SEMESTER V

SEMESTER V

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	CATEGORY	L	T	P	CREDITS
		PCC	3	1	0	4

Preamble: This course aims to analyze and design control systems.

Prerequisite: ECT205: NETWORK THEORY

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

CO 1	Analyze the control systems by transfer function approach.
CO 2	Get an adequate knowledge in the time response of systems & steady state error analysis
CO 3	Learn the concept of stability of control systems and methods of stability analysis.
CO 4	Analyze the control systems using frequency domain method.
CO 5	Apply the State Space Techniques to Control Systems.

Mapping of course outcomes with program outcomes

	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	3	2										
CO 2	3	2										
CO 3	2	3										
CO 4	2	3	2									
CO 5	3	2										

Assessment Pattern

Bloom's Category		Continuous Assessment Tests		End Semester Examination
		1	2	
Remember	K1	10	10	20
Understand	K2	10	10	20
Apply	K3	30	30	60
Analyze	K4			
Evaluate	K5			
Create				

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	**50**	**100**	**3 hours**

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

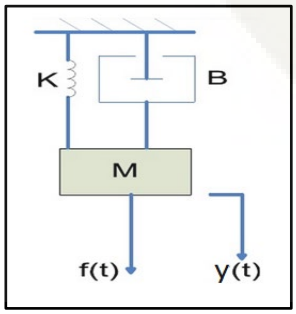
Course Level Assessment Questions

Course Outcome 1 (CO1): Analyze the control systems by transfer function approach

1. Define close loop transfer function and obtain the general equation for the characteristic equation of a system.
2. Explain the terms transmittance and non touching loops with respect to signal flow graphs.

3. (i) Find ***y(t)***, for the given, $Y(s) = \frac{9}{s(s+0.2)(s+3)}$

   (ii) Obtain the transfer function $\frac{\boldsymbol{Y(s)}}{\boldsymbol{F(s)}}$ $for\ f(t) = 1$, for the $Y(s)$ given in the above question. If the obtained transfer function represents the transfer function of a mass-spring-damper system as shown in Figure, find the values of **M, B and K** and also draw its **equivalent force - voltage analogous circuit** clearly writing the numerical values of **R, L and C.**



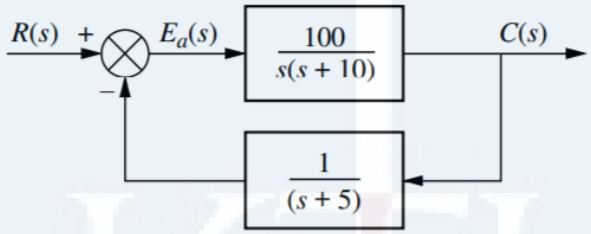
Course Outcome 2 (CO2): Get an adequate knowledge in the time response of systems and steady state error analysis

1. Obtain the ramp response of a general first order system with unity system gain and time constant of 2 seconds. Also draw the time response.

2. Derive the expression for the step response of a second order underdamped system as given below:

$$c(t) = 1 - e^{-\zeta\omega_n t}\left[\cos\omega_d t + \frac{\zeta}{\sqrt{1-\zeta^2}}\sin\omega_d t\right]$$

3. Find the numerical value of steady state error associated with the system shown below for a unit step input.



4. Derive the expression for the maximum percentage overshoot of the second order underdamped system as given below.

$$M_p = e^{-\frac{\pi\zeta}{\sqrt{1-\zeta^2}}} \times 100$$

Course Outcome 3 (CO3): Learn the concept of stability of control systems and methods of stability analysis.

1. Explain briefly the conditions that is to be satisfied for a system to be

   (a) Absolutely stable

   (b) Marginally stable

2. For the transfer function given below, determine how many poles are in the right half s-plane, left half s-plane and on the jω axis.

$$T(s) = \frac{20}{s^8 + s^7 + 12s^6 + 22s^5 + 39s^4 + 59s^3 + 48s^2 + 38s + 20}$$

3. For a unity feedback system, the open loop transfer function is given by

$$G(s)H(s) = \frac{K}{s(s+2)(s^2+6s+25)}$$

(a) Sketch the root locus

(b) At what value of K, the system becomes unstable?

(c) At this point of instability, determine the frequency of oscillation of the system.

Course Outcome 4 (CO4): Analyze the control systems using frequency domain method.

1. Define the frequency domain specifications

   (a) Resonant peak

   (b) Resonant frequency

   (c) Bandwidth

   Also obtain the expressions for the above for a second order underdamped

$$T(s) = \frac{C(s)}{R(s)} = \frac{\omega_n^2}{s^2 + 2\delta\omega_n s + \omega_n^2}$$

   system with transfer function

2. Draw the Bode plot of the system given below. Also find the Gain margin

$$G(s) = \frac{75(1+0.2s)}{s(s^2+16s+100)}$$

   and Phase margin.

3. State and explain Nyquist Stability criteria.

4. The open loop transfer function for an unmanned under water vehicle is given by

$$G(s) = \frac{20}{s(1+as)(1+0.02s)}$$

   (a) At a frequency of 3 rad/sec, it is known that the gain of the system is 5, hence calculate the value of "a".

   (b) Estimate the phase margin for the above value of "a" without drawing Nyquist Plot.

Course Outcome 5 (CO5): Apply the State Space Techniques to Control Systems.

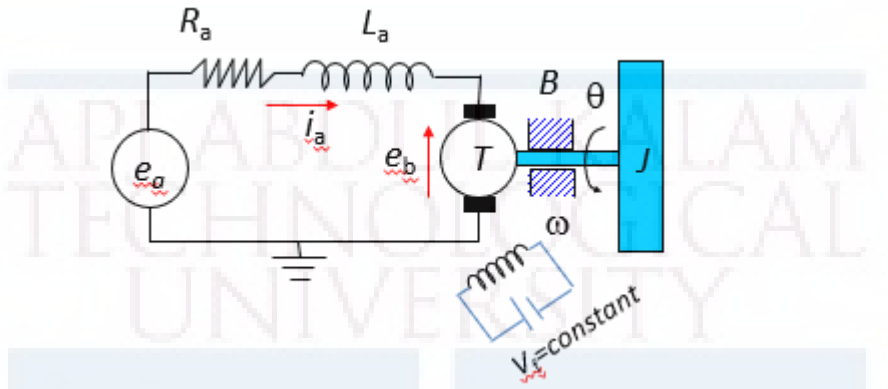
1. Define the following:

   (a) State of a system

(b) State variables

(c) State vector

2. Obtain the state space model of the armature controlled DC motor shown below:



3. Determine the transfer function of the system represented by the state space model given below, for if K=3, B=1 and M=10;

$$\begin{bmatrix}\dot{x}\\ \dot{v}\end{bmatrix}=\begin{bmatrix}0 & 1\\ -\frac{K}{M} & -\frac{B}{M}\end{bmatrix}\begin{bmatrix}x\\ v\end{bmatrix}+\begin{bmatrix}0\\ \frac{1}{M}\end{bmatrix}f(t)$$

$$y(t)=\begin{bmatrix}0 & 1\end{bmatrix}\begin{bmatrix}x\\ v\end{bmatrix}$$

4. A dynamic system is given below. Check whether the system is completely controllable.

$$\dot{X}=\begin{bmatrix}0 & 1 & 0\\ 0 & 0 & 1\\ 0 & -2 & -3\end{bmatrix}X+\begin{bmatrix}0\\ 0\\ 1\end{bmatrix}r$$

SYLLABUS

Module 1:

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.

Module 2:

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.

Module 3:

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.

Module 4:

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.

Module 5:

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.

Text Books

1. S. Hassan Saeed, Automatic Control Systems (with MATLAB programs), KATSON Books.
2. Norman S Nise, Control System Engineering, Sixth Edition.

Reference Books

1. Katsuhiko Ogata, Modern Control Engineering, Pearson Education.
2. M. Gopal, Control Systems, McGraw Hill Education India Education, 2012.
3. B.C. Kuo, PHI, Automatic Control Systems.
4. Richard C Dorf and Robert H. Bishop, Modern Control Systems, Pearson Education, 2001.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**System modeling - Transfer function approach:**	
1.1	Introduction to control system – Classification of control systems.	1
1.2	Principles of automatic control.	1
1.3	Feedback control systems – Practical examples	1
1.4	Transfer function – Transfer function of electrical and mechanical systems	2
1.5	Transfer function of electromechanical systems	1
1.6	Block diagram reduction Techniques	1
1.7	Signal flow graph – Mason's gain formula.	2
2	**Time domain analysis:**	
2.1	Standard test signals - Response of systems to standard test signals	1
2.2	Step response of second order systems in detail	2
2.3	Time domain specifications – delay time, rise time, peak time, maximum percentage overshoot and settling time. Example problems.	4
2.4	Steady state response – Steady state error	1
2.5	Static & Dynamic error coefficients.	2
3	**Stability of linear systems in time domain:**	
3.1	Asymptotic and BIBO stability	1
3.2	Routh-Hurwitz criterion of stability	1
3.3	Root locus - Construction of root locus	3
3.4	Root locus- Examples	2
3.5	Effect of addition of poles and zeros on the root locus	1
4	**Frequency domain analysis:**	
4.1	Frequency response – Frequency domain specifications	1
4.2	Stability in the frequency domain - Nyquist stability criterion. Examples.	3
4.3	Relative stability – Gain margin and phase margin. Examples.	2
4.4	M & N circles – Nichol's chart.	2
5	**State variable analysis:**	
5.1	State space representation of Continuous Time systems. Standard canonical forms.	3
5.2	Transfer function from State Variable Representation	2
5.3	Solution of state equations, state transition matrix. Examples	3
5.4	Concepts of Controllability and Observability, Kalman's Test.	2

Model Question paper

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIFTH SEMESTER B.TECH DEGREE EXAMINATION

Course Code: AET301

Program: Applied Electronics and Instrumentation Engineering

Course Name: Control Systems

Max. Marks: 100 Duration: 3 Hours

PART A

Answer ALL Questions. Each Carries 3 mark.

1.	Write the Force – Current analogies for Mass, Spring constant and Damping coefficient of a mechanical system.	K1	
2	Derive the expression for closed loop transfer function.	K2	
3	Impulse response of a 1st order system is given below: $c(t) = 3e^{-0.5t}$ Find out (a) Time constant T (b) D.C Gain K (c) Transfer Function	K3	
4	Write the expressions for K_p, K_v and K_a, for a given system with open loop transfer function G(s)	K1	
5	What is the inference of having all the elements of a row as zeroes in the Routh Table?	K2	

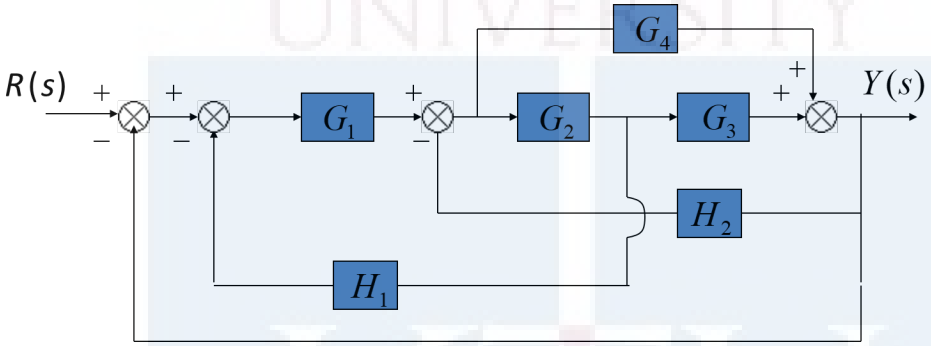
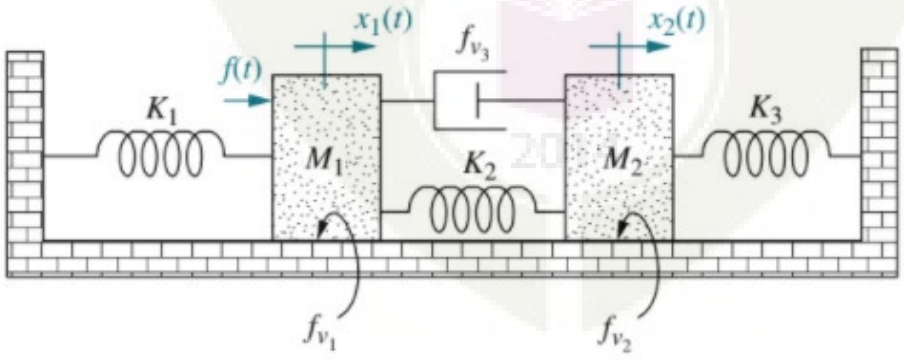
6	Write the angle and magnitude conditions for constructing the root locus of a system.	K1	
7	Briefly explain the steps for drawing a polar plot.	K2	
8	Define (i) Gain cross over frequency (ii) Phase cross over frequency and (iii) Phase Margin	K1	
9	Derive the expression for the state transition matrix from the unforced state equation.	K2	

10	What is duality property between controllable and observable canonical form. Write the 4 equations relating the matrices A, B, C, D in observable and controllable forms.	K2	

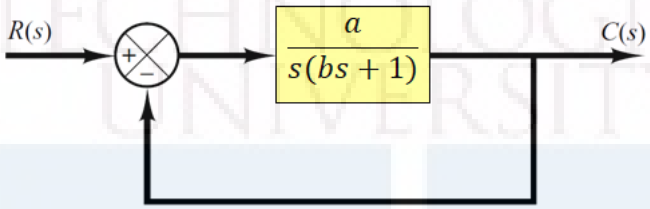
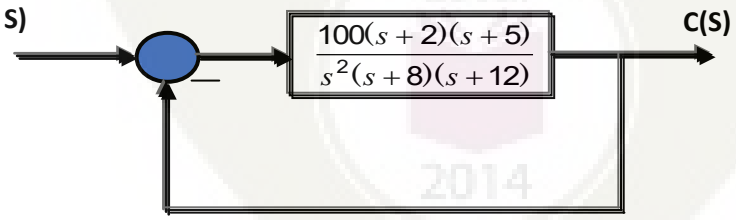
PART – B

Answer one question from each module; each question carries 14 marks.

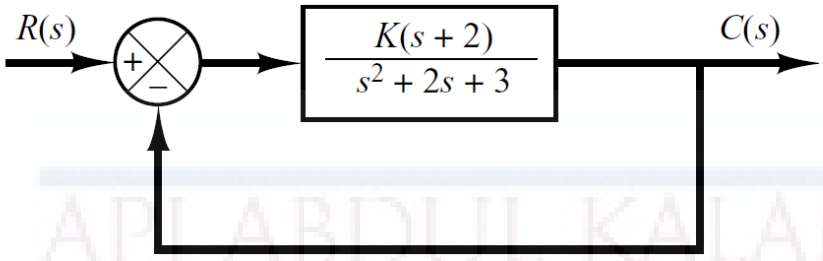
Module – I

11.a)	Write any 2 advantages and disadvantages of closed loop control systems	4	CO1	K1
11.b)	Using block diagram reduction technique, find the overall transfer function of the system shown below: 	10	CO1	K3
	OR			
12.a)	Draw the free-body diagrams of masses M1 and M2, for the system shown below	4	CO1	K1
12.b)	For the mechanical system shown, draw the Force - Current analogous system, after clearly writing the equations of motion for each mass. 	10	CO2	K3

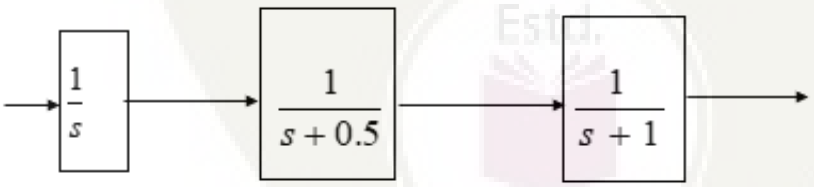
Module – II

13 a)	For the system represented by the block diagram given below, **determine the values** of 'a' and 'b' to yield a unit step response, with maximum percentage overshoot of 5 and undamped natural frequency (ω_n) as 2 rad/sec. 	10	CO2	K3
13 b)	For the obtained values of 'a' and 'b', in the above question, find the **risetime** and **settling time** for a **2%** criterion.	4	CO2	K1
	OR			
14 a)	What are the 4 standard test signals used in control systems. Write the Laplace Transform of the above test signals.	4	CO2	K1
14 b)	For the system shown in figure below, evaluate the static error constants and find the expected steady state errors for the standard step, ramp and parabolic inputs. 	10	CO2	K3

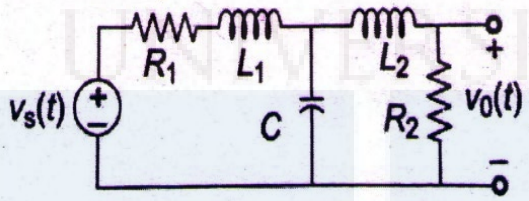
Module – III

15 a)	State and explain the Routh Hurwitz criteria for stability analysis	5	CO3	K2
15 b)	Sketch the complete root locus of the system shown below: 	9	CO3	K3
	OR			
16 a)	Write the 9 rules for construction of root locus.	5	CO3	K2
16 b)	Sketch the root locus for the transfer function given below in a graphsheet $G(s)H(s) = \frac{K}{s(s+1)(s+5)}$ Add a zero at s = -2, to the above transfer function and draw the root locus. Also clearly specify the effect of adding the zero to the transfer function.	9	CO3	K3

Module – IV

17	Sketch the asymptotic bode plot of the open loop system for a system represented by block diagram shown in Figure. Estimate the gain and phase margin of the system and calculate the phase crossover frequency and gain crossover frequency. 	14	CO4	K3
	OR			
18	The open loop transfer function of a control system is given by $G(s) = \frac{K}{s(s+2)(s+10)}$ Determine the value of K so that the system will be stable with (a) Gain Margin = 6 dB (b) Phase Margin = 45^0	14	CO4	K3

Module – V

19 a)	Draw the block diagram representing the state space model given by $$\dot{x}(t) = Ax(t) + Bu(t)$$ $$y(t) = Cx(t) + Du(t)$$	4	CO5	K3
19 b)	**Obtain the state space model** of the electrical network shown below: Clearly **write the state equation and output equation**. 	10	CO5	K3
	OR			
20 a)	Obtain the observable canonical form of the given transfer function: $$\frac{Y(s)}{U(s)} = \frac{s+3}{s^2+5s+2}$$	8	CO5	K3
20 b)	Determine the controllability and observability of the system shown below: $$\begin{bmatrix}\dot{x}\\ \dot{y}\end{bmatrix} = \begin{bmatrix}-0.5 & 0\\ 0 & -2\end{bmatrix}\begin{bmatrix}x\\ y\end{bmatrix} + \begin{bmatrix}0\\ 1\end{bmatrix}u(t)$$ $$y(t) = \begin{bmatrix}0 & 1\end{bmatrix}\begin{bmatrix}x\\ y\end{bmatrix}$$	6	CO5	K3

AET303	INDUSTRIAL INSTRUMENTATION	CATEGORY	L	T	P	CREDITS
		PCC	3	1	0	4

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

Prerequisite: Nil

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

CO 1	Understand the working of different types of temperature sensors
CO 2	Familiarize with the various types of pressure measurement techniques
CO 3	Study the working of various flow measurement devices
CO4	Familiarize with the working of anemometers and viscometers
CO5	Understand the various level measurement techniques

Mapping of course outcomes with program outcomes

	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	3	3										2
CO 2	3	3										2
CO 3	3	3										2
CO 4	3	3										2
CO5	3	3										2

Assessment Pattern

Bloom's Category		Continuous Assessment Tests		End Semester Examination
		1	2	
Remember	K1	10	10	20
Understand	K2	30	30	70
Apply	K3	10	10	10
Analyse	K4			
Evaluate				
Create				

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	**50**	**100**	**3 hours**

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1): Understand the working of different types of temperature sensors

1. Explain the working principle of Resistance Temperature detectors.
2. Explain the theory of operation of thermocouples.

Course Outcome 2 (CO2): Familiarize with the various types of pressure measurement techniques

1. Explain the construction and principle of operation of Bourdon tubes.
2. Compare the performance of various types of electronic pressure sensors.

