systems is possible.
CO.1 – PSO1	M	Has sound technical knowledge in electronics.
CO.1 – PSO3	L	Will be able to learn the data flow, memory hierarchy, hardware requirements/costs, software-hardware trade-offs.
CO.2- PO1	H	Understands the architecture and programmers model of 8051 Microcontroller.
CO.2 – PO3	L	Able to formulate programs using instruction set.
CO.2 – PO4	H	Able to analyze and execute the programs using microcontroller.
CO.2 – PO5	M	With the interfacing knowledge students are able to analyse different tools
CO.2 – PO9	M	Capable of solving interfacing using microcontroller by developing different programs as a team
CO.2 – PO12	H	With the knowledge acquired, development of different program to various systems is possible.
CO.2 – PSO1	M	Has sound technical knowledge in electronics.
CO.2 – PSO3	L	Will be able to learn new concepts.
CO.3- PO1	H	Understands the interfacing of 8051 microcontroller.
CO.3 – PO3	H	Identifying the technique involved in various 8051 interfacing.
CO.3 – PO5	H	Able to develop solutions for various 8051 interfacing.
CO.3 – PO5	H	Able to attempt design experiments
CO.3 – PO6	H	Aware of new tool usage.
CO.3 – PO9	M	Capable of solving programs using modern microcontrollers as a team
CO.3 – PO11	M	With the interfacing knowledge students are able to use the tools

		to build their projects.
CO.3 – PO12	H	With the knowledge acquired, development of different program to various systems is possible.
CO.3 – PSO1	M	Has sound technical knowledge in electronics.
CO.3 – PSO3	L	Able to develop programs for various concepts.

GAPS IN THE SYLLABUS - TO MEET INDUSTRY/PROFESSION REQUIREMENTS:

SNO	DESCRIPTION	PROPOSED ACTIONS	RELEVANCE WITH POs	RELEVANCE WITH PSOs
1	Interfacing of various practical devices has to be concentrated.	Extra lab experiments.	PO2,PO3, PO5	PSO1, PSO3

PROPOSED ACTIONS: TOPICS BEYOND SYLLABUS/ASSIGNMENT/INDUSTRY VISIT/GUEST LECTURER/NPTEL ETC

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN:

SNO	DESCRIPTION	PROPOSED ACTIONS	RELEVANCE WITH POs	RELEVANCE WITH PSOs
1	Detailed study about advanced microcontrollers.	Extra Assignments	PO1	PSO1
2	Familiarization of various development boards and Integrated development area. (IDE)	Short term course	PO1, PO5	PSO1, PSO3

WEB SOURCE REFERENCES:

1	https://nptel.ac.in/courses/106/105/106105193/
2	https://nptel.ac.in/courses/108/102/108102045/
3	https://nptel.ac.in/courses/106/105/106105229/
4	https://nptel.ac.in/courses/106/105/106105172/
5	https://www.watelectronics.com/8051-microcontroller-architecture/

DELIVERY/INSTRUCTIONAL METHODOLOGIES:

☐ **CHALK & TALK**	☐ **STUD. ASSIGNMENT**	☐ WEB RESOURCES	
☐ LCD/SMART BOARDS	☐ STUD. SEMINARS	☐ ADD-ON COURSES	

ASSESSMENT METHODOLOGIES-DIRECT

☐ **ASSIGNMENTS**	☐ STUD. SEMINARS	☐ **TESTS/MODEL EXAMS**	☐ UNIV. EXAMINATION
☐ **STUD. LAB**	☐ **STUD. VIVA**	☐ MINI/MAJOR	☐ CERTIFICATIONS

PRACTICES		PROJECTS	
☐ ADD-ON COURSES	☐ OTHERS		

ASSESSMENT METHODOLOGIES-INDIRECT

☐ **ASSESSMENT OF COURSE OUTCOMES (BY FEEDBACK, ONCE)**	☐ STUDENT FEEDBACK ON FACULTY (TWICE)
☐ ASSESSMENT OF MINI/MAJOR PROJECTS BY EXT. EXPERTS	☐ OTHERS

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(HOD)

