



**PES University, Bangalore**

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Department of Science & Humanities

Maxima Lab

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Semester & Section : **II & D SECTION**

To be filled by the teacher-in-charge:

Marks :    / 5 +    / 5 = 

/10
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Faculty :

Signature with date : \_\_\_\_\_

**Q1 . Find gradient of  $3x^2 + 5y^2 + z^2$  and  $\cos(x)^3 \sin(y)^3$ .**

**a.**

-->    / \* Find gradient of  $3x^2 + 5y^2 + z^2$  and  $\cos(x)^3 \sin(y)^3$ .

```
(%i31) load(vect);
(%i34) f:3*x^2+5*y^2+z^2;
      grad(f);
      express(%);
(f)      z^2+5*y^2+3*x^2
(%o33) grad(z^2+5*y^2+3*x^2)
(%o34) ['diff((z^2+5*y^2+3*x^2),x,1),'diff((z^2+5*y^2+3*x^2),y,1),'diff((z^2+5*y^2+3*x^2),z,1)]
(%i35) ev(%diff);

(%o35) [6*x,10*y,2*z]
```

**b.**

```
(%i19) load(vect);
(%o19) "C:/maxima-5.43.0/share/maxima/5.43.0/share/vector/vect.mac"
(%i30) f1:cos(x)^3*sin(y)^3;
      grad(f1);
      express(%);
(f1)      cos(x)^3*sin(y)^3
(%o29) grad(cos(x)^3*sin(y)^3)
(%o30) ['diff((cos(x)^3*sin(y)^3),x,1),'diff((cos(x)^3*sin(y)^3),y,1),'diff((cos(x)^3*sin(y)^3),z,1)]
(%i27) ev(%diff);
(%o27) [-3*cos(x)^2*sin(x)*sin(y)^3,3*cos(x)^3*cos(y)*sin(y)^2,0]
```

**Q2. Find the Divergence and curl of i)  $x*y^2i+4*x^2*y*zj-6*y*z^2k$   
ii)  $(z^2+4*x+5*y)i+(3*x+2*y+z)j+(2*y+4*z*x)k$**

**a.**

```
--> /* Find the Divergence and curl of i) x*y^2i+4*x^2*y*zj-6*y*z^2k
ii)(z^2+4*x+5*y)i+(3*x+2*y+z)j+(2*y+4*z*x)k
(%i1) load(vect);
(%o1) "C:/maxima-5.43.0/share/maxima/5.43.0/share/vector/vect.mac"
(%i5) F:([x*y^2,4*x^2*y*z,-6*y*z^2]);
      div(F);
```

```

express(%);
ev(%,diff);
(F)      [x*y^2,4*x^2*y*z,\-6*y*z^2]

(%o3)  div([x*y^2,4*x^2*y*z,\-6*y*z^2])
(%o4)  'diff((\ -6*y*z^2),z,1)+'diff((4*x^2*y*z),y,1)+'diff((x*y^2),x,1)
(%o5)  \-12*y*z+4*x^2*z+y^2
(%i8)  curl(F);
express(%);
ev(%,diff);
(%o6)  curl([x*y^2,4*x^2*y*z,\-6*y*z^2])
(%o7)  ['diff((\ -6*y*z^2),y,1)\-'diff((4*x^2*y*z),z,1),'diff((x*y^2),z,1)\-'diff((\ -6*y*z^2),x,1),'diff((4*x^2*y*z),x,1)\-'diff((x*y^2),y,1)]

(%o8)  [\ -6*z^2\ -4*x^2*y,0,8*x*y*z\ -2*x*y]