Course Outcome 3 (CO3): Study the working of various flow measurement devices

1. Explain how venturi tubes are used in Flow Measurement?
2. Explain the working of Angular-momentum type flow meter.

Course Outcome 4 (CO4): Familiarize with the working of anemometers and viscometers

1. What are anemometers used for? Explain the different categories of anemometers.
2. Explain the working of differential pressure type capillary viscometers

Course Outcome 5 (CO5): Understand the various level measurement techniques

1. What are the different types of float type designs for level measurement and control?
2. Compare the performance of various types of electrical level gauging methods

SYLLABUS

Module 1:

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, Electronic Temperature Switches.

Module 2:

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.

Module 3:

Flow Measurement: Introduction, Orifice Plates, Venturi Tubes and Nozzles, Pitot Tubes.

Positive Displacement Flowmeters - Nutating disc flowmeter, Sliding vane flowmeter, Lobed impeller flowmeter, Reciprocating piston flowmeter

Mass Flowmeters – Radiation type, Angular – Momentum type, Impeller-Turbine Flowmeter, Constant torque - Hysteresis Clutch, Twin-Turbine.

Module 4:

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.

Module 5 :

Level Measurement – Float Type level indicator, Displacer Type – Torque tube assembly.

Electrical Methods – Resistance, Conductance, Inductive and Capacitive level gauging**.**

Ultrasonic Method, Microwave Level Switches, Noncontacting optical level sensor, Rotating Paddle Switches.

Text Books

1. Patranabis D, "*Principles of Industrial Instrumentation*", 3rd Edition, Tata McGraw Hill, New Delhi, 2010.
2. Liptak B.G, "*Process Measurement and Analysis*", 4th Edition, Chilton Book Company, Radnor, Pennsylvania, 2003.
3. Doebelin E.O, "*Measurement Systems: Application and Design*", 4th Edition, McGraw Hill, New York, 2003.

Reference Books

1. Andrew W.G, "*Applied Instrumentation in Process Industries – A survey*", Vol I & Vol II, Gulf Publishing Company, Houston, 2001.
2. Douglas M. Considine, "*Process / Industrial Instruments & Controls Handbook*", 5th Edition, McGraw Hill, Singapore, 1999.
3. Spitzer D. W., *Flow measurement*, ISA press, New York, 1998 4. Noltingk B.E., *"Instrumentation Reference Book"*, 2nd Edition, Butterworth Heinemann, 1995.
4. Noltingk B.E., *"Instrumentation Reference Book"*, 2nd Edition, Butterworth Heinemann, 1995.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Temperature Measurement**	
1.1	Resistance Temperature Detectors – Applications, Industrial RTD construction requirement, RTD Transmitters	2
1.2	Thermistors – Principle of Operation, Sensor types, Temperature measurement using Thermistors	2
1.3	Thermocouples – Theory of Operation, Thermocouple types.	1
1.4	Diode – Type Temperature Sensors, Fluidic Sensors	2
1.5	Johnson noise thermometer, Electronic Temperature Switches	2
2	**Pressure Measurement**	
2.1	Manometers, Bourdon Tubes, Diaphragm Elements.	2
2.2	Electronic Pressure Sensors – Strain Gauge Transducers, Capacitance Transducer, Potentiometric Transducer	3
2.3	Resonant Wire Transducer, Piezoelectric Pressure Sensors,	1
2.4	Linear Variable Differential Transformer, Optical Transducers.	2
2.5	Differential Pressure Transmitters – Pneumatic Transmitter	1
3	**Flow Measurement**	
3.1	Introduction, Orifice Plates, Venturi Tubes and Nozzles, Pitot Tubes.	2
3.2	**Positive Displacement Flowmeters -** Nutating disc flowmeter, Sliding vane flowmeter, Lobed impeller flowmeter, Reciprocating piston flowmeter	3
3.3	**Mass Flowmeters** – Radiation type, Angular – Momentum type, Impeller-Turbine Flowmeter	2
3.4	Constant torque-Hysterisis Clutch, Twin-Turbine	2
4	**Anemometers**	
4.1	Mechanical Anemometer, Hot-wire anemometer, Laser Doppler anemometer.	3

4.2	Cross-Correlation flow meter, Ultrasonic flow meter – Transit-time flow meter, Doppler flow meter	3
4.3	**Measurement of Viscosity –** Introduction, Viscometer selection and application.	2
4.4	Capillary Viscometers – Differential Pressure type.	1
5	**Level Measurement**	
5.1	Float Type level indicator, Displacer Type – Torque tube assembly.	2
5.2	Electrical Methods **–** Resistance, Conductance, Inductive and Capacitive level gauging**.**	3
5.3	Ultrasonic Method, Microwave Level Switches,	2
5.4	Noncontacting optical level sensor, Rotating Paddle Switches.	2

Model Question paper

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIFTH SEMESTER B.TECH DEGREE EXAMINATION

Course Code: AET303

Program: Applied Electronics and Instrumentation Engineering/ Electronics and Instrumentation Engineering

Course Name: Industrial Instrumentation

Max. Marks : 100 Duration: 3 Hours

PART A

Answer ALL Questions. Each Carries 3 mark.

1.	Explain the theory of operation of thermocouples.	K2	CO1
2	List two advantages and limitation of RTD's.	K2	CO1
3	Explain the working of a diaphragm pressure gauge.	K2	CO2
4	Explain the construction of a potentiometric pressure transducer.	K2	CO2
5	Illustrate the different types of orifice plates.	K2	CO3
6	Draw the schematic of a lobed impeller flow meter and explain.	K2	CO3
7	Explain the working of any one type of mechanical Anemometer.	K2	CO4
8	Explain any two applications of viscometers.	K2	CO4
9	Explain the working of a typical float type level indicator.	K2	CO5
10	Illustrate the working principle of a noncontacting optical level sensor.	K2	CO5

PART – B

Answer one question from each module each question carries 14 marks.

Module – I

11. a)	What are the considerations that need to be followed in the construction of industrial RTD's ?	8	CO1	K1
11. b)	Explain how temperature measurement is done using thermistors?	6	CO1	K2
	OR			
12.a)	With the help of neat diagrams explain the working of diode type temperature sensor.	7	CO1	K2
12.b)	Explain the working of fluidic sensor with the help of a neat block diagram.	7	CO1	K1

Module – II

13. a)	With the help of neat schematics explain the working of Bourdon pressure gauge.	8	CO2	K2
13. b)	Explain how pressure transducer can be constructed using unbounded strange gauge wires.	6	CO2	K3
	OR			
14.a)	Explain the construction and working of a Resonant wire type differential pressure sensor.	7	CO2	K2
14.b)	Illustrate the working principle of Linear Variable Differential Transformer.	7	CO2	K2

Module III

15. a)	Explain the working principle of pitot tube.	4	CO3	K1
15. b)	With the help of neat schematics explain the working of nutating disc flowmeter and sliding vane flowmeter.	10	CO3	K2
	OR			
16.a)	Draw a neat diagram of a radiation-type mass flowmeter and explain	7	CO3	K2
16.b)	With the help of neat sketches explain the working of Twin-Turbine flowmeter.	7	CO3	K2

Module IV

17. a)	With the help of neat sketches explain the working of Laser Doppler Anemometer.	8	CO4	K2
17. b)	Illustrate the principle of cross-correlation flow monitoring.	6	CO4	K2
	OR			
18.a)	Explain the principle of operation of Doppler flowmeter with the help of neat diagrams	7	CO4	K1
18.b)	With the help of neat schematics explain the working of Differential-pressure-type capillary viscometer	7	CO4	K2

Module – V

19. a)	With neat schematics explain the working of torque tube assembly displacer type level indicator.	6	CO5	K2
19. b)	Draw and explain any two electrical methods for level gauging.	8	CO5	K2

	OR			
20.a)	With the help of a neat block diagram explain about ultrasonic level gauging.	7	CO5	K2
20.b)	Explain how microwave switches are used in level measurement.	7	CO5	K2

AET305	COMPUTER ARCHITECTURE AND EMBEDDED SYSTEMS	CATEGORY	L	T	P	CREDITS
		PCC	3	1	0	4

Preamble: This course aims to impart knowledge of basic computer architecture, microcontroller and embedded programming

Prerequisite: ECT203 Logic Circuit Design & EST102 Programming in C

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

CO 1	Explain the processor architecture and operation.	K2
CO 2	Explain the architecture of 8051 microcontroller.	K2
CO 3	Develop programs using assembly language 8051.	K3
CO4	Develop Programming concepts of Embedded programming in C.	K3
CO5	Explain the concepts of RTOS based embedded system.	K2

Mapping of course outcomes with program outcomes

	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	3	3										3
CO 2	3	3										3
CO 3	3	3	3	3	3							3
CO 4	3	3	3	3	3							3
CO5	3	3										3

Assessment Pattern

Bloom's Category		Continuous Assessment Tests		End Semester Examination
		1	2	
Remember	K1	10	10	10
Understand	K2	30	30	60
Apply	K3	10	10	30
Analyse	K4			
Evaluate				
Create				

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	**50**	**100**	**3 hours**

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1): Explain the processor architecture and operation.

1. Write the sequence of elementary operations required to execute an instruction

a. Sub (R4), R3
b. Add (R4), R1

Course Outcome 2 (CO2): Explain the architecture of 8051 microcontroller.

2. Draw the memory map and briefly explain the memory organization for 128 byte internal RAM of 8051 microcontroller.

Course Outcome 3 (CO3): Develop programs using assembly language 8051.

3. Develop following programs for 8051

a. Program to convert the ASCII number into unpacked BCD.

b. Program to swap a number 0 x ab to 0 x ba, where a and b are hex digits.

c. Program to find the number of 1's in an 8-bit data item.

d. Program to display 'M' and 'E' on the LCD connected to 8051 using the BUSY FLAG.

e. Program to rotate a stepper motor 500 in the clockwise direction.

f. Program to toggle pin P1.4 every second using interrupts for a frequency of 22 MHz. Use timer 1 in mode 1.

g. Program to generate a square wave of 1 kHz with duty cycle 33%. Use timer 1 in interrupt mode with a crystal frequency of 11.0592 MHz.

Course Outcome 4 (CO4): Develop Programming concepts of Embedded programming in C.

4. The following examples may be solved in C program

a. Program to convert the ASCII number into unpacked BCD.

b. Program to swap a number 0 x ab to 0 x ba, where a and b are hex digits.

c. Program to find the number of 1's in an 8-bit data item.

Course Outcome 4 (CO5): Explain the concepts of RTOS based embedded system.

5. What are the functional and non functional requirements that needs to be analysed while choosing an RTOS.

SYLLABUS

Module 1: 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

Module 2: 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.

Module 3: 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

Module 4: 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

Module 5: 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

Text Books

1. V. Carl Hamacher, Zvono G. Vranesic, Safwat G. Zaky Computer Organization. McGraw-Hill International Editions
2. Muhammed Ali Mazidi & Janice Gilli Mazidi, R.D. Kinley, The 8051 microcontroller and Embedded System, Pearson Education, 2nd edition.Robert
3. Shibu K.V, *Introduction to Embedded Systems*, Mc Graw Hill

Reference Books

1. Computer organization and design: The Hardware/Software interface/David A.Patterson, John L. Hennessy. — 5th ed.
2. Mano M M, Computer System Architecture, 3rd Ed, Prentice Hall of India.
3. Wayne Wolf, Computers as Components: Principles of Embedded Computing System Design – Harcourt India, Morgan Kaufman Publishers, First Indian Reprint 2001
4. Lyla B Das, Embedded Systems An Integrated Approach, Pearson, 2013
5. Rajkamal, Embedded Systems Architecture, Programming and Design, TATA McGraw-Hill, First reprint Oct. 2003

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Computer Arithmetic and Processor Basics**	
1.1	Functional units of a computer, Von Neumann and Harvard computer architectures	1
1.2	Processing unit- Fundamental concepts	1
1.3	Execution of a complete Instruction	2
1.4	Hardwired Control	1
1.5	Multiple Bus organization, Other enhancements	1
1.6	Microprogrammed control	1
1.7	Number representations	1
1.8	Fixed and floating point-number representation	1
1.9	Arithmetic operations on floating point numbers	2
2	**8051 Architecture**	
2.1	Microcontrollers and Embedded Processors, Block diagram of 8051	1
2.2	Pin configuration, Registers	1
2.3	Internal Memory, Port Structures, Interrupts	3
2.4	Addressing Modes	1
2.5	Instruction set of 8051	1
2.6	Programming examples in assembly language	2
3	**Programming and Interfacing of 8051**	

3.1	Programming examples Interfacing with 8051 using Seven segment LED display	2
3.2	Interfacing of Keyboard and Stepper Motor	3
3.3	Interfacing of DAC -- with 8051 and its programming.	2
3.4	8051 Timers/Counters - Modes and Applications	3

4	**Embedded programming**	
4.1	Definition of Embedded System, Embedded Systems Vs General Computing Systems.	1
4.2	Programming concepts of Embedded programming in C Program Elements	2
4.3	Macros and functions	1
4.4	Use of Pointers - NULL Pointers	1
4.5	Function Calls – Multiple function calls in a Cyclic Order in the Main Function Pointers	2
4.6	Function Queues and Interrupt Service Routines Queues Pointers	2
5	**RTOS Based Embedded System**	
5.1	Operating System Basics, Types of Operating Systems,	1
5.2	Tasks, Process and Threads	2
5.3	Multiprocessing and Multitasking	1
5.4	Task Scheduling.	1
5.5	How to Choose an RTOS	1

Assignment:

At least one assignment should be simulation of 8051 using KEIL

Model Question paper

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIFTH SEMESTER B.TECH DEGREE EXAMINATION

Course Code: AET305

Program: Applied Electronics and Instrumentation Engineering/ Electronics and Instrumentation Engineering

Course Name: Computer Architecture and Embedded Systems

Max. Marks: 100 Duration: 3 Hours

PART A

Answer ALL Questions. Each Carries 3 mark.

1. Draw IEEE standard floating point number format with single precision K1

2. What are the sequence of operations and control signals generated, for fetching a word from memory K3

3. Draw the bit pattern for 8051 flag register (PSW) K1

4. Explain the following instructions K2
   MOVX A, @DPTR
   DJNZ R0, BACK
   DAA

5. Explain TMOD SFR (Special Function Register) K2

6. How will you generate a 1 ms delay using 8051? K3

7. Compare Embedded System with General Computing System K2

8. How is a pointer different from a NULL pointer? (Any 2 differences) K2

9. Define a thread. What are the advantages of using a multithreaded program K1

10. What are the types of Operating systems K1

PART – B

Answer one question from each module; each question carries 14 marks.

Module – I

11. a)	Rules of Arithmetic operations on floating point numbers	6	CO1	K2
11. b)	With diagrams explain the operation of hardwired control	8	CO1	K3
	OR			
12.a)	Explain with a diagram, how a 3 operand instruction is executed in a 3 bus CPU structure	8	CO1	K2
12.b)	With a diagram explain the basic organization of a microprogrammed control unit	6	CO1	K1

Module – II

13 a)	Draw the memory map and briefly explain the memory organization for 128 byte internal RAM of 8051 microcontroller.	8	CO2	K1
13 b)	Write an 8051 assembly language program to add two 64 bit numbers	6	CO3	K3
	OR			
14 a)	Write a program to find the sum of the values at RAM locations 50 – 54H (5 values) . At the end of the program, register A should contain the low byte of the sum and R7 the high byte of the sum.	8	CO3	K3
14 b)	List the addressing modes of 8051 with proper examples	6	CO2	K2

Module – III

15 a)	Draw a block diagram to interface stepper motor with 8051 with a step angle of 2 degree. Also write an assembly language program to rotate a motor 64 degree in clock wise direction. Use 4 step sequence	14	CO3	K3
	OR			
16 a)	Explain TCON SFR (Special Function Register)	5	CO2	K1
16 b)	How a triangular waveform can be generated using 8051?	9	CO3	K3

Module – IV

17 a)	Explain in detail various data structures used in embedded C programming.	10	CO4	K1
17 b)	Write 4 differences between macros and functions.	4	CO4	K2

	OR			
18 a)	Explain a function pointer with syntax, example and uses.	9	CO4	K2
18 b)	Compare pass by value and pass by reference	5	CO4	K2

Module – V

19 a)	What are the Functional and Non functional requirements that needs to be analysed while choosing an RTOS.	10	CO4	K1
19 b)	What is the use of a watch dog timer.	4	CO4	K2
	OR			
20 a)	What is meant by task synchronization? Discuss on various task synchronization issues and solutions in real time systems.	10	CO4	K2
20 b)	What is a semaphore? How they are classified?	4	CO4	K1

AET307	ANALOG INTEGRATED CIRCUITS	CATEGORY	L	T	P	CREDITS
		PCC	3	1	0	4

Preamble: This course aims to develop the skill to design circuits using operational amplifiers and other linear ICs for various applications.

Prerequisite: ECT202 Analog Circuits

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

CO 1	Outline Op Amp fundamentals and differential amplifier configurations
CO 2	Design operational amplifier circuits for various applications
CO 3	Design Oscillators and active filters using opamps
CO4	Explain the working and applications of timer, VCO and PLL ICs
CO5	Outline the working of Voltage regulator IC's and Data converters

Mapping of course outcomes with program outcomes

	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	3	3	1	2								1
CO 2	3	3	2	2	2							1
CO 3	3	3	2	2	2							1
CO 4	3	3	1	2	2							1
CO 5	3	3	2	2	2							1

Assessment Pattern

Bloom's Category		Continuous Assessment Tests		End Semester Examination
		1	2	
Remember	K1	10	10	10
Understand	K2	20	20	50
Apply	K3	20	20	40
Analyse	K4			
Evaluate				
Create				

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	**50**	**100**	**3 hours**

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1): Understand Op Amp fundamentals and differential amplifier configurations.

1. Explain the working of BJT differential amplifiers.
2. Calculate the input resistance, output resistance, voltage gain and CMRR of differential amplifiers.
3. Explain the non-ideal parameters of differential amplifiers.
4. Derive CMRR, input resistance and output resistance of a dual input balanced output differential amplifier configuration.

Course Outcome 2 (CO2): Design operational amplifier circuits for various applications.

1. Design an opamp circuit to obtain an output voltage $V_0=-(2V_1+4V_2+3V_3)$
2. A 741C op-amp is used as an inverting amplifier with a gain of 50. The voltage gain vs frequency curve of 741C is flat upto 20kHz.What maximum peak to peak input signal can be applied without distorting the output?
3. With the help of a neat circuit diagram, derive the equation for the output voltage of an Instrumentation amplifier.
4. With the help of circuit diagrams and graphs, explain the working of a Full wave Precision rectifier.

Course Outcome 3 (CO3): Design Oscillators and active filters using opamps.

1. Derive the design equations for a second order Butterworth active low pass filter.
2. Design a Notch filter to eliminate power supply hum (50 Hz).
3. Design a first order low pass filter at a cut-off frequency of 2kHz with a pass band gain of 3

Course Outcome 4 (CO4): Explain the working and applications of timer, VCO and PLL ICs .

1. With the help of internal diagram explain the monostable operation of timer IC 555. Draw the input and different output waveforms. Derive the equation for pulse width.
2. Explain the operation of Phase Locked Loop. What is lock range and capture range? Realize a summing amplifier to obtain a given output voltage.
3. Design a circuit to multiply the incoming frequency by a factor of 5 using 565 PLL.

Course Outcome 5 (CO5): Outline the working of Voltage regulator IC's and Data converters

1. What is the principle of operation of Dual slope ADC. Deduce the relationship between analogue input and digital output of the ADC.
2. Explain how current boosting is achieved using I.C 723
3. Explain the working of successive approximation ADC

SYLLABUS

Module 1:

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.

Module 2:

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.

Module 3:

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.

Module 4:

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.

Module 5:

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.