LAB CYCLE

Sl.No	Planned
	CYCLE 1
1	FAMILIARIZATION OF 8051 MICROCONTROLLER
2	ADDITION / SUBTRACTION / MULTIPLICATION / DIVISION OF 8 BIT DATA.
3	SQUARE / CUBE / SQUARE ROOT OF 8 BIT DATA.
4	FAMILIARIZATION OF KEIL µ VISION IDE
5	ADDITION AND SUBTRACTION OF 16 BIT DATA.
6	DATA TRANSFER/EXCHANGE BETWEEN SPECIFIED MEMORY LOCATIONS.
7	LARGEST/SMALLEST FROM A SERIES.
8	SORTING (ASCENDING/DESCENDING) OF DATA
9	CODE CONVERSION – DECIMAL TO ASCII / ASCII TO DECIMAL
10	SUM OF A SERIES OF 8 BIT DATA
11	CODE CONVERSION - HEX TO DECIMAL / DECIMAL TO HEX CONVERSION
12	MATRIX ADDITION
	CYCLE 2
13	TIME DELAY GENERATION USING 8051 MICROCONTROLLER
14	RELAY AND LED INTERFACING WITH 8051 MICROCONTROLLER
15	SEVEN SEGMENT DISPLAY INTERFACING WITH 8051 MICROCONTROLLER
16	STEPPER MOTOR INTERFACING WITH 8051 MICROCONTROLLER
17	DAC INTERFACING WITH 8051 MICROCONTROLLER

Additional Questions

AEL 333: EMBEDDED SYSTEMS LAB

OPEN QUESTIONS

1. Upon power up, the 8051 fetches the first opcode from ROM address location _____
2. Every 8051 family member wakes up at address _____ when it is powered up.
3. Which register is used for accessing external memory?
4. Name a 16 bit register in 8051.
5. In multiplication of two bytes in the 8051, we must place one byte in register _____ and the other one in register _____
6. Is this a valid 8051 instruction? Explain your answer." MUL A, R1"
7. Find the CY and AC flags for the below instruction.

```
MOV A, #3FH
ADD A, #45H
```

8. Find the CY and AC flags for the below instruction.

```
MOV A, #99H
ADD A, #58H
```

9.

```
ORG 00H
MOV A, #92H
ANL A, #0F0H
SWAP A
END
```

Find the final accumulator value.

10

```
ORG 00H
```

```
MOV A, #76H
MOV R1, #04H
L1: RR A
DJNZ R1,L1
END
```

Find the final accumulator value.

11. Registers ACC and B are _____ bits wide.

12. Which of the following instructions are illegal? If illegal state the reason of each.

```
MOV R3, #500H
MOV A, #255H
MOV R9, #50H
MOV A, #50H
```

13. Which of the following instructions are illegal? If illegal state the reason of each.

```
ADD R3, #50H
ADD A, #255H
MOV R9, R4
MOV A, R5
```

14. Assembly language is a _____ level language.

15. To mask upper nibble of the accumulator we must ANL it with _____.

16. What value must R5 have in order for the following instruction not to jump?

```
CJNE R4, #53, OVER
```

17. True or false. The CJNE instruction alters the contents of its operands.

18.

```
MOV A, #00H
MOV R2, 0AH
L2: ADD A, #03H
DJNZ R2, L2
MOV R5, A
```

```
L1: SJMP L1
```

Find the Hex code of the L1 the starting address is 9000H

19.

```
MOV A, #00H
MOV R0, #00H
MOV R1, 0AH
L1: INC R0
ADD A, R0
DJNZ R1, L1
L2: SJMP L2
```

Find the Hex code of the L1 the starting address is 9000H

20. Why does "RLC R1" give an error in the 8051?

21. 8051 is a _____ bit microcontroller.

22. What is the difference between CY and AC in 8051?

23. Show how to perform 77 x 34 in the 8051.

24. Show how to perform 77/ 34 in the 8051.

25. Show the instruction to load 1000 0000 (binary) into R3.

26. Explain the difference between the below instructions.

```
MOV A, R1
MOV A, @R1
```

27. Explain the difference between the below instructions.

```
MOV A, R1
MOVX  A, @DPTR
```

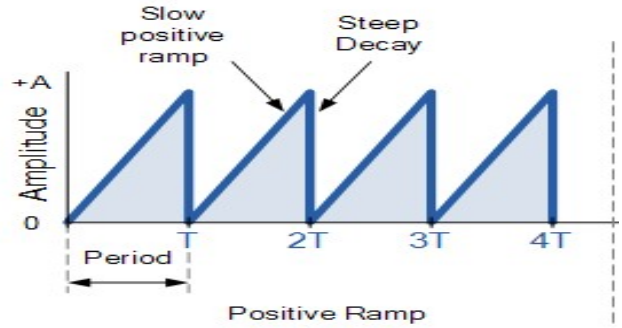
28. The mnemonic DJNZ stands for _____

29. In "JZ NEXT", which registers content is checked to see if it is zero?

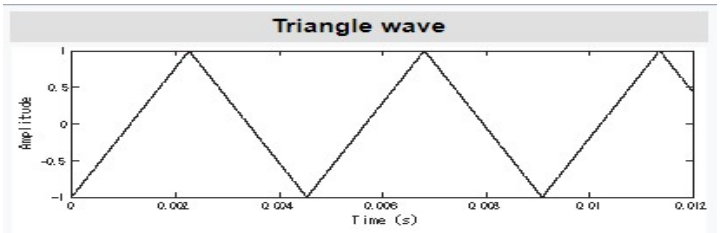
30. What is the content of the A register upon RESET of the 8051?

