YOGI VEMENEA UNIVERSITY

REVISED UG SYLLABUS UNDER CBCS

(Implemented from Academic Year - 2020-21)

PROGRAMME: FOUR YEAR B.A. /B.Sc. (Hons)

Domain Subject: MATHEMATICS

Skill Enhancement Courses (SECs) for Semester V, from 2022-23 *(Syllabus with Learning Outcomes, References, Co-curricular Activities & Model Q.P. Pattern)*

Structure of SECs for Semester– V

Univ Code	Course Number 6&7	Name of Course	Hours/ Week	Credits	Marks	
					IA	Sem End
	6B	Multiple integrals and Applications of Vector Calculus	**6**	**5**	**25**	**75**
	7B	Integral transforms with Applications	**6**	**5**	**25**	**75**

Four-year B.A. /B.Sc. (Hons)

Domain Subject: **MATHEMATICS**

Four Year B.A./B.Sc.(Hons)– Semester – V

Course-6B: Multiple integrals and applications of Vector calculus

(Skill Enhancement Course (Elective), 5 credits) Max Marks: 100

I.Learning Outcomes:

Students after successful completion of the course will be able to

1. Learn multiple integrals as a natural extension of definite integral to a function of twovariables in the case of double integral / three variables in the case of triple integral.
2. Learn applications in terms of finding surface area by double integral and volume by tripleintegral.
3. Determine the gradient, divergence and curl of a vector and vector identities.
4. Evaluate line, surface and volume integrals.
5. understand relation between surface and volume integrals (Gauss divergence theorem), relation between line integral and volume integral (Green' s theorem), relation between lineand surface integral (Stokes theorem)

II. Syllabus: (Hours: Teaching: 75 (incl. unit tests etc.05), Training: 15)

Unit – 1: Multiple integrals (15h)

1. Introduction, Double integrals, Evaluation of double integrals, Properties of double integrals.
2. Region of integration, double integration in Polar Co-ordinates, change of order of integration.
3. Triple integral, region of integration, Evaluation of triple integrals

Unit – 2: Vector differentiation- I (15h)

1. Vector differentiation, ordinary derivatives of vectors, partial differentiation.
2. Gradient of a scalar point function, Directional derivative, Angle between two surfaces.

Unit – 3: Vector differentiation - II (15h)

1. Divergence, Curl and Laplacian operator.
2. Formulae involving these operators.

Unit – 4: Vector integration (15h)

1. Line Integrals with examples.

2. Surface Integral with examples.
3. Volume integral with examples.

Unit – 5: Vector integration applications (15h)

1. Gauss theorem and applications of Gauss theorem.
2. Green's theorem in plane and applications of Green's theorem.
3. Stokes's theorem and applications of Stokes theorem.

III. Reference Books:

1. Dr.M Anitha, Linear Algebra and Vector Calculus for Engineer, Spectrum University Press, SR Nagar, Hyderabad-500038, INDIA.
2. Dr.M.Babu Prasad, Dr.K.Krishna Rao, D.Srinivasulu, Y.AdiNarayana, Engineering Mathematics-II, Spectrum University Press, SR Nagar, Hyderabad-500038,INDIA.
3. V.Venkateswararao, N. Krishnamurthy, B.V.S.S.Sarma and S.Anjaneya Sastry, A text Book of B.Sc., Mathematics Volume-III, S. Chand & Company, Pvt. Ltd., Ram Nagar,NewDelhi-110055.
4. R.Gupta,Vector Calculus, Laxmi Publications.
5. P.C.Matthews, Vector Calculus, Springer Verlag publications.
6. Web resources suggested by the teacher and college librarian including reading material.

IV. Co-Curricular Activities:

A) Mandatory:

1. For Teacher: Teacher shall train students in the following skills for 15 hours, by takingRelevant outside data (Field/Web).

1. The methods of evaluating double integrals and triple integrals in the class room and train to Evaluate These integrals of different functions over different regions.

2. Applications of line integral, surface integral and volume integral.

3. Applications of Gauss divergence theorem, Green's theorem and Stokes's theorem.

2. For Student: Fieldwork/Project work Each student individually shall undertake Fieldwork/Project work and submit a report not exceeding 10 pages in the given format on the work-done in the areas like thefollowing, by choosing any one of the following aspects.