Text Books

1. Roy D. C. and S. B. Jain, Linear Integrated Circuits, New Age International, 3/e, 2010

Reference Books

1. DFranco S., Design with Operational Amplifiers and Analog Integrated Circuits, 3/e, Tata McGraw Hill, 2008
2. Gayakwad R. A., Op-Amps and Linear Integrated Circuits, Prentice Hall, 4/e, 2010
3. Salivahanan S. and V. S. K. Bhaaskaran, Linear Integrated Circuits, Tata McGraw Hill, 2008.
4. Botkar K. R., Integrated Circuits, 10/e, Khanna Publishers, 2010
5. C.G. Clayton, Operational Amplifiers, Butterworth & Company Publ. Ltd. Elsevier, 1971
6. David A. Bell, Operational Amplifiers & Linear ICs, Oxford University Press, 2nd edition,2010
7. R.F. Coughlin & Fredrick Driscoll, Operational Amplifiers & Linear Integrated Circuits,6th Edition, PHI,2001
8. . Sedra A. S. and K. C. Smith, Microelectronic Circuits, 6/e, Oxford University Press, 2013.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Operational amplifiers**	**(9)**
1.1	The 741 Op Amp, Block diagram, Ideal op-amp parameters, typical parameter values for 741	1
1.2	Equivalent circuit, Open loop configurations, Voltage transfer curve, Frequency response curve.	1
1.3	Differential amplifier configurations using BJT, DC Analysis- transfer characteristics	2
1.4	AC analysis- differential and common mode gains, CMRR, input and output resistance, Voltage gain	2
1.5	Constant current bias and constant current source	1
1.6	Concept of current mirror, the two transistor current mirror Wilson and Widlar current mirrors.	2
2	**Op-amp with negative feedback and Op-amp applications**	**10**
2.1	General concept of Voltage Series, Voltage Shunt, current series and current shunt negative feedback,	1
2.2	Op Amp circuits with voltage series and voltage shunt feedback, Virtual ground Concept	1
2.3	analysis of practical inverting and non-inverting amplifier	1
2.4	Summer, Voltage Follower-loading effect	1
2.5	Differential and Instrumentation Amplifiers	1

2.6	Voltage to current and Current to voltage converters	1
2.7	Integrator, Differentiator	1
2.8	Precision rectifiers-half wave and full wave	1
2.9	Comparators, Schmitt Triggers	1
2.10	Log and antilog amplifier	1
3	**Op-amp Oscillators and Multivibrators**	9
3.1	Phase Shift and Wien-bridge Oscillators,	2
3.2	Triangular and Sawtooth waveform generators, Astable and monostable multivibrators	2
3.3	Comparison, design of First and second order low pass and High pass active filters	2
3.4	Design of Second Order Band pass and band reject filters	2
3.5	State variable filters	1
4	**Timer, VCO and PLL**	8
4.1	Timer IC 555- Functional diagram, Astable and monostable operations.	2
4.2	Basic concepts of Voltage Controlled Oscillator	1
4.3	application of VCO IC LM566,	2
4.4	PLL Operation, Closed loop analysis Lock and capture range.	1
4.5	Basic building blocks, PLL IC 565, Applications of PLL	2
5	**Voltage regulators and Data converters**	**9**
5.1	Fixed and Adjustable voltage regulators	1
5.2	IC 723 – Low voltage and high voltage configurations,	2
5.3	Current boosting, Current limiting, Short circuit and Fold-back protection.	2
5.4	Digital to Analog converters, Specifications, Weighted resistor type and R-2R Ladder type.	2
5.5	Analog to Digital Converters: Specifications, Flash type and Successive approximation type.	2
	Total	**45**

Assignment:

Assignment may be given on related innovative topics on linear IC, like Analog multiplier- Gilbert multiplier cell, variable trans-conductance technique, application of analog multiplier IC AD633., sigma delta or other types of ADC etc

At least one assignment should be simulation of opamp circuits on any circuit simulation software

Model Question paper

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIFTH SEMESTER B.TECH DEGREE EXAMINATION

Course Code: AET307

Program: Applied Electronics and Instrumentation Engineering / Electronics and Instrumentation Engineering

Course Name: Analog Integrated Circuits

Max. Marks: 100 Duration: 3 Hours

PART A

Answer ALL Questions. Each Carries 3 mark.

1. Draw and list the functions of 741 IC pins K1
2. Define slew rate with its unit. What is its effect at the output signal? K2
3. How the virtual ground is different from actual ground? K2
4. A differential amplifier has a common mode gain of 0.05 and difference mode gain of 1000.Calculate the output voltage for two signals V1 = 1mV and V2 = 0.9Mv K3
5. Design a second order Butterworth Low Pass Filter with f_H= 2KHz K3
6. Draw the circuit of monostable multivibrator using opamp. K1
7. What is the principle of VCO? K1
8. Design a non inverting amplifier for a gain of 11. K3
9. Define the following terms with respect to DAC (i) Resolution (ii) Linearity (iii) Full scale output voltage K2
10. Differentiate between line and load regulations. K3

PART – B

Answer one question from each module; each question carries 14 marks.

Module – I

11. a)	Derive CMRR, input resistance and output resistance of a dual input balanced output differential amplifier configuration.	7	CO1	K3
11. b)	What is the principle of operation of Wilson current mirror and its advantages? Deduce the expression for its current gain.	7	CO1	K2

	OR			
12.a)	Draw the equivalent circuit of an operational amplifier. Explain voltage transfer characteristics of an operational amplifier.	7	CO1	K3
12.b)	Explain the following properties of a practical opamp (i) Bandwidth (ii) Slew rate (iii) Input offset voltage (iv) Input offset current	7	CO1	K2

Module – II

13. a)	Design a fullwave rectifier to rectify an ac signal of 0.2V peak-to-peak. Explain its principle of operation.	7	CO2	K3
13. b)	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.	7	CO2	K2
	OR			
14.a)	Derive the following characteristics of voltage shunt amplifier: i) Closed loop voltage gain ii)Input resistance iii) Output resistance iv)Bandwidth	7	CO2	K3
14.b)	Explain the working of an inverting Schmitt trigger and draw its transfer characteristics.	7	CO2	K2

Module-III

15 a)	Derive the equation for frequency of oscillation (f0) of a Wein Bridge oscillator. Design a Wein Bridge oscillator for f0 = 1KHz.	7	CO3	K3
15 b)	Derive the equation for the transfer function of a first order wide Band Pass filter.	7	CO3	K3
	OR			
16a	Derive the design equations for a second order Butterworth active low pass filter.	7	CO3	K3
16b	Design a circuit to generate 1KHz triangular wave with 5V peak.	7	CO3	K3

Module-IV

17 a)	Design a circuit to multiply the incoming frequency by a factor of 5 using 565 PLL.	8	CO4	K3
17 b)	With the help of internal diagram explain the monostable operation of timer IC 555. Draw the input and output waveforms. Derive the equation for pulse width.	6	CO4	K2

	OR			
18 a)	Design a monostable multi-vibrator for a pulse duration of 1ms using IC555.	8	CO4	K3
18 b)	Explain the operation of Phase Locked Loop. What is lock range and capture range?	6	CO4	K2

Module-V

19 a)	Explain the working of R-2R ladder type DAC. In a 10 bit DAC, reference voltage is given as 15V. Find analog output for digital input of 1011011001.	7	CO5	K2
19 b)	Explain how short circuit, fold back protection and current boosting are done using IC723 voltage regulator.	7	CO5	K2
	OR			
20 a)	With a functional diagram, explain the principle of operation of Successive approximation type ADC.	7	CO5	K2
20 b)	With a neat circuit diagram, explain the operation of a 3-bit flash converter.	7	CO5	K2

Simulation Assignments (AET307)

The following simulations can be done in QUCS, KiCad or PSPICE. (The course tutor is free to add or modify the list)

1. Design and simulate a BJT differential amplifier. Observe the input and output signals. Plot the AC frequency response.
2. Design and simulate Wien bridge oscillator for a frequency of 10 kHz. Run a transient simulation and observe the output waveform.
3. Design and implement differential amplifier and measure its CMRR. Plot its transfer characteristics.
4. 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 3− db bandwidth.
5. Design and simulate a 3 bit flash type ADC. Observe the output bit patterns and transfer characteristics
6. Design and simulate R − 2R DAC circuit.
7. Design and implement Schmitt trigger circuit for upper triggering point of +8 V and a lower triggering point of −4 V using op-amps.
8. Design a function generator using Op Amp and observe output waveforms.

AEL331	ANALOG INTEGRATED CIRCUITS AND INSTRUMENTATION LAB	CATEGORY	L	T	P	CREDIT
		PCC	0	0	3	2

Preamble: This course aims to

i) Develop skills in designing and testing analog integrated circuits
ii) Expose the students to a variety of practical circuits using various analog ICs
iii) Understand the working principle of various transducers and their application in engineering

Prerequisite: Nil

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

CO 1	Design the linear and non-linear applications of an opamp and special application ICs.
CO 2	Explain and compare the working of multivibrators using special application IC 555
CO 3	Illustrate the function of application specific ICs such as Voltage regulators, Data converters and PLL.
CO4	Explain the working of various transducers and their applications

Mapping of course outcomes with program outcomes

	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	3		2	2	3	3		3	3	2		1
CO 2	3		2	2	3	3		3	3	2		2
CO 3	3		2	2	3	3		3	3	2	2	3
CO4	3		2		2	3		3	3	2		3

Assessment

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	75	75	2.5 hours

Continuous Internal Evaluation Pattern:

Attendance	:	15 marks
Continuous Assessment	:	30 marks
Internal Test (Immediately before the second series test)	:	30marks

End Semester Examination Pattern: The following guidelines should be followed regarding award of marks

(a) Preliminary work	: 15 Marks
(b) Implementing the work/Conducting the experiment	: 10 Marks
(c) Performance, result and inference (usage of equipments and trouble shooting)	: 25 Marks
(d) Viva voce	: 20 marks
(e) Record	: 5 Marks

General instructions: End-semester practical examination is to be conducted immediately after the second series test covering entire syllabus given below. Evaluation is to be conducted under the equal responsibility of both the internal and external examiners. The number of candidates evaluated per day should not exceed 20. Students shall be allowed for the examination only on submitting the duly certified record. The external examiner shall endorse the record.

Part A Analog Integrated Circuits Lab (At least 8 experiments are mandatory)

1. Design and plot the frequency response of i) Inverting and Non inverting amplifiers ii) Differentiator and Integrator.
2. Design of Adder circuits.
3. Measurement of Opamp parameters.
4. Difference Amplifier and Instrumentation amplifier
5. Schmitt trigger circuit using Op –Amps.
6. Astable and Monostable multivibrator using Op -Amps.
7. Triangular and square wave generators using Op- Amps.
8. RC Phase shift Oscillator using Op-Amps
9. Wien bridge oscillator using Op-Amp - without & with amplitude stabilization.
10. Active second order filters using Op-Amp (LPF, HPF, BPF and BSF).
11. Notch filters to eliminate the 50Hz power line frequency.
12. Astable and Monostable multivibrator using Timer IC NE555.
13. IC voltage regulators.
14. A/D converters - Flash type.
15. D/A Converters-R-2R ladder circuit.
16. Study of PLL IC: free running frequency lock range capture range

Part B Instrumentation lab (At least 4 experiments are mandatory)

1. Determination of the characteristics of LVDT
2. Determination of characteristics of temperature sensor (AD590).
3. Determination of the characteristics of thermocouple.
4. Determination of the characteristics of RTD
5. Determination of the characteristics of optical transducers using LDR.
6. Measurement of pressure using piezoelectric pick up.
7. Measurement of strain and load using strain gauges.
8. Level measurement using capacitive transducer

AEL333	EMBEDDED SYSTEMS LAB	CATEGORY	L	T	P	CREDIT
		PCC	0	0	3	2

Preamble: This course aims to

(i) Familiarize the students with Assembly Language Programming of modern microcontrollers.

(ii) Impart the skills for interfacing the microcontroller with the help of Embedded C/Assembly Language Programming.

Prerequisite: Nil

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

CO 1	Write an Assembly language program/Embedded C program for performing data manipulation.
CO 2	Develop ALP/Embedded C Programs to interface microcontroller with peripherals
CO 3	Perform programming/interfacing experiments with IDE for modern microcontrollers.

Mapping of course outcomes with program outcomes

	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	3		3		3				3			3
CO 2	3		3	2	3				3			3
CO 3	3		3	3	3	3			3		3	3

Assessment

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	75	75	2.5 hours

Continuous Internal Evaluation Pattern:

Attendance : 15 marks

Continuous Assessment : 30 marks

Internal Test (Immediately before the second series test) : 30 marks

End Semester Examination Pattern: The following guidelines should be followed regarding award of marks

(a) Preliminary work : 15 Marks

(b) Implementing the work/Conducting the experiment : 10 Marks

(c) Performance, result and inference (usage of equipments and trouble shooting) : 25 Marks

(d) Viva voce : 20 marks

(e) Record : 5 Marks

General instructions: End-semester practical examination is to be conducted immediately after the second series test covering entire syllabus given below. Evaluation is to be conducted under the equal responsibility of both the internal and external examiners. The number of candidates evaluated per day should not exceed 20. Students shall be allowed for the examination only on submitting the duly certified record. The external examiner shall endorse the record.

PART – A (At least 6 experiments are mandatory)

These experiments shall be performed using 8051 trainer kit. The programs shall be written either in embedded C or in assembly language.

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.

PART – B (At least 4 experiments are mandatory.)

Interfacing experiments shall be done using modern microcontrollers such as 8051 or ARM. The interfacing modules may be developed using Embedded C.

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.

SEMESTER V

MINOR

AET381	DIGITAL IMAGE PROCESSING	CATEGORY	L	T	P	CREDITS
		VAC	3	1	0	4

Preamble: This course aims to develop a strong understanding of the basic image processing operations.

Prerequisite: AET281Introduction to Signals and Systems

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

CO 1	Explain the fundamental concepts related to digital image processing and generation of digital images.
CO 2	Apply the principles of various 2D transforms in digital image processing.
CO 3	Implement spatial and frequency domain image enhancement techniques using mathematical principles.
CO4	Interpret the techniques involved in image segmentation and image restoration algorithms.
CO5	Compare different techniques involved in image compression and implement the fundamental image processing algorithms on computers.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO 11	PO 12
CO 1	3				3	3						3
CO 2	3	3			3	3						3
CO 3	3	3			3	3						3
CO 4	3	3			3	3						3
CO5	3	3	3		3	3			3			3

Assessment Pattern

Bloom's Category		Continuous Assessment Tests		End Semester Examination
		1	2	
Remember	K1	10	10	20
Understand	K2	30	30	60
Apply	K3	10	10	20
Analyse	K4			
Evaluate				
Create				

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	**50**	**100**	**3 hours**

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1): Explain the fundamental concepts related to digital image processing and generation of digital images.

1. Explain the fundamental steps in image processing.
2. Explain image digitization.

Course Outcome 2 (CO2): Apply the principles of various 2D transforms in digital image processing.

1. Explain the properties of 2D DFT.
2. Find the KL transform for the given image patch.

Course Outcome 3 (CO3): Implement spatial and frequency domain image enhancement techniques using mathematical principles.

1. Explain the various spatial domain image enhancement techniques.
2. Compare smoothening and sharpening filters.

Course Outcome 4 (CO4): Interpret the techniques involved in image segmentation and image restoration algorithms.

1. Explain region based segmentation.
2. What is image restoration? Give the model of image degradation/restoration process.

Course Outcome 5 (CO5): Compare different techniques involved in image compression and implement the fundamental image processing algorithms on computers.

1. Explain an image compression model.
2. Obtain the Huffman code for the word ‘SEGMENTATION’

SYLLABUS

Module 1:

Image fundamentals: Fundamental Steps in Image Processing, Elements of a Digital Image Processing System, Elements of Visual Perception, A Simple Image Model. Digital Image representation- 2D Sampling and Quantization. Two dimensional systems - 2D convolution, 2D correlation. Colour image fundamentals-RGB, CMY, HIS models

Module 2:

Image transforms: Introduction to Fourier Transform, 2D Discrete Fourier Transform and Properties. Haar Transform, Hadamard Transform, Walsh transform, Discrete Cosine Transform (DCT), Discrete Wavelet Transform (DWT) , KL transform and Singular Value Decomposition.

Module 3:

Image Enhancement in spatial domain: Point operations and Neighbourhood Operations , Gray-Level Transformation, Bit plane slicing , Histogram Processing. Spatial filtering- smoothing filters, sharpening filters. Image Enhancement in frequency domain: Low pass and high pass filters, homomorphic filtering.

Module 4:

Image Restoration: Image Degradation model, Types of Image blur, Classification of image restoration Techniques, Estimation of degradation function. Inverse filtering, Weiner filtering.

Image segmentation: Classification of Image segmentation techniques, Type of edges, Edge detection, Segmentation based on thresholding, Region based segmentation, Hough Transform.

Module 5:

Image Compression: Types of redundancy, Image Compression Model, Lossless Compression methods: Arithmetic Coding, Huffman Coding, Vector quantization - Types.

Image compression standards – JPEG &MPEG, Wavelet based image compression, Introduction to fractal image compression.

Text Books

1. Gonzalez Rafel C, Digital Image Processing, Pearson Education, 2009
2. S Jayaraman, S Esakkirajan, T Veerakumar**,** Digital image processing , Tata Mc Graw Hill, 2015.

Reference Books

1. Anil K Jain , Fundamentals of digital image processing: , PHI,1988
2. Kenneth R Castleman , Digital image processing:, Pearson Education,2/e,2003
3. Pratt William K, Digital Image Processing: , John Wiley,4/e,2007.
4. Milan Sonka et. Al., 'Image Processing, Analysis and Machine Vision', Brookes/Cole, Vikas Publishing House, 2nd edition, 1999.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	Image Fundamentals	
1.1	Fundamental Steps in Image Processing, Elements of a Digital Image Processing System	1
1.2	Elements of Visual Perception, A Simple Image Model.	1
1.3	Digital Image representation- 2D Sampling and Quantization	2
1.4	Two dimensional systems – 2D convolution	2
1.5	2D Correlation	1
1.6	Colour image fundamentals-RGB, CMY, HIS models	2
2	**Image transforms**	
2.1	Introduction to Fourier Transform, 2D Discrete Fourier Transform and Properties.	2
2.2	Hadamard Transform, Walsh transform, Discrete Cosine Transform (DCT), Haar Transform	4
2.3	Discrete Wavelet Transform (DWT)	1
2.4	KL transform and Singular Value Decomposition.	2
3	**Image Enhancement**	
3.1	Point operations and Neighbourhood Operations , Gray-Level Transformation, Bit plane slicing	2
3.2	Histogram Processing	2
3.3	Spatial filtering- smoothing filters, sharpening filters	1
3.4	Image Enhancement in frequency domain: Low pass and high pass filters, homomorphic filtering.	2
4	**Image Restoration**	
4.1	Estimation of degradation function, Image Degradation model	2
4.2	Types of Image blur, Classification of image restoration Techniques.	2
4.2	Inverse filtering, Weiner filtering	1
4.3	**Image segmentation**: Classification of Image segmentation techniques, Type of edges	2
4.4	Edge detection	1
4.5	Segmentation based on thresholding, Region based segmentation.	2

4.6	Hough Transform	1
5	**Image Compression**	
5.1	Types of redundancy, Image Compression Model	2
5.2	Lossless Compression methods : Arithmetic Coding, Huffman Coding	2
5.3	Vector quantization - Types	1
5.5	Image compression standards -JPEG &MPEG	2
5.4	Wavelet based image compression.	1
5.5	Introduction to fractal image compression.	1

Model Question paper

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIFTH SEMESTER B.TECH DEGREE EXAMINATION

Course Code: AET381

Program: Applied Electronics and Instrumentation Engineering

Course Name: Digital Image Processing

Max. Marks : 100 Duration: 3 Hours

PART A

Answer ALL Questions. Each Carries 3 mark.

1.	Explain the fundamental steps in image processing.		CO1
2	What is image digitization?		CO1
3	For the image segment I $=\begin{bmatrix}2 & 2\\ 1 & 3\end{bmatrix}$, compute the transform coefficients using DFT.		CO2
4	What are orthogonal transforms?		CO2
5	Distinguish between unsharp masking and high boost filtering.		CO3
6	What is histogram equalization?		CO3
7	Give the model of image degradation/restoration process and explain.		CO4
8	Mention the different types of edges in an image.		CO4
9	State and explain the state of redundancies in images.		CO5
10	Draw the block diagram of an image compression model.		CO5

PART – B

Answer one question from each module each question carries 14 marks.

