



Sanjay Ghodawat University, Kolhapur

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2018-19  
EXMP/09/01

Year and Program: 2018-19

School of Technology

Department : Mechanical

S.Y. B. Tech.

Course Code: MET201

Course Title: Differential  
Calculus and Transforms

Semester – III

Day and Date Tuesday  
04/06/2019

End Semester Examination  
(ESE)

Time: Max Marks: 100

2:30 to 5:30 pm.

Instructions:

- 1) All questions are compulsory.
- 2) Figures to the right indicate full marks.
- 3) Use of non-programmable Calculator is allowed.

Q.1	Solve the following	Marks	Bloom's Level	CO
a)	Solve $(D^3 + 2D^2 + D)y = x^2 + x$	06	L <sub>3</sub>	CO1
	OR			
a)	Solve $(x^2D^2 + xD + 1)y = \cos(\log x)$	06	L <sub>3</sub>	CO1
b)	A body executes damped forced vibrations given by the equation	06	L <sub>3</sub>	CO2
	$\frac{d^2x}{dt^2} + 2k\frac{dx}{dt} + b^2x = e^{-kt} \sin \omega t$ . Solve the equation for $\omega^2 \neq b^2 - k^2$			
	OR			
b)	The differential equation of motion of a body is	06	L <sub>3</sub>	CO2
	$\frac{d^2x}{dt^2} + K^2x = K^2a \sin nt$ . If at $t = 0$ , $x = 0$ and $\frac{dx}{dt} = 0$ ,			
	show that $x = \frac{Ka}{(K^2 - n^2)}(K \sin nt - n \sin Kt)$ , for $n \neq K$ .			
Q.2				
a)	A spring of negligible weight which stretches 1 inch under tension of 2 lb is fixed at one end and is attached to a weight $W$ lb at the other. It is found that resonance occurs when an axial periodic force $2 \cos 2t$ lb acts on the weight. Show that when the free vibrations have died out the forced vibrations are given by $x = ct \sin 2t$ and find values of $W$ and $C$ .	18	L <sub>4</sub>	CO2
	OR			
a)	The Whirling speed of a shaft length $l$ is given by $\frac{d^4y}{dx^4} - a^4y = 0$	18	L <sub>4</sub>	CO2

**ESE**

where  $a^4 = \frac{W \omega^2}{g EI}$  and  $y$  is the displacement at a distance  $x$  from one

end. If the ends of the shafts are constrained in long bearing then show that the shaft will whirl when  $\cos(al)\cosh(al)=1$

Q.3 a) Solve any Two.

i) Solve  $q(p + \cos x) = \cos y$  05 L<sub>3</sub> CO3

ii) Solve  $9(p^2z + q^2) = 4$  05 L<sub>3</sub> CO3

iii) Solve  $x(y^2 + z)p - y(x^2 + z)q = z(x^2 - y^2)$  05 L<sub>3</sub> CO3

b) Solve any two.

i) Find Laplace Transform of  $[\cosh 4t. \cos 3t]$  05 L<sub>3</sub> CO4

ii) Evaluate  $\int_0^{\infty} e^{-3t} \cos^2 t dt$  by using Laplace transform. 05 L<sub>5</sub> CO4

iii) Find Laplace Transform of  $[t e^{-t} \sin 3t]$  05 L<sub>3</sub> CO4

Q.4 Solve any Three.

a) Find  $L^{-1}\left[\frac{6s-4}{s^2-4s+20}\right]$  06 L<sub>3</sub> CO5

b) Find inverse Laplace Transform by Partial fraction 06 L<sub>3</sub> CO5

$$\frac{s+29}{(s+4)(s^2+9)}$$

c) Solve by method of Laplace Transform 06 L<sub>3</sub> CO5

$(D^3 - 3D^2 + 3D - 1)y = t^2 e^t$  where  $y(0)=1, y'(0)=0, y''(0)=2$

d) Apply convolution theorem to find inverse Laplace transform of 06 L<sub>4</sub> CO5

$$\left[\frac{s}{(s^2 + a^2)^2}\right]$$

Q.5 Solve any Two

a) Find a Fourier Series of  $f(x) = |x|$  in  $(-\pi, \pi)$  09 L<sub>3</sub> CO6

b) Find a Fourier Series of  $f(x) = x^2$  on  $(0, 2\pi)$  09 L<sub>3</sub> CO6

c) Obtain Fourier expansion of  $f(x) = \begin{cases} 0 & ; -3 \leq x \leq 0 \\ 2x & ; 0 \leq x \leq 3 \end{cases}$  09 L<sub>4</sub> CO6

**ESE**

Q.6 a) Apply convolution theorem to find inverse Laplace transform of  $\left[ \frac{1}{(s-2)(s+2)^2} \right]$  07 L<sub>4</sub> CO5

OR

a) Find  $L^{-1} \left[ \frac{4s+5}{(s-1)^2(s+2)} \right]$  07 L<sub>3</sub> CO5

b) Express  $f(x) = x$  as half range sine series in  $0 < x < 2$  07 L<sub>3</sub> CO6

OR

b) Find Half range sine series of  $f(x) = \begin{cases} x & ; 0 \leq x \leq \frac{\pi}{2} \\ \pi - x & ; \frac{\pi}{2} \leq x \leq \pi \end{cases}$  07 L<sub>3</sub> CO6

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