| Name:<br><br>Enrolment No: |  |
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**UNIVERSITY OF PETROLEUM AND ENERGY STUDIES**
**End Semester Examination, December 2022**

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| **Course:**      **Signals and Systems** | **Semester:  III** |
| **Program:**     **B. Tech Mechatronics/ B.Tech  ECE** | **Time**      **: 03 hrs.** |
| **Course Code:**    **ECEG 2010** | **Max. Marks: 100** |

**Instructions:**

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**SECTION A**
**(5Qx4M=20Marks)**

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| S. No. | | Marks | CO |
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| Q 1 | Find whether the following  systems are<br><br>(1) Static and Dynamic (2)Linear and Non Linear<br>(3) Causal and Non causal (4) Time invariant and time Variant<br><br>(a)  Y(t) = \| x(t)\| | 4 | CO1 |
| Q 2 | Determine whether the following signals are power or energy signals or neither.<br>     (a)  x(t)= $e^{-5t}u(t)$ | 4 | CO1 |
| Q 3 | Consider a continuous time system with input x(t) and output y(t) related by y(t) =x sin(t)<br>     (a) Is this system Causal?<br>(b) Is this system linear ? | 4 | CO1 |
| Q 4 | What is the relation between laplace transform and fourier transform? | 4 | CO3 |
| Q 5 | What is the condition for  Z Transform to exist? | 4 | CO4 |

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**SECTION B**
**(4Qx10M= 40 Marks)**

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| Q 6 | Use the unilateral Laplace transform to determine the output of a system represented by the differential equation<br>$$\frac{d^2y(t)}{dt^2}+5\frac{dy(t)}{dt} + 6y(t) = \frac{dx(t)}{dt} + 6\,x(t)$$ | 10 | CO3 |
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| | In response to the input x(t) =u(t). Assume to the initial condition on the system are $y(0^-) = 1$ and $\dot{y}(0^-)=2$ . Identify the zero state response of the system and the zero input response. | | |
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| Q 7 | Find the Fourier Transform of the causal sequence $x(n) = a^n u(n), \lvert a \rvert < 1$ | 10 | CO2 |
| Q 8 | Determine the Laplace transform and the associated ROC for each of the following function of time.<br>(a) $g(t) = te^{-2\lvert t \rvert}$<br>(b) $x(t) = \delta(3t) + u(3t)$ | 10 | CO2 |
| Q 9 | Design a discrete time LTI system with the property that if the input is $$x(n) = \left(\frac{1}{2}\right)^n u(n) - \frac{1}{4}\left(\frac{1}{2}\right)^{n-1} u(n-1)$$ Then the output is $$y(n) = \left(\frac{1}{3}\right)^n u(n)$$ (a) Find the impulse response and frequency response of a discrete time LTI system.<br><br>**OR**<br><br>Determine the z transform of the anticausal signal $x(n) = - a^n u(-n-1)$ and depict the ROC and the locations of poles and zeros in the z plane. | 10<br><br><br><br>10 | CO3 |
| | **SECTION-C**<br>**(2Qx20M=40 Marks)** | | |
| Q 10 | A causal discrete time LTI system is described by $$y(n) - \frac{3}{4} y(n-1) + \frac{1}{8} y(n-2) = x(n)$$ Where x(n) and y(n) are the input and output of the system, respectively<br>(a) Determine the system function H(z) for a causal system function.<br>(b) Find the impulse response h(n) of the system.<br>(c) Find the step response of the system | 20 | CO3 |
| Q 11 | An LTI system is characterized by the system function $$H(z) = \frac{3 - 4z^{-1}}{1 - 3.5z^{-1} + 1.5z^{-2}}$$ | 20 | |

| | | | |
|---|---|---|---|
| | Specify the ROC of H(z) and determine h (n) for the following conditions:<br>   (a) The system is causal and unstable<br>   (b) The system is noncausal and stable<br><br><div align="center">**OR**</div><br>The system function of a causal LTI system is<br>$$H(s) = \frac{s+1}{s^2 + 2s + 2}$$<br>Determine the response Y(t) when the input $x(t) = e^{-\lvert t \rvert}$<br><br>(b) Find the inverse transform of the functions<br><br>$$X(s) = \frac{1}{s^2(s+2)}$$ | **20** | **CO4**<br><br><br><br><br><br>**CO3** |