Module – I

11. a)	State and explain 2D sampling theorem for band limited images.	8	CO1	K2
11. b)	Explain how colour images are represented using HSI colour space model.	6	CO1	K2
	OR			
12.a)	An image f(x, y) = 2 cos 2π (3x + 4y) is sampled with sampling intervals Δx = 0.2 and Δy = 0.2 in x and y direction respectively. Determine the i) Sampled image spectrum ii) Fourier transform of image after it has been low pass filtered iii) Reconstructed image. Will the system produce aliasing error?	7	CO1	K2
12.b)	Explain the basic elements in a digital image processing system.	7	CO1	K2

Module – II

13. a)	State and prove any two properties of 2D DFT.	4	CO2	K1
13. b)	Find the DCT of the sequence x(n) = {11,22,33,44}	10	CO2	K2
	OR			
14.a)	Perform KL transform of the following matrix $X = \begin{matrix} 4 & -1 \\ -2 & 3 \end{matrix}$	10	CO2	K2
14.b)	Define the energy compaction property of a unitary transform.	4	CO2	K1

Module-III

15. a)	Given an image in which the stars are barely visible, owing to superimposed illumination resulting from atmospheric dispersion. Give an enhancement procedure based on homomorphic filtering to bring out the image components due to the stars themselves.	10	CO3	K3
15. b)	Briefly explain the various image enhancement operations in spatial domain.	4	CO3	K2
	OR			
16.a)	What are the advantages of filtering in frequency domain?	4	CO3	K2

16.b)	A 4 x 4 image patch (4 bits/pixel) is given by $I=\begin{bmatrix}12 & 9 & 12 & 10\\12 & 14 & 8 & 10\\9 & 13 & 12 & 10\\12 & 14 & 12 & 10\end{bmatrix}$ Apply histogram equalization to the image by rounding the resulting image pixels to integers. Sketch the histograms of original image and histogram equalised image.	10	CO3	K3

MODULE IV

17. a)	Explain the Wiener filter for image restoration. State the advantages and disadvantages of wiener filter.	8	CO4	K2
17. b)	Explain split and merge procedure in image segmentation.	6	CO4	K2
	OR			
18.a)	Explain how a degraded image can be restored using an inverse filter. Explain its limitations.	7	CO4	K2
18.b)	How edge detection is performed in images?	7	CO4	K2

MODULE – V

19. a)	With the help of a block diagram, explain DCT based JPEG compression standard.	6	CO5	K2
19. b)	Explain the analytics of Arithmetic Coding based Compression.	8	CO5	K3
	OR			
20.a)	Obtain the Huffman code for the word ‘SEGMENTATION’	8	CO5	K3
20.b)	Discuss Vector quantization.	6	CO5	K2

	OR			
16.a)	Explain the advantages of filtering in frequency domain?	4	CO3	K2
16.b)	A 4 x 4 image patch (4 bits/pixel) is given by $I=\begin{bmatrix} 12 & 9 & 12 & 10 \\ 12 & 14 & 8 & 10 \\ 9 & 13 & 12 & 10 \\ 12 & 14 & 12 & 10 \end{bmatrix}$ Apply histogram equalization to the image by rounding the resulting image pixels to integers. Sketch the histograms of original image and histogram equalised image.	10	CO3	K3

Module IV

17. a)	Explain the Wiener filter for image restoration. State the advantages and disadvantages of wiener filter.	8	CO4	K2
17. b)	Explain split and merge procedure in image segmentation.	6	CO4	K2
	OR			
18.a)	Explain how a degraded image can be restored using an inverse filter. Explain its limitations.	7	CO4	K2
18.b)	How edge detection is performed in images?	7	CO4	K2

Module – V

19. a)	With the help of a block diagram, explain DCT based JPEG compression standard.	6	CO5	K2
19. b)	With a suitable example, discuss Vector quantization	8	CO5	K3
	OR			
20.a)	Obtain the Huffman code for the word 'SEGMENTATION'	8	CO5	K3
20.b)	Explain the analytics of Arithmetic Coding based Compression.	6	CO5	K2

AET383	POWER ELECTRONICS	CATEGORY	L	T	P	CREDITS
		VAC	3	1	0	4

Preamble: This course aims to develop the skill of the design of various power electronic circuits.

Prerequisite: AET284- INTRODUCTION TO ANALOG CIRCUITS

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

CO 1	Explain the characteristics of important power semiconductor switches	K2
CO 2	Explain the principle of drive circuits and snubber circuits for power semiconductor switches	K2
CO 3	Build diode bridge rectifiers and Controlled rectifiers	K3
CO4	Explain the principle of DC – DC Switch-Mode Converter.	K2
CO 5	Illustrate the principle of DC – AC Switch-Mode Inverter	K2
CO 6	Apply the principle of power electronics for various applications.	K3

Mapping of course outcomes with program outcomes

	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	3	3			2							2
CO 2	3	3			2							2
CO 3	3	3			2							2
CO 4	3	3			2							2
CO 5	3	3			2							2
CO 6	3	3			2							2

Assessment Pattern

Bloom's Category		Continuous Assessment Tests		End Semester Examination
		1	2	
Remember	K1	10	10	10
Understand	K2	30	30	60
Apply	K3	10	10	30
Analyse	K4			
Evaluate				
Create				

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10marks

Continuous Assessment Test(2numbers) : 25 marks

Assignment/Quiz/Courseproject : 15marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1): Explain the characteristics of important power semiconductor switches.

1. Illustrate the static and dynamic characteristics, Power BJT, Power MOSFET and IGBT.
2. Evaluate the switching losses of the Power diode, Power BJT, Power MOSFET.
3. Model and simulate power semiconductor switches.

Course Outcome 2 (CO2) : Explain the principle of drive circuits and snubber circuits for power semiconductor switches.

1. Explain the base drive circuits for Power BJT.
2. Explain the gate drive circuits forPower MOSFET.
3. Outline the principle of snubber circuits for power switches.
4. Model and simulate above circuits.

Course Outcome 3 (CO3): Build diode bridge rectifiers and Controlled rectifiers.

1. Explain the operation of diode rectifiers and the effect of various loads on the rectifier function.
2. Explain the operation of controlled rectifiers and the effect of various loads on the rectifier function.
3. Model and simulatediode rectifiers and controlled rectifiers for various loads

Course Outcome 4 (CO4): Explain the principle of DC – DC Switch-Mode Converter

1. Illustrate the principle of DC-DC converters under steady state conditions.
2. Model and simulate non-isolated and isolated DC-DC Switch-Modeconverters

Course Outcome 5 (CO5): Illustrate the principle of DC – AC Switch-Mode Inverter.

1. Explain the different types of inverters
2. Construct Driven Inverters for given specifications.
3. Model and simulateDriven Inverters

Course Outcome 6 (CO6) : Apply the principle of power electronics for various applications.

1. Illustrate the principle of Adjustable-speed DC drive.
2. Explain the principle of Variable frequency PWM-VSI Induction Motor drives
3. Give applications of power electronic circuits for residential applications.
4. Explain applications of power electronic circuits for industrial applications

SYLLABUS

Module 1:
Power Semiconductor Switches: Overview of Power electronics application, Power diodes and Bipolar power transistors, Power MOSFET and IGBT,SCR and GTO

Module 2:
Protection circuits and Rectifiers: BJT and MOSFET driver circuits, Semiconductor device temperature control, Single phase and three phase diode bridge rectifiers, Single phase and three phase Controlled rectifiers.

Module 3:
DC – DC Switch-Mode Converter: Buck, Boost and Buck-Boost converters underContinuous conduction mode, Isolated Converters: Forward, Push-Pull, Half bridge and Full bridge configurations, Selection of power switches, Switched Mode Power Supply.

Module 4:
DC – AC Switch-Mode Inverter: Inverter topologies, Driven Inverters: Push-Pull, Half bridge and Full bridge configurations, Three phase Inverter, Pulse width modulation.

Module 5:
Applications: DC Motor Drives, Induction Motor Drives, Residential and Industrial applications, Electric utility applications.

Text Books

1. Mohan N. and T. M. Undeland, Power Electronics: Converters, Applications and Design, John Wiley, 2015
2. Umanand L., Power Electronics Essentials and Applications, Wiley India, 2015.

Reference Books

1. Rashid M. H., "Power Electronics Circuits, Devices and Applications", Prentice Hall India, Third Edition, New Delhi.
2. Daniel W. Hart, Power Electronics, McGraw Hill, 2011.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Power Semiconductor Switches**	
1.1	Power electronics versus Linear Electronics, Overview of Power electronics application	1
1.2	Power diodes and Bipolar power transistors, structure	3
1.3	Power MOSFET and IGBT - structure	3
1.4	SCR and GTO – construction and characteristics	2
2	**Protection circuits and Rectifiers**	
2.1	BJT and MOSFET driver circuits (one circuits each)	2
2.2	Semiconductor device temperature control	2
2.3	Single phase and three phase diode bridge rectifiers – basic principles only	2
2.4	Single phase and three phase Controlled rectifiers (with R, RL & RLE loads) – basic principles only	3
3	**DC – DC Switch-Mode Converter**	
3.1	Buck, Boost and Buck-Boost DC-DCconverters	2
3.2	Waveforms and expression of DC-DC converters for output voltage, voltage and current ripple under continuous conduction mode. (Derivation not required)	2
3.3	Isolated Converters : Forward, Push-Pull, Half bridge, and Full bridge configurations, waveforms and design equations. (Derivation not required)	3
3.4	Selection of power switches	1
3.5	Switched Mode Power Supply, Principles of PWM switching schemes	1
4	**DC – AC Switch-Mode Inverter**	
4.1	Inverter topologies	2
4.2	Driven Inverters : Push-Pull, Half bridge and Full bridge configurations	2
4.3	Three phase Inverter	2
4.4	Sinusoidal PWM in three phase inverters	3
5	**Applications**	

5.1	DC Motor Drives – Adjustable-speed DC drive	2
5.2	Induction Motor Drives – Variable frequency PWM-VSI drives	3
5.3	Residential and Industrial applications	2
5.4	Electric utility applications	2

Assignment:

Atleast one assignment should be simulation of power electronic circuits using any circuit simulation software

Model Question paper

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIFTH SEMESTER B.TECH. DEGREE EXAMINATION

Course Code: AET 383

Program: Minor in Applied Electronics and Instrumentation Engineering/ Electronics & Instrumentation Engineering

Course Name: Power Electronics

Max. Marks: 100 Duration: 3 Hours

	PART A Answer ALL Questions. Each Carries 3 mark.		
1.	What is the switching losses in a power diode ?	K3	CO1
2	What is the tail current in IGBT ?	K2	CO1
3	What is the purpose of snubbercircuits ?	K2	CO2
4	Obtain the expression for average load voltage in three phase full wave bridge rectifier	K3	CO3
5	What is volt-second balancing?	K2	CO4
6	What is the flux walking problem in push-pull converter ?	K2	CO4
7	What is the distinction between chopper, oscillators and inverters ?	K3	CO5
8	Distinguish between driven and self-driven inverters.	K2	CO5
9	How converters are used in induction heating ?	K2	CO6
10	What is the principle of harmonic filters ?	K2	CO6

	PART – B Answer one question from each module; each question carries 14 marks.			
	Module – I			
11. a)	Compare and contrast power BJT, MOSFET and IGBT for switching applications	7	CO1	K2
11. b)	A diode and a 10 Ω resistor are connected in series to a square wave voltage source of 50V peak. The reverse recovery time for the diode is 200nsec. Find the switching loss of the diode when the input frequency is 100 KHz.	7	CO1	K3
	OR			
12.a)	With the two transistor model of SCR, explain the working principle of SCR	7	CO1	K2
12.b)	Illustrate the dynamic characteristics of GTO	7	CO1	K2
	Module – II			
13.a)	Illustrate the base current requirement of power BJT	7	CO2	K2
b)	Explain the operation of any one of the power BJT base drive circuit	7	CO2	K2
	OR			
14.a)	Illustrate the principle of operation of a single-phase, 2 pulse, fully controlled rectifier for RL load with circuit diagram and waveforms.	10	CO3	K2
b)	Deduce the expression for average load voltage in the circuit.	4	CO3	K2

	Module – III			
15 a)	Explain the operation of Buck-Boost converter and illustrate the operation with the inductor current and switching waveforms.	8	CO4	K2
b)	A Buck-Boost converter that switching at 50 KHz is supplied with an input voltage that varies between 5V to 10V. The output is required to be regulated at 15V. A load resistor of 15Ω is connected across the output. If the maximum allowable inductor current ripple is 10% of the average inductor current, estimate the value of the inductance to be used in the Buck-Boost converter.	6	CO4	K3
	OR			
16 a)	Describe the principle of operation of the full-bridge converter with circuit diagram and waveforms.	8	CO4	K2
b)	How is the flux walking problem solved in full-bridge converter ?	6	CO4	K2
	Module – IV			
17 a)	Explain the operation of push-pull inverter	8	CO5	K2

b)	Illustrate the PWM switching scheme for sine wave output of the inverter	6	CO5	K2
	OR			
18 a)	Enumerate the principle of operation ofthree phase inverters	8	CO5	K2
b)	Explain sinusoidal pulse width modulation in three phase inverters	6	CO5	K2
	Module – V			
19 a)	Explain the principle of adjustable speed DC drive using switched mode DC-DC converter.	8	CO6	K2
b)	Compare adjustable speed DC drives using switched mode DC-DC converter and line frequency controlled converter.	6	CO6	K2
	OR			
20 a)	Illustrate the principle of operation of Variable frequency PWM-VSI Induction Motor drive.	9	CO6	K2
b)	Explain regenerative braking scheme in Induction Motor drive.	5	CO6	K2

AET385	CONTROL SYSTEMS	CATEGORY	L	T	P	CREDITS
		VAC	3	1	0	4

Preamble: This course aims to analyze and design control systems.

Prerequisite: ECT205: NETWORK THEORY

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

CO 1	Analyze the control systems by transfer function approach.
CO 2	Get an adequate knowledge in the time response of systems & steady state error analysis
CO 3	Learn the concept of stability of control systems and methods of stability analysis.
CO 4	Analyze the control systems using frequency domain method.
CO 5	Design of basic control actions and controller characteristics.

Mapping of course outcomes with program outcomes

	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	3	2										
CO 2	3	2										
CO 3	2	3										
CO 4	2	3	2									
CO 5	3	2										

Assessment Pattern

Bloom's Category		Continuous Assessment Tests		End Semester Examination
		1	2	
Remember	K1	10	10	20
Understand	K2	10	10	20
Apply	K3	30	30	60
Analyze	K4			
Evaluate	K5			
Create				

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	**50**	**100**	**3 hours**

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions in Part A. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

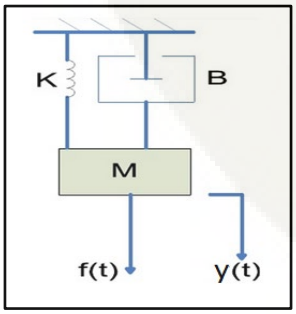
Course Level Assessment Questions

Course Outcome 1 (CO1): Analyze the control systems by transfer function approach

1. Define closed loop transfer function and obtain the general equation for the characteristic equation of a system.
2. Explain the terms transmittance and non touching loops with respect to signal flow graphs.

3. (i) Find ***y(t)***, for the given, $G(s) = \frac{9}{s(s+0.2)(s+3)}$

   (ii) Obtain the transfer function $\frac{C(s)}{R(s)}$ for $G(s) = 1$, for the $G(s)$ given in the above question. If the obtained transfer function represents the transfer function of a mass-spring-damper system as shown in Figure, find the values of **M, B and K** and also draw its **equivalent force - voltage analogous circuit** clearly writing the numerical values of **R, L and C.**



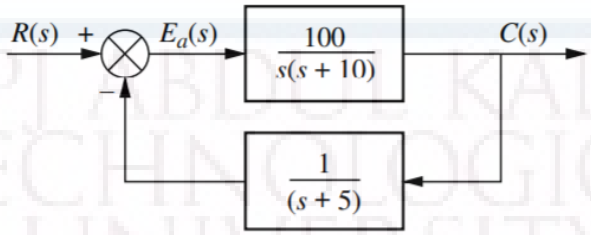
Course Outcome 2 (CO2): Get an adequate knowledge in the time response of systems and steady state error analysis

1. Obtain the ramp response of a general first order system with unity system gain and time constant of 2 seconds. Also draw first order system time response.

2. Derive the expression for the step response of a second order underdamped system as given below:

$$c(t) = 1 - e^{-\zeta\omega_n t}\left[\cos\omega_d t + \frac{\zeta}{\sqrt{1-\zeta^2}}\sin\omega_d t\right]$$

3. Find the numerical value of steady state error associated with the system shown below for a unit step input.



4. Derive the expression for the maximum percentage overshoot of the second order underdamped system as given below.

$$\%OS = e^{-\frac{\pi\zeta}{\sqrt{1-\zeta^2}}} \times 100$$

Course Outcome 3 (CO3): Learn the concept of stability of control systems and methods of stability analysis.

1. Explain briefly the conditions that is to be satisfied for a system to be

   (c) Absolutely stable

   (d) Marginally stable

2. For the transfer function given below, determine how many poles are in the right half s-plane, left half s-plane and on the jω axis.

$$T(s) = \frac{20}{s^8 + s^7 + 12s^6 + 22s^5 + 39s^4 + 59s^3 + 48s^2 + 38s + 20}$$

3. For a unity feedback system, the open loop transfer function is given by

$$G(s)H(s) = \frac{K}{s(s+2)(s^2+6s+25)}$$

   (d) Sketch the root locus

   (e) At what value of K, the system becomes unstable?

   (f) At this point of instability, determine the frequency of oscillation of the system.

Course Outcome 4 (CO4): Analyze the control systems using frequency domain method.

1. Define the frequency domain specifications

   (d) Resonant peak

   (e) Resonant frequency

(f) Bandwidth

Also obtain the expressions for the above for a second order underdamped system

$$T(s) = \frac{C(s)}{R(s)} = \frac{\omega_n^2}{s^2 + 2\delta\omega_n s + \omega_n^2}$$

with transfer function

2. Draw the Bode plot of the system given below. Also find the Gain margin and

$$G(s) = \frac{75(1+0.2s)}{s(s^2+16s+100)}$$

Phase margin.

3. State and explain Nyquist Stability criteria.

4. The open loop transfer function **for an unmanned under water vehicle** is given by

$$G(s) = \frac{20}{s(1+as)(1+0.02s)}$$

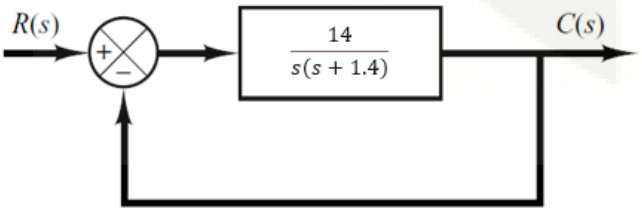
(c) At a frequency of 3 rad/sec, it is known that the gain of the system is 5, hence calculate the value of "a".

(d) Estimate the **phase margin** for the above value of "a" **without drawing Nyquist Plot.**

Course Outcome 5 (CO5): Design of basic control actions and controller characteristics.

1. Obtain the transfer function of a PD controller. Draw its controller characteristics. How the system performance is improved by including the derivative controller?

2. A closed loop control system with unity feedback is shown in Figure. By using the derivative control, the damping ratio is to be made 0.7. Determine **the derivative rate feedback K_d and the derivative time T_d.**



3. Draw the circuit diagram of the **PID controller** using a single opamp, resistors and capacitors. Obtain the values of R_1, R_f C_1 C_f in terms of K_p and T_d.

4. Briefly explain the principle of **Proportional plus Integral** controller and obtain its transfer function. Also draw the **PI controller characteristics**.

SYLLABUS

Module 1:

System modelling - 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 systems – Block diagram – Signal flow graph – Mason's gain formula.

Module 2:

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.

Module 3:

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.

Module 4:

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.

Module 5:

Controller Design:

Basic Control actions and Controller characteristics: Classification of Controllers, Two position control, proportional, integral and derivative controllers. Integral control action and derivative control action. Electronic Controllers- Design of PI, PD and PID controllers using opamp.

Text Books

1. S. Hassan Saeed, Automatic Control Systems (with MATLAB programs), KATSON Books.
2. Norman S Nise, Control System Engineering, Sixth Edition.