```

## **b.**

```

(%i9)  load(vect);
(%o9)  "C:/maxima-5.43.0/share/maxima/5.43.0/share/vector/vect.mac"
(%i13) F1:([z^2+4*x+5*y,3*x+2*y+z,2*y+4*z*x]);
div(F1);
express(%);
ev(%,diff);
(F1)      [z^2+5*y+4*x,z+2*y+3*x,4*x*z+2*y]

(%o11)  div([z^2+5*y+4*x,z+2*y+3*x,4*x*z+2*y])
(%o12)  'diff((z^2+5*y+4*x),x,1)+'diff((4*x*z+2*y),z,1)+'diff((z+2*y+3*x),y,1)
(%o13)  4*x+6
(%i16)  curl(F1);
express(%);
ev(%,diff);
(%o14)  curl([z^2+5*y+4*x,z+2*y+3*x,4*x*z+2*y])

```

```
(%o15) ['diff((4*x*z+2*y),y,1)\-'diff((z+2*y+3*x),z,1),'diff((z^2+5*y+4*x),z,1)\-'diff((4*x*z+2*y),x,1),'diff((z+2*y+3*x),x,1)\-'diff((z^2+5*y+4*x),y,1)]
```

```
(%o16) [1,-2*z,-2]
```

**Q3. Find the Directional derivative of  $x^2+y^2-z^2$  at  $(1,1,-4)$  in the direction of the vector  $i + j + 4k$**

```
--> /* Find the Directional derivative of x^2+y^2-z^2 at (1,1,-4) in the direction of the vector i+ j + 4k
```

```
(%i1) load(vect);
```

```
(%o1) "C:/maxima-5.43.0/share/maxima/5.43.0/share/vector/vect.mac"
```

```
(%i5) f:x^2+y^2-z^2;
```

```
a:[1,1,4];
```

```
b:grad(f);
```

```
express(%);
```

```
(f) \-z^2+y^2+x^2
```

```
(a) [1,1,4]
```

```
(b) grad(\-z^2+y^2+x^2)
```

```
(%o5) ['diff((\-z^2+y^2+x^2),x,1),'diff((\-z^2+y^2+x^2),y,1),'diff((\-z^2+y^2+x^2),z,1)]
```

```
(%i6) ev(%diff);
```

```
(%o6) [2*x,2*y,-2*z]
```

```
(%i7) define(b(x,y,z),%);
```

```
(%o7) b(x,y,z):=[2*x,2*y,-2*z]
```

```
(%i8) (b(1,1,-4).a)/sqrt(a.a);
```

```
(%o8) 3*2^(3/2)
```

**Q4. Find the Gamma of 6,9,11,5/2,4/5,8/3**

```
--> /*Find the Gamma of 6,9,11,5/2,4/5,8/3
```

```
(%i1) gamma(n);
```

```
(%o1) gamma(n)
```

```
(%i2) map('gamma,[6,9,11,5/2,4/5,8/3]);
```

```
(%o2) [120,40320,3628800,(3*sqrt(%pi))/4,gamma(4/5),(10*gamma(2/3))/9]
```

**Q5. Find the i)Beta(8,9) ii)beta(4,3/2) iii)beta(3/2,5/2) iv)beta(4/3,-1/3)**

```
--> /*Find the i)Beta(8,9) ii)beta(4,3/2) iii)beta(3/2,5/2) iv)beta(4/3,-1/3)
```

```
(%i9) beta(8,9);
```

```
(%o9) 1/102960
```

```
(%i10) beta(4,3/2);
```

```
(%o10) 32/315
```

```
(%i11) beta(3/2,5/2);
```

```
(%o11) %pi/16
```

```
(%i16) beta(4/3,-1/3);
```

```
(%o16) \-(2*%pi)/sqrt(3)
```

**Q6. Find Bessel functions of orders 7/2, 5/2,-7/2,9/2**

```
-->
```

```
/* Find Bessel functions of orders 7/2, 5/2,-7/2,9/2
```

```
(%i8) besselexpand:true$
```

```
bessel_j(7/2,x);
```

```
(%o8) (sqrt(2)*sqrt(x)*((15/x^4\ -6/x^2)*sin(x)+(1/x\ -15/x^3)*cos(x)))/sqrt(%pi)
```

```
(%i9) bessel_j(5/2,x);
```

```
(%o9) (sqrt(2)*sqrt(x)*((3/x^3\ -1/x)*sin(x)\ -(3*cos(x))/x^2))/sqrt(%pi)
```

```
(%i10) bessel_j(-7/2,x);
```

```
(%o10) (sqrt(2)*sqrt(x)*((1/x\ -15/x^3)*sin(x)\ -(15/x^4\ -6/x^2)*cos(x)))/sqrt(%pi)
```

```
(%i13) bessel_j(9/2,x);
```

```
(%o13) (sqrt(2)*sqrt(x)*((1/x\ -45/x^3+105/x^5)*sin(x)\ -(105/x^4\ -10/x^2)*cos(x)))/sqrt(%pi)
```