31. Write a program to generate a sinusoidal wave Vout = 2 + 2 sinθ using DAC 0808.

32. Write a program to generate the following waveform using DAC 0808.



33. Write a program to generate the following waveform using DAC 0808.



34. Write a program to rotate stepper motor in clockwise direction with 2ms delay in wave drive mode using rotate instruction

35. Write a program to rotate stepper motor in anticlockwise direction with 3ms delay in wave drive mode using rotate instruction

36. Write a program to rotate stepper motor in 76^0 anticlockwise direction with a step angle of 4^0

37. Write a program to rotate stepper motor in 150^0 clockwise direction and 480^0 anticlockwise direction

38. Write a program to interface seven segment display to display digits 0,1,8,7,6,5,0,1,8,7,6,5,….with 8051 microcontroller. Assume XTAL = 11.0592 MHz.

39. Write a program to generate a square wave of 60 Hz frequency on pin P1.0 with 50% duty cycle (Ton = Toff). Assume XTAL = 11.0592 MHz

40. Write a program to generate a square wave on pin P1.0 with T_{ON} = 5mS and T_{OFF} = 3ms. Assume XTAL = 11.0592 MHz

41. Write a program to blink a LED which is connected to P3.1 with 6ms delay. Select timer 0, mode 1 operation

42. Write a program to blink a LED which is connected to P2.2 with 8ms delay. Select timer 0, mode 1 operation

AEL 333: EMBEDDED SYSTEMS LAB
ADVANCED QUESTIONS

1. WALP in 8051 µC to evaluate the following series:1+4+9+16+25+…..n terms; n being given as input.

2. WALP to find out the value of y according to the equation $y= x^3+ 5x^2 +4$ for any given value of x.

3. Write a Embedded C program to rotate a stepper motor 90^0 in the clock wise direction with 1.5µS delay for each step using 8051µC.The speed of the rotation should be halved for the remaining $270^{0.}$.

4. Write a Embedded C program to rotate stepper motor continuously in the clock wise direction for an angle of 180^0 at 25 rpm and then in anti-clock wise direction for 5 complete rotations using 8051µC.The speed of the rotation should be halved for the remaining.

5. WALP to read port 1 to generate a square wave with 60% duty cycle if the value being read is FF_H, otherwise to generate a square wave with 10% duty cycle for all other cases.

6. Write an Embedded C program to display the sequence 1,3,5,7,9,0,2,4,6,8 for 5 times & stop the display using 8051 and seven segment display.

7. Write an Embedded C program to display the sequence 1,3,5,7,9,0,2,4,6,8 continuously using 8051 and seven segment display.

8. Design a one-way traffic line system with delay of 4 sec and pedestrian delay of 2 sec using 8051.

9. WALP to set up a Ring counter for 8 bits using 8051.

10. WALP to set up a Twisted-Ring counter for 8 bits using 8051.

11. WALP to generate a ramp signal

12. To generate the following wave form using 8051.

13. Design an up/down decade counter with 1.5 sec delay using LED's.

14. WALP to find out first 'n' prime numbers using 8051.

15. WALP to count how many times a particular number occurs in an array using 8086.

16. WALP to find out the square of the odd numbers from a given set of n numbers.

17. WALP to separate odd and even numbers from a given array without using DIV instruction

18. Write an Embedded C program to rotate stepper motor continuously in the clock wise direction for an angle of 180^0 at 35 rpm and then in anti-clock wise direction for 5 complete rotations using 8051μC.The speed of the rotation should be doubled for the remaining.

19. WALP to find out the number of occurrence of one's in a particular number using 8051 using LED's.

20. WALP to find the n terms of the sum of square series for a given value of n;
$1^2+2^2+3^2\ldots\ldots+n^2$

21. WALP to find the n terms of the sum of cubes series for a given value of n;
$1^3+2^3+3^3\ldots\ldots+n^3$

22. WALP to evaluate the series: 3+10+17+24+….. up to n terms.

23.WALP to interchange two blocks of data.

24. A block of data with "n" entries is stored in memory locations from 2500H onwards, write a program to transfer the data bytes to locations from 3000H onwards in reverse order.

25. WALP to display the factorial of a number using 8051, the input is given at port1 and display the output at port2 using LED's.

26. WALP to add multi-byte numbers.

27. WALP to count how many times a particular number occurs in an array.

28.WALP to find out the average of a given set of numbers using 8086.
29.WALP to display the results of two 8 bit numbers using ports.