Reference Books

1. Katsuhiko Ogata, Modern Control Engineering, Pearson Education.
2. M. Gopal, Control Systems, McGraw Hill Education India Education, 2012.
3. B.C. Kuo, PHI, Automatic Control Systems.
4. Richard C Dorf and Robert H. Bishop, Modern Control Systems, Pearson Education, 2001.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**System modelling - Transfer function approach:**	
1.1	Introduction to control system – Classification of control systems.	1
1.2	Principles of automatic control.	1
1.3	Feedback control systems – Practical examples	1
1.4	Transfer function – Transfer function of electrical and mechanical systems	2
1.5	Transfer function of electromechanical systems	1
1.6	Block diagram reduction Techniques	1
1.7	Signal flow graph – Mason's gain formula.	2
2	**Time domain analysis:**	
2.1	Standard test signals - Response of systems to standard test signals	1
2.2	Step response of second order systems in detail	2
2.3	Time domain specifications – delay time, rise time, peak time, maximum percentage overshoot and settling time. Example problems.	4
2.4	Steady state response – Steady state error	1
2.5	Static & Dynamic error coefficients.	2
3	**Stability of linear systems in time domain:**	
3.1	Asymptotic and BIBO stability	1
3.2	Routh-Hurwitz criterion of stability	1
3.3	Root locus - Construction of root locus	3
3.4	Root locus- Examples	2
3.5	Effect of addition of poles and zeros on the root locus	1
4	**Frequency domain analysis:**	
4.1	Frequency response – Frequency domain specifications	1
4.2	Stability in the frequency domain - Nyquist stability criterion. Examples.	3
4.3	Relative stability – Gain margin and phase margin. Examples.	2
4.4	M & N circles – Nichol's chart.	2
5	**Basic Control actions and Controller characteristics:**	
5.1	Classification of Controllers, Two position control, proportional, integral and derivative controllers.	3
5.2	Controller characteristics: Proportional, Integral and Derivative Controllers	2
5.3	Design of PI, PD and PID controllers using opamp	3
5.4	Integral Control Action and Derivative Control Action	2

Model Question paper

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIFTH SEMESTER B.TECH DEGREE EXAMINATION

Course Code: AET385

Program: Minor in Applied Electronics & Instrumentation Engineering/ Electronics & Instrumentation Engineering

Course Name: Control Systems

Max. Marks: 100 Duration: 3 Hours

PART A

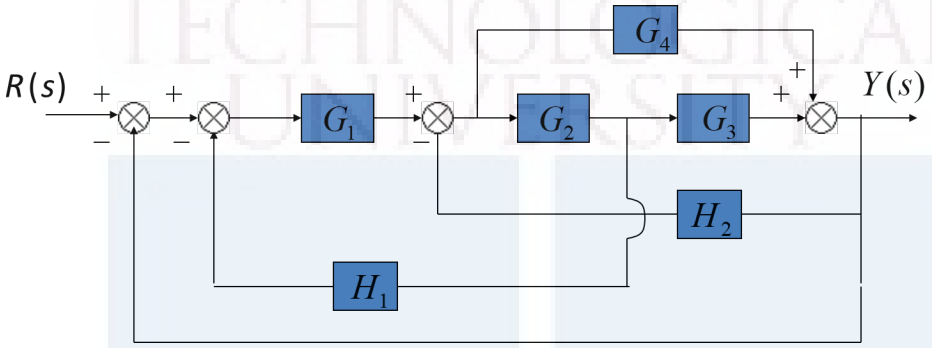
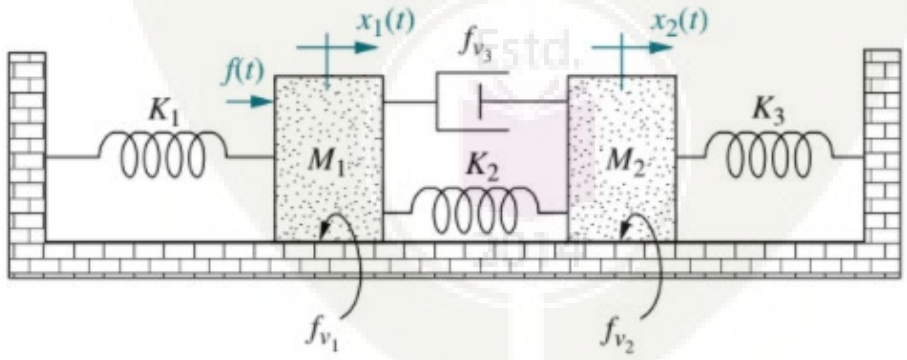
Answer ALL Questions. Each Carries 3 mark.

1.	Write the Force – Current analogies for Mass, Spring constant and Damping coefficient of a mechanical system.	K1
2	Derive the expression for closed loop transfer function.	K2
3	Impulse response of a 1st order system is given below: $c(t) = 3e^{-0.5t}$ Find out (a) Time constant T (d) D.C Gain K (e) Transfer Function	K3
4	Write the expressions for □□, □□ □□□ □□, for a given system with open loop transfer function G(s)	K1
5	What is the inference of having all the elements of a row as zeroes in the Routh Table?	K2
6	Write the angle and magnitude conditions for constructing the root locus of a system.	K1
7	Briefly explain the steps for drawing a polar plot.	K2
8	Define (i) Gain cross over frequency (ii) Phase cross over frequency and (iii) Phase Margin	K1
9	Briefly describe the derivative control action. What is the disadvantage of using the derivative controller alone?	K2
10	Draw the circuit diagram of the PID controller using a single opamp, resistors and capacitors. Obtain the values of □□, □□ □□□ □□ in terms of □ and □.	K2

PART – B

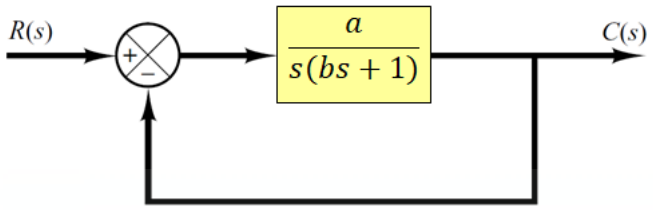
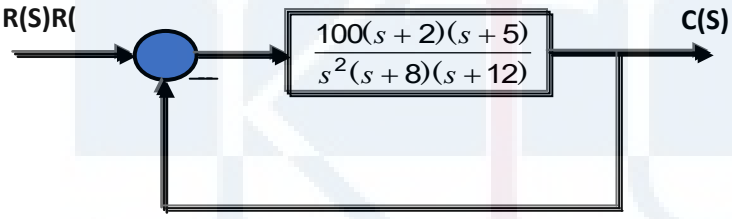
Answer one question from each module; each question carries **14 marks**.

Module – I

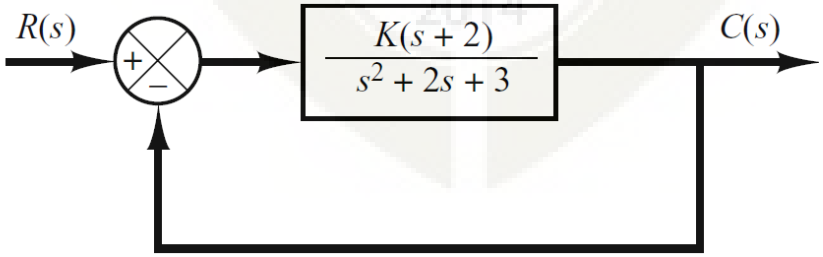
11.a)	Write any 2 advantages and disadvantages of closed loop control systems	4	CO1	K1
11.b)	Using block diagram reduction technique, find the overall transfer function of the system shown below: 	10	CO1	K3
	OR			
12.a)	Draw the free-body diagrams of masses M1 and M2, for the system shown below	4	CO1	K1
12.b)	For the mechanical system shown, draw the Force - Current analogous system, after clearly writing the equations of motion for each mass. 	10	CO2	K3

Module – II

13 a)	For the system represented by the block diagram given below, **determine the values** of '□' and '□' to yield a unit step response, with maximum percentage overshoot of *5* and undamped natural frequency (□□) as 2 rad/sec.	10	CO2	K3

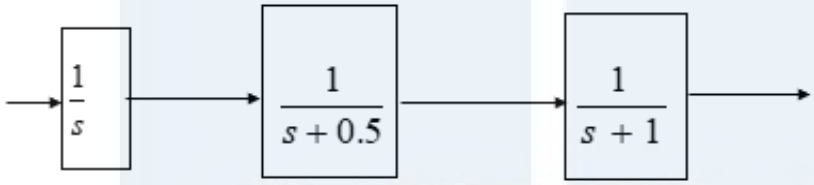
				
13 b)	For the obtained values of '□' and '□', in the above question, find the **risetime** and **settling time** for a **2%** criterion.	4	CO2	K1
	OR			
14 a)	What are the 4 standard test signals used in control systems. Write the Laplace Transform of the above test signals.	4	CO2	K1
14 b)	For the system shown in figure below, evaluate the static error constants and find the expected steady state errors for the standard step, ramp and parabolic inputs. 	10	CO2	K3

Module – III

15 a)	State and explain the Routh Hurwitz criteria for stability analysis	5	CO3	K2
15 b)	Sketch the complete root locus of the system shown below: 	9	CO3	K3
	OR			
16 a)	Write the 9 rules for construction of root locus.	5	CO3	K2

16 b)	Sketch the root locus for the transfer function given below in a graph sheet $$G(s)H(s) = \frac{K}{s(s+1)(s+5)}$$ Add a zero at s = -2, to the above transfer function and draw the root locus. Also clearly specify the effect of adding the zero to the transfer function.	9	CO3	K3

Module – IV

17	Sketch the asymptotic bode plot of the open loop system for a system represented by block diagram shown in Figure. Estimate the gain and phase margin of the system and calculate the phase crossover frequency and gain crossover frequency.  	14	CO4	K3
	OR			
18	The open loop transfer function of a control system is given by $$G(s) = \frac{K}{s(s+2)(s+10)}$$ Determine the value of K so that the system will be stable with (c) Gain Margin = 6 dB (d) Phase Margin = 45^0	14	CO4	K3

Module – V

19	Consider a second order process with the transfer function $\square(\square) = \frac{\square}{\square^2+\square_1\square+\square_2}$ The closed loop system with a PI controller is a third order system. Show that it is possible to position the closed loop poles as long as the sum of the poles is $-\square_1$. **Give equations** for the parameters that give the **closed loop characteristic polynomial** $(\square + \square_0)(\square^2 + 2\square_0\square_0\square + \square_0{}^2)$ Express $\square_\square$ $\square\square\square$ $\square_\square$ in terms of $\square_0$, $\square_0$ $\square\square\square$ $\square_0$	14	CO5	K3
	OR			
20	Consider a system with the transfer function: $$P(s) = (s+1)^{-2}$$	14	CO5	K3

	Find an integral controller that gives a closed loop pole at $s = -a$ and **determine the value of** a that maximizes the integral gain. Assume that the integral gain is given by $K_I(s) = \frac{s}{s(-s)}$ **Determine also the other poles of the system.**			

SEMESTER V

HONOURS

AET393	OPTIMIZATION TECHNIQUES	CATEGORY	L	T	P	CREDIT
		VAC	3	1	0	4

Preamble: This course aims to provide abroad picture of various applications of optimization methods used in engineering.

Prerequisite: NIL

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

CO 1 K4	Formulate and classify different optimisation problems.
CO 2 K3	Apply classical and numerical methods solving linear and non-linear optimisation problems.
CO 3 K3	Apply modern methods of optimisation for solving optimisation problems.

Mapping of course outcomes with program outcomes

	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	3	3										2
CO 2	3	3										2
CO 3	3	3										2

Assessment Pattern

Bloom's Category		Continuous Assessment Tests		End Semester Examination
		1	2	
Remember	K1	10	10	10
Understand	K2	20	20	20
Apply	K3	20	20	70
Analyse				
Evaluate				
Create				

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1): Formulate optimisation problems. (K3)

1. Understand the different classification of optimization problems
2. Apply basic concepts of mathematics to formulate an optimization problem.
3. Formulation of real world problems as linear programming problems.

Course Outcome 2 (CO2) : Obtain optimised solution using classical methods for constrained and unconstrained problems. (K3)

1. Identify extreme points of a given function and classify as minimum, maximum or saddle point.
2. Formulate Lagragian equation for constrained problems and solution using KKT conditions.
3. Find optimum solution using Simplex method for the given problem.

Course Outcome 2 (CO2): Obtain optimised solution using numerical methods for non-linear problems. (K3)

1. Apply elimination search and direct root methods for finding the optimal solution
2. Find optimal point of a given function using gradient methods.

Course Outcome 3 (CO3): Apply modern methods of optimisation for solving optimisation problems. (K3)

1. Explain different steps in the genetic algorithm.
2. Evaluate the strategies to be adopted for players using game theory.
3. Using algorithms find minimum spanning tree and shortest distance for given network path.
3. Two identical sections of the given networks are connected in parallel. Obtain the two port network parameters of the combination.

SYLLABUS

Module 1 : Introduction to classical method

Engineering applications of optimization, Formulation of design problems as mathematical programming problems.

Classification of optimization problems/techniques.

Classical optimization: unconstrained single and multivariable optimisation, Constrained optimization.

Module 2 : Linear programming problems

Mathematical formulation of LP Problems, Solving using Simplex method and Graphical method

Module 3 : Game Theory, Network path models

Game Theory: Introduction, 2- person zero – sum game -Saddle point; Mini-Max and Maxi-Min Theorems (statement only)- Graphical solution (2x n, m x 2 game), dominance property.

Introduction to network tree - Minimal Spanning Tree - Prim's Algorithm.

Shortest path problems- solution methods – Dijkstra's Method.

Module 4 : Nonlinear unconstrained optimization

Single variable optimization methods- Fibonacci search method, Newton Raphson method

Multi-variable methods- Hook-Jeeves pattern search method, Cauchy's (steepest descent) method

Module 5 : Modern methods of optimization

Introduction to Genetic algorithm, Basic GA framework

GA operators: Encoding, Crossover, Selection, Mutation

Introduction to Fuzzy logic. Fuzzy sets and membership functions. Operations on Fuzzy sets. Optimization of Fuzzy Systems.

Text Books

1. S.S.Rao, Engineering Optimization.; Theory and Practice; Revised 3rd Edition, New Age International Publishers, New Delhi

2. H.A. Taha, " Operations Research", 5/e, Macmillan Publishing Company, 1992.

Kanti Swarup, P.K.Gupta and Man Mohan, Operations Research, Sultan Chand and Sons

Reference Books

1. Kalynamoy Deb. "Optimization for Engineering Design- Algorithms and Examples", Prentice-Hall of India Pvt. Ltd., New Delhi.

2. A. Ravindran, D. T. Phillips, J. J. Solberg, Operations Research – Principles and Practice, John Wiley and Sons.

3.. Ashok D Belegundu, Tirupathi R Chandrupatla, "Optimization concepts and Application in Engineering", Pearson Education.

4. Hadley, G. "Linear programming", Narosa Publishing House, New Delhi

5. J. S. Arora, Introduction to Optimum Design, McGraw-Hill Book Company.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Introduction to classical method**	
1.1	Engineering applications of optimization, Formulation of design problems as mathematical programming problems, objective function, constraints	1
1.2	Classification of optimization problems/techniques.	1
1.3	**Classical optimization**: unconstrained single and multivariable minimization necessary and sufficient conditions for optimality,	3
1.4	**Constrained optimization:** Lagrangian method - Sufficiency conditions - Kuhn-Tucker optimality conditions.	3
		8
2	**Linear programming problems**	
2.1	Mathematical formulation of LP Problems	1
2.2	Slack, surplus and artificial variables, Reduction of a LPP to the standard form, feasible solutions.	1
2.3	Graphical solution method	2
2.4	simplex algorithm and solution using tabular method,	2
2.5	optimality conditions and degeneracy	1
2.6	Duality in linear programming	2
		9
3	**Game Theory, Network path models**	
3.1	Game Theory: Introduction, 2- person zero – sum game	1
3.2	Saddle point; Mini-Max and Maxi-Min Theorems (statement only)	2
3.3	Graphical solution (2x n, m x 2 game), dominance property.	2
3.4	Introduction to network tree	1
3.5	Minimal Spanning Tree - Prim's Algorithm.	1
3.6	Shortest path problems- solution methods – Dijkstra's Method	1
		8
4	**Nonlinear unconstrained optimization**	
4.1	Single variable optimization methods- Fibonacci search method,	3
4.2	Newton Raphson method	3
4.3	Multi-variable methods- Hook-Jeeves pattern search method,	3
4.4	Cauchy's (steepest descent) method	2
		11
5	**Modern methods of optimization**	
5.1	Introduction to Genetic algorithm, Basic GA framework	1
5.2	GA operators: Encoding, Crossover, Selection, Mutation	2
5.3	Introduction to Fuzzy logic.	1
5.4	Fuzzy sets and membership functions.	1
5.5	Operations on Fuzzy sets.	2
5.6	Optimization of Fuzzy Systems	2
		9

Simulation Assignments:

Atleast one assignment should be simulation of optimization Problems using MATLAB/Scilab/Python. The following simulations .

1. Find the solution of the linear programming problem using simplex method.

$$\text{Minimize } f = -x_1 - 2x_2 - x_3$$

subject to

$$2x_1 + x_2 - x_3 \leq 2$$
$$2x_1 - x_2 + 5x_3 \leq 6$$

Refer MATLAB Solution of LP Problems SS Rao.

2.

In an interval reduction problem, the initial interval is given to be 4.68 units. The final interval desired is 0.01 units. Find the number of interval reductions using Fibonacci method.

Ashok D. Belegundu, Tirupathi R. Chandrupatla

3.

Given $f = x_1^2 + 2x_2^2 + 2x_1x_2$, a point $\mathbf{x}^1 = (0.5, 1)^T$, with $f_1 \equiv f(\mathbf{x}^1) = 3.25$, apply the Hooke and Jeeves algorithm. Assume step $s = 1, r = 0.25, \varepsilon = 0.001, \alpha = 1$.

Ashok D. Belegundu, Tirupathi R. Chandrupatla

Model Question paper

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIFTH SEMESTER B.TECH DEGREE EXAMINATION

Course Code: AET393

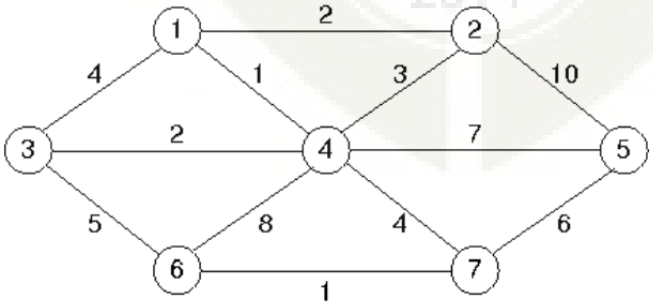
Course Name: OPTIMIZATION TECHNIQUES

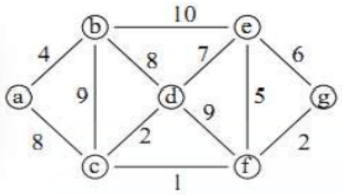
Max. Marks: 100 Duration: 3 Hours

PART A

Answer ALL Questions. Each Carries 3 mark.