1. Going through the web sources like Open Educational Resources to find the values of double and triple integrals of specific functions in a given region and make conclusions. (or)

2. Going through the web sources like Open Educational Resources to evaluate line integral, surface integral and volume integral and apply Gauss divergence theorem, Green's theorem and Stokes theorem and make conclusions.

3. Max. Marks for Fieldwork/Project work Report: 05.

4. Suggested Format for Fieldwork/Project work Report: Title page, Student Details, Index page, Stepwise work-done, Findings, Conclusions and Acknowledgements.

4. Unit tests (IE).

b) Suggested Co-Curricular Activities:

1. Assignments/collection of data, Seminar, Quiz, Group discussions/Debates
2. Visits to research organizations, Statistical Cells, Universities, ISI etc.
3. Invited lectures and presentations on related topics by experts in the specified are

V. Suggested Question Paper Pattern:

Max.Marks:75 **Time:3 hrs**

SECTION – A

(Answer any **five questions**. Each answer carries 5 Marks) 5 X 5=25

1) Evaluate $\int_0^1 \int_x^{\sqrt{x}} (x^2 + y^2) dxdy$

2) Evaluate $\int_{x=0}^{a} \int_{y=0}^{x} \int_{z=0}^{x+y} e^{x+y+z}\, dxdydz$

3) If $\bar{r} = x\bar{i} + y\bar{j} + z\bar{k}$ where $x = \frac{2t+1}{t-1}, y = \frac{t^2}{t-1}, z = t+2$ then prove that $[\bar{r}' \ \bar{r}'' \ \bar{r}'''] = 0.$

4) Find the directional derivative of $\Phi = x^2-2y^2+4z^2$ at (1,1,-1) in the direction of the vector $2\bar{i} + \bar{j} - \bar{k}$.

5) If $\bar{f}$ = grad $(x^3 + y^3 + z^3 - 3xyz)$ then find div $\bar{f}$ and curl $\bar{f}$.

6) Find $\nabla^2 \left| \frac{1}{r} \right|$

7) Evaluate $\int_C \bar{F} \cdot d\bar{r}$ where $\bar{F} = xy\,\bar{i} + yz\,\bar{j} + zx\,\bar{k}$ and the curve $\bar{r} = t\,\bar{i} + t^2\,\bar{j} + t^3\bar{k}$, t varying from -1 to 1.

8) Evaluate $\iiint (2x + y)\, dV$ where V is the closed region bounded by x=0, y=0, z=0, and x=2, y=2, $z=4-x^2$.

9) If $\bar{F} = 2xy\,\bar{i} + yz\,\bar{j} + x^2\,\bar{k}$, find $\int_S \bar{F} . \bar{N}\, ds$ where S is the surface of the cube bounded the planes x=0, x=a, y=0, y=a, z=0, z=a by the application of Gauss divergence theorem.

10) Find $\oint_C (3x^2 - 8y^2)dx + (4y - 6xy)dy$ by Green's theorem where C is the boundary defined by x=0, y=0, x+y=1.

SECTION - B

(Answer ALL the questions. Each question carries 10 Marks) 5 X 10 =50

11) Evaluate $\int_{y=0}^{a} \int_{x=0}^{\sqrt{a^2-y^2}} (x^2 + y^2) dydx$ by changing the order of integratin .

(OR)

12) Evaluate $\iiint_V (x^2 + y^2 + z^2)\, dxdydz$ where V is the volume of the cube bounded by the coordinate planes and the planes x = a, y = a, z = a.

13) If $\bar{r} = 2t\,\bar{i} + t^2\bar{j} + \frac{t^3}{3}\bar{k}$ then prove that $\frac{[\bar{r}' \ \bar{r}'' \ \bar{r}''']}{(\bar{r}' \cdot \bar{r}'')^2} = \frac{|\bar{r}' \cdot \bar{r}''|}{|\bar{r}'|^3}$ at t = 1 .

(OR)

14) If a=x+y+z, b=$x^2+y^2+z^2$, c=xy+yz+zx then prove that [a b c]=0.

15) Prove that i) div($\phi\bar{A}$) = (grad ϕ). $\bar{A}$ + ϕdiv $\bar{A}$ ii) div($\bar{A} \cdot \bar{B}$) = $\bar{B}$.curl $\bar{A}$ - $\bar{A}$.curl $\bar{B}$.