**Q7. Find the Laplace transforms of**

**cos(t)^3\*sin(t)^2,sin(2\*t)+cos(2\*t)^3,sin(t)^2\*cos(t)/t,e^(4\*t)\*sin(3\*t)^2**

```

--> /*Find the Laplace transforms of
cos(t)^3*sin(t)^2,sin(2*t)+cos(2*t)^3,sin(t)^2*cos(t)/t,e^(4*t)*sin(3*t)^2
(%i1) laplace(cos(t)^3*sin(t)^2,t,s);

(%o1) (2*s^3+26*s)/(s^6+35*s^4+259*s^2+225)
(%i2) laplace(sin(2*t)+cos(2*t)^3,t,s);
(%o2) (s^3+28*s)/(s^4+40*s^2+144)+2/(s^2+4)
(%i3) laplace(sin(t)^2*cos(t)/t,t,s);
(%o3) 2*(log(s^2+9)/16\ -log(s^2+1)/16)
(%i4) laplace(e^(4*t)*sin(3*t)^2,t,s);
(%o4) 18/(s^3\ -12*log(e)*s^2+(48*log(e)^2+36)*s\ -64*log(e)^3\ -144*log(e))
(%i6) laplace(t^2*cos(t)^2,t,s);

(%o6) 2/(s^3+4*s)\ -(4*s*(3*s^2+4))/(s^3+4*s)^2\ -
(6*s*(s^2+2))/(s^3+4*s)^2+(2*(s^2+2)*(3*s^2+4)^2)/(s^3+4*s)^3

```

**Q8. Find Inverse Laplace Transforms of  $1/(s-4)$ ,  $s/(s^2+49)$ ,  $s/(s^2-64)$ ,  $1/(s^2-64)$ ,  $1/(s^2+64)$**

```

--> /* Find Inverse Laplace Transforms of 1/(s-4),s/(s^2+49),s/(s^2-64),1/(s^2-64),1/(s^2+64)
(%i3) ilt(1/(s-4),s,t);
(%o3) %e^(4*t)
(%i4) ilt(s/(s^2+49),s,t);
(%o4) cos(7*t)
(%i5) ilt(s/(s^2-64),s,t);
(%o5) %e^(8*t)/2+%e^(\ -8*t)/2
(%i7) ilt(1/(s^2-64),s,t);
(%o7) %e^(8*t)/16\ -%e^(\ -8*t)/16
(%i9) ilt(1/(s^2+64),s,t);
(%o9) sin(8*t)/8

```

**Q9. Inverse laplace transforms by convulation theorem  $1/s*(s+49)^2$  and  $s/(s^2+81)^2$**

```

--> /* Inverse laplace transforms by convulation theorem 1/s*(s+49)^2 and s/(s^2+81)^2/

```

```
(%i16) F:1/(s+49)^2;
```

```
(F) 1/(s+49)^2
```

```
(%i14) G:1/(s);
```

```
(G) 1/s
```

```
(%i17) ilt(F*G,s,t);
```

```
(%o17) \-(t*e^(-49*t))/49\-%e^(-49*t)/2401+1/2401
```

```
(%i23) F1:s/(s^2+81);
```

```
G1:1/(s^2+9^2);
```

```
ilt(F1*G1,s,t);
```

```
(F1) s/(s^2+81)
```

```
(G1) 1/(s^2+81)
```

```
(%o23) (t*sin(9*t))/18
```