1	are the necessary and sufficient conditions for the relative minimum of a function of a single variable?	K2
2	Find the extreme points of the function $f(x_1, x_2) = x_1^3 + x_2^3 + 2x_1^2 + 4x_2^2 + 6$	K3
3	Give five typical applications of optimization techniques in engineering discipline.	K1
4	What is the significance of gradient function in minimization problem?	K2
5	State the duality principle and write the dual of the following LPP. Minimize $Z = 24x_1 + 30x_2$ subject to $2x_1 + 3x_2 \geq 10, 4x_1 + 9x_2 \geq 15, 6x_1 + 6x_2 \geq 20, x_1, x_2 \geq 0$	K3
6	Write a short note on Dijkstra's shortest path algorithm	K1
7	Explain the transformations needed to represent an LPP in standard form	K1
8	State dominance property in game theory	K1
9	Discuss membership function in fuzzy logic	K2
10	Name and describe the main five features of Genetic Algorithm	K2
	PART – B Answer one question from each module; each question carries 14 marks.	
	Module - I	
11 a.	Maximize $f(x) = 2x_1 + x_2 + 10$ subject to $x_1 + 2x_2^2 - 3 = 0$	7 K3
b.	Find the extreme points of the funct $f(x_1, x_2, x_3) = x_1 + 2x_3 + x_2x_3 - x_1^2 - x_2^2 - x_3^2.$	7 K3
	OR	

12 a.	Determine whether the following matrix is positive or negative definite. $A=\begin{pmatrix} 3 & 1 & -1 \\ 1 & 3 & -1 \\ -1 & -1 & 5 \end{pmatrix}$	7 K3
b.	Using method of Lagrange multipliers, Minimize $f(x_1, x_2, x_3) = {x_1}^2 + {x_2}^2 + {x_3}^2$ subject to constraints $4x_1 + {x_2}^2 + 2x_3 = 14$	7 K3
	Module - II	
13 a.	Solve the following LPP graphically, Minimize $Z=20x_1 + 40x_2$ Subject to the constraints $36\,x_1 + 6\,x_2 \geq 108$ $3x_1 + 12\,x_2 \geq 36$ $20x_1 + 10\,x_2 \geq 100$ and $x_1, x_2 \geq 0$	14 K3
	OR	
14	Solve the following LPP using simplex method. Maximize $Z = 10x_1 + 15x_2 + 20x_3$ subject to the constraints $2x_1 + 4x_2 + 6x_3 \leq 24, 3x_1 + 9x_2 + 6x_3 \leq 30, x_1, x_2, x_3 \geq 0.$	14 K3
	Module - III	
15 a.	Solve the game using graphical method. Player | B A | 2 | -4 | 6 | -3 | 5 A | -3 | 4 | -4 | 1 | 0	7 K3
b.	Using Dijkstra's method find the shortest path from node 1 to node 7 from the following network path model. 	7 K3
	OR	

16 a.	Using Prim's algorithm find the minimum spanning tree and the shortest distance from node 'a' to node 'b'.  	7 K3
b.	Solve the following payoff matrix using the graphical method. a. Find the optimal strategy for player A b. Find the optimal strategy for player B c. Value of the game d. Saddle point	7 K3

	1	2	3	4	5
1	-5	5	0	-1	8
2	8	-4	-1	6	-5

	Module - IV	
17	Solve the non linear unconstrained minimised optimisation problem by Hooke-Jeeves pattern search method by taking $\Delta x_1 = \Delta x_2 = 0.5$ and the starting point as $(x_1, x_2) = (2, -1)$ where $f(x_1, x_2) = x_1^2 + 3x_2^2 + 6x_1x_2 - x_1 - x_2$.	14 CO3 K3
	OR	
18	Using Fibonacci method, minimise $f = x^5 - 5x^3 - 20x + 5_1$ the interval (0,5) in six steps.	14 K3
	Module - V	
19 .	Consider membership function of two fuzzy sets $\tilde{A}$ and $\tilde{B}$ are given by $\mu_A(x) = \frac{x}{x+2}$ and $\mu_B(x) = 3^{-x}$. Find the membership function of i) $\tilde{A}^C$ ii) $\tilde{B}^C$, iii) $\tilde{A} \cup \tilde{B}$, iv) $\tilde{A} \cap \tilde{B}$, v) $(\tilde{A} \cup \tilde{B})^C$, where ^{C} is complement.	14 K3
	OR	
20	Consider the fuzzy relation R defined in A x A. Check whether the fuzzy relation is i) Reflexive, ii) Symmetric and iii) Transitive. $R = \begin{bmatrix} 0.4 & 0.1 & 0.7 \\ 0.1 & 0.2 & 0.2 \\ 0.4 & 0.5 & 0.3 \end{bmatrix}$	7 K3
	Explain the working principles of Genetic Algorithms.	7 K2

AET395	ARM ARCHITECTURE DESIGN	CATEGORY	L	T	P	CREDITS
		VAC	3	1	0	4

Preamble: This course aims to develop a basic knowledge of both Hardware and software of ARM processors.

Prerequisite: Basic knowledge of Digital Electronics and Microprocessors

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

CO 1	Summarize the basic architecture of ARM processors	K2
CO 2	Explain the ARM instruction set	K2
CO 3	Compare the features of Thumb mode and ARM mode	K2
CO4	Summarize architectural support and memory	K2
CO5	Explain the architectural features of ARM Cortex	K2

Mapping of course outcomes with program outcomes

	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	3	2										2
CO 2	3	2										2
CO 3	3	2										2
CO 4	3	2										2
CO 5	3	2										2

Assessment Pattern

Bloom's Category		Continuous Assessment Tests		End Semester Examination
		1	2	
Remember	K1	10	10	20
Understand	K2	40	40	80
Apply				
Analyse				
Evaluate				
Create				

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1): Summarize the basic architecture of ARM processors

1. Draw a neat diagram of ARM architecture and explain its features.
2. Draw and explain the programmer's model of ARM.
3. Explain about ARM organizations and its implementations.
4. Explain the three stages pipelining in ARM processor.
5. Differentiate between three stages and five stages pipelining in ARM organization.

Course Outcome 2 (CO2): Explain the ARM instruction set

1. Explain the different types of ARM instruction sets and give examples for each.
2. What are the different data types? Explain.
3. Explain coprocessor instructions.
4. Differentiate between Status register to general register transfer instructions and General register to status register transfer instructions.

Course Outcome 3 (CO3): Compare the features of Thumb mode and ARM mode

1. Explain Thumb programmer's model using a neat diagram.
2. What are the different types of thumb instruction sets?
3. Difference between Thumb single and multiple data transfer instructions.
4. Explain about Thumb data processing instructions with an example.

Course Outcome 4 (CO4): Summarize architectural support and memory

1. Explain about ARM memory interfaces.
2. What is ARM debug architecture?
3. Explain the memory management in ARM processor.
4. Describe about the different H/w system prototyping tools.

Course Outcome 5 (CO5): Explain the architectural features of ARM Cortex

1. Explain about memory units and need for the memories. Also briefly describe about the memory declarations in FPGA design tools.
2. What are the Memory handling in ASIC designs?
3. Differentiate between TCM integration and Cache integration.
4. Explain about power management features.

SYLLABUS

MODULE 1(9 Hrs)

ARM Introduction:. Overview of ARM architecture – Architecture inheritance, Programmer`s model, ARM organization and implementation: 3-stage pipeline ARM organization, 5-stage pipeline ARM organization, ARM instruction execution, ARM implementation.

MODULE 2: (9 Hrs)

ARM Instruction set -. ARM instruction set (exceptions, conditional execution, branching instructions, multiply instructions, coprocessor instructions). Data types, Floating point datatypes, Conditional statements, Loops. Multiply instructions, Single word and unsigned byte data transfer instructions, Half-word and signed byte data transfer instructions,

Multiple register transfer instructions, Swap memory and register instructions,

Status register to general register transfer instructions, General register to status register transfer instructions, Coprocessor instructions.

MODULE 3: (9Hrs)

Thumb instruction set-Thumb bit, Thumb programmer`s model, Thumb Branch instructions, Thumb data processing instructions, Thumb single and multiple data transfer instructions, Thumb break point instruction, Thumb implementation, Thumb software interrupt instructions, Thumb application

MODULE 4: (9Hrs)

ARM memory interface, AMBA, ARM reference peripheral specifications, H/w system prototyping tools, ARMulator, JTAG, ARM debug architecture, Embedded trace, signal processing support, ARM processor cores.

Memory size and speed, On-chip memory, Caches, Memory management.

MODULE 5 (9Hrs)

Introduction to system design with Cortex-M processors, Overview of Cortex-M Processors. Need for the memories, Overview of memories -Memory declarations in FPGA design tools, Memory handling in ASIC designs, Memory endianness, Defining the peripherals, Memory map definition, Bus and memory system design, TCM integration, Cache integration, Defining the processor's configuration options, Interrupt signals and related areas. Event interface Clock generation Reset generation SysTick Debug integration Power management features, Major Applications .

Text book

1. ARM System-on-chip architecture, Steve Furber, Pearson Education

2. System-on-Chip Design with Arm® Cortex®-M Processors JOSEPH YIU Arm Education Media is an imprint of Arm Limited, 110 Fulbourn Road, Cambridge, CBI 9NJ, UK

Reference:

1. Valvano, Jonathan W - Embedded systems_ introduction to ARM® Cortex(TM)-M microcontrollers. 1-CreateSpace Independent Publishing Platform (2014)

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**ARM Introduction**	**9**
1.1	ARM Introduction: Overview of ARM architecture – Architecture inheritance, Programmer`s model	3
1.2	ARM organization and implementation: 3-stage pipeline ARM organization, 5-stage pipeline ARM organization	3
1.3	ARM instruction execution, ARM implementation.	3
2	**ARM instruction set**	**9**
2.1	ARM Instruction set and programming -. ARM instruction set (exceptions, conditional execution, branching instructions, multiply instructions, coprocessor instructions	2
2.2	Data types, Floating point datatypes, Conditional statements, Loops.	2
2.3	Multiply instructions, Single word and unsigned byte data transfer instructions, Half-word and signed byte data transfer instructions,	2

	Multiple register transfer instructions	
2.4	Swap memory and register instructions, Status register to general register transfer instructions, General register to status register transfer instructions, Coprocessor instructions.	3
3	**Thumb mode and its instruction set**	**9**
3.1	Thumb instruction set-Thumb bit, Thumb programmer`s model	2
3.2	Thumb Branch instructions, Thumb data processing instructions	2
3.3	Thumb single and multiple data transfer instructions	2
3.4	Thumb break point instruction, Thumb implementation, Thumb software interrupt instructions, Thumb application	3
4	**Architectural support and memory**	**9**
4.1	ARM memory interface, AMBA, ARM reference peripheral specifications	2
4.2	H/w system prototyping tools, ARMulator, JTAG, ARM debug architecture	3
4.3	Embedded trace, signal processing support, ARM processor cores.	2
4.4	Memory size and speed, On-chip memory, Caches, Memory management.	2
5	**Architectural features of ARM Cortex**	**9**
5.1	Introduction to system design with Cortex-M processors, Overview of Cortex-M Processors.	1
5.2	Need for the memories, Overview of memories -Memory declarations in FPGA design tools, Memory handling in ASIC designs, Memory endianness.	2
5.3	Defining the peripherals, Memory map definition, Bus and memory system design	2
5.4	TCM integration, Cache integration, Defining the processor's configuration options	2
5.5	Interrupt signals and related areas. Event interface Clock generation Reset generation SysTick Debug integration Power management features, Major Applications.	2

		Total	45

Model Question paper

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIFTH SEMESTER B.TECH DEGREE EXAMINATION

Course Code: AET395

Program: Honours in Applied Electronics and Instrumentation Engineering/ Electronics and Instrumentation Engineering

Course Name: ARM Architecture Design

Max. Marks: 100 Duration: 3 Hours

PART A

Answer ALL Questions. Each Carries 3 mark.

1.	Draw a neat diagram of ARM architecture.	K1
2.	Explain coprocessor instructions.	K2
3.	What are the different types of thumb instruction sets?	K2
4.	Summarize ARM debug architecture?	K2
5.	Explain TCM integration.	K2
6.	What are ARM memory interfaces.	K2
7.	Explain ARMulator.	K2
8.	What is On-chip memory?	K1
9.	What are the 3-stage pipeline ARM organization	K2
10.	What are Cortex-M Processors.	K1

PART – B

Answer one question from each module; each question carries 14 marks.

Module – I

11. a)	Draw a neat diagram of ARM architecture and explain its features.	7	CO1	K2
11. b)	Explain about ARM organizations and its implementations.	7	CO1	K2
	OR			
12.a)	Differentiate between three stages and five stages pipelining in ARM organization.	6	CO1	K2
12.b)	Draw and explain the programmer's model of ARM.	8	CO1	K2

Module – II

13. a)	Explain the different types of ARM instruction sets and give examples for each.	7	CO2	K2
13. b)	What are the different data types? Explain	7	CO2	K2
	OR			
14.a)	List the various coprocessor instructions.	7	CO2	K1
14.b)	Differentiate between Status register to general register transfer instructions and General register to status register transfer instructions	7	CO2	K2

Module – III

15 a)	Explain Thumb programmer's model using a net diagram.	7	CO3	K2
15b)	What are the different types of thumb instruction sets?	7	CO3	K2
	OR			
16a)	Difference between Thumb single and multiple data transfer instructions.	7	CO3	K2
16b)	Explain about Thumb data processing instructions with an example.	7	CO3	K2

Module – IV

17 a)	Explain about ARM memory interfaces.	8	CO4	K2
17b)	Discuss ARM debug architecture?	6	CO4	K2
	OR			
18 a)	Explain the memory management in ARM processor.	7	CO4	K2
18b)	Describe about the different H/w system prototyping tools.	7	CO4	K2

Module – V

19 a)	Explain about memory units and need for the memories. Also briefly describe about the memory declarations in FPGA design tools.	7	CO5	K2
19b)	Explain memory handling in ASIC designs?	7	CO5	K2
	OR			
20 a)	Differentiate between TCM integration and Cache integration.	7	CO5	K2
20b)	Write short notes on power management features.	7	CO5	K1

AET397	WAVELETS	CATEGORY	L	T	P	CREDITS
		VAC	3	1	0	4

Preamble: This course aims to familiarize with wavelet transform of signals, construction of wavelets, filter implementation and practical applications

Prerequisite: ECT204 Signals and Systems

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

CO 1	Outline the different frequency transform methods and design multirate systems for applications like sub-band coding. (K2)
CO 2	Relate the principles of Short Time Fourier Transform and Wavelet Transform, taking into consideration time frequency analysis. (K2)
CO 3	Build discrete wavelet transforms with multirate digital filters for signal analysis and understand multi resolution analysis (K3)
CO 4	Develop and implement wavelet based systems using different algorithms. (K3)
CO 5	Apply wavelet transforms for image and audio processing. (K3)

Mapping of course outcomes with program outcomes

	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	3	3	3									2
CO 2	3	3	3									2
CO 3	3	3	3									2
CO 4	3	3	3									2
CO 5	3	3	3									2

Assessment Pattern

Bloom's Category		Continuous Assessment Tests		End Semester Examination
		1	2	
Remember	K1	10	10	10
Understand	K2	20	20	50
Apply	K3	20	20	40
Analyse	K4			
Evaluate	K5			
Create				

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10marks

Continuous Assessment Test (2numbers) : 25 marks

Assignment/Quiz/Course project : 15marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1): Outline the different frequency transform methods and design multirate systems for applications like sub-band coding.

1. Explain the relation of DFT to DTFT and z-transforms.
2. Find the output of given cascaded multirate blocks.
3. Derive the frequency domain representation of an M-fold down/up sampler.
4. Find the output spectrum of system involving upsampler/downsampler.
5. Explain the applications of multirate systems.

Course Outcome 2 (CO2): Relate the principles of Short Time Fourier Transform and Wavelet Transform, taking into consideration time frequency analysis.

1. Explain time-frequency resolution issues in analysis of signals using Fourier transform
2. State and Prove Heisenburg's Uncertainty Principle
3. Compare STFT and CWT
4. Interpret the filter bank implementation of STFT
5. Find STFT of given signal.
6. Prove any given property of CWT
7. Find CWT of given signal.

8. Explain admissibility condition of wavelets. Check whether the given function is an admissible wavelet.

Course Outcome 3 (CO3): Build discrete wavelet transforms with multirate digital filters for signal analysis and understand multi resolution analysis

1. Draw the time frequency tiling of Short Time Fourier Transform (STFT) and Discrete Wavelet Transform (DWT). Compare the merits and demerits of these transforms.
2. Show the m-level Haar Wavelet decomposition of the given discrete sequence.
3. Prove that the space spanned by scaling function bases is nested and the space spanned by wavelet function bases is orthogonal among themselves.
4. Explain Haar scaling and refinement relations.
5. Derive the filter bank implementation for signal analysis using DWT. Show the filter bank structure and the spectrum involved.
6. Explain the axioms of MRA.

Course Outcome 4 (CO4): Develop and implement wavelet based systems using different algorithms.

1. State and prove the conditions to be satisfied by filter coefficients to satisfy requirements to develop orthogonal wavelet system. (like orthonormality of translates of scaling function)
2. For 8-tap Daubechies wavelet system, derive the equations that must be satisfied by scaling function coefficients.
3. Derive Daubechies wavelet system with three vanishing moment (a 6-tap wavelet - system).
4. Derive the Mallat Filterbank structure (Analysis & Synthesis) for a Orthogonal Wavelet System.
5. Explain Wavelet Transform using Lifting scheme.
6. What are the advantages of Wavelet Packet Transform over Wavelet Transform?
7. Obtain the best wavelet packet basis and then draw the best wavelet packet tree structure for the given data given below using normalized Haar wavelet filter given.

Course Outcome 5 (CO5): Apply wavelet transforms for image and audio processing.

1. Explain how wavelet transform can be used for image compression.
2. lllustrate the filter bank implementation of wavelet transform of images
3. Find the EZW coding of given wavelet decomposed image
4. Explain the application of wavelet transform in image denoising/edge detection/object detection
5. Explain how wavelet transform can be used for audio compression/coding.

6. Explain application of Wavelet packet analysis.

SYLLABUS

Module 1:

Introduction to signals - Stationary and non-stationary signals, Signal representation using basis functions and orthonormal bases.

Signal transforms-Brief introduction to signal transforms from time to frequency domain-CTFT, DTFT, DFT and z-transform, Frequency Response analysis (Detailed analysis not required)

Multirate signal processing-Fundamentals of Multirate systems, Basic Upsampling and downsampling in time domain and frequency domain representation, Noble Identities, Multirate Filter Banks and sub band coding of signals.

Module 2:

Time - frequency analysis of signals - Spectral analysis of signals, Spectral leakage by windowing effect. Time and frequency localization of signals, the uncertainty principle and its implications

Short Time Fourier transform – Continuous time and discrete time STFT, Filterbank implementation of STFT

Continuous Wavelet Transform (CWT) – Concept of wavelets, CWT for signal analysis, Condition of admissibility and its implications, Inverse Continuous Wavelet Transform, Properties of CWT.

Module 3:

Discrete Wavelet Transform – Concept of DWT, Time frequency tiling of DWT and comparison to STFT. Haar Scaling and Wavelet functions, Function Spaces, Refinement relation, Wavelet decomposition of signals. Daubechies wavelets.

Designing orthogonal wavelet systems- Relation of DWT to filter banks for signal decomposition and reconstruction

Multi resolution Analysis (MRA) - Concept of MRA and Relating it to filter banks, Axioms of MRA

Module 4 :

Construction of wavelets: Design of wavelet filter coefficients using time domain and frequency domain approaches, Computation of discrete wavelet transform using Mallat Algorithm and Lifting Scheme

Wavelet Packet Transform – Signal representation using wavelet packet analysis – selection of best basis.

Module 5:

Wavelet Transform Applications in image processing – Wavelet Transform of images, Applications of Wavelets in Image compression, EZW Coding - Applications of Wavelets in Image Denoising, Edge detection and Object detection.

Wavelet Transform Applications in audio processing - Application of wavelets in audio compression, wavelet based audio coding. Applications of wavelet packet analysis.