(OR)

16) Prove that div $\{(\bar{r} \cdot \bar{a})\,\bar{b}\} = -2\,(\bar{b} \cdot \bar{a})$ and Curl $\{(\bar{r} \cdot \bar{a})\,\bar{b}\} = \bar{b} \cdot \bar{a}$ where $\bar{a}$ and $\bar{b}$ are constant vectors

17) Evaluate $\int_C \bar{F} \cdot d\bar{r}$ where $\bar{F} = (x^2 + y^2)\,\bar{i} - 2xy\,\bar{j}$ and C is the rectangle in xy plane bounded by the lines x=0, x=a, y=0, y=b.

(OR)

18) Evaluate $\int_S \bar{F} . \bar{N}\, ds$ where $\bar{F} = 18z\,\bar{i} - 12\,\bar{j} + 3y\,\bar{k}$ and S is the part of the plane 2x+3y+6z=12 located in the first octant.

19) State and prove Gauss divergence theorem.

(OR)

20) Verify Green's theorem for $\int_C (xy + y^2)dx + x^2dy$ where C is the closed curve of the region bounded by y=x, y=x^2.

Four-year B.A. /B.Sc. (Hons)

Domain Subject: **MATHEMATICS**

Four Year B.A./B.Sc.(Hons)– Semester – V

Max Marks: 100

Course-7B: Integral transforms with applications

(Skill Enhancement Course (Elective), 5 credits)

I.Learning Outcomes:

Students after successful completion of the course will be able to

1. Evaluate Laplace transforms of certain functions, find Laplace transforms of derivatives andof integrals.
2. Determine properties of Laplace transform which may be solved by application of special functions namely Dirac delta function, error function, Bessel function and periodic function.
3. Understand properties of inverse Laplace transforms, find inverse Laplace transforms ofderivatives and of integrals.
4. Solve ordinary differential equations with constant/ variable coefficients by using Laplacetransform method.
5. Comprehend the properties of Fourier transforms and solve problems related to finite Fouriertransforms.

II. Syllabus :(Hours: Teaching: 75 (incl. unit tests etc.05), Training: 15)

Unit – 1: Laplace transforms- I (15h)

1. Definition of Laplace transform, linearity property-piecewise continuous function.
2. Existence of Laplace transform, functions of exponential order and of class A.
3. First shifting theorem, second shifting theorem and change of scale property.

Unit – 2: Laplace transforms- II (15h)

1. Laplace Transform of the derivatives, initial value theorem and final value theorem. Laplacetransforms of integrals.
2. Laplace transform of t^n. f (t), division by t, evolution of integrals by Laplace transforms.
3. Laplace transform of some special functions-namely Dirac delta function, error function,Bessel function and Laplace transform of periodic function.

Unit – 3: Inverse Laplace transforms - I (15h)

1. Definition of Inverse Laplace transform, linear property
2. First shifting theorem, secondshifting theorem, change of scale property
3. Use of partial fractions.

Unit – 4: Inverse Laplace transforms - II

1. Inverse Laplace transforms of derivatives, inverse Laplace transforms of integrals
2. Multiplication by powers of ' p' , division by ' p' .
3. Convolution, convolution theorem proof and applications.

Unit – 5: Applications of Laplace transforms (15h)

1. Solutions of differential equations with constants coefficients
2. Solutions of differentialequations with variable coefficients.
3. Applications of Laplace transforms to integral equations- Abel' s integral equation.

III. Reference Books:

1. Dr. S.Sreenadh, S.Ranganatham, Dr.M.V.S.S.N.Prasad, Dr. V.Ramesh Babu, Fourier series and Integral Transforms, S. Chand & Company, Pvt. Ltd., Ram Nagar, New Delhi-110055.
2. A.R. Vasistha, Dr. R.K. Gupta, Laplace Transforms, Krishna Prakashan Media Pvt. Ltd.Meerut.
3. M.D.Raisinghania, H.C. Saxsena , H.K. Dass, Integral Transforms, S. Chand & Company Pvt. Ltd., Ram Nagar, New Delhi-110055.
4. Shanthi Narayana , P.K. Mittal, A Course of Mathematical Analysis, S. Chand & Company Pvt.Ltd. Ram Nagar, New Delhi-110055.
5. Web resources suggested by the teacher and college librarian including reading material.