### **Q10. solve the differential equatin using laplace transformations**

**$y^{111}+2y^{11}-y^1-2y = 0$  ; $y(0)=y^1(0)=0$  and  $y^{11}(0) = 6$**

```
--> /*solve the differential equatin using laplace transformations  $y^{111}+2y^{11}-y^1-2y = 0$ 
;  $y(0)=y^1(0)=0$  and  $y^{11}(0) = 6$ */
```

```
(%i1) ode:'diff(y(t),t,3)+2*'diff(y(t),t,2)'\-'diff(y(t),t)-2*y(t)=0;
```

```
(ode) 'diff(y(t),t,3)+2*('diff(y(t),t,2))'\-'diff(y(t),t,1)\-2*y(t)=0
```

```
(%i2) atvalue(y(t),t=0,0);
```

```
(%o2) 0
```

```
(%i3) atvalue('diff(y(t),t),t=0,0);
```

```
(%o3) 0
```

```
(%i4) atvalue('diff(y(t),t,2),t=0,6);
```

```
(%o4) 6
```

```
(%i5) lap-ode:laplace(ode,t,s);
```

```
(%o5) \-s^3*laplace(y(t),t,s)\-
```

```
2*s^2*laplace(y(t),t,s)+s*laplace(y(t),t,s)+2*laplace(y(t),t,s)+lap+6=lap
```

```
(%i6) sol:solve(%, 'laplace(y(t),t,s));
```

```
(sol) [laplace(y(t),t,s)=6/(s^3+2*s^2\-\s\-\2)]
```

```
(%i7) map(lambda([eq],ilt(eq,s,t)),sol);
```

```
(%o7) [y(t)=e^t\ -3*e^(-t)+2*e^(-2*t)]
```

### Q11. Find the Fourier series of the function $f(x)=e^{(-5x)}$ in $(-\pi, \pi)$

```
--> /*Find the Fourier series of the function f(x)=e^(-5x) in (-pi,pi)*/
```

```
(%i22) load(fourie);
```

```
l:fourier(e^(-5*x),x,%pi);
```

```
(%o21) "C:/maxima-5.43.0/share/maxima/5.43.0/share/calculus/fourie.mac"
```

```
(l) a[0]=(e^(5*%pi))/(5*log(e))\ -1/(5*e^(5*%pi)*log(e))/(2*%pi)
```

```
(l)
```

```
a[n]=((n*sin(%pi*n))/(e^(5*%pi*log(e))*n^2+25*e^(5*%pi*log(e))*log(e)^2)+(e^(5*%pi*log(e))*n*sin(%pi*n))/(n^2+25*log(e)^2)\ -
(5*log(e)*cos(%pi*n))/(e^(5*%pi*log(e))*n^2+25*e^(5*%pi*log(e))*log(e)^2)+(5*e^(5*%pi*log(e))*log(e)*cos(%pi*n))/(n^2+25*log(e)^2))/%pi
```

```
(l) b[n]=(-(5*log(e)*sin(%pi*n))/(e^(5*%pi*log(e))*n^2+25*e^(5*%pi*log(e))*log(e)^2)\ -
(5*e^(5*%pi*log(e))*log(e)*sin(%pi*n))/(n^2+25*log(e)^2)\ -
(n*cos(%pi*n))/(e^(5*%pi*log(e))*n^2+25*e^(5*%pi*log(e))*log(e)^2)+(e^(5*%pi*log(e))*n*cos(%pi*n))/(n^2+25*log(e)^2))/%pi
```

```
(l) [t22,t23,t24]
```

```
(%i25) fourierexpand(l,x,%pi,4);
```

```
(%o25) (((4*e^(5*%pi*log(e)))/(25*log(e)^2+16)\ -
4/(25*e^(5*%pi*log(e))*log(e)^2+16*e^(5*%pi*log(e))))*sin(4*x))/%pi+(((5*e^(5*%pi*log(e))*log(e))/(25*log(e)^2+16)\ -
(5*log(e))/(25*e^(5*%pi*log(e))*log(e)^2+16*e^(5*%pi*log(e))))*cos(4*x))/%pi+((3/(25*e^(5*%pi*log(e))*log(e)^2+9*e^(5*%pi*log(e)))\ -
(3*e^(5*%pi*log(e)))/(25*log(e)^2+9))*sin(3*x))/%pi+
```

```
((5*log(e))/(25*e^(5*%pi*log(e))*log(e)^2+9*e^(5*%pi*log(e)))\ -
(5*e^(5*%pi*log(e))*log(e))/(25*log(e)^2+9))*cos(3*x))/%pi+(((2*e^(5*%pi*log(e)))/(25*log(e)^2+4)\ -
2/(25*e^(5*%pi*log(e))*log(e)^2+4*e^(5*%pi*log(e))))*sin(2*x))/%pi+(((5*e^(5*%pi*log(e))*log(e))/(25*log(e)^2+4)\ -
(5*log(e))/(25*e^(5*%pi*log(e))*log(e)^2+4*e^(5*%pi*log(e))))*cos(2*x))/%pi+
```

```
((1/(25*e^(5*%pi*log(e))*log(e)^2+e^(5*%pi*log(e)))\ -
e^(5*%pi*log(e))/(25*log(e)^2+1))*sin(x))/%pi+(((5*log(e))/(25*e^(5*%pi*log(e))*log(e)^2+e^(5*%pi*log(e)))\ -
(5*e^(5*%pi*log(e))*log(e))/(25*log(e)^2+1))*cos(x))/%pi+(e^(5*%pi)/(5*log(e))\ -
1/(5*e^(5*%pi)*log(e)))/(2*%pi)
```