Text Books

1. K. P. Soman, K. I. Ramachandran, N. G. Resmi, PHI, *Insight into wavelets : From theory to practice*

2. Reghuveer M. Rao, Ajit S. Bopardikar, *Wavelet Transforms – Introduction to Theory and Applications*, Pearson Education

Reference Books

1. Proakis J. G. and Manolakis D. G., *Digital Signal Processing*, 4/e, Pearson Education
2. P. P. Vaidyanathan, *Multirate Systems & Filter banks* , Prentice Hall
3. G. Strang& T. Nguyen , *Wavelets and Filter bank*, Wellesly-Cambridge
4. M. Vetterli & J. Kovacevic, *Wavelets and sub band coding*, Prentice Hall

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Introduction to signals**	
1.1	Stationary and non-stationary signals, Signal representation using basis functions and orthonormal bases.	2
	Signal transforms in Fourier domain	
1.2	Introduction to CTFT, DTFT, DFT and z-transform , Frequency Response Analysis	2
	Multirate signal processing	
1.3	Fundamentals of Multirate systems, Basic Upsampling and downsampling in time domain	2
1.4	Frequency domain representation of upsampler and downsampler. Noble Identities	2
1.5	Multirate Filter Banks and sub band coding of signals.	1
2	**Time - frequency analysis of signals**	
2.1	Frequency Analysis of Signals using the DFT, Spectral leakage by windowing effect ,Time and frequency localization of signals	2
2.2	Uncertainty principle and its implications	1
	Short Time Fourier transform	
2.3	Continuous time and discrete time STFT	1
2.4	Filterbank implementation of STFT	1
	Continuous Wavelet Transform	
2.5	CWT for signal analysis, Condition of admissibility and its implications, Inverse Continuous Wavelet Transform.	2
2.6	Properties of CWT.	1
3	**Discrete Wavelet Transform**	
3.1	Concept of DWT, Time frequency tiling of DWT and comparison to STFT.	2
3.2	Haar Scaling and Wavelet functions, Function Spaces, Refinement relation, Wavelet decomposition of signals.	3
3.3	Daubechies wavelets.	1
	Designing orthogonal wavelet systems	
3.4	Relation of DWT to filter banks for signal decomposition and	3

	reconstruction	
	Multi resolution Analysis (MRA)	
3.5	Concept of MRA and Relating it to filter banks, Axioms of MRA	2
4	**Construction of wavelets**	
4.1	Design of wavelet filter coefficients using time domain and frequency domain approaches	3
4.2	Computation of DWT using Mallat Algorithm	2
4.3	Computation of DWT using Lifting Scheme	2
	Wavelet Packet Transform	
4.4	Signal representation using wavelet packet analysis – selection of best basis.	2
5	**Wavelet Transform Applications in image processing**	
5.1	Wavelet Transform of images, Applications of Wavelets in Image compression, EZW Coding	3
5.2	Applications of Wavelets in Image Denoising, Edge detection and Object detection.	2
	Wavelet Transform Applications in audio processing	
5.3	Application of wavelets in audio compression, wavelet based audio coding.	2
5.4	**Applications of wavelet packet analysis**	1

Assignment:

Assignments can be given from textual exercise problems. Atleast two assignments can be given on spectral analysis and wavelet applications using Matlab or any other software.

Model Question paper

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIFTH SEMESTER B.TECH HONOURS EXAMINATION

Course Code: AET397

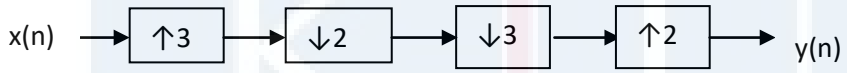
Program: Honours in Applied Electronics and Instrumentation Engineering/ Electronics and Instrumentation Engineering

Course Name: Wavelets

Max. Marks: 100 Duration: 3Hours

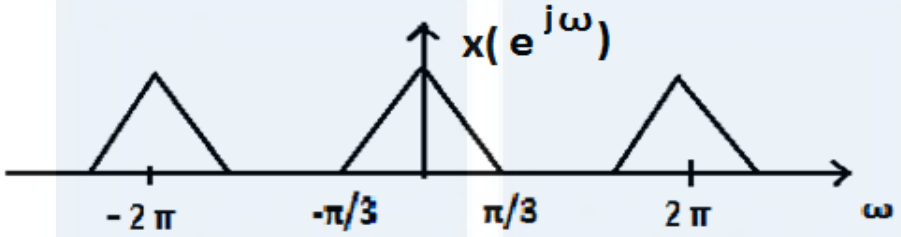
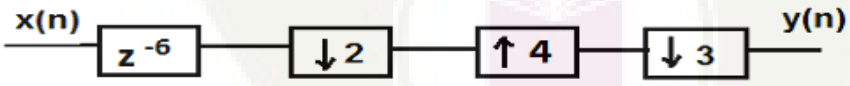
PART A

Answer ALL Questions. Each question carries 3 marks.

1.	How can you deduce that a downsampling system is not a time invariant system?	K3	CO1
2	Simplify the multirate systems shown below and develop an expression for y(n) in terms of x(n). 	K3	CO1
3	Give the advantage of using STFT over Fourier analysis for signal analysis.	K1	CO2
4	Illustrate and interpret the filter bank implementation of STFT	K2	CO2
5	What is the need for Multi Resolution Analysis in images?	K1	CO3
6	Illustrate the time frequency tiling of Short Time Fourier Transform (STFT) and Discrete Wavelet Transform (DWT).	K2	CO3
7	Explain the steps for finding wavelet transform through lifting scheme	K2	CO4
8	What are the advantages of Wavelet Packet Transform over Wavelet Transform?	K1	CO4
9	Bring out a comparison between Wavelet based and DCT based image compression.	K3	CO5
10	Explain the application of Wavelet packet analysis.	K2	CO5

PART – B

Answer one question from each module; each question carries 14 marks.

	Module I			
11. a)	How is DFT related to DTFT ?	6	K2	CO1
11. b)	Prove the orthogonality of basis signals used in Fourier series representation of signals	8	K2	CO1
	OR			
12.a)	Sketch □(□^□□) for M=3 and M=4. Given □(□^□□)  Also suggest a system to recover x(n) from y(n) if M=3.	8	K2	CO1
12.b)	Simplify the multirate system shown below and develop an expression for y(n) in terms of x(n)  	6	K2	CO1
	Module II			
13.a)	State and Prove Heisenburg's Uncertainty Principle	7	K2	CO2
13.b)	**Given two signals** $x_1(n) = \cos\left(\frac{\pi}{4}n\right) + 0.5\cos\left(\frac{\pi}{4}n\right)$ $x_2(n) = \begin{cases} \cos\left(\frac{\pi}{4}n\right), & 0 \le n \le 35 \\ 0.5\cos\left(\frac{\pi}{4}n\right), & 36 \le n \le 71 \\ 0, & \text{otherwise} \end{cases}$ If X(r, k) denotes the STFT of signal, compute the STFT of two signals when both the DFT length N and sampling interval R equals 36. The window	7	K3	CO2

	w(n) is a rectangular window of length L=36. (r is the time parameter, $-\infty<r<\infty$ and k is the frequency parameter ,$0\leq k\leq N-1$)			
	OR			
14.a)	Check whether the Haar wavelet satisfies admissibility condition. Justify your answer.	7	K2	CO2
14.b)	For the signal f(t) given by $f(t) = \begin{cases} 1 & 0 \leq t < 1 , \\ 0 & \text{otherwise.} \end{cases}$ evaluate Continuous Wavelet Transform using Haar wavelet.	7	K3	CO2
	Module III			
15.a)	Prove that the space spanned by scaling function bases is nested and the space spanned by wavelet function bases is orthogonal among themselves.	6	K2	CO3
15.b)	Decompose the signal x(n)= [4, 8, 2 ,-6 ,2, 14, 12, 6, 2,6,8,12] in V_3 space to its components in V_2,V_1 ,V_0 and W_0 space using Haar Wavelet function.	8	K3	CO3
	OR			
16.a)	Explain the axioms of MRA.	6	K2	CO3
16.b)	From the dilation and wavelet equation derive the filter bank implementation for signal analysis using DWT.	8	K3	CO3
	Module IV			
17.a)	State the conditions to be satisfied by filter coefficients to satisfy the requirements to develop orthogonal wavelet system.	6	K2	CO4
17.b)	For an 8-tap Daubechies wavelet system, derive the equations that must be satisfied by scaling function coefficients.	8	K3	CO4
	OR			
18.a)	Derive the Mallat Filterbank structure (Analysis & Synthesis) for a Orthogonal Wavelet System.	8	K3	CO4
18.b)	Explain wavelet packet best basis algorithm.	6	K2	CO4
	Module V			
19.a)	How can you use wavelet filter bank for perceptual audio coding?	8	K3	CO5

COMMON COURSES

(S5 & S6)

MCN 301	DISASTER MANAGEMENT	Category	L	T	P	CREDIT	YEAR OF INTRODUCTION
		Non - Credit	2	0	0	Nil	2019

Preamble: The objective of this course is to introduce the fundamental concepts of hazards and disaster management.

Prerequisite: Nil

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

CO1	Define and use various terminologies in use in disaster management parlance and organise each of these terms in relation to the disaster management cycle (Cognitive knowledge level: **Understand**).
CO2	Distinguish between different hazard types and vulnerability types and do vulnerability assessment (Cognitive knowledge level: **Understand**).
CO3	Identify the components and describe the process of risk assessment, and apply appropriate methodologies to assess risk (Cognitive knowledge level: **Understand**).
CO4	Explain the core elements and phases of Disaster Risk Management and develop possible measures to reduce disaster risks across sector and community (Cognitive knowledge level: **Apply**)
CO5	Identify factors that determine the nature of disaster response and discuss the various disaster response actions (Cognitive knowledge level: **Understand**).
CO6	Explain the various legislations and best practices for disaster management and risk reduction at national and international level (Cognitive knowledge level: **Understand**).

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO1 0	PO1 1	PO1 2
CO1		2				2				2		2
CO2	2	3	2		2	2	3			3		2
CO3	2	3	2	2	2	2	3			3		2
CO4	3	3	3		2	2	3					2
CO5	3	3			2	2	3					2
CO6	3					2	3	3				2

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Life long learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks
	Test 1 (Marks)	Test 2 (Marks)	
Remember	**10**	**10**	**20**
Understand	**25**	**25**	**50**
Apply	**15**	**15**	**30**
Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	**50**	**100**	**3 hours**

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment - Test : 25 marks

Continuous Assessment - Assignment : 15 marks

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A.

Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

SYLLABUS

MCN 301 Disaster Management

Module 1

Systems of earth

Lithosphere- composition, rocks, soils; Atmosphere-layers, ozone layer, greenhouse effect, weather, cyclones, atmospheric circulations, Indian Monsoon; hydrosphere- Oceans, inland water bodies; biosphere

Definition and meaning of key terms in Disaster Risk Reduction 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.

Module 2

Hazard types and hazard mapping; Vulnerability types and their assessment- physical, social, economic and environmental vulnerability.

Disaster risk assessment –approaches, procedures

Module 3

Disaster risk management -Core elements and phases of Disaster Risk Management

Measures for Disaster Risk Reduction – prevention, mitigation, and preparedness.

Disaster response- objectives, requirements; response planning; types of responses.

Relief; international relief organizations.

Module 4

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

Module 5

Common disaster types in India; Legislations in India on disaster management; National disaster management policy; Institutional arrangements for disaster management in India.

The Sendai Framework for Disaster Risk Reduction- targets, priorities for action, guiding principles

Reference Text Book

1. R. Subramanian, Disaster Management, Vikas Publishing House, 2018
2. M. M. Sulphey, Disaster Management, PHI Learning, 2016
3. UNDP, Disaster Risk Management Training Manual, 2016
4. United Nations Office for Disaster Risk Reduction, Sendai Framework for Disaster Risk Reduction 2015-2030, 2015

Sample Course Level Assessment Questions

Course Outcome 1 (CO1):

1. What is the mechanism by which stratospheric ozone protects earth from harmful UV rays?
2. What are disasters? What are their causes?
3. Explain the different types of cyclones and the mechanism of their formation
4. Explain with examples, the difference between hazard and risk in the context of disaster management
5. Explain the following terms in the context of disaster management (a) exposure (b) resilience (c) disaster risk management (d) early warning systems, (e) damage assessment (f) crisis counselling (g) needs assessment

Course Outcome 2 (CO2):

1. What is hazard mapping? What are its objectives?
2. What is participatory hazard mapping? How is it conducted? What are its advantages?
3. Explain the applications of hazard maps
4. Explain the types of vulnerabilities and the approaches to assess them

Course Outcome 3 (CO3):

1. Explain briefly the concept of ‘disaster risk’

2. List the strategies for disaster risk management ‘before’, ‘during’ and ‘after’ a disaster
3. What is disaster preparedness? Explain the components of a comprehensive disaster preparedness strategy

Course Outcome 4 (CO4):

1. What is disaster prevention? Distinguish it from disaster mitigation giving examples
2. What are the steps to effective disaster communication? What are the barriers to communication?
3. Explain capacity building in the context of disaster management

Course Outcome 5 (CO5):

1. Briefly explain the levels of stakeholder participation in the context of disaster risk reduction
2. Explain the importance of communication in disaster management
3. Explain the benefits and costs of stakeholder participation in disaster management
4. How are stakeholders in disaster management identified?

Course Outcome 6 (CO6):

1. Explain the salient features of the National Policy on Disaster Management in India
2. Explain the guiding principles and priorities of action according to the Sendai Framework for Disaster Risk Reduction
3. What are Tsunamis? How are they caused?
4. Explain the earthquake zonation of India

Model Question paper

QP CODE: **PAGES:3**

Reg No:_____ **Name :_____**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIFTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: MCN 301

Course Name: Disaster Management

Max.Marks:100 **Duration: 3 Hours**

PART A

Answer all Questions. Each question carries 3 Marks

1. What is the mechanism by which stratospheric ozone protects earth from harmful UV rays?
2. What are disasters? What are their causes?
3. What is hazard mapping? What are its objectives?
4. Explain briefly the concept of 'disaster risk'
5. List the strategies for disaster risk management 'before', 'during' and 'after' a disaster
6. What is disaster prevention? Distinguish it from disaster mitigation giving examples
7. Briefly explain the levels of stakeholder participation in the context of disaster risk reduction
8. Explain the importance of communication in disaster management
9. What are Tsunamis? How are they caused?
10. Explain the earthquake zonation of India

Part B

Answer any one Question from each module. Each question carries 14 Marks

11. a. Explain the different types of cyclones and the mechanism of their formation [10]

b. Explain with examples, the difference between hazard and risk in the context of disaster management
[4]

OR

12. Explain the following terms in the context of disaster management [14]

(a) exposure (b) resilience (c) disaster risk management (d) early warning systems, (e) damage assessment (f) crisis counselling (g) needs assessment

13. a. What is participatory hazard mapping? How is it conducted? What are its advantages?

[8]

b. Explain the applications of hazard maps [6]

OR

14. Explain the types of vulnerabilities and the approaches to assess them [14]

15. a. Explain the core elements of disaster risk management [8]

b. Explain the factors that decide the nature of disaster response [6]

OR

16. a. What is disaster preparedness? Explain the components of a comprehensive disaster preparedness strategy [6]

b. Explain the different disaster response actions [8]

17. a. Explain the benefits and costs of stakeholder participation in disaster management [10]

b. How are stakeholders in disaster management identified? [4]

OR

18. a. What are the steps to effective disaster communication? What are the barriers to communication? [7]

b. Explain capacity building in the context of disaster management [7]

19. Explain the salient features of the National Policy on Disaster Management in India

[14]

OR

20. Explain the guiding principles and priorities of action according to the Sendai Framework for Disaster Risk Reduction [14]

Teaching Plan

	Module 1	**5 Hours**
1.1	Introduction about various Systems of earth, Lithosphere-composition, rocks, Soils; Atmosphere-layers, ozone layer, greenhouse effect, weather	1 Hour
1.2	Cyclones, atmospheric circulations, Indian Monsoon; hydrosphere-Oceans, inland water bodies; biosphere	1 Hour
1.3	Definition and meaning of key terms in Disaster Risk Reduction and Management- disaster, hazard,	1 Hour
1.4	Exposure, vulnerability, risk, risk assessment, risk mapping, capacity, resilience, disaster risk reduction, Disaster risk management, early warning systems	1 Hour
1.5	Disaster preparedness, disaster prevention, disaster, Mitigation, disaster response, damage assessment, crisis counselling, needs assessment.	1 Hour
	Module 2	**5 Hours**
2.1	Various Hazard types, Hazard mapping; Different types of Vulnerability types and their assessment	1 Hour
2.2	Vulnerability assessment and types, Physical and social vulnerability	1 Hour
2.3	Economic and environmental vulnerability, Core elements of disaster risk assessment	1 Hour
2.4	Components of a comprehensive disaster preparedness strategy approaches, procedures	1 Hour
2.5	Different disaster response actions	1 Hour
	Module 3	**5 Hours**
3.1	Introduction to Disaster risk management, Core elements of Disaster Risk Management	1 Hour
3.2	Phases of Disaster Risk Management, Measures for Disaster Risk Reduction	1 Hour
3.3	Measures for Disaster prevention, mitigation, and preparedness.	1 Hour

3.4	Disaster response- objectives, requirements. Disaster response planning; types of responses.	1 Hour
3.5	Introduction- Disaster Relief, Relief; international relief organizations.	1 Hour
	Module 4	**5 Hours**
4.1	Participatory stakeholder engagement	1 Hour
4.2	Importance of disaster communication.	1 Hour
4.3	Disaster communication- methods, barriers. Crisis counselling	1 Hour
4.4	Introduction to Capacity Building. Concept – Structural Measures, Non-structural Measures.	1 Hour
4.5	Introduction to Capacity Assessment, Capacity Assessment; Strengthening, Capacity for Reducing Risk	1 Hour
	Module 5	**5 Hours**
5.1	Introduction-Common disaster types in India.	1 Hour
5.2	Common disaster legislations in India on disaster management	1 Hour
5.3	National disaster management policy, Institutional arrangements for disaster management in India.	1 Hour
5.4	The Sendai Framework for Disaster Risk Reduction and targets	1 Hour
5.5	The Sendai Framework for Disaster Risk Reduction-priorities for action, guiding principles	1 Hour

HUT 300	Industrial Economics & Foreign Trade	Category	L	T	P	CREDIT
		HSMC	3	0	0	3

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

Prerequisite: Nil

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

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**)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2										3	
CO2	2	2			2	2	3				3	
CO3	2	2	1								3	
CO4	2	2	1			1					3	
CO5	2	2	1								3	

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Lifelong learning

Assessment Pattern

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination Marks**
	Test 1 (Marks)	**Test 2 (Marks)**	
Remember	**15**	**15**	**30**
Understand	**20**	**20**	**40**
Apply	**15**	**15**	**30**

Mark Distribution

Total Marks	**CIE Marks**	**ESE Marks**	**ESE Duration**
150	**50**	**100**	**3 hours**

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment - Test (2 numbers)	: 25 marks
Continuous Assessment - Assignment	: 15 marks

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B.

Part A	: 30 marks
Part B	: 70 marks

Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have maximum 3 sub-divisions and carries 14 marks.

SYLLABUS

HUT 300 Industrial Economics & Foreign Trade

Module 1 (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.

Module 2 (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 – Technical progress 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.

Module 3 (Market Structure)

Perfect and imperfect competition – monopoly, regulation of monopoly, monopolistic completion (features and equilibrium of a firm) – oligopoly – Kinked demand curve – Collusive oligopoly (meaning) – Non-price competition – Product pricing – Cost plus pricing – Target return pricing – Penetration pricing – Predatory pricing – Going rate pricing – Price skimming.

Module 4 (Macroeconomic 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 – Demat account and Trading account - SENSEX and NIFTY.

Module 5 (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.

Reference Materials

1. Gregory N Mankiw, 'Principles of Micro Economics', Cengage Publications
2. Gregory N Mankiw, 'Principles of Macro Economics', Cengage Publications
3. Dwivedi D N, 'Macro Economics', Tata McGraw Hill, New Delhi.
4. Mithani D M, 'Managerial Economics', Himalaya Publishing House, Mumbai.
5. Francis Cherunilam, 'International Economics', McGraw Hill, New Delhi.

Sample Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Why does the problem of choice arise?
2. What are the central problems?
3. How do we solve the basic economic problems?
4. What is the relation between price and demand?
5. Explain deadweight loss due to the imposition of a tax.

Course Outcome 2 (CO2):

1. What is shutdown point?
2. What do you mean by producer equilibrium?
3. Explain break-even point;
4. Suppose a chemical factory is functioning in a residential area. What are the external costs?

Course Outcome 3 (CO3):

1. Explain the equilibrium of a firm under monopolistic competition.
2. Why is a monopolist called price maker?
3. What are the methods of non-price competition under oligopoly?

4. What is collusive oligopoly?

Course Outcome 4 (CO4):

1. What is the significance of national income estimation?
2. How is GDP estimated?
3. What are the measures to control inflation?
4. How does inflation affect fixed income group and wage earners?

Course Outcome 5 (CO5):

1. What is devaluation?
2. Suppose a foreign country imposes a tariff on Indian goods. How does it affect India's exports?
3. What is free trade?
4. What are the arguments in favour of protection?