IV. Co-Curricular Activities:

A) Mandatory:

1. **For Teacher:** Teacher shall train students in the following skills for 15 hours, by takingRelevant outside data (Field/Web).
   1. Demonstrate on sufficient conditions for the existence of the Laplace transform of a function.
   2. Evaluation of Laplace transforms and methods of finding Laplace transforms.
   3. Evaluations of Inverse Laplace transforms and methods of finding Inverse Laplace transforms.
   4. Fourier transforms and solutions of integral equations.
2. **For Student: Fieldwork/Project work;** Each student individually shall undertake Fieldwork/Project work and submit a report not exceeding 10 pages in the given format on the work-done in the areas like the following, by choosing any one of the aspects.
   1. Going through the web sources like Open Educational Resources on Applications of Laplace transforms and Inverse Laplace transforms to find solutions of ordinary differential equations with constant /variable coefficients and make conclusions. (or)
   2. Going through the web sources like Open Educational Resources on Applications ofconvolution theorem to solve integral equations and make conclusions. (or)

3. **Max. Marks for Fieldwork/Project work Report: 05.**

Suggested Format for Fieldwork/Project work Report: Title page, Student Details, Index page,Stepwise work-done, Findings, Conclusions and Acknowledgements.

4. Unit tests (IE).

b) Suggested Co-Curricular Activities:

1. Assignments/collection of data, Seminar, Quiz, Group discussions/Debates
2. Visits to research organizations, Statistical Cells, Universities, ISI etc.
3. Invited lectures and presentations on related topics by experts in the specified area.

V. Suggested Question Paper Pattern:

Max.Marks:75 **Time:3 hrs**

SECTION – A

(Answer any **five questions**. Each answer carries 5 Marks) 5 X 5=25

1. Find $L\{(\sin t-\cos t)^2\}$

2. Find $L\{e^t\cos^2 t\}$

3. Find $L\{t^2\cos 3t\}$

4. Find $L\left\{\frac{1-e^t}{t}\right\}$

5. Find $L^{-1}\left\{\frac{s+1}{s^2+6s+25}\right\}$

6. Find $L^{-1}\left\{\frac{e^{-5s}}{(s-2)^4}\right\}$

7. Find $L^{-1}\left\{\log\left(1+\frac{1}{s^2}\right)\right\}$

8. Find $L^{-1}\left\{\frac{1}{s^3(s^2+1)}\right\}$

9. Solve $(D^2+2D+2)y=0$, if $y=Dy=1$ when $t=0$.

10. Solve the integral equation $F(t) = 1+2\int_0^t F(t-u)e^{-2u}\,du$

SECTION - B

(Answer ALL the questions. Each question carries 10 Marks) 5 X 10 =50

11. Find $L\{\sin\sqrt{t}\}$

(OR)

12. State and prove second shifting theorem in Laplace Transform

13. Prove that $\int_0^{\infty} t^3 e^{-t} \sin t \, dt = 0$

(OR)

14. Prove that $L\{J_0(t)\}= \frac{1}{\sqrt{s^2+1}}$ and hence deduce that $L\{J_0(at)\}= \frac{1}{\sqrt{s^2+a^2}}$

15. Find $L^{-1}\left\{\frac{4s+5}{(s-4)^2(s+3)}\right\}$

(OR)

16. Find $L^{-1}\left\{\frac{s^2}{s^4+4a^4}\right\}$

17. Find $L^{-1}\left\{\frac{s}{(s^2+1)(s^2+4)}\right\}$ by using convolution theorem

(OR)

18. State and prove convolution theorem.

19. Solve $(D^2+9)\,y = \cos 2t$, if $y(0) = 1$, $y(\frac{\pi}{2}) = -1$.

(OR)

20. Solve the integral equation $F(t) = e^{-t} - 2\int_0^t \cos(t-u)\,F(u)\,du$.

Recommended Question Paper Pattern and Model

BLUE PRINT FOR QUESTION PAPER PATTERN

Semester - V

Unit	**S.A.Q**(including choice)	**E.Q**(including choice)	**Total Marks**

I	2	2	30
II	2	2	30
III	2	2	30
IV	2	2	30
V	2	2	30
	10	**10**	**150**

S.A.Q. **=** Short answer questions (5 marks)

E.Q. **=** Essay questions (10 marks)

Short answer questions : 5 X 5 M = 25 M

Essay questions : 5 X 10 M = 50 M

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Total Marks = 75 M