### Q12. Find the Fourier sine series of $f(x)=x^2+x$ , in $(0, \pi)$ ;

```
--> /*Find the Fourier sine series of f(x)=x^2+x, in (0,pi);
```

```
(%i2) load(fourie);
```



```
foursin(x^2+x,x,%pi);
```

```
(%o1) "C:/maxima-5.43.0/share/maxima/5.43.0/share/calculus/fourie.mac"
```

```
(%t2) b[n]=(2*((2*%pi*sin(%pi*n))/n^2+sin(%pi*n)/n^2\-(%pi^2*cos(%pi*n))/n\-(%pi*cos(%pi*n))/n+(2*cos(%pi*n))/n^3\-(2/n^3)))/%pi
```

```
(%o2) [%t2]
```

```
(%i3) fourexpand(%x,%pi,4);
```

```
(%o3) (2*(\-%pi^2/4\-%pi/4)*sin(4*x))/%pi+(2*(%pi^2/3+%pi/3\-(4/27)*sin(3*x))/%pi+(2*(\-%pi^2/2\-%pi/2)*sin(2*x))/%pi+(2*(%pi^2+%pi\-(4)*sin(x))/%pi
```

### Q13. Find the Fourier cosine series of $f(x)=1-x^2$ in $(0,4)$

```
--> /* Find the Fourier cosine series of f(x)=1-x^2 in (0,4)
```

```
(%i10) load(fourie);
```

```
fourcos(1-x^2,x,4);
```

```
(%o9) "C:/maxima-5.43.0/share/maxima/5.43.0/share/calculus/fourie.mac"
```

```
(%t10) a[0]=\ -13/3
```

```
(%t11) a[n]=(\ -(60*sin(%pi*n))/(%pi*n)+(128*sin(%pi*n))/(%pi^3*n^3)\ -(128*cos(%pi*n))/(%pi^2*n^2))/2
```

```
(%o11) [%t10,%t11]
```

```
(%i12) fourexpand(%x,4,6);
```

```
(%o12) \ -(16*cos((3*%pi*x)/2))/(9*%pi^2)+(64*cos((5*%pi*x)/4))/(25*%pi^2)\ -(4*cos(%pi*x))/%pi^2+(64*cos((3*%pi*x)/4))/(9*%pi^2)\ -(16*cos((%pi*x)/2))/%pi^2+(64*cos((%pi*x)/4))/%pi^2\ -13/3
```