Model Question paper

QP CODE: **PAGES:3**

Reg No:_____ **Name :_____**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY FIFTH /SIXTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: HUT 300

Course Name: Industrial Economics & Foreign Trade

Max.Marks:100 **Duration: 3 Hours**

PART A

Answer all Questions. Each question carries 3 Marks

1. Why does an economic problem arise?

2. What should be the percentage change in price of a product if the sale is to be increased by 50 percent and its price elasticity of demand is 2?

3. In the production function Q= $2L^{1/2}K^{1/2}$ if L=36 how many units of capital are needed to produce 60 units of output?

4. Suppose in the short run AVC 4. Suppose in the short run AVC<P<AC. Will this firm produce or shut down? Give reason.

5. What is predatory pricing?

6. What do you mean by non- price competition under oligopoly?

7. What are the important economic activities under primary sector?

8. Distinguish between a bond and share?

9. What are the major components of balance of payments?

10. What is devaluation? **(10 x 3 = 30 marks)**

PART B

(Answer one full question from each module, each question carries 14 marks)

MODULE I

11. a) Prepare a utility schedule showing units of consumption, total utility and marginal utility, and explain the law of diminishing marginal utility. Point out any three limitations of the law.

    b) How is elasticity of demand measured according to the percentage method? How is the measurement of elasticity of demand useful for the government?

Or

12. a) Explain the concepts consumer surplus and producer surplus.

    b) Suppose the government imposes a tax on a commodity where the tax burden met by the consumers. Draw a diagram and explain dead weight loss. Mark consumer surplus, producer surplus, tax revenue and dead weight loss in the diagram.

MODULE II

13. a) What are the advantages of large-scale production?

    b) Explain Producer equilibrium with the help of isoquants and isocost line. What is expansion path?

Or

14. a) Explain break-even analysis with the help of a diagram.

    b) Suppose the monthly fixed cost of a firm is Rs. 40000 and its monthly total variable cost is Rs. 60000.

    i. If the monthly sales is Rs. 120000 estimate contribution and break-even sales.
    ii. If the firm wants to get a monthly profit of Rs.40000, what should be the sales?

    c) The total cost function of a firm is given as $TC=100+50Q - 11Q^2+Q^3$. Find marginal cost when output equals 5 units.

MODULE III

15. a) What are the features of monopolistic competition?

b) Explain the equilibrium of a firm earning supernormal profit under monopolistic competition.

Or

16. a) Make comparison between perfect competition and monopoly.

b) Explain price rigidity under oligopoly with the help of a kinked demand curve.

MODULE IV

17. a) How is national income estimated under product method and expenditure method?

b) Estimate GDPmp, GNPmp and National income

Private consumption expenditure	= 2000 (in 000 cores)
Government Consumption	= 500
NFIA	= -(300)
Investment	= 800
Net=exports	=700
Depreciation	= 400
Net-indirect tax	= 300

Or

18. a) What are the monetary and fiscal policy measures to control inflation?

b) What is SENSEX?

MODULE V

19. a) What are the advantages of disadvantages of foreign trade?

b) Explain the comparative cost advantage.

Or

20. a) What are the arguments in favour protection?

b) Examine the tariff and non-tariff barriers to international trade.

(5 × 14 = 70 marks)

Teaching Plan

Module 1 (Basic concepts and Demand and Supply Analysis)		**7 Hours**
1.1	Scarcity and choice – Basic economic problems - PPC	1 Hour
1.2	Firms and its objectives – types of firms	1 Hour
1.3	Utility – Law of diminishing marginal utility – Demand – law of demand	1 Hour
1.4	Measurement of elasticity and its applications	1 Hour
1.5	Supply, law of supply and determinants of supply	1 Hour
1.6	Equilibrium – changes in demand and supply and its effects	1 Hour
1.7	Consumer surplus and producer surplus (Concepts) – Taxation and deadweight loss.	1 Hour
Module 2 (Production and cost)		**7 Hours**
2.1	Productions function – law of variable proportion	1 Hour
2.2	Economies of scale – internal and external economies	1 Hour
2.3	producers equilibrium – Expansion path	1 Hour
2.4	Technical progress and its implications – cob Douglas Production function	1 Hour
2.5	Cost concepts – social cost: private cost and external cost – Explicit and implicit cost – sunk cost	1 Hour
2.6	Short run cost curves & Long run cost curves	1 Hour
2.7	Revenue (concepts) – shutdown point – Break-even point.	1 Hour
Module 3 (Market Structure)		**6 hours**
3.1	Equilibrium of a firm, MC – MR approach and TC – TR approach	1 Hour
3.2	Perfect competition & Imperfect competition	1 Hour
3.3	Monopoly – Regulation of monopoly – Monopolistic competition	1 Hour
3.4	Oligopoly – kinked demand curve	1 Hour
3.5	Collusive oligopoly (meaning) – Non price competition	1 Hour
3.6	Cost plus pricing – Target return pricing – Penetration, Predatory pricing – Going rate pricing – price skimming	1 Hour

Module 4 (Macroeconomic concepts)		7 Hours
4.1	Circular flow of economic activities	1 Hour
4.2	Stock and flow – Final goods and intermediate goods – Gross Domestic Product - National income – Three sectors of an economy	1 Hour
4.3	Methods of measuring national income	1 Hour
4.4	Inflation – Demand pull and cost push – Causes and effects	1 Hour
4.5	Measures to control inflation – Monetary and fiscal policies	1 Hour
4.6	Business financing – Bonds and shares – Money market and capital market	1 Hour
4.7	Stock market – Demat account and Trading account – SENSEX and NIFTY	1 Hour
Module 5 (International Trade)		**8 Hours**
5.1	Advantages and disadvantages of international trade	1 Hour
5.2	Absolute and comparative advantage theory	2 Hour
5.3	Heckscher – Ohlin theory	1 Hour
5.4	Balance of payments - components	1 Hour
5.5	Balance of payments deficit and devaluation	1 Hour
5.6	Trade policy – Free trade versus protection	1 Hour
5.7	Tariff and non tariff barriers.	1 Hour

HUT 310	Management for Engineers	Category	L	T	P	Credit
		HMC	3	0	0	3

Preamble: This course is intended to help the students to learn the basic concepts and functions of management and its role in the performance of an organization and to understand various decision-making approaches available for managers to achieve excellence. Learners shall have a broad view of different functional areas of management like operations, human resource, finance and marketing.

Prerequisite: Nil

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

CO1	Explain the characteristics of management in the contemporary context (Cognitive Knowledge level: **Understand**).
CO2	Describe the functions of management (Cognitive Knowledge level: **Understand**).
CO3	Demonstrate ability in decision making process and productivity analysis (Cognitive Knowledge level: **Understand**).
CO4	Illustrate project management technique and develop a project schedule (Cognitive Knowledge level: **Apply**).
CO5	Summarize the functional areas of management (Cognitive Knowledge level: **Understand**).
CO6	Comprehend the concept of entrepreneurship and create business plans (Cognitive Knowledge level: **Understand**).

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**2**				**1**	**2**	**2**	**2**		**2**	**1**	**1**
CO2	**2**				**1**	**1**		**2**	**1**	**2**	**1**	**1**
CO3	**2**	**2**	**2**	**2**	**1**							
CO4	**2**	**2**	**2**	**2**	**1**						**2**	**1**
CO5	**2**					**1**	**1**		**1**	**2**	**1**	
CO6		**2**	**2**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**

Abstract POs defined by National Board of Accreditation			
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Life long learning

Assessment Pattern

Bloom's Category	**Test 1 (Marks in percentage)**	**Test 2 (Marks in percentage)**	**End Semester Examination (Marks in percentage)**
Remember	15	15	30
Understand	15	15	30
Apply	20	20	40
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 Hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment - Test : 25 marks

Continuous Assessment - Assignment : 15 marks

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

SYLLABUS

HUT 310 Management for Engineers (35 hrs)

Module 1 (Introduction to management Theory- 7 Hours)

Introduction to management theory, Management Defined, Characteristic of Management, Management as an art-profession, System approaches to Management, Task and Responsibilities of a professional Manager, Levels of Manager and Skill required.

Module 2 (management and organization- 5 hours)

Management Process, Planning types , Mission, Goals, Strategy, Programmes, Procedures, Organising, Principles of Organisation, Delegation, Span of Control, Organisation Structures, Directing, Leadership, Motivation, Controlling..

Module 3 (productivity and decision making- 7 hours)

Concept of productivity and its measurement; Competitiveness; Decision making process; decision making under certainty, risk and uncertainty; Decision trees; Models of decision making.

. Module 4 (project management- 8 hours)

Project Management, Network construction, Arrow diagram, Redundancy. CPM and PERT Networks, Scheduling computations, PERT time estimates, Probability of completion of project, Introduction to crashing.

Module 5 (functional areas of management- 8 hours)

Introduction to functional areas of management, Operations management, Human resources management, Marketing management, Financial management, Entrepreneurship, Business plans, Corporate social responsibility, Patents and Intellectual property rights.

References:

1. H. Koontz, and H. Weihrich, Essentials of Management: An International Perspective. 8th ed., McGraw-Hill, 2009.
2. P C Tripathi and P N Reddy, Principles of management, TMH, 4th edition, 2008.
3. P. Kotler, K. L. Keller, A. Koshy, and M. Jha, Marketing Management: A South Asian Perspective. 14th ed., Pearson, 2012.
4. M. Y. Khan, and P. K. Jain, Financial Management, Tata-McGraw Hill, 2008.
5. R. D. Hisrich, and M. P. Peters, Entrepreneurship: Strategy, Developing, and Managing a New Enterprise, 4th ed., McGraw-Hill Education, 1997.
6. D. J. Sumanth, Productivity Engineering and Management, McGraw-Hill Education, 1985.
7. K.Ashwathappa, 'Human Resources and Personnel Management', TMH, 3 rd edition, 2005.
8. R. B. Chase, Ravi Shankar and F. R. Jacobs, Operations and Supply Chain Management, 14th ed. McGraw Hill Education (India), 2015.

Sample Course Level Assessment Questions

Course Outcome1 (CO1): Explain the systems approach to management?

Course Outcome 2 (CO2): Explain the following terms with a suitable example Goal, Objective, and Strategy.

Course Outcome 3 (CO3): Mr. Shyam is the author of what promises to be a successful novel. He has the option to either publish the novel himself or through a publisher. The publisher is offering Mr. Shyam Rs. 20,000 for signing the contract. If the novel is successful, it will sell 200,000 copies. Else, it will sell 10,000 copies only. The publisher pays a Re. 1 royalty per copy. A market survey indicates that there is a 70% chance that the novel will be successful. If Mr. Shyam undertakes publishing, he will incur an initial cost of Rs. 90,000 for printing and marketing., but each copy sold will net him Rs. 2. Based on the given information and the

decision analysis method, determine whether Mr. Shyam should accept the publisher's offer or publish the novel himself.

Course Outcome 4 (CO4): Explain the concepts of crashing and dummy activity in project management.

Course Outcome 5 (CO5): Derive the expression for the Economic order quantity (EOQ)?

Course Outcome 6 (CO6): Briefly explain the theories of Entrepreneurial motivation.?

Model Question Paper

QP CODE: PAGES: 4

Reg No:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FOURTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: HUT 310

Course name: Management for Engineers

Max Marks: 100 **Duration: 3 Hours**

PART-A (Answer All Questions. Each question carries 3 marks)

1. "Management is getting things done through other." Elaborate.

2. Comment on the true nature of management. Is it a science or an art?

3. Planning is looking ahead and controlling is looking back. Comment with suitable examples

4. Explain the process of communication?

5. Explain the hierarchy of objectives?

6. Explain the types of decisions?

7. Describe the Economic man model?

8. Explain the concepts of crashing and dummy activity in project management.

9. Differentiate the quantitative and qualitative methods in forecasting.

10. What are the key metrics for sustainability measurement? What makes the measurement and reporting of sustainability challenging?

PART-B (Answer any one question from each module)

11. a) Explain the systems approach to management. **(10)**

b) Describe the roles of a manager **(4)**

OR

12. a) Explain the 14 principles of administrative management? **(10)**

b) Explain the different managerial skills (**4)**

13. a) What are planning premises, explain the classification of planning premises. **(10)**

b) Distinguish between strategy and policy. How can policies be made effective. **(4)**

OR

14 a) Explain three motivational theories. **(9)**

b) Describe the managerial grid. **(5)**

15. a) Modern forest management uses controlled fires to reduce fire hazards and to stimulate new forest growth. Management has the option to postpone or plan a burning. In a specific forest tract, if burning is postponed, a general administrative cost of Rs. 300 is incurred. If a controlled burning is planned, there is a 50% chance that good weather will prevail and burning will cost Rs. 3200. The results of the burning may be either successful with probability 0.6 or marginal with probability 0.4. Successful execution will result in an estimated benefit of Rs. 6000, and marginal execution will provide only Rs. 3000 in benefits. If the weather is poor, burning will be cancelled incurring a cost of Rs. 1200 and no benefit. i) Develop a decision tree for the problem. (ii) Analyse the decision tree and determine the optimal course of action. **(8)**

b) Student tuition at ABC University is $100 per semester credit hour. The Education department supplements the university revenue by matching student tuition, dollars per dollars. Average class size for typical three credit course is 50 students. Labour costs are $4000 per class, material costs are $20 per student, and overhead cost are $25,000 per class. (a) Determine the total factor productivity. (b) If instructors deliver lecture 14 hours per week and the semester lasts for 16 weeks, what is the labour productivity? **(6)**

OR

16. a) An ice-cream retailer buys ice cream at a cost of Rs. 13 per cup and sells it for Rs. 20 per cup; any remaining unsold at the end of the day, can be disposed at a salvage price of Rs. 2.5 per cup. Past sales have ranged between 13 and 17 cups per day; there is no reason to believe that

sales volume will take on any other magnitude in future. Find the expected monetary value and EOL, if the sales history has the following probabilities: **(9)**

Market Size	13	14	15	16	17
Probability	0.10	0.15	0.15	0.25	0.35

b) At Modem Lumber Company, Kishore the president and a producer of an apple crates sold to growers, has been able, with his current equipment, to produce 240 crates per 100 logs. He currently purchases 100 logs per day, and each log required 3 labour hours to process. He believes that he can hire a professional buyer who can buy a better quality log at the same cost. If this is the case, he increases his production to 260 crates per 100 logs. His labour hours will increase by 8 hours per day. What will be the impact on productivity (measured in crates per labour-hour) if the buyer is hired? What is the growth in productivity in this case? **(5)**

17. a) A project has the following list of activities and time estimates:

Activity	**Time (Days)**	**Immediate Predecessors**
A	1	-
B	4	A
C	3	A
D	7	A
E	6	B
F	2	C, D
G	7	E, F
H	9	D
I	4	G, H

(a) Draw the network. (b) Show the early start and early finish times. (c) Show the critical path. **(10)**

b) An opinion survey involves designing and printing questionnaires, hiring and training personnel, selecting participants, mailing questionnaires and analysing data. Develop the precedence relationships and construct the project network. **(4)**

OR

18. a) The following table shows the precedence requirements, normal and crash times, and normal and crash costs for a construction project:

Activity	Immediate Predecessors	Required Time (Weeks)		Cost (Rs.)	
		Normal	Crash	Normal	Crash
A	-	4	2	10,000	11,000
B	A	3	2	6,000	9,000
C	A	2	1	4,000	6,000
D	B	5	3	14,000	18,000
E	B, C	1	1	9,000	9,000
F	C	3	2	7,000	8,000
G	E, F	4	2	13,000	25,000
H	D, E	4	1	11,000	18,000
I	H, G	6	5	20,000	29,000

Draw the network. (b) Determine the critical path. (c) Determine the optimal duration and the associated cost. **(10)**

b) Differentiate between CPM and PERT. **(4)**

19. a) What is meant by market segmentation and explain the process of market segmentation **(8)**

b) The Honda Co. in India has a division that manufactures two-wheel motorcycles. Its budgeted sales for Model G in 2019 are 80,00,000 units. Honda's target ending inventory is 10,00, 000 units and its beginning inventory is 12, 00, 000 units. The company's budgeted selling price to its distributors and dealers is Rs. 40, 000 per motorcycle. Honda procures all its wheels from an

outside supplier. No defective wheels are accepted. Honda's needs for extra wheels for replacement parts are ordered by a separate division of the company. The company's target ending inventory is 3,00,000 wheels and its beginning inventory is 2,00,000 wheels. The budgeted purchase price is Rs. 1,600 per wheel.

(a) Compute the budgeted revenue in rupees.

(b) Compute the number of motorcycles to be produced.

Compute the budgeted purchases of wheels in units and in rupees.? **(6)**

OR

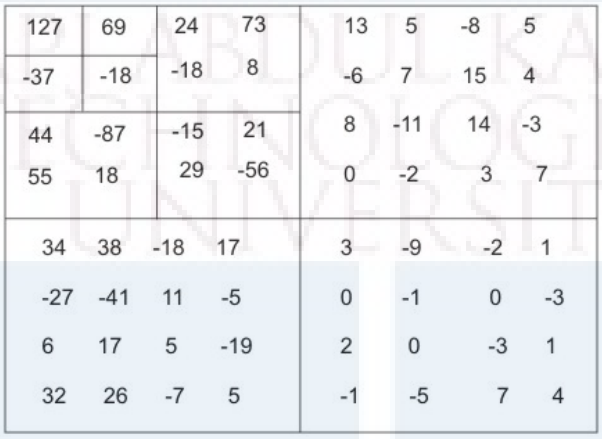
20. a) a) "Human Resource Management policies and principles contribute to effectiveness, continuity and stability of the organization". Discuss. (b) What is a budget? Explain how sales budget and production budgets are prepared? **(10)**

b) Distinguish between the following: (a) Assets and Liabilities (b) Production concept and Marketing concept (c) Needs and Wants (d) Design functions and Operational control functions in operations **(4)**

Teaching Plan

Sl.No	TOPIC	SESSION
	Module I	
1.1	Introduction to management	1
1.2	Levels of managers and skill required	2
1.3	Classical management theories	3
1.4	neo-classical management theories	4
1.5	modern management theories	5
1.6	System approaches to Management,	6
1.7	Task and Responsibilities of a professional Manager	7
	Module 2	
2.1	Management process – planning	8
2.2	Mission – objectives – goals – strategy – policies – programmes – procedures	9
2.3	Organizing, principles of organizing, organization structures	10
2.4	Directing, Leadership	11
2.5	Motivation, Controlling	12
	Module III	
3.1	Concept of productivity and its measurement Competitiveness	13
3.2	Decision making process;	14
3.3	Models in decision making	15
3.4	Decision making under certainty and risk	16
3.5	Decision making under uncertainty	17
3.6	Decision trees	18
3.7	Models of decision making.	19
	Module IV	
4.1	Project Management	20

Sl.No	TOPIC	SESSION
	Module I	
4.2	Network construction	21
4.3	Arrow diagram, Redundancy	22
4.4	CPM and PERT Networks	23
4.5	Scheduling computations	24
4.6	PERT time estimates	25
4.7	Probability of completion of project	26
4.8	Introduction to crashing	
	Module V	
5.1	Introduction to functional areas of management,	28
5.2	Operations management	29
5.3	Human resources management ,	30
5.4	Marketing management	31
5.5	Financial management	32
5.6	Entrepreneurship,	33
5.7	Business plans	34
5.8	Corporate social responsibility, Patents and Intellectual property rights	35

19.b)	Explain the application of wavelet transform in image denoising	6	K2	CO5
	OR			
20. a)	Given a DWT coefficient array for 3 levels on an image. Implement EZW algorithm for coding the image (do atleast 2 dominant passes).  127 69 24 73 13 5 -8 5 -37 -18 -18 8 -6 7 15 4 44 -87 -15 21 8 -11 14 -3 55 18 29 -56 0 -2 3 7 34 38 -18 17 3 -9 -2 1 -27 -41 11 -5 0 -1 0 -3 6 17 5 -19 2 0 -3 1 32 26 -7 5 -1 -5 7 4	8	K3	CO5
20.b)	lllustrate the filter bank implementation of wavelet transform of images	6	K2	CO5

Simulation Assignments in MATLAB

1) Spectral analysis of audio or image signals
2) Wavelet applications for image or audio processing